San Benito County Water District GSA

Valley Water

North San Benito Groundwater Sustainability Plan

November 2021

TODD GROUNDWATER

This page is intentionally blank.

North San Benito Subbasin Groundwater Sustainability Plan

November 2021

TODD GROUNDWATER

2490 Mariner Square Loop, Suite 215
Alameda, CA 94501
510.747.6920
www.toddgroundwater.com

SIGNATURE PAGE

Iris Priestaf, PhD, President

PROFESSIONAL GEOLOGIST
CHAD
N
TAYLOR
NO. 8443
STATE OF CALIFORNIA

CERTIFIED HYDROGEOLOGIST
CHAD
N
TAYLOR
NO. 915
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
MAUREEN K. REILLY
C 67841
EXP. 6/30/23
CIVIL
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
Eugene
B.
Yates
No. 7178
Exp. 1/31/22
STATE OF CALIFORNIA

CERTIFIED HYDROGEOLOGIST
Eugene
B.
Yates
No. 740
Exp. 1/31/22
STATE OF CALIFORNIA

Table of Contents

List of Tables

List of Figures (following text)

Appendices (following text)

List of Acronyms

AF	acre-foot
AFY	acre-foot per year
AgMAR	agricultural managed aquifer recharge
APN	Assessor's Parcel Number
ASR	aquifer storage recovery
ATSDR	Agency for Toxic Substances and Disease Registry
AWMP	Agricultural Water Management Plan
Basin	North San Benito Subbasin
Basin Plan	Water Quality Control Plan for the Central Coastal Basin
BMPs	best management practices
Cal Poly	California Polytechnic State University
CASGEM	California Statewide Groundwater Elevation Monitoring
CCGC	Central Coast Groundwater Coalition
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Equality Act
CFS	cubic feet per second
CGS	California Geological Survey, formerly Division of Mines and Geology
CIMIS	California Irrigation Management Information System
ClO^{4-}	perchlorate
COC	constituent of concern
CPUC	California Public Utilities Commission
CRP	City and Regional Planning
Cr	chromium
Cr(VI)	hexavalent chromium
CSA	Community Service Area
CVP	Central Valley Project
CWC	California Water Commission
DDW	Division of Drinking Water
DHS	Department of Health Services
District	San Benito County Water District
DMS	data management system
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Water Assessment Program
EC	electrical conductivity
EIR	Environmental Impact Report
ET	evapotranspiration
ETo	reference evapotranspiration
FB	Financing and Budgeting
Fe	iron
ft	feet
ft-bgs	feet below ground surface
GAMA	Groundwater Ambient Monitoring and Assessment
GBPO	General Basin Plan Objective
GDE	groundwater dependent ecosystem
GICIMA	Groundwater Information Center Interactive Map

GIS	Geographic Information Systems
GPS	Global Positioning System
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWMP	Groundwater Management Plan
HBSL	Health-Based Screening Level
HUA	Hollister Urban Area
HUAWP	Hollister Urban Area Water Project
IFI	Important Farmlands Inventory
IGC	Inter-Governmental Coordination
ILRP	Irrigated Lands Regulatory Program
in	inch
InSAR	Interferometric Synthetic Aperture Radar
IRWMP	Integrated Regional Water Management Plan
JP	Joint Partnerships with the Private Sector
JPL	Jet Propulsion Laboratory
JSA	Jones and Stokes Associates
LSCE	Luhdorff & Scalmanini Consulting Engineers
LTWMP	Long-term Wastewater Management Plans
MA	Management Area
MAR	managed aquifer recharge
MBAS	methylene blue active substances
MCL	Maximum Contaminant Level
MGD	million gallons per day
ug/L	micrograms per liter
mg/L	milligrams per liter
M&I	Municipal and Industrial
MMT	methylcyclopentadienyl manganese tricarbonyl
MO	Measurable Objective
MOU	Memorandum of Understanding
MPSP	Infrastructure and Service Master Plans, Strategies, and Programs
MRP	Monitoring and Reporting Program
msl	mean sea level
MT	Minimum Threshold
MW	monitoring well
N	nitrogen
NASA	National Aeronautics and Space Administration
NAVSTAR	Navigation Satellite Timing and Ranging System
NCCAG	Natural Communities Commonly Associated with Groundwater
NDMI	normalized difference moisture index
NDVI	normalized difference vegetation index
NED	National Elevation Dataset
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NO_3	nitrate
NPS	nonpoint source
NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
NTUs	Nephelometric Turbidity Unit

OWTS	On-Site Wastewater Treatment System
PEIR	Program Environmental Impact Report
PI	public information
Ppb	parts per billion
PPWD	Pacheco Pass Water District
PREP	Pacheco Reservoir Expansion Project
PRISM	Parameter-Elevation Regressions on Independent Slopes Model
PSR	Planning Studies and Reports
Puc	Pliocene Unnamed Continental Mudstone (Purisima Formation)
Pus	Pliocene Unnamed Continental Sandstone (Purisima Formation)
PVWMA	Pajaro Valley Water Management Agency
Q	young alluvium
Qb	basin deposits
Qg	stream gravel
Qo	older alluvium
QT	continental
RDR	Regulation and Development Review
RMA	Resource Management Agency
RWQCB	Central Coast Regional Water Quality Control Board
SBCWD	San Benito County Water District
SBCWD GSA	San Benito County Water District GSA
SCVWD	Valley Water, formerly Santa Clara Valley Water District
SGMA	Sustainable Groundwater Management Act
SGMP	Sustainable Groundwater Management Planning
SMCL	Secondary Maximum Contaminant Level
SNMP	Salt and Nutrient Management Plan
SO	County Services and Operations
SSCWD	Sunnyslope County Water District
SSURGO	Soil Survey Geographic Database
SVRA	State Vehicular Recreation Area
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TCE	trichloroethylene
TDS	Total Dissolved Solids
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TPWD	Tres Pinos Water District
UNAVCO	University Navigation Satellite Timing and Ranging System Consortium
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WD	Water District
WDL	Water Data Library
WDR	Waste Discharge Requirement
WHO	World Health Organization

WRA	Water Resources Association
WSCP	Water Shortage Contingency Plan
WSP	Water Supply Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
WY	water year

This page is intentionally blank.

EXECUTIVE SUMMARY

The North San Benito Groundwater Basin (Basin) is the plan area for this Groundwater Sustainability Plan (GSP), developed consistent with the Sustainable Groundwater Management Act (SGMA). This basin was formed in 2019 by consolidating the Bolsa, Hollister, and San Juan Bautista Subbasins of the Gilroy-Hollister Basin and the Tres Pinos Valley Basin. Including about 200 square miles, the Basin is predominantly in San Benito County with small areas in Santa Clara County (**Figure ES-1**). The Basin shares a boundary along the Pajaro River with the Llagas Subbasin in Santa Clara County.

This GSP applies best available information to describe the plan area, groundwater resources, and associated surface water resources. Analysis of the groundwater basin condition, made with reference to sustainability indicators defined in SGMA, indicates that the North San Benito Basin has been managed sustainably, given availability of imported Central Valley Project (CVP) water.

Projections have been made into the future (simulated with the numerical groundwater flow model) of existing conditions, climate change, and reasonably anticipated growth. These projections indicate that the Basin can continue to be sustainable, assuming reasonable availability of CVP water, with implementation of projects and management actions to avoid undesirable results. These projects and management actions do not include any long-term planned reductions in groundwater pumping.

ES-1 GSP DEVELOPMENT AND SUSTAINABILITY GOAL

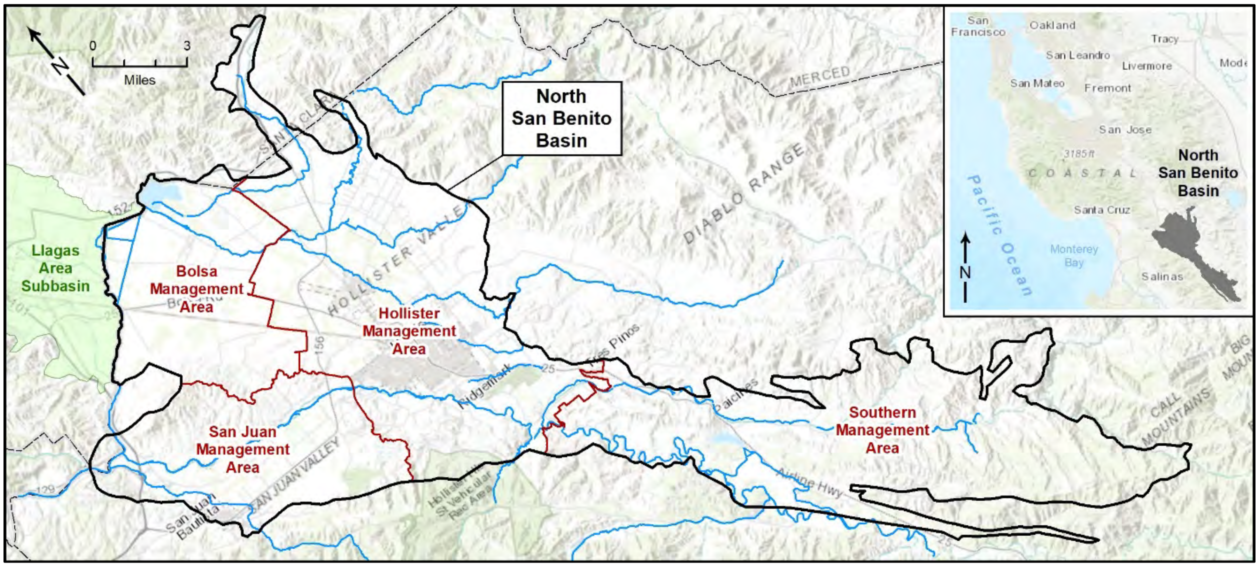
To manage this basin sustainably, the San Benito County Water District (SBCWD) and the Santa Clara Valley Water District, now Valley Water, have become Groundwater Sustainability Agencies (GSAs) and have agreed to collaborate in preparing this GSP with SBCWD GSA taking the lead and with cooperative implementation of the GSP into the future.

This GSP has been prepared with the participation of the public, local water and planning agencies, state agencies, and non-governmental organizations. SBCWD organized a Technical Advisory Committee (TAC) to support GSP development with multiple meetings open to the public. In addition, six public workshops have been conducted, and regular updates provided at public meetings of the SBCWD Board of Directors. Fact sheets, fliers, and mailers on key topics have been distributed. Workshop and meeting notices have been posted to the SBCWD website, which also provides information on SGMA and the GSP. Outreach materials including factsheets have also been translated into Spanish.

The goal of the GSAs in preparing this GSP is to sustain groundwater resources for the current and future beneficial uses of the North San Benito Basin in a manner that is adaptive and responsive to the following objectives:

- to provide a long-term, reliable, and efficient groundwater supply for agricultural, domestic, and municipal and industrial uses
- to provide reliable storage for water supply resilience during droughts and shortages
- to protect groundwater quality
- to prevent subsidence
- to support beneficial uses of interconnected surface waters, and
- to support integrated and cooperative water resource management.

Figure ES-1. North San Benito Basin and GSP Management Areas.



This sustainability goal, consistent with SGMA, was developed by GSA staff and consultants and the TAC through public discussion and based on the technical information in this GSP.

Preparation of this GSP began in 2018 with award by the California Department of Water Resources (DWR) to SBCWD of a Sustainable Groundwater Management Planning Grant amounting to $830,366. Subsequently, SBCWD applied for additional grant funding—part of the so-called Round 3—and was awarded an additional $1.17 million. With SBCWD GSA cost sharing of $390,000, the total Round 3 project cost is $1.56 million. The Round 3 project, initiated in June 2020, involves a program to site, design, and install dedicated monitoring wells and a feasibility study for Managed Aquifer Recharge (MAR) to supplement groundwater recharge. The Round 3 project is incorporated into this GSP.

Implementation of the GSP will include compliance with SGMA with GSP administration, monitoring of the basin (including annual assessment of groundwater extraction), expanded reporting, and five-year updates. This expanded management will involve increased annual costs. Accordingly, SBCWD has investigated means of funding within its authority from the original San Benito County Water District Act and from SGMA. As described in this GSP, funding methods include an acreage-based fee for parcels in the basin benefitting from groundwater management and a groundwater-extraction based fee that supports annual measurement of groundwater pumping.

ES-2 Plan Area

The Plan Area includes valley areas characterized by productive agriculture, urban areas including the City of Hollister and the City of San Juan Bautista, rural communities, and upland areas with grazing land. While SBCWD and Valley Water provide regional water management, much of the population in the GSP area is served by local water agencies. The largest of these are the City of Hollister and Sunnyslope County Water District (SSCWD), which serve the Hollister urban area.

Groundwater is the main source of water supply. Groundwater provides supply to municipal, agricultural, and domestic users through more than 1,000 production wells located throughout the GSP Area. The other major source is imported water from CVP, which is delivered to municipal water suppliers and to agricultural customers in the SBCWD zone of benefit, Zone 6.

Local surface water also is a supply, made available through groundwater recharge. SBCWD owns and operates two reservoirs along the San Benito River, Hernandez Reservoir and Paicines Reservoir, where water is stored and then released for groundwater recharge. Local surface water also is supplied from other local streams, including Pacheco Creek, for groundwater recharge. Recycled water is a reliable, local supply for non-potable uses. Water recycling is a cooperative effort of SBCWD and the City of Hollister; recycled water is provided by the City of Hollister for irrigation.

Both SBCWD and Valley Water have a long history of water management, including coordination with the respective counties, cities, and other agencies with responsibility for land use planning. A summary is provided of previous and ongoing water resources monitoring and management programs. The GSP builds on previous monitoring and management programs to evaluate groundwater conditions in light of the sustainability goal and SGMA sustainability criteria, to identify monitoring and management needs, and to plan and implement projects and management actions for long-term sustainability. To support planning and implementation, this GSP process has identified four Management Areas—Southern, Hollister, San Juan, and Bolsa—shown in **Figure ES-1**.

ES-3 Hydrogeologic Conceptual Model

The *hydrogeologic conceptual model* of the North San Benito Basin is a description of the physical framework of the Basin, including its geology and the aquifers that provide significant groundwater. It also addresses the interaction between groundwater and surface water, and areas of groundwater recharge and discharge.

The Basin consists of a series of connected valleys and intervening uplands in the Coast Ranges. It is characterized by unconsolidated to semi-consolidated sediments that were deposited in alluvial fan and stream environments from a variety of source rocks and directions. These deposits interfinger in the subsurface so that regional zones of low or high permeability have not been distinguished. The valley portions contain unconsolidated alluvial deposits—clay, silt, sand, and gravel—that store and transmit significant quantities of groundwater. These geologic deposits also underlie some upland areas (such as the Lomerias Muertas, Flint Hills, and hills in the southern portion of the Basin) but generally are more consolidated and less permeable than in the valley areas. The Principal aquifers include the unconsolidated alluvial deposits in the valley areas and generally range from 0 to 300 feet thick. Secondary aquifers include the older, less permeable deposits that underlie the valleys at depth, crop out in portions of the valley areas, and occur in upland areas with thickness up to several thousand feet.

The Basin boundaries are defined mostly by geology (contacts with relatively impermeable consolidated rocks) and by faults that may form barriers to groundwater flow. Faults crossing the Basin, most notably the Calaveras Fault, are partial barriers to groundwater and also are important because they may offset bedrock and affect the local depth of the Basin.

Unlike most North San Benito boundaries, the northern boundary with the Santa Clara County Llagas Subbasin is defined by the county line. Like the northernmost North San Benito Basin, the Llagas

Subbasin underlies a relatively flat valley and consists of unconsolidated alluvial sediments. The North San Benito and Llagas basins are hydrologically connected with groundwater flow across the boundary.

The Basin is situated within the Pajaro River watershed. Main tributaries to the Pajaro River include the San Benito River, Tres Pinos Creek, and Pacheco Creek, among others. These streams are dry over most of their lengths for much of the year, flowing mainly during wet winter conditions.

Groundwater recharge occurs over the entire surface of the Basin, in varying intensities. Dispersed recharge over broad areas derives from deep percolation of rainfall and applied irrigation water. Subsurface inflow to the Basin occurs from surrounding consolidated formations and from Llagas Subbasin. Percolation from streams is a major source of recharge. Percolation from ponds also occurs, including percolation from wastewater treatment plant disposal ponds. Recharge also occurs through SBCWD's MAR programs with a long history of percolating available surface water to augment recharge.

With regard to groundwater discharge, wells are by far the largest discharges from the Basin. Natural outflow from the Basin consists of groundwater discharge into streams. The primary exit points are groundwater seepage into the lower ends of the Pajaro and San Benito Rivers as they approach the northwestern end of the basin and enter the bedrock canyon leading to the coast.

ES-4 Current and Historical Groundwater Conditions

The North San Benito Basin has been actively monitored for decades. For this GSP's description of groundwater conditions, a historical period has been defined that begins in 1975 and extends through 2017. This period is representative of long term conditions and includes droughts and wet periods, with an average annual rainfall of 12.97 inches. Current conditions are described as 2015 through 2017. Groundwater conditions are described in terms of sustainability indicators including groundwater elevations, groundwater storage, land subsidence, groundwater quality, and interconnected surface water and groundwater dependent ecosystems.

Groundwater Elevations

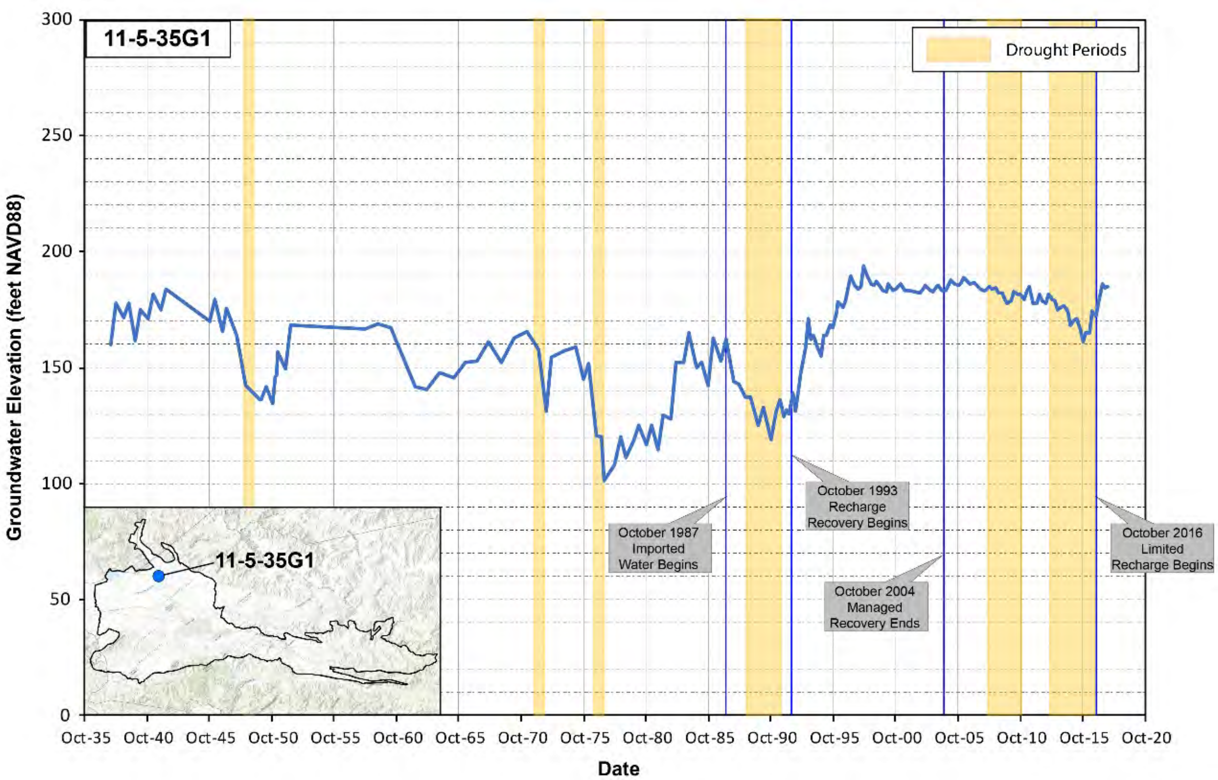
Groundwater is present in the principal and secondary aquifers that generally are not distinguished in the Basin. Groundwater in Basin aquifers occurs under unconfined to confined (pressurized) conditions, and areas with artesian flowing wells have been mapped. However, distinct vertical zones have not been mapped, so groundwater level maps and hydrographs generally represent a range of depth zones. In addition, most monitored wells in the Basin are production wells with considerable screen lengths. Nonetheless, these generally represent the productive zones of the Basin.

Groundwater elevations change in response to wet years and droughts, groundwater pumping, importation of water, and managed aquifer recharge programs. Long term changes in groundwater elevations are illustrated in this GSP by hydrographs from representative wells across the Basin. Most of these show conditions since 1975. A hydrograph dating back to 1935 is shown in **Figure ES-2.**

As a historical overview, groundwater elevations are estimated to have been at historical highs prior to 1913. With gradual development of irrigated agriculture and intensification of groundwater pumping, groundwater elevations in valley areas of the Basin generally decreased from the 1940s to the 1970s, indicating a state of overdraft. At the time, the Basin relied solely on groundwater (although recharged from local reservoirs) and groundwater elevations in many wells reached historical lows.

In 1987, SBCWD began importation of CVP water and groundwater elevations began to rise in the Hollister and San Juan valleys and Bolsa, although Bolsa does not directly receive CVP water. The severe 1987-1992 drought slowed the recovery of groundwater elevations because of reduced CVP imports and reduced recharge from rainfall and surface water. Following that drought, CVP imports increased, allowing reduction of groundwater pumping and recovery of groundwater elevations. In addition, from 1994 to 2004, SBCWD actively recharged the Basin with CVP water along stream channels. The result of CVP imports and SBCWD MAR programs was significant recovery especially in the Hollister and San Juan valleys where imported water is delivered. With groundwater elevation recovery, SBCWD has shifted its MAR program from recovery to maintenance and local sustainable management of groundwater.

Figure ES-2. Long-term Hydrograph of Groundwater Elevations, Hollister Management Area



This GSP presents groundwater elevation contour maps to show current (2017) groundwater flow conditions. Groundwater flow generally parallels the major surface streams from the southeast and eastern portions of the Basin toward the northwestern portions and the Pajaro River. In the Bolsa, groundwater flow converges into areas of low groundwater elevations that are caused by groundwater pumping. Such groundwater depressions occurred historically, not only in the Bolsa, but also in the Hollister and San Juan valleys. As shown on the map, the groundwater depressions in Hollister and San Juan valleys have filled and general northward groundwater flow has resumed.

The current monitoring network for groundwater elevations provides little information about vertical groundwater gradients within the Basin. Flowing artesian wells have been reported historically and in recent years clearly indicate that upward gradients and flow exist locally.

Groundwater Storage

The groundwater basin provides not only supply, but also storage. SBCWD has managed groundwater and surface water sources conjunctively, such that groundwater in storage is used when surface water supplies are diminished, and groundwater storage is replenished when surface water supplies are available. Accordingly, groundwater storage is characterized by changes in the short term. However, the key issue is to avoid long term depletion of storage, commonly understood as overdraft. The Annual Groundwater Reports prepared by SBCWD have included an annual accounting for groundwater storage, and in North San Benito, groundwater storage has been stable for the long term, given availability of CVP supply since 1987.

Land Subsidence

Land subsidence is the uneven lowering or settlement of the ground surface due to pumping and groundwater level declines. Subsidence can have impacts including collapsed well casings, damage to infrastructure (including foundations, roads, bridges, or pipelines), diminished effectiveness of levees, and loss of conveyance in canals, streams, or channels.

In brief, as groundwater pumping occurs and groundwater elevations decline, fine-grained deposits such as clay and silt can become compacted, causing the overlying ground surface to subside. While land subsidence due to groundwater withdrawals can be temporary (elastic), it can also become permanent (inelastic) when groundwater elevations in the aquifer reach a historically low groundwater elevation.

Inelastic subsidence has not been a known issue in the Basin. Nonetheless, its potential was recognized in the 2003 Groundwater Management Plan, which recommended maintenance of groundwater levels above the historical low levels of about 1977 to avoid or minimize the potential for inelastic land subsidence. SBCWD management of groundwater elevations generally has been successful in meeting these objectives, and there have been no local reports of subsidence problems. However, mapping of land surface elevation changes by DWR since 2015 (using satellite imagery) indicated local land surface subsidence. To check this mapping, land surface elevation data from UNAVCO (a university-organized program that measures the shape of the earth) were reviewed for this GSP. The UNAVCO data also indicated local subsidence in the Bolsa. Measured locally at a rate of about two inches over the past 15 years, the available data suggest inelastic subsidence. Continued tracking of InSAR and UNAVCO is planned by this GSP.

Groundwater Quality

Groundwater quality in the Basin has been described as highly mineralized and of marginal water quality for drinking and agricultural purposes. The mineralized water quality is typical of other relatively small Coast Range groundwater basins and reflects the geology of the watershed and relatively low permeability of groundwater basin sediments.

Groundwater in the Basin has also been impacted by human activities including agricultural, urban, and industrial land uses. State agencies with regulatory oversight for water quality in the Basin include the Central Coast Regional Water Quality Control Board (RWQCB) and the State Water Resources Control Board – Division of Drinking Water (DDW). This GSP summarizes potential threats to water quality including regulated sites with soil and groundwater contamination, septic tanks, an oil and gas field, and non-point sources, for example nitrate from agricultural and landscaping applications.

This GSP summarizes regional water quality monitoring networks. SBCWD currently monitors a distributed network of 18 wells for water quality and maintains a comprehensive water quality database, created in 2004 and updated every three years with reporting through the SBCWD Annual Groundwater Reports. Available data have been compiled from SBCWD, local water agencies, RWQCB, and DDW. The RWQCB regulates discharges from irrigated agricultural lands to protect surface water and groundwater, focusing on priority water quality issues, such as pesticides and toxicity, nutrients, sediments, and especially nitrate impacts to drinking water sources. DDW regulates drinking water systems in the Basin. The GSAs share information and collaborate with both.

Total dissolved solids (TDS) is a key constituent of concern for the Basin. TDS concentrations are naturally high because of local geology. However, TDS also is affected by human activities (e.g., infiltration of urban runoff, agricultural return flows, and wastewater disposal).

Nitrate also is a key constituent of concern. Elevated nitrate levels in groundwater are found in valley areas throughout the Basin, reflecting agricultural activities, septic systems, confined animal facilities, landscape fertilization, and wastewater treatment facility discharges.

Other constituents are described in this GSP including hardness, boron, perchlorate, and metals including arsenic, chromium, iron, manganese, and selenium.

Interconnected Surface Water and Groundwater Dependent Ecosystems

Interconnection of groundwater and surface water occurs wherever the water table intersects the land surface and groundwater discharges into a stream channel or spring. In this GSP, locations of interconnected surface water and groundwater have been evaluated using information on stream flow, depth to groundwater, and vegetation. In addition, groundwater dependent ecosystems (GDEs) also have been identified with consideration of wetlands, riparian vegetation, and animals including amphibians and steelhead trout. This GSP also includes analysis of potential undesirable effects of groundwater pumping on riparian vegetation and on steelhead. This has included: review of aerial photographs and imagery to assess other factors such as in-channel gravel mining, scour by flood events, and drought; evaluation of any correlation of groundwater levels with vegetation extent and vigor; and numerical modeling to assess effects of basin pumping on steelhead migration.

ES-5 Water Balances

This GSP provides a quantitative assessment of the water balance (or water budget) of the North San Benito Basin. Both surface water and groundwater balances are provided for each of the four Management Areas. Annual balances based on historical data are presented for three periods: a Pre-CVP Historical (1975-1988), a Historical Recovery (1989-2014), and a Current (2015-2017). Cumulative changes in groundwater storage generally have increased for the historical and current periods as illustrated in **Figure ES-3**. In addition, a future water balance (2018-2068) has been simulated with numerical modeling. The Future period represents conditions expected to occur over the next 50 years and the "future baseline" simulation assumes a continuation of existing land use, urban water demand, water, and wastewater treatment and CVP availability.

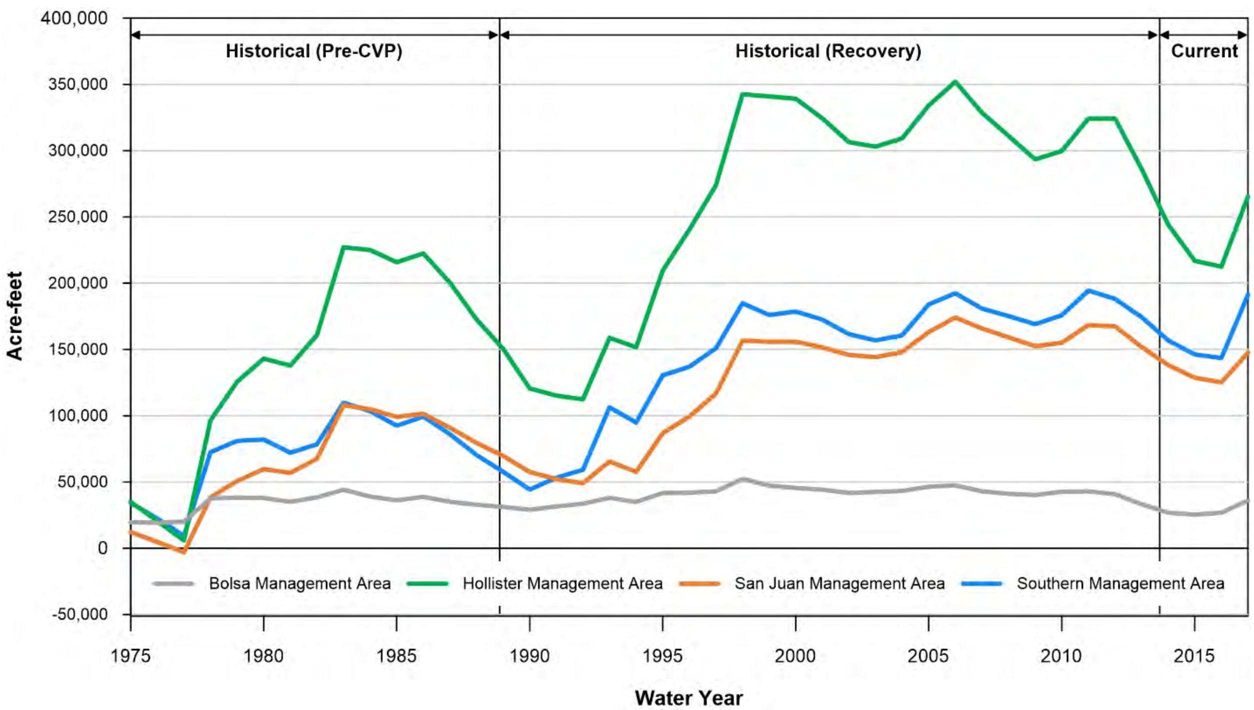
The groundwater balances (including inflows, outflows, and change in storage) are summarized for each of the four periods and for the four management areas. In brief, the balances generally are positive—

indicating net increases in storage—although very small declines in storage (probably in the range of uncertainty) are indicated in the Future scenario for Hollister, San Juan, and Bolsa Management Areas.

In addition, the GSP presents additional numerical modeling forecasting scenarios, building on the future baseline scenario with climate change and with growth. The climate change scenario (based on the future baseline scenario) involved adjustments to climate, stream flow, and imports as projected by DWR. The general result is that the climate in 2070 will be warmer and wetter, and CVP imports are expected to be reduced. Climate changes results in increased pumping in the scenario but expected groundwater level declines are offset by increased stream flow and rainfall recharge. In brief, no significant long-term water-level or storage trends are shown by the climate change scenario relative to the baseline scenario.

The future growth scenario assumes buildout in the Hollister urban area and an increase in vineyard acreage. This scenario assumes 2068 buildout and land use throughout the simulation and does not phase in land use changes over time. This approach reveals the full effect of 2068 assumed land use; as simulated, the effects of projected growth on groundwater storage change over time are small.

Figure ES-3. Cumulative Storage Change over Historical and Current Periods for Management Areas



ES-6 Sustainable Management Criteria

This GSP defines sustainable management as the use and management of groundwater in a manner that can be maintained without causing *undesirable results*, which are defined as significant and unreasonable effects caused by groundwater conditions occurring throughout the Basin, specifically in consideration of the following SGMA sustainability indicators:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion. [1]
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

For these sustainability indicators, a GSP must develop quantitative sustainability criteria that allow the GSA to define, measure, and track sustainable management. These criteria include the following:

- Undesirable Result – significant and unreasonable conditions for any of the six sustainability indicators.
- Minimum Threshold (MT) – numeric value used to define undesirable results for each sustainability indicator.
- Measurable Objective (MO) – specific, quantifiable goal to track the performance of sustainable management.

While the North San Benito Basin has been managed sustainably, the following sustainability criteria are defined in this GSP because potential exists for undesirable results. Sustainability criteria are as follows:

- The Minimum Threshold relative to **chronic lowering of groundwater levels** is defined at designated Key Wells by historical groundwater low levels adjusted to provide reasonable protection to nearby wells. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in 60 percent or more of the Key Wells (e.g., three of five wells) in each Management Area. The Measurable Objective is to maintain groundwater levels above the MTs and to maintain groundwater levels within the historical operating range.
- The Minimum Threshold for **reduction of storage** for all Management Areas is fulfilled by the minimum threshold for groundwater levels as proxy. The Measurable Objective for storage is fulfilled by the MT for groundwater levels, which maintains groundwater levels within the historical operating range.
- The Minimum Threshold for **land subsidence** is defined as a rate of decline equal to or greater than 0.2 feet in any five-year period. This has been considered in terms of a potential cumulative decline equal to or greater than one foot of decline since 2015; 2015 represents current conditions and the SGMA start date. The extent of cumulative subsidence across the basin will be monitored and evaluated using InSAR data. Subsidence is closely linked to groundwater levels, and it is unlikely that significant inelastic subsidence would occur if groundwater levels remain above their minimum thresholds.
- The Minimum Thresholds for **degradation of water quality** address nitrate and TDS for each MA. The MT for nitrate is defined initially as the percentage of wells with concentrations exceeding the nitrate maximum contaminant limit (45 mg/L) based on current conditions (2015-

[1] Seawater intrusion is noted, but no risk of seawater intrusion exists in this inland basin.

2017). The MT for TDS is defined initially as the percentage of wells with concentrations exceeding the TDS value of 1,200 mg/L based on current conditions. The Measurable Objectives for both are defined as maintaining or reducing the percentage of wells with median concentrations exceeding the MTs.

- The Minimum Threshold for **depletion of interconnected surface water** is the amount of depletion associated with the lowest water levels during the 1987-1992 drought, with some adjustments made for wells with groundwater levels lower in 2016 than in 1992. Undesirable results would occur if more than 25 percent of monitored wells within 1 mile of a shallow water table reach along the Pajaro River, Pacheco Creek, San Benito River, or Tres Pinos Creek had static spring water levels lower than the lowest static spring water level during 1987-1992.

ES-7 Monitoring

The GSAs have maintained active monitoring for decades, but compliance with SGMA will require more intensive monitoring across the Basin. The GSP describes the monitoring network needed to provide the information that fulfills SGMA requirements, guides GSP implementation, and allows demonstration of sustainable conditions. The monitoring program includes a monitoring network that documents groundwater and related conditions as relevant to the sustainability indicators: groundwater levels, storage, land subsidence, water quality, and interconnected surface water.

This GSP also describes the monitoring protocols for data collection, development and maintenance of the data management system (DMS), and regular assessment and improvement of the monitoring program. Data gaps are identified and the steps to fill the data gaps are described. This GSP also summarizes the siting of new dedicated monitoring wells, installed with funding assistance from the Sustainable Groundwater Management Round 3 Grant program (Round 3).

ES-8 Projects and Management Actions

As assessed in this GSP, groundwater conditions in North San Benito are sustainable. However, long-term sustainability requires continuation of monitoring, reporting, and management actions that are adaptive to changing climatic, water supply, and water demand conditions. Accordingly, this GSP presents ongoing, new, and recommended projects and management actions needed to maintain sustainability. Projects and actions are described in terms of objectives, circumstances of implementation, public notice, permitting and regulatory process, timetable, benefits, costs, and how the action will be accomplished.

Projects are substantial efforts that involve an increase in water supply or a reduction in demand for the GSP Area. Four categories of projects are presented as listed below:

- Develop Surface Water Storage (Pacheco Reservoir Expansion Project)
- Expand Managed Aquifer Recharge (MAR)
- Enhance Conjunctive Use
- Enhance Water Conservation.

The projects involve conjunctive use of available supplies plus water conservation. These produce benefits by maintaining groundwater levels above minimum thresholds and thereby avoiding chronic groundwater level declines, storage depletion, subsidence, and reduction of potential impacts to GDEs.

The projects also promote water quality improvement by maximizing high quality imports and supporting basin outflows.

Management Actions provide a framework for groundwater management including establishing GSP procedures or policies, filling data gaps with scientific studies or improved monitoring, and providing for funding. Six categories are provided:

- Improve Monitoring Program and Data Management System (DMS)
- Develop Response Plans
- Enhance Water Quality Improvement Programs
- Reduce Potential Impacts to GDEs (Steelhead and Riparian Vegetation)
- Provide Long-term Basin-wide Funding Mechanism
- Provide Administration, Monitoring, and Reporting.

The first management action supports the cost-effective implementation of all projects and management actions. The next three management actions address response plans, water quality improvement, and protection of GDEs. These were identified during the GSP process to provide specific GSA responses to potential undesirable results. Water quality protection is addressed not only by maximizing high quality imports and improving wastewater quality, but also by supporting the SNMP, RWQCB, and other programs. The last two actions in the list provide the needed funding, administration, monitoring, and reporting on an annual basis.

ES-9 Implementation Plan

While the North San Benito Groundwater Basin is considered to be sustainably managed, this status is by no means taken for granted. Potential effects of growth, land use change, and climate change have been evaluated by means of modeling simulations, but effects are likely to be cumulative, and thereby present challenges to sustainability. Additional projects and actions must be continued or implemented to satisfy the Sustainability Goal to the foreseeable planning horizon. This GSP presents an implementation plan with a timeline that begins in 2022 and continues until 2042.

1. INTRODUCTION

Since its founding in 1953, San Benito County Water District (SBCWD or District) has actively managed water resources in San Benito County. This management, focused on conjunctive use of groundwater and surface water sources, was formalized in 1998 through adoption of its Groundwater Management Plan (GWMP), updated in 2004. In 2014, the State of California passed the Sustainable Groundwater Management Act (SGMA) to empower local agencies to adopt Groundwater Sustainability Plans (GSPs) tailored to the resources and needs of their communities. SGMA also empowers local agencies to form a Groundwater Sustainability Agency (GSA) for managing groundwater resources sustainably. Accordingly, the San Benito County Water District GSA (SBCWD GSA) was formed to continue groundwater management with the goal of sustainability in accordance with SGMA.

Figure 1-1 shows the full extent and boundaries of the North San Benito Basin No. 3-003.05, a subbasin of the Gilroy-Hollister Basin per California Department of Water Resources (DWR) Bulletin 118, which is also the Plan Area for this GSP. This basin was formed in 2019 by consolidating the Bolsa, Hollister, and San Juan Bautista Subbasins of the Gilroy-Hollister Basin and the Tres Pinos Valley Basin. The Plan Area is predominantly in San Benito County with 3,354 acres or about 2.6 percent extending into Santa Clara County.

In May 2017, SBCWD became the GSA for the Bolsa Subbasin and for the Hollister and San Juan Bautista Subbasins within San Benito County. In August 2018, SBCWD became GSA for the Tres Pinos Valley. **Appendix A** provides the SBCWD Notices of Decision to become a Groundwater Sustainability Agency. Valley Water (formerly known as Santa Clara Valley District (SCVWD) prior to 2019) is the GSA for the portions in Santa Clara County.

Wishing to provide a framework for cooperative groundwater management efforts, in July 2017, SBCWD and SCVWD (Valley Water) executed a Memorandum of Understanding (MOU), which sets forth their respective roles and responsibilities in GSP preparation for the North San Benito Basin. These include data sharing and coordinated outreach, among other responsibilities. Per the MOU, SBCWD is responsible for executing contracts with consultants to undertake development of the GSP. This MOU is reproduced in **Appendix B**.

The four historical groundwater basins (Bolsa, Hollister, San Juan Bautista, and Tres Pinos Valley) were defined by DWR in its Bulletin 118 (DWR, 2004a, b, c, d). These were managed and monitored by SBCWD (in cooperation with Valley Water) since at least 1976, although the definition of basin boundaries and the focus of various studies have differed over the years. Recognizing that the basins are contiguous, hydraulically connected, and comprehensively managed, SBCWD submitted a request to DWR to consolidate the four basins into a single basin, termed the North San Benito Groundwater Basin. The SBCWD Resolution 2018-05, making this request, is included in **Appendix A**. This request was approved in 2019 and followed by appropriate update of GSA Formation Notifications to DWR.

As described in Section 5 and shown in **Figure 1-1**, the North San Benito Basin has been divided into four Management Areas—Southern, Hollister, San Juan, and Bolsa—to support GSP planning and implementation.

1.1. PURPOSE OF THE GROUNDWATER SUSTAINABILITY PLAN

The purpose of this GSP is to assess water resource and land use conditions within the Plan Area, through an open and collaborative process, and to implement management activities to achieve (or maintain) long-term groundwater sustainability as defined by SGMA.

1.2. SUSTAINABILITY GOAL

The sustainability goal can be described as the mission statement of the GSAs for managing the basin; it embodies the purpose of sustainably managing groundwater resources and reflects the local community's values—economic, social, and environmental. The sustainability goal for the North San Benito Groundwater Basin, stated below and described in more detail in Section 6.1, was developed by GSA staff and consultants and the Technical Advisory Committee (TAC) through public discussion.

1.2.1. Description of Sustainability Goal

The goal of the GSAs in preparing this GSP is to sustain groundwater resources for the current and future beneficial uses of the North San Benito Basin in a manner that is adaptive and responsive to the following objectives:

- to provide a long-term, reliable, and efficient groundwater supply for agricultural, domestic, and municipal and industrial uses
- to provide reliable storage for water supply resilience during droughts and shortages
- to protect groundwater quality
- to prevent subsidence
- to support beneficial uses of interconnected surface waters, and
- to support integrated and cooperative water resource management.

This goal is consistent with SGMA and is based on information from the Plan Area, Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Budget sections of this GSP.

1.3. AGENCY INFORMATION

Two GSAs—SBCWD and Valley Water—are collaborating on preparation of this GSP, as described in the July 2017 MOU between the two districts. Valley Water is the exclusive GSA for groundwater basins within its jurisdiction, per §10723 of the Water Code. SBCWD GSA was formed through the following processes for the Bolsa, Hollister, and San Juan Bautista basins and for the Tres Pinos Valley:

Bolsa/Hollister/San Juan Bautista

- A properly noticed public hearing was held by SBCWD on February 8, 2017 to determine whether to become a GSA for the Bolsa, Hollister, and San Juan Bautista basins within San Benito County. The SBCWD Board of Directors adopted Resolution 2017-03 to form a GSA.
- On February 24, 2017, SBCWD submitted to DWR a Notice of Decision to Become a Groundwater Sustainability Agency, along with required information including a boundary map of the GSA and a list of interested parties.
- After the 90-day review period, on May 30, 2017, SBCWD GSA became exclusive groundwater sustainability agency.

Tres Pinos Valley

- On April 25, 2018, a properly noticed public hearing was held by SBCWD to determine whether to become a GSA for the Tres Pinos Valley. The SBCWD Board of Directors adopted Resolution 2018-06 to form a GSA for the Tres Pinos Valley.
- On May 4, 2018, SBCWD submitted to DWR a Notice of Decision to Become a Groundwater Sustainability Agency, along with the required information including a boundary map and list of interested parties.
- After the 90-day review period, on August 2, 2018, SBCWD GSA became exclusive groundwater sustainability agency for Tres Pinos Valley.

Subsequently in May 2018 SBCWD submitted a request to DWR to consolidate the four basins into a single basin, termed the North San Benito Groundwater Basin. This request was approved in 2019 and on July 2, 2019, SBCWD GSA submitted a GSP Initial Notification to DWR for development of a GSP for the North San Benito Groundwater Basin. On July 9, 2019, the SBCWD GSA became the exclusive GSA for the North San Benito Groundwater Basin in San Benito County. On July 30, 2019, Valley Water updated its status as exclusive GSA for the North San Benito Groundwater Basin in Santa Clara County.

As required by GSP Regulations §354.6 and SGMA §10723.8, the Notices of Decision to become a Groundwater Sustainability Agency are included in **Appendix A**. These each include the resolution, list of interested parties, and boundary map.

The point of contact for the SBCWD GSA is:

Jeff Cattaneo, General Manager
San Benito County Water District
30 Mansfield Rd
Hollister, Ca 95024
(831) 637-8218
jcattaneo@sbcwd.com

1.4. GROUNDWATER SUSTAINABILITY AGENCY INFORMATION

Preparation of this GSP is under the authority of SBCWD and Valley Water, which are GSAs for the Plan Area and are working together with SBCWD serving as lead agency.

San Benito County Water District is a special district formed in 1953 under State law (California Water Code Appendix 70) pursuant to the San Benito County Water District Act. It originally was formed as the San Benito County Water Conservation and Flood Control Act. The name was changed from the San Benito County Water Conservation and Flood Control District to San Benito County Water District in 1989.

SBCWD has broad powers for the acquisition, storage and distribution of water for irrigation, domestic, fire protection, municipal, commercial, industrial, and all other beneficial uses, as follows:

- to store water in surface or underground reservoirs
- to conserve and reclaim water
- to appropriate and acquire water and water rights, import water and conserve it
- to control flood and storm waters of streams that flow into district, and to conserve such waters for beneficial purposes by spreading, storing, retaining, and causing to percolate

- to carry on technical and other necessary investigations, make measurements, collect data, make analyses, studies, and inspections pertaining to water supply, water rights, control of flood and storm waters, and use of water.

SBCWD is the county-wide manager of water resources, the owner and operator of local surface water reservoirs (Hernandez and Paicines) and associated recharge operations, and the wholesaler for Central Valley Project (CVP) supplies from the U.S. Bureau of Reclamation (USBR). SBCWD has established three Zones of Benefit reflecting these responsibilities, as described in **Table 1-1**. While Zone 1 is the entire San Benito County, the extents of Zones 3 and 6 are shown in **Figure 1-2.** Zone 6 is the area where CVP water is provided; remaining areas rely on groundwater wells.

Table 1-1. SBCWD Zones of Benefit

Zone	Area	Provides
1	Entire County	Specific District administrative expenses
3	San Benito River Valley (Paicines to San Juan) and Tres Pinos Creek Valley (Paicines to San Benito River)	Operation of Hernandez and Paicines reservoirs and related groundwater recharge and management activities
6	San Juan, Hollister East, Hollister West, Pacheco, Bolsa SE, and Tres Pinos subbasins	Importation and distribution of CVP water and related groundwater management activities

SBCWD is governed by a five-person Board of Directors that elects a president from its members and appoints a secretary. The SBCWD Board of Directors serves as the Board of Directors for the SBCWD GSA. The Board meets monthly at its office, located at 30 Mansfield Road, Hollister. Meetings are announced, and agenda are posted on the SBCWD website; the meetings are open to the public. The board (except as otherwise specifically provided in the California Water Code) manages and conducts the business and affairs of SBCWD and the GSA. A majority vote of directors present at any meeting attended by a quorum is necessary to determine any proposition or resolution presented. The Board is supported by operations staff and by Administrative Staff, including the General Manager who is the GSA Point of Contact (see above) and Project Manager for the GSP.

Valley Water (SCVWD) is the GSA for the portion of the GSP area in Santa Clara County. Valley Water is a special district with jurisdiction throughout Santa Clara County. It formed in 1951 as the Santa Clara County Flood Control and Water District; its name subsequently was changed to Santa Clara Valley Water District. As of 2019, SCVWD is known as Valley Water and this name is used in this GSP, except when the historical name is needed for clarity. Valley Water provides wholesale water supply, stream and watershed stewardship, and flood protection for Santa Clara County. In addition, Valley Water manages the County's groundwater basins. Valley Water is a CVP and State Water Project (SWP) contractor and receives water from the San Felipe Division facilities through the Pacheco and Santa Clara Conduits, with imported water customers in the Santa Clara County portion of the GSP area along Pacheco Creek.

Valley Water's Board of Directors includes seven members, each elected from equally divided districts drawn through a formal process. The Board of Directors holds regular meetings twice monthly on the second and fourth Tuesday. All meetings are held in the Valley Water Headquarters Board Room, at 5700 Almaden Expressway, San Jose, unless otherwise noted on the meeting agenda.

1.4.1. Legal Authority of the GSA

SBCWD is a public agency overlying the North San Benito Basin within San Benito County. Valley Water is a public agency overlying portions of the basin in Santa Clara County. Both are qualified exclusive GSAs and have the authority to develop and implement SGMA within their respective service areas. Based on their respective legislation, each has broad powers and authorities for water management. SGMA specifies additional enabling powers; for example, GSAs may choose to adopt standards for measuring and reporting water use, develop and implement metering, and manage extraction from individual wells. GSAs also may impose fees to fund the cost of a groundwater sustainability program.

1.4.2. GSP Development Costs and Funding Sources

In November 2017, SBCWD applied for a Sustainable Groundwater Management Planning (SGMP) Grant to fund preparation of this GSP. In April 2018, DWR awarded SBCWD with full funding of $830,366. Subsequently in 2019, SBCWD GSA applied to DWR for additional grant funding as part of the 2019 Sustainable Groundwater Management Grant Program Planning – Round 3 Grant and in 2020 was awarded $1.17 million in grant funds. With SBCWD GSA cost sharing of $390,000, the total Round 3 project cost is $1.56 million. The Round 3 project, initiated in June 2020, involves three technical tasks: a program to site, design, and install dedicated monitoring wells, a feasibility investigation for Managed Aquifer Recharge (MAR), and two Annual Reports. These tasks supplement GSP preparation.

Implementation of the GSP will involve projects and management actions to maintain groundwater sustainability in North San Benito Basin. These are presented in Section 8 Projects and Management Actions. Estimated costs also are presented as available. Implementation of the GSP will involve increased annual costs for monitoring of the basin, compliance with SGMA monitoring requirements (including annual assessment of groundwater extraction), expanded reporting, and five-year updates.

Accordingly, as part of the GSP, SBCWD has investigated means of funding within its authority from the original San Benito County Water District Act and from SGMA. As detailed in Section 8, funding methods include a property-based fee for landowners in the basin benefitting from groundwater management and a potential groundwater-extraction based fee that supports annual measurement of groundwater pumping.

The costs of GSP preparation and implementation will be funded by the Groundwater Management Fee. In its Resolution No. 2021-13 (in Appendix A), the SBCWD GSA Board of Directors has determined that the amount of the Groundwater Management Fee is no more than necessary to cover the reasonable costs of the governmental activity financed thereby and that the manner in which those costs are allocated to landowners charged with the Groundwater Management Fee bears a fair and reasonable relationship to the owners' benefits received from management of the Basin.

As stated in Resolution No. 2021-13 and its Attachment A, the SBCWD GSA has identified the total costs of GSP preparation and the expected annual management and administration costs over the next five years, that the GSA adopts and levies and provides for the collection of the Groundwater Management Fee:

Table 1-2. Total GSP Plan Development and Annual Expense

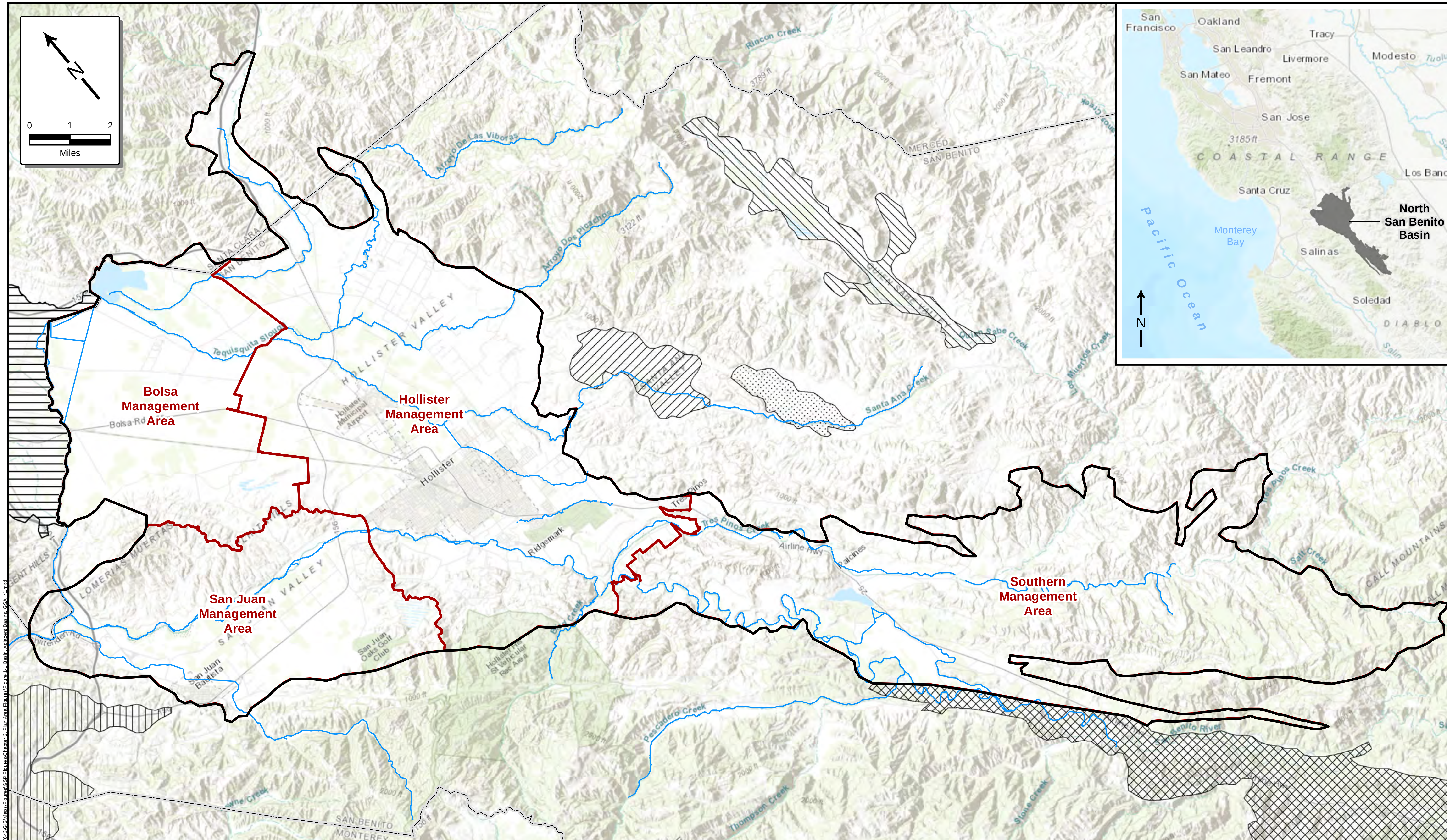
Fiscal year	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026
Total Expense	$525,935	$539,401	$553,271	$567,557	$582,272

1.5. GSP ORGANIZATION

This GSP is organized generally to follow the Groundwater Sustainability Plan (GSP) Annotated Outline provided by DWR as one of its Guidance Documents. Major sections include:

- Executive Summary
- Introduction
- Plan Area
- Hydrogeologic Conceptual Model
- Groundwater Conditions
- Water Budget
- Sustainability Criteria
- Monitoring Network
- Management Actions and Projects
- Plan Implementation
- References

A Preparation Checklist demonstrating compliance with SGMA is attached in **Appendix C.** Additional appendices convey the Communication Plan (**Appendix D**); Technical Memoranda on data, the data management system, and management areas (**Appendix E**); Annual Reports (**Appendix F**); and Groundwater Model Update and Enhancement Report (**Appendix G**)**,** Dedicated Monitoring Well Installation Program Technical Memorandum (**Appendix H**), and List of Public Meetings and Comments on the Plan (**Appendix I**).

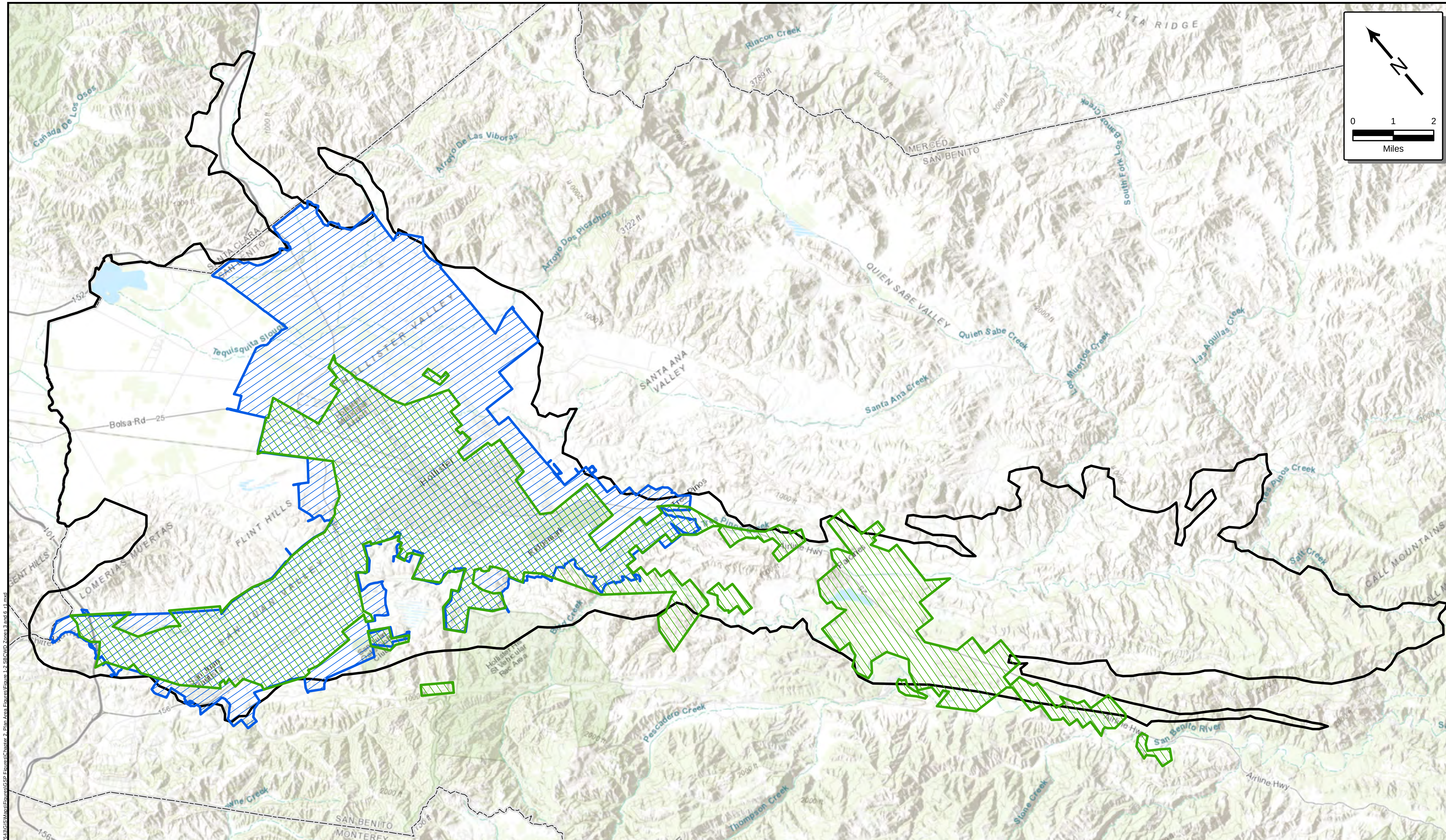


Llagas Area Subbasin of the Gilroy-Hollister Basin
Pajaro Valley Subbasin of the Corralitos Basin
Quien Sabe Valley Basin
Santa Ana Valley Basin
Upper Santa Ana Valley Basin
San Benito River Valley Basin
North San Benito Basin
Management Areas

November 2021

TODD GROUNDWATER

Figure 1-1
North San Benito Basin, Adjacent Basins, and SBCWD GSA



North San Benito Basin Zone of Benefit 1

San Benito County Water District (SBCWD) Zone of Benefit 3

San Benito County Water District (SBCWD) Zone of Benefit 6

November 2021

TODD GROUNDWATER

Figure 1-2
San Benito County Water District Zones of Benefit

2. PLAN AREA

The Plan Area includes valley areas characterized by productive agriculture, urban areas including the City of Hollister and the City of San Juan Bautista, rural communities, and upland areas characterized by grazing land.

2.1. DESCRIPTION OF THE PLAN AREA

The following provides a general description of the North San Benito Groundwater Sustainability Plan (GSP) Area, including local jurisdictions, water resource management and monitoring programs, well permitting procedures, general plans and other land use plans, and additional groundwater management elements.

2.1.1. Geographic Area

Figure 1-1 shows the boundaries of the Plan Area along with other groundwater basins in San Benito County. **Figure 1-1** also shows the adjacent Llagas Subbasin in Santa Clara County, which shares a common boundary along the Pajaro River, and the Pajaro Valley Basin which extends into San Benito County but is not adjacent to North San Benito.

Figure 1-1 shows the boundaries of Groundwater Sustainability Agencies (GSAs) in San Benito County; Valley Water is the GSA for all groundwater basin areas in Santa Clara County. No adjudicated areas exist in the basin, or in San Benito County and adjacent Santa Clara County. In addition, no areas of the North San Benito basin are covered by an Alternative Plan. Alternative Plans are equivalent to GSPs and represent options for basins with documented sustainability for the ten years but were due by January 1, 2017. Alternative Plans were submitted to California Department of Water Resources (DWR) by SCVWD (Valley Water) for the adjacent Llagas Subbasin and by Pajaro Valley Water Management Agency for the nearby Pajaro Basin.

2.1.2. Jurisdictional Agencies

This section identifies agencies with land use management responsibilities.

Counties. The GSP area overlaps two counties: San Benito and Santa Clara. Through the Resource Management Agency (RMA), San Benito County has jurisdiction for land use planning for unincorporated areas. San Benito County also has responsibility for small water systems and for on-site wastewater treatment systems (OWTS) through its Department of Environmental Health. The San Benito County Code of Ordinances (Title 15 Public Works, Chapter 15.05 Water, Article 1) also asserts groundwater aquifer protections and appoints San Benito County Water District (SBCWD) as the enforcing agency.

Similarly, the Santa Clara County Department of Planning and Development has jurisdiction for land use planning in unincorporated areas, including all Santa Clara County portions of the GSP Area. The Santa Clara Department of Environmental Health is responsible for small water systems and for OWTS. While Valley Water is responsible for regulation of the construction, destruction, and maintenance of wells, Santa Clara Department of Environmental Health provides review of all new well construction applications for domestic and agricultural uses prior to submittal to Valley Water; this review ensures adequate separation of wells from OWTS.

Cities. Figure 2-1 shows the boundaries of other jurisdictions that have land use management responsibilities. These include two municipalities: City of Hollister and the City of San Juan Bautista. These have land use planning responsibilities within their respective planning areas. General plan elements relevant to the GSP are discussed in Section 2.1.3. In addition to land use planning, the City of Hollister Public Works Department is responsible for stormwater management, for sewage collection, and for producing and distributing potable water for the western half of the City; the eastern portion of the City and the Ridgemark community are served by Sunnyslope County Water District (SSCWD). The City of San Juan Bautista provides water and sewer service within its service area.

State Parks. California State Parks has jurisdiction for the Hollister Hills State Vehicular Recreation Area (SVRA). Park facilities are mostly in Cienega Valley, but the eastern park overlaps the GSP Plan Area (see **Figure 2-1**). The overlapping portion of the SVRA is mostly designated as non-motorized special use area and buffer area and is open space with some ranch buildings. The Hollister Hills SVRA is guided by its Resource Management Plan and General Development Plan, completed in 1978 (California Department of Parks and Recreation, 1978). Planning relevant to water is generally to provide safe, serviceable water systems for picnic and camping areas; to protect habitat associated with seeps, springs, ponds, and riparian areas; and to control water pollution.

California Department of Fish & Wildlife. Also relevant are state wildlife refuges, lands owned by the California Department of Fish & Wildlife (CDFW), and lands with conservation easements. Of these in the GSP Area, the Wildlife Heritage Foundation/Wildlands manages the Pajaro River Wetland Mitigation Bank along the Pajaro River just downstream from San Felipe Lake.

Federal Lands. Federal lands within the GSP Area include parcels around and providing access to San Justo Reservoir. The reservoir is part of the US Bureau of Reclamation's Central Valley Project, and the land is administered by the Bureau of Land Management. No other federal lands overlie the Plan Area, such as military installations or United States Forest Service lands. No tribal lands are known within the GSP Area, but to the west, the U.S. Bureau of Indian Affairs administers an area of Tribal Trust Land along Harlan Creek, a tributary to Cienega Valley.

2.1.2.1. Water Supply Sources

Water supply for agricultural, Municipal and Industrial (M&I), and domestic uses is from groundwater, local surface water, imported water from the Central Valley Project (CVP), and recycled water; groundwater is the major source of supply.

Water Providers. While SBCWD and Valley Water have jurisdiction for water management throughout their respective counties, much of the population in the GSP area is served by local water agencies. The largest of these (in terms of permanent population) include the City of Hollister, Sunnyslope County Water District (SSCWD), Aromas Water District, City of San Juan Bautista, Tres Pinos Water District, and Community Service Area (CSA) No. 31-Stonegate Water System. Other small systems are operated by private mutual water companies and some communities do not have water purveyors and systems that provide water service. These small systems and communities—plus rural businesses, schools, parks, and residents—rely on private wells and groundwater.

- **City of Hollister.** The City of Hollister, a General Law City, is the largest incorporated city in San Benito County with a population of about 37,000. The City provides groundwater from four active production wells in the GSP Area, treated CVP water through the Lessalt and West Hills Water Treatment Plants (WTPs), and recycled water for non-potable uses.
- **Sunnyslope County Water District (SSCWD).** Sunnyslope County Water District is a special district in accordance with the California State Water Code. It is a water purveyor whose service

area includes part of the City of Hollister and unincorporated areas including the Ridgemark community. Serving a population over 20,000, SSCWD provides groundwater from five active wells located in the GSP Area and treated imported CVP water from the Lessalt WTP.

- **Aromas Water District.** Aromas Water District supplies groundwater to approximately 2,700 residents located in and around Aromas. While overlying a portion of the GSP Area, most of its customers and its three production wells are located outside the area.
- **City of San Juan Bautista.** The City of San Juan Bautista, a General Law City, serves water to a population of about 1,900 residents. The City operates four wells located within the GSP Area.
- **Tres Pinos Water District.** Tres Pinos Water District (TPWD) serves groundwater to the community of Tres Pinos, which has a population of about 500. TPWD has one active well.
- **CSA No. 31-Stonegate.** CSA No. 31 serves about 250 people in a residential community located along Pinnacles Highway. SBCWD provides Stonegate with CVP surface water and groundwater from one well that is located within the GSP Area.
- **Pacheco Pass Water District.** The service area of Pacheco Pass Water District (PPWD) is in the northern GSP Area along Pacheco Creek. PPWD owns and operates Pacheco Reservoir on North Fork Pacheco Creek in Santa Clara County. With a design capacity of 6,000 AF, the reservoir currently is operated by PPWD for groundwater recharge along the downstream creek channel. PPWD also holds surface water rights for impoundment along Arroyo de las Viboras and for diversion into the adjacent Frog Ponds for percolation.

Groundwater. Groundwater currently is the main source of water supply in the GSP Area. Groundwater provides supply to municipal, agricultural, and domestic users through an estimated 1,026 production wells located throughout the GSP Area (DWR, 2018b). The other major source is CVP water that is delivered to municipal water suppliers as noted above and to agricultural customers in Zone 6. In Zone 6, the relative proportions of groundwater and CVP water use are affected primarily by the availability of CVP water from USBR; in recent years, CVP supply has ranged from less than 20 percent to more than 50 percent of total Zone 6 supply.

Water Supply Wells. Figure 2-2 shows the density of water supply wells in and around the Plan Area; this map is based on the DWR Well Completion Report Map Application tool (DWR, 2018b). As indicated, the density of supply wells is generally less than 20 wells per section. Relatively high densities generally occur around the northern margins of the basin, in areas including low density residential development. **Figures 2-3**, **2-4**, and **2-5** show the estimated density of domestic wells, production wells, and public wells. Most of the production wells, as classified by DWR, are presumably irrigation wells but also include some industrial and commercial wells.

Beyond the service areas of the City of Hollister and SSCWD (Hollister and Ridgemark), and the Stonegate community, communities and rural residents depend on groundwater. The largest of the groundwater dependent communities in the GSP Area is the City of San Juan Bautista, where a population of about 1,900 depends solely on groundwater. Other communities depending on groundwater in the GSP Area include Tres Pinos (served by Tres Pinos Water District), Paicines, and Dunneville.

As shown in **Figure 2-6,** disadvantaged communities have been mapped in the area (DWR, DAC Mapping Tool). As of 2018, the DAC extending across San Juan Valley (mapped as census block groups) includes about 150 households / 660 persons. Households in this area rely on groundwater for domestic supply. Four smaller DAC areas are within the City of Hollister service area include over 3,300 households and a population of nearly 5,000. These DACs have access to City water supply, a blend of treated imported water and groundwater.

Local Surface Water. SBCWD owns and operates two reservoirs along the San Benito River. Hernandez Reservoir (capacity 17,200 AF) is located on the upper San Benito River in southern San Benito County. Paicines Reservoir (capacity 2,870 AF) is an offstream reservoir between the San Benito River and Tres Pinos Creek. It is filled by water diverted from the San Benito River, with some of the diversions consisting of natural runoff and some consisting of water released from Hernandez Reservoir. Water stored in the two reservoirs is released for percolation in Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season. Zone 3 is the zone of benefit for local surface water (see **Figure 1-2)**.

Local surface water also is diverted from Arroyo de las Viboras into the adjacent Frog Ponds for percolation, based on PPWD surface water rights.

Pacheco Reservoir, owned by PPWD, is in Santa Clara County just north of the northernmost tip of the GSP Area. Water released from the reservoir flows down Pacheco Creek and provides groundwater recharge. In 2018, SCVWD (Valley Water) was awarded $484.5 million in funding from the State of California for the Pacheco Reservoir Expansion Project, which is a collaborative effort of SCVWD (Valley Water), SBCWD, and PPWD. The project includes construction of a new, larger reservoir and a pipeline providing a connection to the Pacheco Conduit, the CVP pipeline that delivers water into Santa Clara and San Benito counties from San Luis Reservoir. The expanded reservoir, when filled by a combination of Central Valley Project supplies and local inflows, would expand the storage of CVP water available to Valley Water and SBCWD, provide more flexibility for use of CVP water, enhance the continuity of flows in Pacheco Creek, and benefit downstream habitats along Pacheco Creek and the local steelhead population.

Imported Water. The Central Valley Project (CVP) is a Federal water system operated by the U.S. Bureau of Reclamation (USBR) with multiple uses including irrigation water supply for agricultural and urban uses, flood control, navigation improvement on the Sacramento River, water quality enhancement, hydroelectric power, fish and wildlife, and recreation. The CVP consists of 20 dams and reservoirs, 11 power plants, and 500 miles of major canals, conduits, and tunnels. While mostly serving the Central Valley, the San Felipe Division diverts water supply from San Luis Reservoir (shared with the State Water Project or SWP) through the Pacheco Tunnel and Pacheco Conduit to Santa Clara and San Benito counties. The Santa Clara Conduit conveys water to the Santa Clara Valley and the San Benito (Hollister) Conduit conveys water to San Justo Dam, an offstream storage reservoir in San Benito County.

SBCWD has a 40-year contract (to February 29, 2028, with options for renewal) for a maximum of 8,250 AFY of M&I water and 35,550 AFY of agricultural water. Actual CVP deliveries are modified on an annual basis by USBR, reflecting hydrologic conditions (e.g., drought), reservoir storage, and the environmental status of the Sacramento-San Joaquin Delta.

SBCWD distributes CVP water to agricultural, municipal, and industrial customers in Zone 6 through 12 subsystems containing approximately 158 miles of pressurized pipeline laterals (SBCWD, 2015). Zone 6, SBCWD's zone of benefit for CVP water, overlies northern portions of the GSP Area (see **Figure 1-2**). Such distribution of CVP water "in lieu" of groundwater pumping has been instrumental in reversing historical overdraft and preventing future overdraft. The Hollister Conduit, CVP distribution systems, and San Justo Reservoir (where CVP water is stored in the basin) is shown on **Figure 2-7**. SBCWD also has recharged groundwater with CVP water through offstream recharge ponds.

The City of Hollister and SSCWD purchase CVP water as the primary M&I CVP customers. Other M&I uses of CVP water include urban irrigation, golf courses, and potable supply for the Stonegate community. Treatment of CVP water for potable M&I supplies within the Hollister Urban Area (HUA) is provided by the Lessalt and West Hills Water Treatment Plants (WTPs) on the east and west sides of

Hollister, respectively. Lessalt WTP, a facility owned by SBCWD and operated by SSCWD, was placed into operation in 2003. An expansion was completed in 2015 that increased the operational capacity of Lessalt to 2.0 million gallons per day (MGD), treating an annual total of 2,240 AFY. West Hills WTP, with an initial design capacity of 4.5 MGD, began operation in late 2017. West Hills WTP not only provides additional treatment capacity for CVP water, but also improves the quality of water delivered on the west side. Together the WTPs enhance the reliability of HUA water supply, improve the water quality delivered to customers, and improve the quality of wastewater effluent and thereby support water recycling.

Recycled Water. Water recycling is a cooperative effort of SBCWD and the City of Hollister. Recycled water has been provided by the City of Hollister for landscape irrigation since 2010. As of 2016, SBCWD has been delivering recycled water from the City water reclamation facility for agricultural irrigation. Recycled water use is a relatively small but increasing supply.

2.1.3. Water Use Sectors

Water use sectors are defined in the GSP Regulations as 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. In the GSP Area, these are summarized as follows.

- Urban water use sectors are focused in the City of Hollister and City of San Juan Bautista.
- Areas of industrial water use are mostly in the City of Hollister, with some in City of San Juan Bautista. Industrial sites in unincorporated San Benito County are generally near Hollister, but also include a light industrial park on Union Road west of Hollister and industry near the San Benito River at Highway 101.
- Agricultural land uses comprise extensive areas in the San Juan, Bolsa, Pacheco, Hollister, Tres Pinos, and Paicines valley areas.
- Managed wetlands include the Pajaro River Wetland Mitigation Bank (see **Figure 2-1**) that encompasses 273 acres of land along the Pajaro River south of San Felipe Lake and currently includes uplands, seasonal marsh, and semi-permanent emergent marsh habitat.
- Managed aquifer recharge is conducted by SBCWD along the channels of the San Benito River and Tres Pinos Creek and at offstream basins including the Union Road Pond near the San Benito River and the Frog Pond on Arroyo de Las Viboras (see **Figure 1-1** for stream locations).
- Native vegetation, including rangeland, accounts for the remainder including upland areas and along streams.

2.1.4. Water Resources Monitoring and Management Programs

This section summarizes water resources monitoring and management in the GSP Area as the foundation for GSP preparation and implementation. SBCWD has been managing water resources since its inception, has monitored groundwater levels since 1976, and since 1996 has provided summaries of its management and monitoring activities in its Annual Groundwater Reports (see **Appendix F** for recent reports). SBCWD also has conducted numerous special investigations over the decades; while these have contributed to the overall understanding and management of local water resources, they are not summarized here.

2.1.4.1. Water Resource Monitoring

Water resource monitoring programs considered in this section include:

- Climate

- Surface water flows
- Imported water deliveries
- Groundwater recharge
- Water recycling
- Land use and cropping
- Wells and groundwater pumping
- Groundwater levels
- Land subsidence
- Water quality.

Monitoring programs undertaken by local, state, and federal agencies are summarized below as they are relevant to the GSP. Much of this information is compiled regularly for the Annual Groundwater Reports.

Climate. Climate data are regularly compiled from DWR's California Irrigation Management Information System (CIMIS) and include total solar radiation, soil temperature, air temperature/relative humidity, wind direction, wind speed, and precipitation. Two CIMIS stations are active in the GSP Area, both of which also measure evapotranspiration (ETo):

- #126 San Benito, located at the SBCWD office on Mansfield Road with a record beginning in June 1994.
- #143, San Juan Valley, located at the San Juan Golf Course with a record beginning January 1998.

Historical rainfall data are available for Hollister dating back to 1874. For the Annual Groundwater Reports, historical annual precipitation has been compiled and reported using the Hollister rain gage for water years 1875-1995 and the CIMIS San Benito station thereafter (CIMIS, 2021).

Several maps are available showing the geographic distribution of annual rainfall across the GSP Area. These include the state-wide map by USGS (Rantz, 1969), which used data from 1907-1956; the SCVWD (Valley Water) map (SCVWD, 1989) that used data through 1988; and maps created using data from the Parameter-Elevation Regressions on Independent Slopes Model (PRISM) Climate Group (PRISM, 2021).

Surface water flows. Surface water monitoring has been summarized in Annual Groundwater Report and an appendix includes location maps of active and inactive USGS stations in and near the San Benito River system with the respective period of record (see Figures C-2 and C-3 in Todd Groundwater, 2018). Streamflow data are regularly downloaded. The sites for SBCWD miscellaneous surface water measurements are shown, including data from Pacheco Creek in Santa Clara County.

Imported water deliveries. Imported water deliveries began in September 1987 (LSCE, 1991). The Annual Groundwater Reports summarize annual CVP allocations, deliveries of CVP water to Zone 6, and San Justo reservoir water budgets. Delivery data are generated according to distribution subsystems; for historical reporting purposes, these data have been subsequently allocated to groundwater subbasins and to agricultural and municipal/domestic uses.

Groundwater recharge. The Annual Groundwater Reports summarize managed percolation activities. Information on SBCWD percolation of local surface water include annual reservoir budgets and releases for Hernandez and Paicines reservoirs. Percolation of CVP water also is tabulated, as is percolation of municipal wastewater from local wastewater treatment plants. In addition to regular monitoring, SBCWD also has conducted special studies of percolation along selected streams.

Recycled water. Recycled water use is documented in the Annual Groundwater Reports, with annual tabulation.

Wells and groundwater pumping. Groundwater pumping information is summarized in the Annual Groundwater Reports; this includes annual amounts from municipal providers (who measure groundwater production at least monthly).

Information also is provided on irrigation pumping in Zone 6, where SBCWD monitors groundwater pumping from major irrigation wells (with discharge pipes 3 inches in diameter or greater). Pumping amounts are calculated semiannually by metering the number of hours of operation and multiplying by the average discharge rate, which is measured a few times per year. This monitoring program began in about 1990 (soon after CVP imports started) and was based on recognition that CVP imports resulted in reduced pumping, increased recharge, and recovering groundwater storage with regional benefits. This contrasts with other California basins where imported water was used to increase irrigated acreage (LSCE, 1991). Irrigation pumping beyond Zone 6 is not monitored but has been estimated for regular water budget updates based on land use information and water use factors.

Groundwater levels. SBCWD has had a semi-annual groundwater level monitoring program since Water Year (WY) 1977; groundwater level data gathered by USGS and other agencies are available as early as 1913 (Clark, 1924). The Annual Groundwater Reports provide quarterly groundwater level data for each year. The data are the basis for groundwater level contour maps, change maps, hydrographs, groundwater level profiles, and storage change computations presented in the Annual Groundwater Reports. These are focused on Zone 6, where SBCWD delivers CVP water and maintains a relatively intensive monitoring program; the adjacent Bolsa area also is addressed. The SBCWD monitoring program includes wells in the Pacheco Valley in Santa Clara County. Valley Water's monitoring program provides data for the southern Llagas Subbasin; these shared data are used in the SBCWD annual groundwater level maps.

SBCWD is the designated California Statewide Groundwater Elevation Monitoring (CASGEM) monitoring agency for the GSP Area; CASGEM data are available from DWR's online Groundwater Information Center Interactive Map (GICIMA).

Land use. Land use maps have been prepared by DWR for San Benito County, with the earliest maps in 1967. GIS-based land use maps are available online for 1997, 2002, and 2014 with the DWR Land Use Viewer (DWR, 2018a). In 2012, SBCWD prepared an update of the 2002 map to 2010 using 2010 aerial photography. The 1997 and 2002 maps were used in preparing the Salt Nutrient Management Plan (Todd, 2014) and in updating water budgets for the 2014 Annual Groundwater Report.

Land subsidence. While the potential for subsidence was recognized in the 2003 Groundwater Management Plan, it was not a known issue in the GSP Area and ground surface elevations were not tracked for this issue until DWR initiated its satellite mapping program in 2015. Nonetheless, groundwater levels generally have been managed to stay above historical low levels to minimize the potential for ground subsidence.

Water quality. In 1997, SBCWD initiated a program for monitoring nitrate and electrical conductivity (EC) in wells. In 2004, SBCWD established a comprehensive water quality database that contains over 450,000 records from water systems and regulated facilities. The database is updated on a triennial basis as part of the Annual Groundwater Reports with maps and data provided in an appendix. SBCWD surface water quality monitoring sites also are identified. Monitoring for the Salt Nutrient Management Plan is closely coordinated.

State-wide sources of groundwater quality data include the Water Data Library (WDL), Geotracker/ Groundwater Ambient Monitoring and Assessment (GAMA) program, and the State Water Resources Control Board's Division of Drinking Water (DDW). These are accessed for the triennial update of the SBCWD Water Quality Database.

2.1.4.2. Incorporation of Existing Monitoring into GSP

The monitoring program for the GSP is described in Section 7, Monitoring Network. The GSP Monitoring Network builds on existing monitoring programs that provide historical information and a context for future monitoring. It also includes an expansion to represent the entire North San Benito Basin. Data gaps have been defined throughout the GSP preparation process; an initial discussion of available data and data gaps was included in the December 2018 Technical Memorandum, "Data to Support GSP Preparation" (in **Appendix E**). Additional data and monitoring needs also have been identified in Sections 3 through 6 describing the Hydrogeologic Conceptual Model and Groundwater Conditions, quantifying the Water Budget, and setting Sustainability Criteria. These needs are addressed in Section 7. Objectives for the monitoring program, laid out in Section 7, provide guidance for the incorporation of existing monitoring into the GSP.

As described in Section 7, the existing monitoring programs will be enhanced and fully incorporated into the expanded monitoring program for GSP implementation. Monitoring data will be entered regularly into the Data Management System (DMS). The DMS in turn will: 1) provide data to inform and update the hydrogeologic conceptual model, water budget, and numerical model, 2) provide tracking and early warning regarding groundwater conditions and undesirable results, and 3) demonstrate progress toward and achievement of sustainability. As described in the 2020 Annual Groundwater Report (in **Appendix F**), the SBCWD annual reporting already has been transitioning in content and format toward a SGMA-compliant annual report. Additional details are provided in the next section, 2.1.4.3 Water Resources Management.

2.1.4.3. Water Resources Management

This section describes the water resources management plans developed by SBCWD for the Plan Area; note that monitoring is addressed in Section 2.1.2.1.

Groundwater Management Plan, 1998 and 2003. The groundwater management planning process in San Benito County was initiated in May 1997 as a collaborative effort among local water agencies and other organizations. The involved water agencies included the Aromas Water District, City of Hollister, City of San Juan Bautista, SBCWD, SSCWD, and TPWD. The other cooperating organizations included San Benito County, San Benito County Farm Bureau, San Benito County Builders and Developers Association, Granite Rock Company and the Sierra Club. This collaboration resulted in the Groundwater Management Plan for the San Benito County Part of the Gilroy-Hollister Groundwater Basin (JSA, 1998) which was adopted on April 29, 1998, pursuant to Water Code Appendix Section 70-7.

The 1998 Groundwater Management Plan addressed San Benito County portions of the Gilroy-Hollister Basin and extended southward to include the Tres Pinos Valley Basin. The 1998 plan summarized the local hydrogeology, water budgets, water quality, water supply and demand, and regulatory setting. It developed management objectives, identified issues, and presented 32 management actions with an implementation plan.

Recognizing that groundwater management is an ongoing process that is best accomplished on a collaborative basis, four key agencies (SBCWD, City of Hollister, City of San Juan Bautista, and SSCWD) formalized their relationship in June 1998 as the Water Resources Association (WRA) of San Benito

County. This association was granted the power to coordinate the study and planning of water programs, to undertake studies and programs to implement the groundwater plan, and to update the Groundwater Management Plan.

Accordingly, the WRA embarked on a process of expanding the groundwater management plan and developing an associated program environmental impact report (PEIR) to inform decision makers and the general public of the environmental effects that might result from approval of the plan. SBCWD served as the lead agency in this effort, which culminated in the August 2003 Groundwater Management Plan (GWMP) Update for the San Benito County Portion of the Gilroy-Hollister Groundwater Basin (Kennedy/Jenks, 2003). The GWMP Update and PEIR were approved by SBCWD on July 28, 2004.

The 2003 Update focused on northern portions of the Gilroy-Hollister basin in San Benito County. It described groundwater basin conditions, defined basin management objectives, identified nine major issues, and presented numerous management elements. Overall, it provided the basis for subsequent activities and related management planning, including:

- Urban water conservation and agricultural irrigation efficiency programs
- Salt and nitrate management programs (e.g., water softener rebate program)
- Enhancement of data management and monitoring programs (e.g., dedicated monitoring well and water quality database)
- Update and application of regional groundwater flow model
- Surface water importation
- Water transfers and banking
- Management of groundwater recharge operations
- Surface water treatment (e.g., Lessalt and subsequent West Hills Plants)
- Management of municipal wastewater percolation and water recycling.

Most of these have been cooperative efforts involving multiple agencies.

Numerical Groundwater Modeling. In 2001, SBCWD developed a groundwater flow model of the San Benito County part of the Gilroy-Hollister Groundwater Basin. The model has been applied for various water and wastewater planning, design, and environmental impact studies since then. The updated model is described in **Appendix G**. It has evolved “organically,” with incremental addition of new features and localized recalibration to meet the needs of individual studies. Examples of these enhancements include the addition of particle-tracking to estimate subsurface travel time of percolated wastewater, linking of the flow model to a solute transport model to simulate salt accumulation and movement in groundwater, and expansion of the simulated flow domain to include some of the hills adjacent to the valley floor areas.

In 2015, a systematic update and enhancement of the groundwater model and the pre- and post-processing programs was conducted (Todd, 2015). This overhaul included:

- Extending the simulation base period by 10 years, to cover water years 1975-2014.
- Replacing the previous set of spreadsheet tools for estimating rainfall recharge, irrigation pumping and return flow, and stream flow with a more flexible and integrated set of spreadsheets and Fortran programs that better represent surface hydrologic processes.
- Eliminating data-preparation procedures that had been introduced for specific past projects but were deemed not necessary for current and future model applications.
- Adding the capability to easily simulate evolving land use or incorporate variable stress period durations.

Integrated Regional Water Management Plan, 2007. The IRWMP is a collaborative effort by the Pajaro Valley Water Management Agency (PVWMA), SBCWD, and SCVWD (Valley Water) to identify regional and multi-benefit projects for the Pajaro River Watershed. Adopted in 2007 (SBCWD et al., 2007), the IRWM Plan describes the region, provides goals and objectives, and identifies and evaluates projects and programs, including assessment of climate change. On an individual basis, PVWMA, SBCWD, and Valley Water have each investigated and evaluated various resource, environmental, and management options for the overall health and well-being of the watershed within their jurisdictions. The IRWMP integrates these various efforts and investigates the greater Pajaro River Watershed area to identify and prioritize integrated regional projects for the watershed to maximize benefits to the broadest group of stakeholders in the region. A major component of the IRWMP has been the Hollister Urban Area (HUA) water and wastewater master planning process, summarized below.

Hollister Urban Area Water Project. The Hollister Urban Area Water Project (HUAWP) is an ongoing collaborative effort by the City of Hollister, SBCWD, and SSCWD to improve drinking water quality for residents and businesses and to help meet wastewater discharge requirements and protect the groundwater basin. The area of the HUAWP includes the City of Hollister and nearby unincorporated areas of San Benito County designated for urban development (HUAWMP, 2017).

This effort was initiated in 2004 with an MOU among the three entities to develop the HUA Water and Wastewater Master Plan (HDR, 2008), which identified projects or program elements for water, wastewater, and recycled water with implementation defined out through 2023. The HUA water projects have included: (1) purchases or transfers of imported water supplies, (2) North County Groundwater Bank, (3) new urban wells, (4) upgrade of the Lessalt Water Treatment Plant, (5) new surface water treatment plant [West Hills], (6) demineralization of urban wells, (7) a new pipeline to Ridgemark, and (8) new treated water storage. Wastewater elements include (1) Ridgemark Wastewater Treatment Plant upgrades, (2) expansion of the City of Hollister Water Reclamation Facility, and (3) the Cielo Vista Estates connection to the City of Hollister Water Reclamation Facility. Recycled water elements include (1) Phase 1 recycled water facilities (2) Phase 2a and Phase 2b recycled water facilities, and (3) Ridgemark recycled water facilities. Non-structural solutions include water conservation, salinity education, water softener ordinance, new development connections to the city sewer, and other measures.

Salt and Nutrient Management Plan (SNMP), 2014. SNMPs are required for groundwater basins throughout California and are intended to help streamline permitting of new recycled water projects while ensuring attainment of water quality objectives and protection of beneficial uses. The San Benito SNMP (Todd, 2014) was developed in accordance with the Recycled Water Policy adopted by the California State Water Resources Control Board. The San Benito SNMP addresses the Bolsa, Hollister, San Juan Bautista, and Tres Pinos Valley groundwater basins as defined by DWR. It includes:

- Definition of water recycling goals and objectives
- Identification of salt and nutrient sources
- Estimation of the salt and nutrient loading to groundwater basins and their capacity to assimilate the additional loading
- Development of salt and nutrient loading mitigation strategies
- Improvement of ground water quality monitoring.

The SNMP provides projected salt/nutrient balances for twelve subareas and found that all but two (Bolsa and Tres Pinos Valley) have predicted stable or decreasing trends in total dissolved solids (TDS) concentrations. Most areas had predicted increasing trends in nitrate concentrations in groundwater, but predicted increases are small. Potential adverse water quality impacts of recycled water irrigation projects were found to be minimal, and in some cases, impacts were positive.

Agricultural Water Management Plan (AWMP), 2015. SBCWD has prepared AWMPs in compliance with Water Code Section 10826. The AWMP (SBCWD, 2015) provides a description of SBCWD, the agricultural water supplier, its Zone 6 service area for CVP supply, and local conveyance, storage, and distribution facilities. The AWMP also documents the quantity of water used for agricultural irrigation, recreational purposes (e.g., at San Justo Reservoir until closed in 2008 due to Zebra Mussel infestation), and municipal / industrial purposes. Groundwater recharge operations and transfers/exchanges also are summarized. Water supplies are documented, and the reliability of water sources is assessed, including consideration of climate change. The AWMP presents SBCWD's implementation of efficient water management practices.

Irrigated Lands Regulatory Program (ILRP). The Irrigated Lands Regulatory Program (ILRP) of the Central Coast Regional Water Quality Control Board (RWQCB) regulates waste discharges from irrigated lands through its Waste Discharge Requirements (WDRs) including Order No. R3-2012-0011 for Discharges from Irrigated Lands (Agricultural Order), and Monitoring and Reporting Program Order Nos. R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03 (MRPs). In response, the Central Coast Groundwater Coalition (CCGC) was founded in July 2013 to represent landowners and growers who operate in Monterey, San Benito, Santa Clara, Santa Cruz, San Luis Obispo and Santa Barbara counties, and the northern portion of Ventura County. CCGC is a non-profit organization whose primary function is to fulfill groundwater quality regulatory requirements in the ILRP of the RWQCB.

CCGC developed a plan for groundwater monitoring that was approved by RWQCB in July 2013. A key component of the plan is sampling of drinking water wells with a focus on nitrate. In June 2015, CCGC submitted to a groundwater characterization report (LSCE, 2015) for the northern counties, including the Salinas, Pajaro, and Gilroy-Hollister valleys. This report, documenting nitrate concentrations in groundwater, was approved by the RWQCB in 2015. Subsequent sampling was scheduled for 2017 and 2019.

Water Quality Control Plan for the Central Coast Basins. The Water Quality Control Plan for the Central Coastal Basin (Basin Plan) provides the framework for how surface water and groundwater quality in the Central Coast Region should be managed to provide the highest water quality reasonably possible. The Basin Plan lists beneficial uses, describes the water quality which must be maintained to allow those uses, provides an implementation plan, details State Water Resources Control Board (SWRCB) and RWQCB plans and polices to protect water quality, and presents surveillance and monitoring programs. The most recent update in 2017 presents revised Total Maximum Daily Loads (TMDLs) for nitrogen compounds and orthophosphate in streams of the Pajaro River Basin, including the Pajaro River, San Juan Creek, and Tequisquita Slough of the GSP Area.

Urban Water Management Plans (UWMPs). The California Urban Water Management Planning Act requires preparation of UWMPs by urban water providers with 3,000 or more connections. The UWMPs, generally required every five years, provide information on water supply and water demand—past, present, and future—and allow comparisons as a basis for ensuring reliable water supplies. UWMPs examine water supply and demand in normal years and during one-year and multi-year droughts. UWMPS also provide information on per-capita water use, encourage water conservation, and present contingency plans for addressing water shortages. UWMPs have been prepared for the Hollister urban area since 1991; the most recent was a joint effort of City of Hollister, SBCWD, and SSCWD (Todd, 2021). Much of the coordination and community participation regarding water conservation within the HUA is achieved through the Water Resources Association (WRA) of San Benito County, which serves water customers of Hollister, SSCWD, SBCWD, and the City of San Juan Bautista.

According to the 2021 UWMP, total water demand will increase as population grows, but per-capita water demand has been responsive to water conservation efforts and has successfully met State guidelines. Water demands are satisfied with a combination of local groundwater and imported CVP water. Construction of water treatment plants as part of the HUA Water Project allows direct use of imported water, which improves delivered water quality, conserves groundwater for use during drought, and improves wastewater quality and thereby supports water recycling.

Despite challenges of drought, climate change, and environmental and legal factors, the HUA agencies have been able to provide reliable supply. This has been achieved by actively managing the portfolio of water supplies (groundwater, imported water, recycled water), by improving facilities (e.g., water treatment plants), and by promoting conservation.

SBCWD Annual Groundwater Reports. The San Benito County Water District Act authorizes the SBCWD Board of Directors to require SBCWD staff to prepare an annual groundwater report; this report addresses groundwater conditions and the zones of benefit for the water year. The Board has consistently ordered preparation of Annual Reports, and the reports have included contents specified in the Act:

- An estimate of the annual overdraft for the current water year and for the ensuing water year
- Information for the consideration of the Board in its determination of the annual overdraft and accumulated overdraft as of September 30 of the current year
- A report as to the total production of water from the groundwater supplies of the District and its zones as of September 30 of the current year
- Information for the consideration of the Board in its determination of the estimated amount of agricultural water and the estimated amount of water other than agricultural water to be withdrawn from the groundwater supplies of the District and its zones
- The amount of water the District is obligated to purchase during the ensuing water year
- A recommendation as to the quantity of water needed for surface delivery and for replenishment of the groundwater supplies of the District and its zones during the ensuing water year
- A recommendation as to whether or not a groundwater charge should be levied in any zone(s) of the District in the ensuing water year and if so, a rate per acre-foot for all water other than agricultural water for such zone(s)
- Any other information the Board requires.

Annual Groundwater Reports generally provide information on a Water Year basis (October 1-September 30) with completion of the report in December of that year and presentation at a Board of Directors meeting on the second Monday of the following January.

The Annual Groundwater Reports have served for decades as a reliable "state of the basin" report. The Annual Groundwater Reports also have been used to conduct and summarize selected groundwater investigations, for example addressing issues such as water quality, salt loading, shallow wells, and others. In recent years, water balance and water quality updates have been provided on a triennial basis. Recent Annual Reports are provided on the SBCWD website. The Annual Groundwater Reports for 2015, 2016, 2017, 2018, 2019, and 2020 are in **Appendix F.** The 2021 Annual Groundwater Report, completed after GSP submittal in January 2021, will be available on the SBCWD website.

Adaptation of Existing Monitoring and Management to SGMA. SBCWD has been actively monitoring and managing water resources throughout the GSP Area for decades. This management generally has been successful, especially where supplemental surface water supplies have been developed and where zones of benefit—namely Zone 3 and Zone 6—have been established. Some considerations for adaptation to SGMA include:

- Compliance with SGMA will require extension of monitoring and management activities to encompass all areas within the DWR-defined basin boundaries.
- As described in **Appendix G**, the numerical model was updated to include 2015 and recently available data, expanded to encompass the entire GSP area, and modified to address issues and specific sustainability criteria.
- Some adaptations may be considered about the timing of activities during the year. For example, historical computation of storage change has been based on autumn conditions, while SGMA requires analysis of seasonal high and low conditions.
- SBCWD Annual Groundwater Reports have specific content and timing; SBCWD has been considering how best to effectively fulfill requirements of Annual Reports (as ordered by the Board) and SGMA.
- Monitoring and management activities have addressed groundwater management issues as defined at the time; compliance with SGMA will involve re-visiting issues with the procedures laid out in the GSP Requirements.

Existing monitoring and management on the North San Benito Basin have been conducted by SBCWD in collaboration with Valley Water and public agencies in San Benito County. GSP implementation is built on, incorporates, and often expands existing programs, which thus are not expected to limit operational flexibility.

2.1.5. General Plans, Land Use Planning, and Well Permitting

This section presents relevant elements of General Plans and other land use planning in the GSP Area as relevant to groundwater sustainability. It summarizes the goals, objectives, policies, and implementation measures as variously described in the General Plans for San Benito County, Santa Clara County, City of Hollister, City of San Juan Bautista, and Hollister Hills SVRA which together encompass the GSP Area. This section also summarizes local well permitting procedures and well ordinances.

2.1.5.1. Land Use

The GSP area includes highly developed agriculture on prime farmland, mostly in valley areas, and rangeland with some vineyards on surrounding hills.

Figure 2-8, Important Farmland, provides an overview of land uses in the GSP Area that emphasizes the importance of local agriculture. The California Department of Conservation, Farmland Mapping and Monitoring Program identifies lands that have agricultural value and maintains a statewide map in its Important Farmlands Inventory (IFI). IFI classifies land according to its productive capabilities, which is based on many characteristics, including fertility, slope, texture, drainage, depth, salt content and availability of water for irrigation. Farmland categories are based on their suitability for agriculture:

> **Prime Farmland.** This land has the best combination of physical and chemical characteristics for crop production. When treated and managed, its soil quality, growing season, and irrigation supply produce sustained high crop yields.

Unique Farmland. This land does not meet the criteria for Prime Farmland or Farmland of Statewide Importance but has produced specific crops with high economic value.
Farmland of Statewide Importance. This is land that does not qualify as Prime Farmland but has a good combination of irrigation and physical and chemical characteristics for crop production.
Farmland of Local Importance. This land is either currently producing crops or has the capability to produce crops but does not meet the criteria above.
Grazing Land. This is land with vegetation that is suitable for grazing livestock.

Other lands include semi-agricultural land and rural commercial land.

Figure 2-9 documents land use as mapped by DWR in 2014 (DWR, 2018a). As shown, the GSP Area is characterized by extensive truck crops with areas of grain and hay, vineyards, and deciduous fruits and nuts. Urbanization is mostly in the Hollister-Ridgemark and San Juan Bautista areas.

2.1.5.2. General Plans

Land use planning within the GSP Area is guided by the General Plans for San Benito County, Santa Clara County, City of Hollister, and City of San Juan Bautista.

San Benito County General Plan. The San Benito County General Plan, adopted in 2015, states that water is a critical resource for San Benito County's economy and residents (EMC Planning, 2015). Of the three main sources (groundwater, Central Valley Project, and local surface water), groundwater is recognized as the largest source of water used in the county. The General Plan recognizes that such a valuable resource must be appropriately planned and managed and acknowledges SBCWD as having jurisdiction over water management throughout the County.

The San Benito County 2035 General Plan provides a summary of 21 Guiding Principles. One of these is to encourage new growth in communities that are clustered to preserve prime farmland and rangeland, protect natural habitats, and reduce impacts of urban sprawl. The County General Plan presents four New Community Study Areas: Bolsa, Fairview, San Juan, and Union. These broad areas are presented as opportunities for the County to accommodate some future growth in new unincorporated communities, although new community proposals are not limited to the Study Areas. The General Plan indicates that New Communities are typically master-planned communities, but also states that proposals would be considered on a case-by-case basis.

Another principle is to ensure that agriculture and agriculture-related industries remain a major economic sector. In fact, the General Plan has a strong statement that the County is determined to protect and support the agricultural and ranching industries in the county. This determination is expressed in part through identification of a Wine/Hospitality Priority Area, where activities related to the wine industry are encouraged including vineyards, wineries, tasting rooms, hotels, restaurants, stores, and processing facilities.

Regarding water resources, other guiding principles encourage future growth near available water and sewer infrastructure and encourage future growth that can be supported by adequate, long-term access to water. Guiding principles also call for protection of natural resources and open space areas from incompatible uses, and for preservation of the county's environmental quality and diverse natural habitats. A final guiding principle is to coordinate County planning efforts with those of the City of Hollister and the City of San Juan Bautista.

Figure 2-10 shows general Land Use Planning Designations of the San Benito County General Plan throughout the GSP Area. As indicated, broad areas are designated as agriculture and rangeland; urban uses are mostly within city spheres of influence.

Relevant land use planning goals and policies are summarized in **Table 2-1**, located at the end of this section**.** This table is a summary and may not include all General Plan policies relevant to the GSP; accordingly, specific issues will likely involve consultation with Planning Department staff. **Table 2-1** also indicates how the County will implement policies and programs; this is accomplished in the General Plan through reference to eight categories of implementation:

- Regulation and Development Review (RDR)
- Infrastructure and Service Master Plans, Strategies, and Programs (MPSP)
- Financing and Budgeting (FB)
- Planning Studies and Reports (PSR)
- County Services and Operations (SO)
- Inter-Governmental Coordination (IGC)
- Joint Partnerships with the Private Sector (JP)
- Public Information (PI)

Two ongoing implementation programs for the Public Facilities and Services element of the General Plan are the following:

- **PFS-E: Groundwater Monitoring Program.** The County shall work with water purveyors, groundwater basin managers, and willing landowners to improve groundwater monitoring including quality, yields, and groundwater elevations. This should include identifying monitoring sites, installing monitoring wells, identifying gaps in the monitoring network, establishing monitoring protocols and developing a groundwater budget. This implements Policy PFS-4.1; the responsible department is the Environmental Health Division, supported by Planning and Building Inspection Services.
- **PFS-F: Regional Planning Group.** The County shall participate in regional water, wastewater, and watershed planning groups designed to discuss and solve water supply, water quality, watershed, and other water/wastewater-related issues within the county, and to identify and pursue alternative funding sources for future projects. This implements Policies PFS-4.1 through PFS-4.8, and PFS-5.1 through PFS-5.6; the responsible department is the Environmental Health Division, supported by Public Works.

Santa Clara County General Plan. Figure 2-11 is the 2013 Santa Clara County Land Use Plan. The Santa Clara County General Plan, adopted in 1994, is organized into two parts; Book A presents county-wide issues and policies, and Book B focuses on rural areas. Both are relevant to those portions of the Plan Area that extend into Santa Clara County. This discussion focuses on the Resource Conservation section of Book A, particularly the section on Water Supply Resources, but acknowledges that strategies and policies relevant to groundwater may be presented in other parts of the General Plan.

The Santa Clara County General Plan presents goals for responsible resource conservation; goals particularly relevant to groundwater sustainability include:

Water Supply Resources Conserved and Protected

- An adequate supply of high quality water to meet domestic and economic needs.
- Water resources used efficiently and protected from contamination, particularly water supply watersheds and groundwater aquifers.

Special Water Environments Protected and Restored

- Healthy, well-functioning creek, streamside, Bay, and Bay wetlands ecosystems capable of providing stable wildlife habitat, corridors linking habitat areas, and protection for endangered species; passive recreational and interpretive nature study; and aesthetic enhancement of urban and rural settings.

Table 2-2 (located at the end of this section) summarizes selected strategies, policies, and implementation measures from the Water Supply Resources, Water Quality and Watershed Management, and Safety and Noise/ Waste Water Disposal sections. **Table 2-2** also presents selected water supply, water quality, and Development Hazards/Environmental Safety policies from the South County Joint Area Plan. As a summary, this table does not include all policies relevant to the GSP and some issues may require consultation with County planning staff.

City of Hollister General Plan. The City of Hollister General Plan (Moore lacofano Goltsman, 2005) was adopted in 2005 and subsequently amended in 2007. It is being updated as of 2020. **Figure 2-12** shows the planning area that surrounds the City of Hollister and includes portions of the GSP area.

Goals, policies, and implementation measures with relevance to groundwater sustainability are summarized in **Table 2-3** (located at the end of this section). Implementation measures are listed with each goal; these are one-sentence summaries with a designation (e.g., H.B) and each General Plan element (e.g., Housing) provides a detailed discussion of each measure. As a summary, this table may not include all relevant General Plan policies and specific issues may arise that will likely involve consultation with City planning staff.

City of San Juan Bautista General Plan. The City of San Juan Bautista General Plan was adopted in 2015 (Cal Poly CRP, 2015). **Figure 2-13** shows the planning area, sphere of influence, and area of concern that surround the City of San Juan Bautista and overlap portions of the GSP area.

Goals, objectives, policies, and programs with specific relevance to groundwater sustainability are summarized in **Table 2-4**, drawing from the Land Use, Conservation, Open Space, Public Facilities and Services, and Health elements of the General Plan. This table may not include all relevant policies and specific issues will likely involve consultation with City planning staff.

2.1.5.3. General Plan Influences on GSA Ability to Achieve Sustainability

Land use planning could affect the ability of the GSA to achieve sustainable groundwater management over the planning and implementation horizon. This would occur chiefly by land use planning agencies allowing or promoting land use development (agricultural, urban, or rural) in the basin or watershed with net increases in water demand that challenge the GSAs' ability to secure water supply in a timely or cost-effective manner. Such potential challenges are being addressed by the GSAs with transparent reporting on GSP preparation and implementation and active outreach to and collaboration with agencies that have land use planning roles. The General Plans of major agencies are discussed below with regard to water management.

San Benito County. The San Benito County General Plan addresses the importance of groundwater and acknowledges SBCWD as having water management jurisdiction throughout the County. The General Plan also restates the California Water Code requirements for developments to prepare Water Supply Assessments. However, review of the goals in **Table 2-1** indicates an emphasis on needed future growth and on needs of existing and future agriculture and development. The policies and implementation of the land use and public facilities/services elements indicate that the County role is only to support and encourage SBCWD and local water agencies in ensuring that water supply is available. Similarly, with wastewater issues and protection of water quantity and quality, the County role is limited to encouragement of other agencies, developers, and landowners. The General Plan contains little policy to manage land use within the constraints of available water supply.

Santa Clara County. Review of **Table 2-2** summarizing the Santa Clara County General Plan and South County Plan indicates that the County is proactive in water management. The strategies, policies, and implementation measures are coordinated with the overall water supply planning of Valley Water to maximize long term dependability of water supply. Most importantly, the General Plan states clearly that land use and growth management planning should be coordinated with water supply planning; this is an important distinction from general plans that emphasize land use planning and growth and then place the responsibility for water supply on water agencies. Given the historical and ongoing collaboration between Valley Water (SCVWD) and SBCWD, the relevant Santa Clara County general plans and GSP are mutually supportive.

City of San Juan Bautista. The City of San Juan Bautista serves a population that is predicted to increase from 1,862 in 2010 to about 2,105 residents by 2035 (Cal Poly CRP, 2015). While State housing mandates are larger and present a challenge, the General Plan indicates that growth can be accommodated within the City with smart growth, that local groundwater is sufficient, and that water resources can be kept for surrounding agriculture. In recent years, water issues for the City have mostly concerned water quality; to provide residents with good quality water now and in the future, the City has recently constructed two new wells. City land use policies generally are protective of agricultural land and hillsides, and conservation policies address water efficiency, water recycling, sustainability measures, and coordination with other agencies including WRA and San Benito County. The City of San Juan Bautista General Plan and GSP are compatible.

City of Hollister. The City of Hollister is the County Seat and the largest city in San Benito County. In the 1990s, the City experienced rapid growth resulting in loss of agricultural land and severe constraints on City infrastructure, including wastewater capacity issues. Subsequently in 2002 Hollister voters enacted a growth cap of 244 homes per year. For planning purposes, the 2020 UWMP estimates City growth from 25,963 in 2020 to 49,978 in 2040 (Todd, 2021); these population values were used in the 2015 UWMP, prepared by City of Hollister, SBCWD, and SSCWD. As summarized in the UWMP, the City has reliable supply (assuming continued availability of imported water) and moreover, the three HUA agencies are collaborating closely on water and wastewater issues. With this coordination, which is specified in the City General Plan, the Hollister General Plan and GSP are compatible and mutually supportive. The Hollister General Plan is being updated as of 2020.

2.1.5.4. GSP Influences on General Plans

GSP implementation generally will occur as an extension and expansion of existing management, which has been responsive to growing demands for water while protecting groundwater resources and beneficial uses of groundwater. The GSP provides background information on groundwater conditions and quantitative criteria for the sustainability criteria relative to levels, storage, subsidence, groundwater quality, and interconnected surface water and groundwater dependent ecosystems (GDEs). The GSP will be informative to land use planners through monitoring, regular reporting, and management actions (including some scientific investigations) that could affect land use planning and environmental assessments.

City of San Juan Bautista. Implementation of the GSP will support the City of San Juan Bautista in providing good quality water in sufficient quantities to serve its residents into the future, including drought periods. In light of historical water resources management by SBCWD, the GSP will be supportive of City of San Juan Bautista policies regarding water conservation, water recycling, other sustainability measures, and inter-agency cooperation.

City of Hollister. Implementation of the GSP will support the City of Hollister in providing good quality water in sufficient quantities to serve its residents into the future, including drought periods. In light of historical water resources management by SBCWD, the GSP will be supportive of City of Hollister policies regarding water conservation, water recycling, other sustainability measures, and inter-agency cooperation.

Santa Clara County. Implementation of the GSP will support Santa Clara County in its land use planning that prioritizes water supply and incorporates cooperation with Valley Water.

San Benito County. The San Benito County General Plan generally assumes that local water agencies can ensure adequate high-quality water supplies into the future. The GSP provides additional, specific information, documents potential challenges to water supply, and explores undesirable results that may occur with future agricultural expansion and rural development. Undesirable results will be defined with sustainability criteria, and if identified, will be addressed with management actions. These management actions may have ramifications for County land use planning. For example, GSPs are authorized within the GSP Plan Areas to impose well spacing requirements and control groundwater pumping and control extractions by regulating, limiting, or suspending extractions from individual groundwater wells. Such regulation may present a constraint on potential land uses.

2.1.5.5. Well Permitting

In San Benito County, permitting of wells (including new, replacement, cathodic, and geothermal wells) is administered by SBCWD; well permit forms are provided, and procedures are described on the SBCWD website. The process includes an application by the property owner and certified well driller, a site inspection by SBCWD, and an annular well seal inspection by SBCWD. Timely submittal of a Well Completion Report is required. SBCWD also requires registration of a water producing facility. Well standards are DWR California Well Standards, Combined.

In Santa Clara County, any person planning to dig, bore, drill, deepen, modify, repair, or destroy a water well, cathodic protection well, observation well, monitoring well, geothermal heat exchange well, exploratory boring, or other deep excavation intersecting groundwater must first obtain a permit from Valley Water. The well permitting process is described on the Valley Water website and forms are provided. Valley Water regulates the construction and destruction of wells based on its Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County and on the California Well Standards.

2.1.6. Additional GSP Elements

The California Water Code contains a checklist for preparation of GSPs, which provide groundwater management elements that may be applicable for incorporation into the North San Benito GSP. Most management programs relevant to this checklist are described in Section 2.1 above; programs are summarized below for each topic to ensure that the additional plan elements listed in the GSP regulations (Section 354.8 (g)) have been considered.

a) *Control of saline water intrusion.* Seawater intrusion is not applicable because this is not a coastal basin.

b) *Wellhead protection areas and recharge areas.* Section 2.1.2.1 introduces major water providers, most of whom have production wells. **Figure 2-5** shows the areas with public wells in terms of density. Recharge areas are discussed in Section 3.10.
c) *Migration of contaminated groundwater.* Regulated facilities with soil and groundwater contamination are described in Section 4.6.1 and shown on **Figure 4-17**. RWQCB files for such facilities have been and will continue to be checked regularly as part of the SBCWD water quality monitoring program.
d) *Well abandonment and well destruction program.* Well permitting, including well abandonment and destruction, is discussed in Section 2.1.5.5.
e) *Replenishment of groundwater extractions*. Existing replenishment activities are discussed in Section 2.1.2 (surface water percolation) and Section 2.1.3 (groundwater recharge). Managed Aquifer Recharge (MAR) is discussed in Section 8 as a project for GSP implementation.
f) *Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.* Conjunctive use (involving coordinated use of surface water supplies, groundwater supplies, and groundwater storage, and including recharge activities) is described throughout Section 2.1. Conjunctive use projects are discussed is discussed in Section 8 for GSP implementation.
g) *Well construction policies.* Well permitting by both SBCWD and Valley Water is discussed in Section 2.1.5.5.
h) *Groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects.* Local agencies in the Plan Area cooperate with the appropriate regulators on contaminated sites; more information is provided in Section 4.6.1. Groundwater recharge, in lieu, and other managed aquifer recharge programs are described in Sections 2.1.2 and 2.1.3 and discussed throughout this GSP. Water recycling is discussed in Sections 2.1.2 and 2.1.3. Water conveyance is discussed in Section 2.1.2.1. Such projects are discussed in Section 8.
i) *Efficient water management practices.* Water demand management is discussed in Section 2.1.4.3 mostly with reference to activities of the Water Resources Association (WRA) as part of Groundwater Management Plans and Urban Water Management Plans.
j) *Relationships with State and federal regulatory agencies.* Such relationships are implicit in many local efforts. These include, for example, the cooperation of local agencies with state and federal agencies on contamination sites, local efforts toward SGMA compliance in cooperation with DWR, RWQCB, and SWRCB, cooperation with USEPA and USACE on the Kern River and wetlands with respect to the federal Clean Water Act, and cooperation with US Fish & Wildlife Service and CDFW (among others) on environmental issues and endangered species.
k) *Land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity.* Land use planning agencies are identified in Section 2.1.1 and general plans are discussed in Section 2.1.5 in terms of relevance to water resources, supply and demands. County and city representatives were invited to participate in GSP preparation through participation in the Technical Advisory Committee (TAC) or workshops.
l) *Impacts on GDEs.* The interconnection of groundwater and surface water is discussed in Groundwater Conditions Section 4.11 including preliminary identification of GDEs (plants and animals). Potential depletion of interconnected surface water is further discussed in terms of undesirable results and sustainability criteria in Section 6.7.

2.1.7. Notice and Communication

As described in this section, groundwater is the major source of supply in the GSP Area and supports a range of beneficial uses: agricultural, municipal, rural, and environmental. To some degree in the GSP area, all land and property owners, residents, businesses, employees, farmers, and visitors are potentially affected by groundwater use. This reflects the agricultural orientation of the GSP area, its Central Coast setting, and its amenities for small-city living and rural residence and recreation. While recognizing the critical importance of imported CVP supply, reliable groundwater is essential.

The two GSAs have encouraged public participation in the ongoing planning and development activities supporting the GSP process. SBCWD organized a Technical Advisory Committee (TAC) to support the GSP process; regularly scheduled TAC meetings have been announced on the SBCWD website and have been open to the public. In addition, public workshops regarding development of the GSP have been conducted to encourage public participation and to provide educational outreach. Meeting notices have been provided to the list of interested parties that is maintained pursuant to Water Code Section 10723.2. Additionally, GSP development information and meeting notices have been posted to the SBCWD website.

Recognizing the importance of communication, multiple and diverse agencies and interested parties have been identified. These are listed in the SBCWD GSA Communication Plan, which is included as **Appendix D.**

The Communication Plan in **Appendix D** also provides an overview of outreach to the public by means of informational materials (e.g., fact sheets), regular and special GSA Board meetings, public Technical Advisory Committee meetings, workshops, and the GSA website. These inform the public about the GSP development and implementation process and encourage active involvement by interested parties.

Table 2-1. Selected San Benito County General Plan Goals, Policies, and Implementation Measures	
Goal	**Policy and Implementation (see footnote)**
LU-1 To maintain San Benito County's rural character and natural beauty while providing areas for needed future growth.	***LU-1.10* Development Site Suitability** The County shall encourage specific development sites to avoid natural and manmade hazards, including, but not limited to, active seismic faults, landslides, slopes greater than 30 percent, and floodplains. Development sites shall also be on soil suitable for building and maintaining well and septic systems (i.e., avoid impervious soils, high percolation or high groundwater areas, and provide setbacks from creeks). *(RDR)*
PFS-3 To ensure reliable supplies of water for unincorporated areas to meet the needs of existing and future agriculture and development, while promoting water conservation and the use of sustainable water supply sources.	**PFS-3.1 Water District Support** The County shall support efforts of the San Benito County Water District to ensure that adequate high-quality water supplies are available to support current residents and businesses and future development projects. *(MPSP/IGC)* **PFS-3.2 Interagency Coordination** The County shall cooperate with public and private water agencies in order to help address existing and future water needs for the county. *(IGC)* **PFS-3.3 Water Rights Protection** The County shall support public and private water agencies in their efforts to protect their water rights and water supply contracts, including working with Federal and State water projects to protect local water rights. *(IGC)* **PFS-3.4 Drought Response** The County shall encourage all public and private water agencies to develop and maintain drought contingency and emergency services plans, emergency inter-ties, mutual aid agreements and related measures to ensure adequate water services during drought or other emergency water shortage. *(MPSP/IGC)* **PFS-3.5 Water Supply Development** The County shall support plans to develop new reliable future sources of supply, including, but not limited to, the expansion of surface water storage and conjunctive use of surface water and groundwater, while promoting water conservation and water recycling/reuse. *(RDR/MPSP/IGC)* **PFS-3.6 Conjunctive Use** The County shall support conjunctive use of groundwater and surface water to improve water supply reliability. *(MPSP/IGC)* **PFS-3.7 Groundwater Management** The County shall support cooperative, regional groundwater management planning by water resource agencies, water users, and other affected parties to ensure a sustainable, adequate, safe, and economically viable groundwater supply for existing and future uses within the county. *(MPSP/IGC)* **PFS-3.8 Integrated Management** The County shall support and participate in the integrated management of surface water and groundwater resources, wastewater, stormwater treatment and use, and the use of reclaimed water. *(MPSP/IGC)* **PFS-3.9 Sufficient Water Supply for New Development** The County shall require new developments to prepare a source water sufficiency study and water supply analysis for use in preparing, where required, a Water Supply Assessment per SB 610 and a Source Water Assessment per Title 22. This shall include studying the effect of new development on the water supply of existing users. The County encourages the development of integrated regional water management plans or similar plans. *(RDR)*
PFS-4 To maintain an adequate level of service in the water systems serving unincorporated areas to meet the needs of existing and future agriculture and development, while improving water system efficiency.	**PFS-4.1 Adequate Water Treatment and Delivery Facilities** The County shall ensure, through the development review process, that adequate water supply, treatment and delivery facilities are sufficient to serve new development and are able to be expanded to meet capacity demands when needed. Such needs shall include capacities necessary to comply with water quality and public safety requirements. *(RDR)* **PFS-4.2 Water Facility Infrastructure Fees** As a condition of approval for discretionary developments, the County shall not issue approval for a final map until verification of adequate water and wastewater service has been provided, which may include verification of payment of fees imposed for water and wastewater infrastructure capacity per the fee payment schedule from the water and wastewater provider. *(RDR)* **PFS-4.3 Minimum Lot Size** The County shall require a minimum lot size for properties that have on-site septic systems to minimize adverse water quality impacts on groundwater. *(RDR)* **PFS-4.4 Single User Well Consolidation** The County shall encourage consolidation of single user wells into public water districts. *(RDR/MPSP)* **PFS-4.5 Water System Rehabilitation** The County shall encourage the rehabilitation of irrigation systems and other water delivery systems to reduce water losses and increase the efficient use and availability of water. *(RDR/MPSP)*

	PFS -4.6 New Community Water Systems The County shall require any new community water system, in the unincorporated area of the county, serving residential, industrial, or commercial development to be owned and operated by a public or private entity that can demonstrate to the County adequate financial, managerial, and operational resources. *(RDR/IGC)* **PFS-4.7 Consistent Fire Protection Standards for New Development** The County, in coordination with public and private water purveyors and fire protection agencies, shall ensure consistent and adequate standards for fire flows and fire protection for new development, with the protection of human life and property as the primary objectives. *(RDR/IGC)* **PFS-4.8 Water Supply Planning** The County shall encourage water purveyors to develop plans for responding to droughts and the effects of global climate change, including contingency plans, the sharing of water resources to improve overall water supply reliability, and the allocation of water supply to priority users. *(MPSP/IGC)*
PFS-5 To ensure wastewater treatment facilities and septic systems are available and adequate to collect, treat, store, and safely dispose of wastewater.	**PFS-5.1 Water and Sewer Expansion** The County shall encourage public wastewater system operators to maintain and expand their systems to meet the development needs of the county. *(MPSP/IGC)* **PFS-5.2 Reclaimed Water** The County shall encourage public wastewater system operations to upgrade existing wastewater treatment systems to produce reclaimed water suitable for unrestricted reuse. *(MPSP/IGC)* **PFS-5.6 Septic System Design** The County shall require individual septic systems to be properly designed, constructed, and maintained to avoid degradation of ground and surface water quality. *(RDR)*
PFS-6 To manage stormwater from existing and future development using methods that reduce potential flooding, maintain natural water quality, enhance percolation for groundwater recharge, and provide opportunities for reuse.	**PFS-6.1 Adequate Stormwater Facilities** The County shall require that stormwater drainage facilities are properly designed, sited, constructed, and maintained to efficiently capture and dispose of runoff and minimize impacts to water quality. *(RDR)* **PFS-6.2 Best Management Practices** The County shall require best management practices in the development, upgrading, and maintenance of stormwater facilities and services to reduce pollutants from entering natural water bodies while allowing stormwater reuse and groundwater recharge. *(RDR)* **PFS-6.3 Natural Drainage Systems** The County shall encourage the use of natural stormwater drainage systems (e.g., swales, streams) to preserve and enhance the environment and facilitate groundwater recharge. *(RDR)* **PFS-6.4 Development Requirements** The County shall require project designs that minimize stormwater drainage concentrations and impervious surfaces, complement groundwater recharge, avoid floodplain areas, and use natural watercourses in ways that maintain natural watershed functions and provide wildlife habitat. *(RDR)* **PFS-6.5 Stormwater Detention Facilities** Where necessary, the County shall require on-site detention/retention facilities and/or velocity reducers to maintain pre-development runoff flows and velocities in natural drainage systems. *(RDR)* **PFS-6.6 Stormwater Detention Basin Design** The County shall require stormwater detention basins be designed to ensure public safety, be visually unobtrusive, provide temporary or permanent wildlife habitat, and where feasible, provide recreation opportunities. *(RDR)* **PFS-6.7 Runoff Water Quality** The County shall require all drainage systems in new development and redevelopment to comply with applicable State and Federal non-point source pollutant discharge requirements. *(RDR)* **PFS-6.8 Reduce Erosion and Sedimentation** The County shall ensure that drainage systems are designed and maintained to minimize soil erosion and sedimentation and maintain natural watershed functions. *(RDR)*
NCR-2 To protect and enhance wildlife communities through a comprehensive approach that conserves, maintains, and restores important habitat areas.	**NCR-2.5 Mitigation for Wetland Disturbance or Removal** The County shall encourage the protection of the habitat value and biological functions of oak woodlands, native grasslands, riparian and aquatic resources, and vernal pools and wetlands. The County shall require that development avoid encroachment and require buffers around these habitats to the extent practicable. The County shall further require mitigation for any development proposals that have the potential to reduce these habitats. Recreational trails and other features established within natural wetlands and aquatic and riparian buffer areas shall be, as long as such areas are not required to meet the Americans with Disabilities Act, located along the outside of the sensitive habitat whenever possible to minimize intrusions and maintain the integrity of the habitat. Exceptions to this action include irrigation pumps, roads and bridges, levees, docks, public boat ramps, and similar uses. In all cases where intrusions into these buffers are made, only the minimum amount of vegetation necessary to construct the feature shall be removed. *(RDR)*
NCR-4 To protect water quantity and quality in natural water bodies and	**NCR-4.1 Mitigation for Wetland Disturbance or Removal** The County shall consider implementing Regional Water Quality Control Board Basin Plan policies to improve areas of low water quality, maintain water quality on all drainage, and protect and enhance habitat for fish and other wildlife on major tributaries to the Pajaro River (San Benito River, Pacheco Creek) and the Silver Creek watershed. *(RDR/MPSP/IGC)*

groundwater basins and avoid overdraft of groundwater resources.	**NCR-4.2 Water Quality Tests** The County shall require new development to prepare water quality tests prior to project approval, demonstrating whether proposed domestic water supply will meet State primary and secondary drinking water standards. (*RDR)* **NCR-4.3 Agricultural Water** The County shall require well tests for nonagricultural development to provide evidence that 100 percent of the water needs may be met without connecting to the San Felipe Water system. *(RDR)* **NCR-4.4 Open Space Conservation** The County shall encourage conservation and, where feasible, creation or restoration of open space areas that serve to protect water quality such as riparian corridors, buffer zones, wetlands, undeveloped open space areas, and drainage canals. *(RDR/MPSP)* **NCR-4.5 Groundwater Recharge** The County shall encourage new development to preserve, where feasible, areas that provide important groundwater recharge and stormwater management benefits such as undeveloped open spaces, natural habitat, riparian corridors, wetlands, and natural drainage areas. *(RDR)* **NCR-4.6 Groundwater Studies for New Development** To ensure an adequate water supply, large-scale development projects that meet the criteria in California Water Code section 10912 shall prepare an analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project in accordance with SB 610. *(RDR)* **NCR-4.7 Best Management Practices** The County shall encourage new development to avoid significant water quality impacts and protect the quality of water resources and natural drainage systems through site design, source controls, runoff reduction measures, and best management practices (BMPs). *(RDR)* **NCR-4.8 Water Education** The County shall encourage water districts to provide public education to encourage existing homeowners to adopt water conservation practices for landscaping and interior plumbing. *(IGC/PI)* **NCR-4.9 Water Conservation Plan** The County shall maintain and implement the San Benito County Water Conservation Plan as necessary to promote water conservation and efficient use. *(MPSP)* **NCR-4.10 Water Efficient Landscape Ordinance** The County shall develop, maintain, and implement a Water Efficient Landscape Ordinance, consistent with the Model Water Efficient Landscape Ordinance prepared by the California Department of Water Resources, to require greater use of regionally native drought-tolerant vegetation, limitations on the amount of turf in residential development, and other measures as appropriate. *(RDR)* **NCR-4.11 Reclaimed Water** The County shall require, where feasible, the use of reclaimed water irrigation systems in new development wherever possible. *(RDR)* **NCR-4.12 Rainwater Catchment** The County shall encourage homeowners to install roof catchment systems and use rainwater for non-potable uses in order to reduce the need for groundwater. *(RDR)* **NCR-4.13 Shared Water Systems** The County shall develop, maintain, and implement an ordinance to allow for shared water systems to facilitate the clustering of homes and preservation of agricultural land, where an entity is established to provide maintenance or financing for the maintenance of the water system. *(RDR)* **NCR-4.14 Wastewater Treatment** The County shall require wastewater treatment systems to be designed to promote the long-term protection of groundwater resources in San Benito County. Domestic wastewater treatment systems shall be required to use tertiary wastewater treatment as defined by Title 22. *(RDR/MPSP)* **NCR-4.15 Septic Systems** The County shall require septic systems to be limited to areas where sewer services are not available and where it can be demonstrated that septic systems will not contaminate groundwater. *(RDR)* **NCR-4.16 Develop in Existing Areas** The County shall encourage development to occur in or near existing developed areas in order to reduce the use of individual septic systems in favor of domestic wastewater treatment in an effort to protect groundwater quality. *(RDR)*

* Implementation Categories: RDR - Regulation and Development Review
MPSP - Infrastructure and Service Master Plans, Strategies, and Programs
IGC - Inter-Governmental Coordination

Table 2-2. Selected Santa Clara County General Plan Strategies, Policies and Implementation	
Strategy	**Policy and Implementation**
Water Supply Resources	
Conserve and Reclaim Water	**C-RC 5** An adequate, high quality water supply for Santa Clara County should be considered essential to the needs of households, business and industry. **C-RC 6** A comprehensive strategy for meeting long term projected demand for water should at a minimum include the following: • Continued conservation and increased reclamation; • Securing additional sources as supplemental supply; • System and local storage capacity improvements; and • Drought contingency planning and groundwater basin management programs. **C-RC 7** Countywide land use and growth management planning should be coordinated with overall water supply planning by the SCVWD in order to maximize dependability of long term water supply resources. **C-RC 8** Environmental impacts of all state and local water supply planning and decision-making should be taken into full consideration. **C-RC 9** Conservation should continue to be considered an integral component of local water "supply" resources, effectively minimizing the amount of supplemental supplies which must be obtained from other sources. **C-RC 10** Educational measures should be continued/increased in order inform the public of the need for conservation over the long term, rather than as a temporary response to periodic drought. **C-RC 11** Domestic conservation should be encouraged throughout Santa Clara County by a variety of means, including reduced flow devices, drought-resistant landscaping, and elimination of wasteful practices. **C-RC 12** More efficient use of water for agricultural irrigation and industrial processes should be promoted through improved technology and practices. **C-RC 13** Use of reclaimed wastewater for landscaping and other uses, including groundwater recharge if adequately treated, should be encouraged and developed to the maximum extent possible.
Obtain Additional Sources of Imported Water	**C-RC 14** Reforms of the state-wide system of water allocation and distribution should be encouraged which facilitate the ability of urban area water suppliers to purchase needed supplies through market mechanisms.
Make System and Local Storage Capacity Improvements	**C-RC 15** Potential for new and/or expanded local reservoirs should be thoroughly examined as a part of any long term strategy for assuring adequate water supply, taking into full account environmental and financial feasibility. **C-RC 16** Seismic safety considerations for new and existing reservoirs should be addressed in order to ensure water supply and public safety in the event of earthquake.
Maintain Drought Contingency and Groundwater Basin Management Plans	**C-RC 17** Drought contingency plans and groundwater basin management programs should be reviewed and updated to prepare for the likelihood of future periods of short-term drought and to minimize: • the potential adverse impacts of drought upon households, business, and industry, and • the possibility of groundwater overdraft and land subsidence.
Water Quality and Watershed Management	
Reduce Non-Point Source Pollution	**C-RC 18** Water quality countywide should be maintained and improved where necessary to ensure the safety of water supply resources for the population and the preservation of important water environments and habitat areas. **C-RC 19** The strategies for maintaining and improving water quality on a countywide basis, in addition to ongoing point source regulation, should include: • effective non-point source pollution control; • restoration of wetlands, riparian areas, and other habitats which serve to improve Bay water quality; and • comprehensive Watershed Management Plans and "best management practices" (BMPs). **C-RC 20** Adequate safeguards for water resources and habitats should be developed and enforced to avoid or minimize water pollution of various kinds, including: • erosion and sedimentation; • organic matter and wastes; • pesticides and herbicides; • effluent from inadequately functioning septic systems; • effluent from municipal wastewater treatment plants; • chemicals used in industrial and commercial activities and processes; • industrial wastewater discharges; • hazardous wastes; and • non-point source pollution.

	C-RC 21 Multi-jurisdictional, countywide programs and regulatory efforts to address water pollution problems should have the full support and participation of each jurisdiction within Santa Clara County, including cities, special districts, state and federal agencies, and County government.
Protect the Biological Integrity of Critical Habitat Areas	**C-RC 31** Areas of habitat richest in biodiversity and necessary for preserving threatened or endangered species should be formally designated to receive greatest priority for preservation, including baylands and riparian areas, serpentine areas, and other habitat types of major significance. **Implementation Recommendations** ***C-RC(i)15*** Explore opportunities for restoration of habitat, particularly with respect to wetland, riparian, and other habitat types rich in diversity or needed to protect threatened and endangered species. {Implementors: Cities, County, RWQCB, state agencies}
Encourage Habitat Restoration	**C-RC 34** Restoration of habitats should be encouraged and utilized where feasible, especially in cases where habitat preservation and flood control, water quality, or other objectives can be successfully combined.
Safety and Noise: Waste Water Disposal	
Prevent Waste Water Contamination of Groundwater Supplies	**C-HS 42** The long-term viability and safety of underground aquifers and groundwater systems countywide shall be protected to highest degree feasible. **C-HS 43** Urban land uses should be in cities and served by centralized wastewater treatment systems. **C-HS 44** All new on-site wastewater treatment systems should be located only in areas where: • there is reasonable assurance that they will function well over a long period; • they can be designed to have a minimum negative impact on the environment; and • they will not contaminate wells, groundwater or surface water. **C-HS 45** On-site wastewater treatment systems should not be allowed in areas where soil characteristics impede their operation (e.g., areas of high groundwater conditions, areas with saturated soils, areas with limited depth to bedrock, etc.). **C-HS 46** Hazardous materials, whether commercial, industrial, agricultural, or residential in character, should not be disposed of in any wastewater or on-site wastewater treatment system. **Implementation Recommendations** **C-HS(i) 42** Develop and implement standards for land subdivision and development which must rely on using on-site wastewater treatment systems so as to minimize negative environmental impacts and maximize the useful life of such systems. (Implementors: County and cities.) **C-HS(i) 43** Prevent overdevelopment requiring on-site wastewater treatment systems in areas where groundwater quality has been so impacted as to pose a discernible threat to the long term integrity and safety of underground water supplies. (Implementors: County and cities.)
Monitor Groundwater Quality	**C-HS 47** Groundwater quality should be monitored to ensure the long-term integrity of countywide water resources. **Implementation Recommendations** **C-HS(i) 44** Monitor the groundwater quality throughout the county to insure the long-term integrity of the aquifers and the safety of water supplies to all users. (Implementors: County and Cities.) **C-HS(i) 45** Maintain low cost laboratory access for well water testing. (Implementors: County and Cities.)
South County Joint Area Plan Policies	
Water Supply	***SC 7.0*** New development should not exceed the water supply, and management of water should be made more efficient through appropriate means, such as watershed protection, percolation, reclamation, and conservation. ***SC 7.1*** Programs to identify and seal abandoned and unused wells should be continued, as such wells may be prime sources for transferring contaminants from the upper to lower aquifer. ***SC 7.2*** The South County jurisdictions should develop a program to track existing water quality, water supply and water flow monitoring programs. This information should be used to evaluate current regulations and procedures, and to assess the need for new monitoring programs or for revisions or consolidation of existing programs. ***SC 7.3*** Each jurisdiction and agency pumping water from wells should be responsible for knowing the demand that its well pumping imposes on the direction of flow of water and how it affects others that are pumping from the same aquifer, and to prevent any adverse impacts on existing groundwater contamination problems. ***SC 7.4*** All jurisdictions and agencies pumping water from wells should cooperate in managing the aquifer so as to preserve the natural ecology of the region, securing the aquifer's utility as a water resource and ensuring the water's quality. ***SC 7.5*** Streambeds and other appropriate percolation areas should be protected. ***SC 7.6*** There should be continuing coordination among the South County jurisdictions and the Santa Clara Valley Water District to assure that the South County will get sufficient deliveries of San Felipe water as needs require. ***SC 7.7*** The water district should continue developing programs to assure effective management of the water resources, such as well monitoring, percolation of imported water, reclamation and conservation. ***SC 7.8*** New development should not exceed the water supply, and use of water should be made more efficient through appropriate means, such as conservation and reclamation. ***SC 7.9*** The development of water reclamation facilities should be encouraged, where feasible, in order to make reclaimed water available to help meet the growing needs of the South County region.

Water Quality	***SC 8.0*** Water quality should be protected from contamination, and should be monitored to assure that present policies and regulations are adequate. Such uses as waste facilities, septic systems and industries using toxic chemicals should be prohibited where polluting substances may come in contact with groundwater, floodwaters, and creeks or reservoir waters. ***SC 8.1*** Land use policies should be continued that limit the number of individual septic systems in areas vulnerable to groundwater contamination, because of the potential for cumulative degradation of water quality. ***SC 8.2*** In areas where future development is expected to be served by sewers, large lot policies (which allow minimal development and limited numbers of septic systems) should be continued. This approach increases the feasibility of designing future urban density subdivisions with smaller lots, which are more efficient for sewers in terms of service and cost. ***SC 8.3*** In the unincorporated area current County policies regarding septic systems and land use should be continued with no lessening of standards. ***SC 8.4*** Groundwater and surface water quality conditions throughout the South County should be monitored to determine if changes in regulations regarding septic systems and land use are needed. Protection of groundwater quality requires continued caution in the siting of landfills and transfer stations and rigorous enforcement of local and regional regulations. ***SC 8.6*** Continued caution should be taken as to the siting of landfills, the construction of landfills (i.e., they should have clay liners, etc.), and the waste allowed in a sanitary landfill in South County so as not to create hazards to groundwater quality. ***SC 8.7*** Solid waste and hazardous waste transfer stations should be sited and operated so as to minimize hazards to ground and surface water quality. ***SC 8.8*** Regulations relating to solid waste disposal should continue to be rigorously enforced by the local jurisdictions and by the Regional Water Quality Control Boards. ***SC 8.11*** Properties located in areas that have soils with rapid water percolation shall be protected from future development in order to ensure existing water quality. Such development should not begin until preceded by the inclusion within the Cities' and County's Hazardous Materials Storage Ordinance a section specifically related to high percolation rates. ***SC 8.12*** Commercial and industrial developments proposed to be located in areas that have soils with rapid water percolation should be permitted only under the strict safety limitations as may be required by the Cities' and/or County's Hazardous Materials Specialists. ***SC 8.13*** In order to provide greater protection of the aquifers which supply drinking water to the South County, special consideration should be given to the management of contaminants (e.g., hazardous materials, sanitary effluents) in groundwater recharge areas where no protective aquitard layer exists. ***SC 8.14*** Each agency and jurisdiction responsible for well monitoring should continue to monitor wells and provide results to a central agency (yet known) which would coordinate the data and make it available to all jurisdictions and agencies. ***SC 8.15*** Programs for monitoring private wells should continue to expand the scope of testing by including tests of more wells and including tests on constituents not yet tested in private wells (i.e., volatile organics, bacteriological, radiological, etc.), and periodic retesting of selected private wells
Development Hazards/Environmental Safety	***SC 15.8*** Natural streamside and riparian areas should be left in their natural state, in order to preserve their value as percolation and recharge areas, natural habitat, scenic resources, recreation corridors and for bank stabilization. If flood control projects needed to protect presently existing development make this infeasible, disruption should be minimized, maintaining slow flow and stable banks through design and other appropriate mitigation measures.

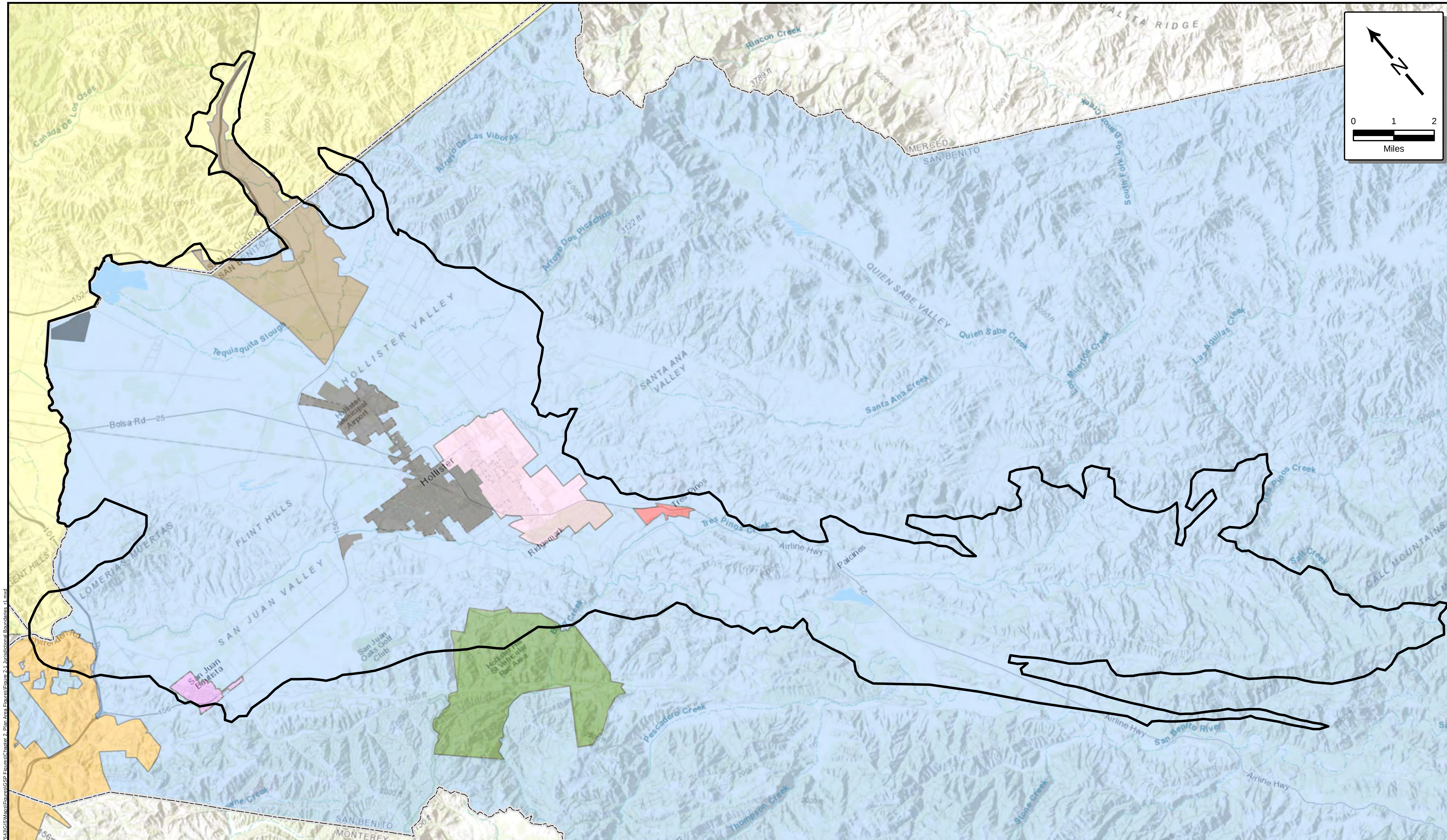
Table 2-3. Selected City of Hollister General Plan Goals, Policies, and Implementation Measures		
Goal	**Policy**	**Implementation Measures**
Housing Element		
H1 Work together to build a sense of community and achieve housing goals	**H1.4 Timing of Housing and Infrastructure** Continue to support the timing of new housing with needed infrastructure improvements.	Expand sewer and water system capacity to meet housing needs [H.B]
Community Services and Facilities Element		
CSF1 Coordinate with other agencies and plan for the provision of adequate infrastructure, facilities and services	**CSF1.1 Adequate Capabilities and Capacity of Local Public Services** Ensure that future growth does not exceed the capabilities and capacity of local public services such as wastewater collection and treatment, local water supply systems, fire and police protection, maintenance of streets and roads, local school systems, parks and recreational facilities, and landfill capacity, and ensure that public services meet Federal and State standards and are available in a timely fashion. **CSF1.6 Other Infrastructure Planning** Require the preparation of infrastructure master plans in areas outside the designated Sphere of Influence as a prerequisite to annexation. Such plans shall contain, but not be limited to, plans for sewer services, water service, storm drainage, traffic circulation, recreation facilities, school facilities and funding alternatives for police and fire services. **CSF1.7 Development Review Criteria for Public Services** Prior to granting approval, evaluate each new development in terms of the following criteria: 1. Would the proposed development share a common border with a property that has already been developed? 2. Would the proposed development be adequately served by infrastructure (water, sewer, streets, schools, parks, etc.), which is already in place or mitigated? 3. Would the proposed development be located within the existing service areas of local service providers (fire protection, police protection, solid waste disposal, schools, etc.), and not result in a reduction in their current capabilities?	Maintain an up-to-date CIP [CSF.CC] Adopt a performance standards ordinance [CSF.D] Coordinate with the San Benito County Water District, San Benito County and the Sunnyslope County Water District in water and wastewater system expansion needs [CSF.F]
CSF 2 Plan for adequate sewer and water facilities	**CSF2.1 Sewer and Water Facilities** Coordinate with responsible districts and agencies to assure that sewer and water facility expansion and/or improvements meet Federal and State standards and occur in a timely manner. **CSF2.4 Local Water Supply System** Encourage development in those portions of the Hollister Planning Area which are already served by the local water supply systems or to which water supply systems can reasonably be extended. **CSF2.6 Provision of Water Service to New Development** Require developers who will require water service for their project to apply to the City of Hollister, the Sunnyslope County Water District and the San Benito County Water District, in that order, for service. Only if the proposed	Maintain data on sewer and water system capacity [CSF.DD] Monitor water quality at the wastewater treatment plant [CSF.EE] Establish requirements for water conservation in new development [CSF.I] Provide information on water conserving landscaping [CSF.M] Identify opportunities for water recycling [CSF.Q] Update the City's Water System Master Plan [CSF.R] Coordinate with the water resources association of San Benito County [CSF.V] Implement plans for a regional wastewater treatment facility [CSF.Z]

	development is denied service by all three agencies can it then be allowed to use groundwater as a source of water. **CSF2.7 Water Conservation Measures** Encourage water-conserving practices and features in the design of structures and landscaping, and in the operation of businesses, homes and institutions, and increase the use of recycled water.	
CSF3 Provide adequate drainage facilities, limit erosion and maintain clean water	**CSF3.3 Local, State and Federal Standards for Water Quality** Continue to comply with local, State and Federal standards for water quality. **CSF3.4 Water Quality Tests and Mitigation** As part of the development review process, require developers to conduct well and ditch tailwater tests to determine the presence of "Category I" herbicides and pesticides, and triazide herbicides, as well as other chemicals that have the potential to pollute the groundwater and cause health risks. Based on findings, and at the project applicant's expense, implement appropriate requirements to protect public health. **CSF3.5 Infiltration Areas** Require new development to identify sites which may be used for vegetated swales or strips, infiltration, media infiltration, water-oil separators, wet ponds, constructed wetlands, extended detention basins and multiple systems which may enhance water quality. **CSF3.6 Education and Outreach on Water Quality Programs** Support public education regarding water pollution prevention and mitigation programs. **CSF3.7 Pollution from Urban Runoff** Address non-point source pollution and protect receiving waters from pollutants discharged to the storm drain system by requiring Best Management Practices. This would include: 1. Support alternatives to impervious surfaces in new development, redevelopment, or public improvement projects to reduce urban runoff into storm drain system and creeks; 2. Require that site designs work with the natural topography and drainages to the extent practicable to reduce the amount of grading necessary and limit disturbance to natural water bodies and natural drainage systems; and, 3. Where feasible, use vegetation to absorb and filter fertilizers, pesticides and other pollutants.	Establish procedures and requirements for well and ditch tail water tests [CSF.H] Implement actions for pesticide and fertilizer management [CSF.L] Adopt a Storm Water Master Plan [CSF.O] Identify drainage system improvements [CSF.P] Prepare guidelines for water quality source control program [CSF.S] Conduct water quality education programs [CSF.T] Continue to require proper disposal of pollutants [CSF.U]
CSF4 Provide for an adequate level of community services and facilities to ensure the continued health, education, welfare and safety of all residents and businesses	**CSF4.3 Coordination with Utility Providers** Promote the availability and adequate delivery of reliable, modern, and competitively priced utilities necessary for businesses to prosper, such as power, water and telecommunications.	Require utility providers review [CSF.MM]
Natural Resources and Conservation Element		
NRC1 Assure enhanced habitat for native plants and animals, and special protection for threatened or endangered species	**NRC 1.1 Protection of Environmental Resources** Protect or enhance environmental resources, such as wetlands, creeks and drainageways, and habitat for threatened and endangered species. **NRC 1.5 Wetlands Preservation** Maintain existing riparian areas in their natural state to provide for wildlife habitat, groundwater percolation, water quality, aesthetic relief and	Require project mitigation for habitat [NRC.V] Require wetlands delineation [NRC.X] Require wetlands replacement plans [NRC.Y]

	recreational uses that are environmentally compatible with wetland preservation. Require appropriate public and private wetlands preservation, restoration and/or rehabilitation through compensatory mitigation in the development process for unavoidable impacts. Support and promote acquisition from willing property owners, and require those development projects, which may result in the disturbance of delineated seasonal wetlands to be redesigned to avoid such disturbance. **NRC 1.6 Enhancement of Creeks and Drainageways** Explore enhancement of, and support continuous upgrades to, drainageways to serve as wildlife habitat corridors for wildlife movement and to serve as flood control facilities to accommodate storm drainage. Require setbacks, creek enhancement and associated riparian habitat restoration/creation for projects adjacent to creeks to maintain storm flows, reduce erosion and maintenance and improve habitat values, where feasible. Generally, all new structures and paved surfaces should be set back 100 feet from wetlands and creeks.	
NRC3 Conserve and manage natural resources	NRC 3.1 Development Practices to Conserve Resources Promote development practices, which will result in the conservation of energy, water, minerals and other natural resources, and promote the use of renewable energy technologies (such as solar and wind) when possible. NRC 3.2 Resource-Efficient Organizations and Businesses Encourage businesses, commercial property owners, apartment building owners and non-profit organizations to be resource, energy and water efficient.	Encourage "green" building standards and processes [NRC.E] Apply Title 24 requirements [NRC.J] Implement the LEED program [NRC.O] Publicize energy conservation programs [NRC.Q]

Table 2-4. Selected City of San Juan Bautista General Plan Goals, Objectives, Policies, and Programs		
Goals and Objectives	**Policy**	**Program**
Land Use		
LU2 A town with a balanced and diversified set of land uses **LU 2.7** Prohibit land uses for, or in support of, oil and gas exploration and development in order to: • Preserve agricultural land and viewsheds; • Protect groundwater supplies, air and water quality, and wildlife habitat; • Expand tourism; • Encourage desired industries; and • Avoid incompatible land uses.	**LU 2.7.1** Prohibit development, construction, installation, or use of any facility or above ground equipment for, or in support of, oil or gas exploration or development on all lands within the City's boundaries.	**LU 2.7.1.1** Adopt a zoning ordinance to conform the zoning code to Policy LU 2.7.1 and adopt Hillside Development regulations. **LU 2.7.1.2** Encourage the County of San Benito to regulate land use within the City's Sphere of Influence and Planning Area (or Area of Concern) Boundary consistent with Policy LU 2.7.1.
Conservation		
CO 2 Clean air and water for residents and visitors **CO 2.1** Protect the quality of surface and groundwater resources.	**CO 2.1.1** Improve groundwater quality by maintaining high potable water quality standards.	**CO 2.1.1.1** Finish and implement plans for a 'pellet plant' that will treat water in central location before it is delivered to customers.
CO 3 Efficient use of energy and natural resources **CO 3.2** Practice sustainable water resource management.	**CO 3.2.1** Integrate water efficiency into local government operations and policies.	**CO 3.2.1.1** Provide resources for water efficient landscaping and fixtures in new developments. **CO 3.2.1.2** Retrofit municipal landscapes with water-efficient planting. **CO 3.2.1.3** Monitor municipal water use and develop water conservation goals. **CO 3.2.1.4** Retrofit municipal facilities with water efficient fixtures and appliances. **CO 3.2.1.5** Retrofit municipal facilities to utilize reclaimed water in landscaping. **CO 3.2.1.6** Install purple pipe infrastructure at future municipal facilities and parks to facilitate the use of reclaimed water for irrigation. **CO 3.2.1.7** Require new subdivisions and commercial development to utilize sustainability measures for capture and storage of rainwater for such appropriate uses as irrigation of public open space areas, parks, and lawns.
CO 4 Protection of wildlife, habitat, air quality, and water resources **CO 4.1** Protect all state and federally listed special-status species and their critical habitat. **CO 4.4** Meet state mandated per capita water consumption goals established in Senate Bill X7-7.	**CO 4.1.1** Comply with federal and state laws regarding the protection of special-status species and habitat, as defined by US Fish and Wildlife Service. **CO 4.4.1** Inform the public about city-wide water use and water conservation goals.	**CO 4.1.1.1** Provide a list of local native plant species for landscaping in order to prevent the introduction of invasive species. **CO 4.1.1.2** Establish tree protection guidelines. **CO 4.4.1.1** Incorporate information on current water use, water conservation goals, and ways to reduce water use with water bills for residents and businesses. **CO 4.4.1.2** Regularly monitor city-wide water use and include results in local government reporting. **CO 4.4.1.3** Work with the Water Resource Association of San Benito County and the State Water Resources Control Board to promote and expand water conservation programs to local residents and businesses.
Open Space		
OS 4 Preserve prime farmland with viable local agricultural operations **OS 4.1** Avoid or mitigate loss of prime farmland soils and conserve non-prime agricultural uses.	**OS 4.1.1** Promote City-centered and contiguous smart growth.	**Program OS 4.1.1.1** Keep existing water resources for agricultural activities.

Public Facilities and Services		
PF 1 A community with high quality water and sewer services provided in the most efficient, cost effective, and environmentally sound manner **PF 1.1** Improve the quality of water, water treatment facilities, and water services for residents and businesses. **PF 1.2** Manage groundwater resources to maintain a secure water supply for residents and businesses. **PF 1.3** Improve the quality of sewer treatment facilities and services for residents and businesses.	**PF 1.1.1** Maintain land uses around City wells that minimize the risk of groundwater contamination. When private development occurs around a City well, require the provision of a replacement well if the development could potentially have an adverse impact on well water quality. **PF 1.1.2** Improve potable water quality and groundwater quality by treating water to a higher standard before delivery to residents and businesses. **PF 1.2.1** Maintain adequate water capacity for residents and businesses. New development should only be permitted when water services can be provided without threatening the level of service to the rest of the city. **PF 1.2.2** Allow private water wells within the sphere of influence only where the City cannot feasibly provide public water service or where an established water system, such as the one serving San Juan School, has been determined adequate by the City Engineer. In the former case, the use of private wells should be discontinued when City water service becomes available. **PF 1.2.3** Provide extensions of City potable water service only to properties within the designated sphere of influence. Do not extend service or sell capacity to development on agricultural or open space lands outside the City's Urban Growth Boundary. **PF 1.3.1** Allow individual septic systems within the sphere of influence only where the City cannot feasibly provide sewer service and where the County Health Department has determined that sufficient area and soil conditions exist for a septic tank leach field or other accepted method of effluent disposal. In such cases, the use of septic systems should be discontinued when City sewer service becomes available within 600 feet of the property. **PF 1.3.2** Provide extensions of City sewer service only to properties within the designated sphere of influence. Do not extend service to development on agricultural or open space lands outside the City's sphere of influence.	**PF 1.1.2.1** Finish and implement plans for a 'pellet plant' that will treat water in a central location before it is delivered to customers. **PF 1.1.2.2** Promote and incentivize the removal of home water softeners once water quality goals are met to reduce the salinity of wastewater. **PF 1.1.2.3** Produce an annual report to the City Council on water quality. Use this information to determine whether the City is meeting state water quality standards. **PF 1.2.3.1** Produce an annual report to the City Council on water capacity and actual use. Use this information to determine where and when capital improvements are needed. **1.3.2.1** Produce an annual report to the City Council on sewer capacity and actual use. Use this information to determine where and when capital improvements are needed. **PF 1.3.2.2** As part of the City's Capital Improvements Program, reduce infiltration and inflow problems at the City's wastewater treatment plant by improving the trunk line leading from the collection system into the wastewater plant. Undertake other capital improvements as determined necessary by the plant operator and City Engineer. **PF 1.3.2.3** Develop a plan for the long-term expansion or relocation of the City's wastewater treatment plant or begin planning a second facility.
Health		
HE 6 Environmental quality to increase public health HE 6.2 Enhance air and water quality.	HE 6.2.1 Create design standards in the planning review process to enhance water quality. HE 6.2.2 Continue to work with residents, businesses, and the relevant environmental protection agencies to create a plan for improving water quality.	HE 6.2.1.1 Protect the quality of water sources, including cones of influence, water recharge areas, and water wells from future degradation through design standards. HE 6.2.1.2 Ensure that design standards for all stormwater retention and detention systems are adhered to in order to prevent the degradation of surface water bodies. HE 6.2.1.3 Require that impervious surfaces be limited and mitigated with low impact development in prime recharge areas. HE 6.2.2.1 Protect potable water well fields from man-made and natural sources of pollution. HE 6.2.2.2 Plan for emergency conservation and use of recycled water sources. HE 6.2.2.3 Create a San Juan Creek restoration program.

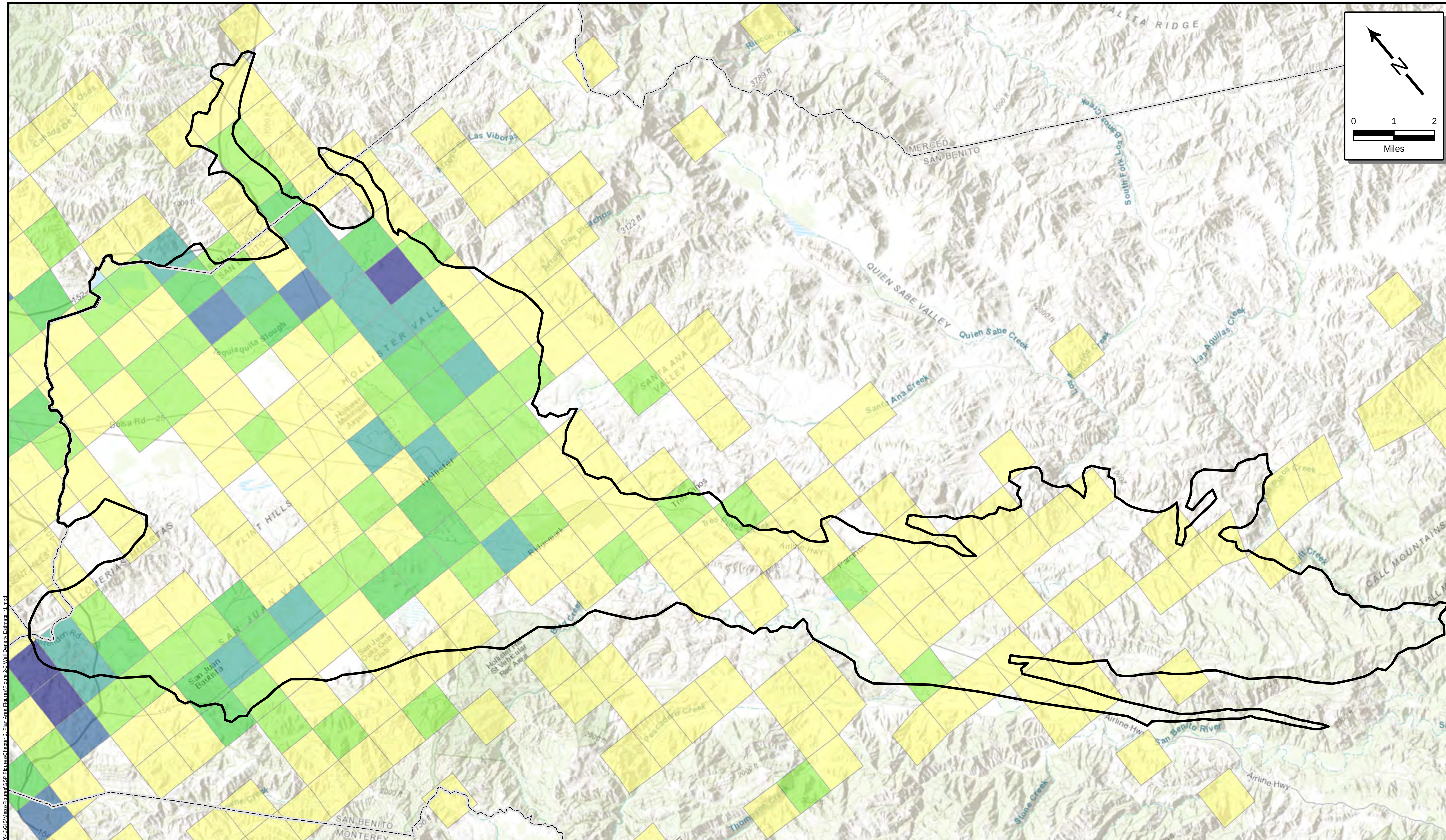


San Benito County Water District	City of San Juan Bautista	Sunnyslope County Water District	Wildlife Heritage Foundation Pajaro River Mitigation Bank
Santa Clara Valley Water District	Aromas Water District	Tres Pinos County Water District	North San Benito Basin
City of Hollister	Pacheco Pass Water District	CA Parks And Recreation, Hollister Hills	

November 2021

TODD GROUNDWATER

Figure 2-1
Jurisdictional Boundaries



Estimated Well Density by PLSS Section* - All Wells

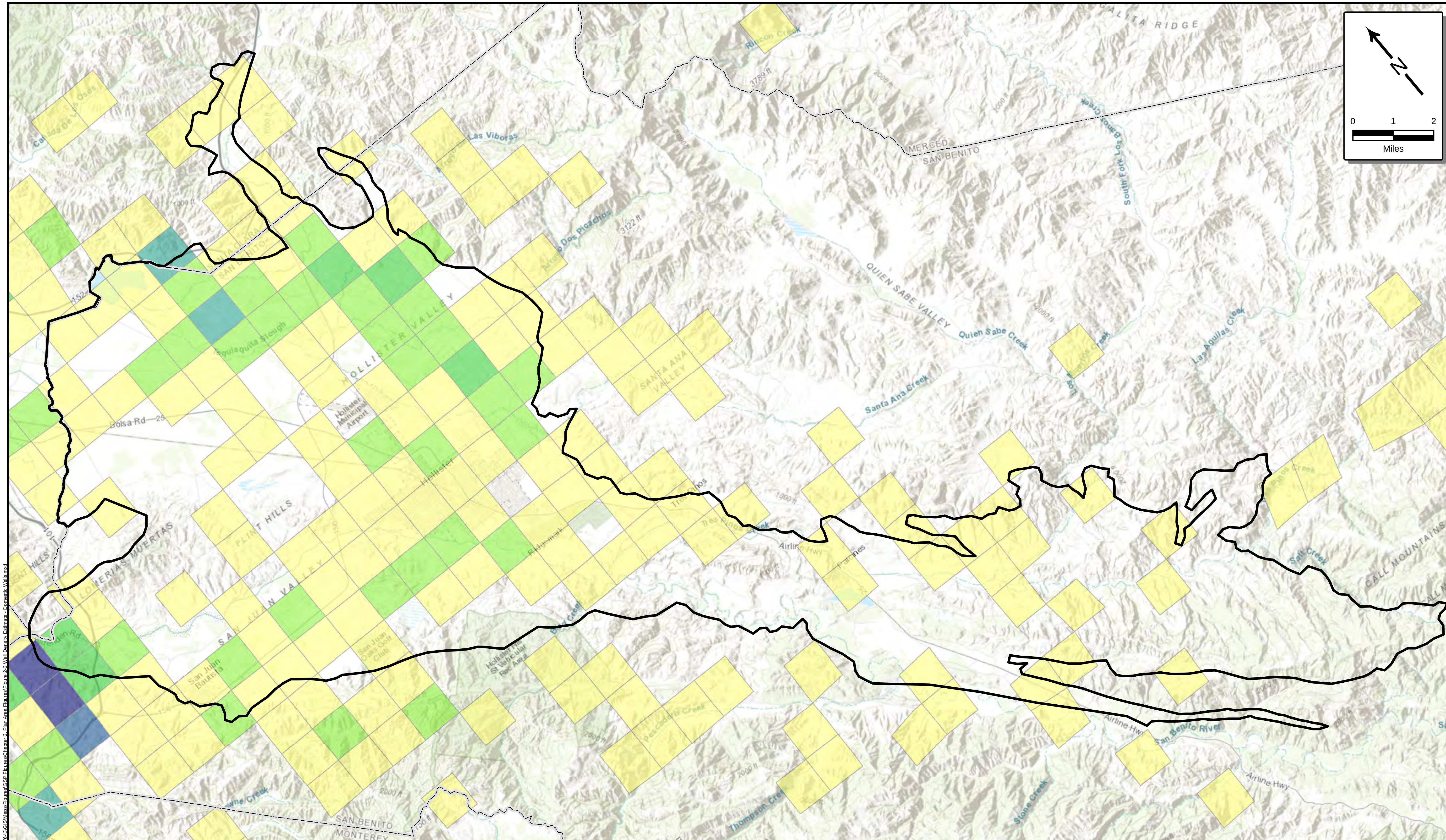
- 1 to 5 Wells Total
- 5 to 10 Wells Total
- 10 to 15 Wells Total
- 15 to 20 Wells Total
- 20 to 25 Wells Total
- 25 to 30 Wells Total
- North San Benito Basin

* The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. PLSS Sections are one-mile square rectangular grids of 640 miles each. All lands in the public domain are subject to subdivision by this rectangular system of surveys, which is regulated by the U.S. Department of the Interior, Bureau of Land Management (BLM).

November 2021

TODD GROUNDWATER

Figure 2-2
Estimated Density of All Wells



Estimated Well Density by PLSS Section* - Domestic Wells

- 1 to 5 Domestic Wells
- 5 to 10 Domestic Wells
- 10 to 15 Domestic Wells
- 15 to 20 Domestic Wells
- 20 to 25 Domestic Wells
- 25 to 30 Domestic Wells
- North San Benito Basin

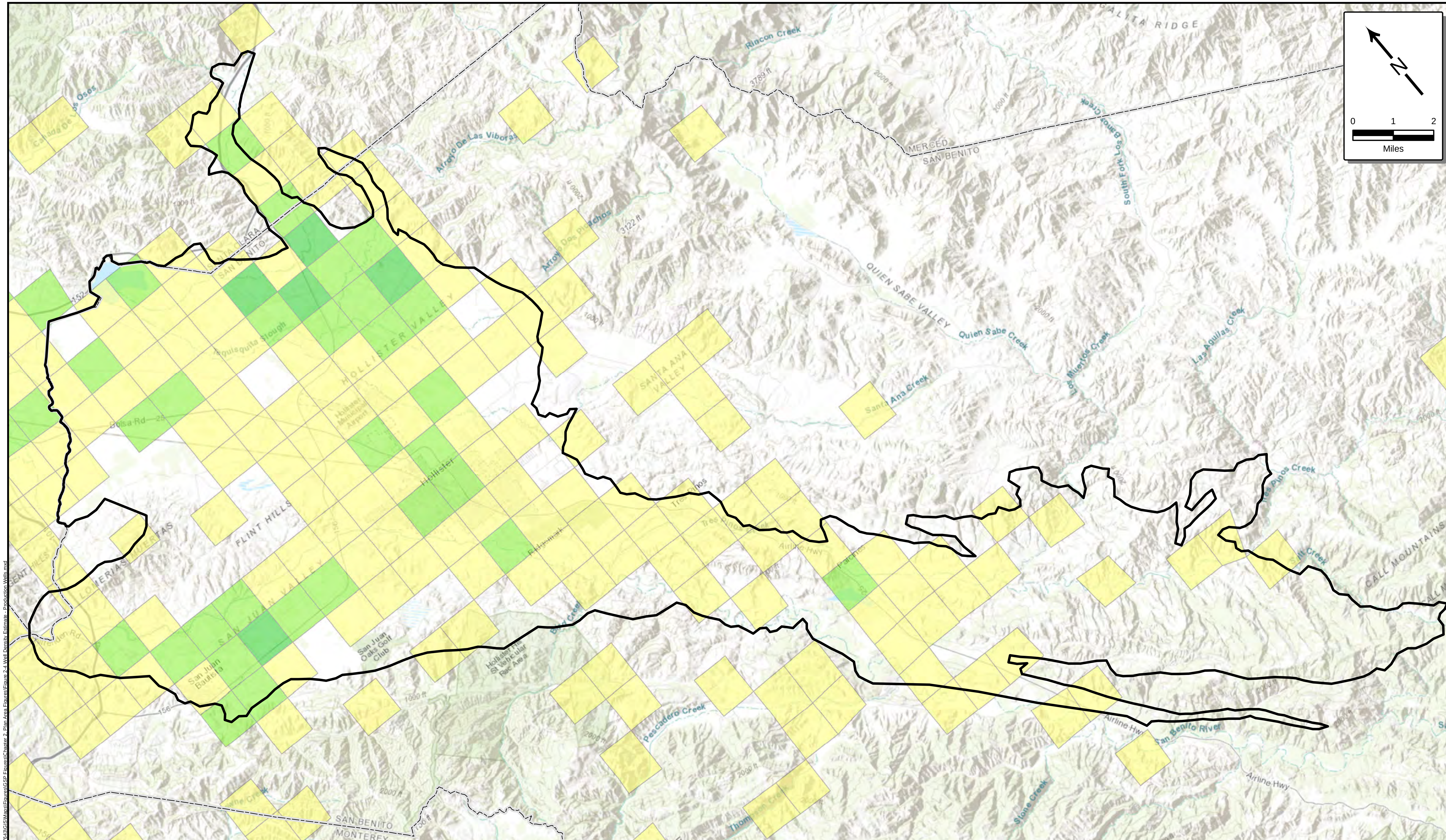
* The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. PLSS Sections are one-mile square rectangular grids of 640 miles each. All lands in the public domain are subject to subdivision by this rectangular system of surveys, which is regulated by the U.S. Department of the Interior, Bureau of Land Management (BLM).

November 2021

TODD GROUNDWATER

Figure 2-3
Estimated Density of Domestic Wells

Path: T:\Projects\San Benito GSP 37643\GIS\Maps\Figures\GSP Figures\Chapter 2- Plan Area Figures\Figure 2-3 Well Density Estimate - Domestic Wells.mxd



Estimated Well Density by PLSS Section* - Production Wells

- 1 to 5 Production Wells
- 5 to 10 Production Wells
- 10 to 15 Production Wells
- 15 to 20 Production Wells
- 20 to 25 Production Wells
- 25 to 30 Production Wells
- North San Benito Basin

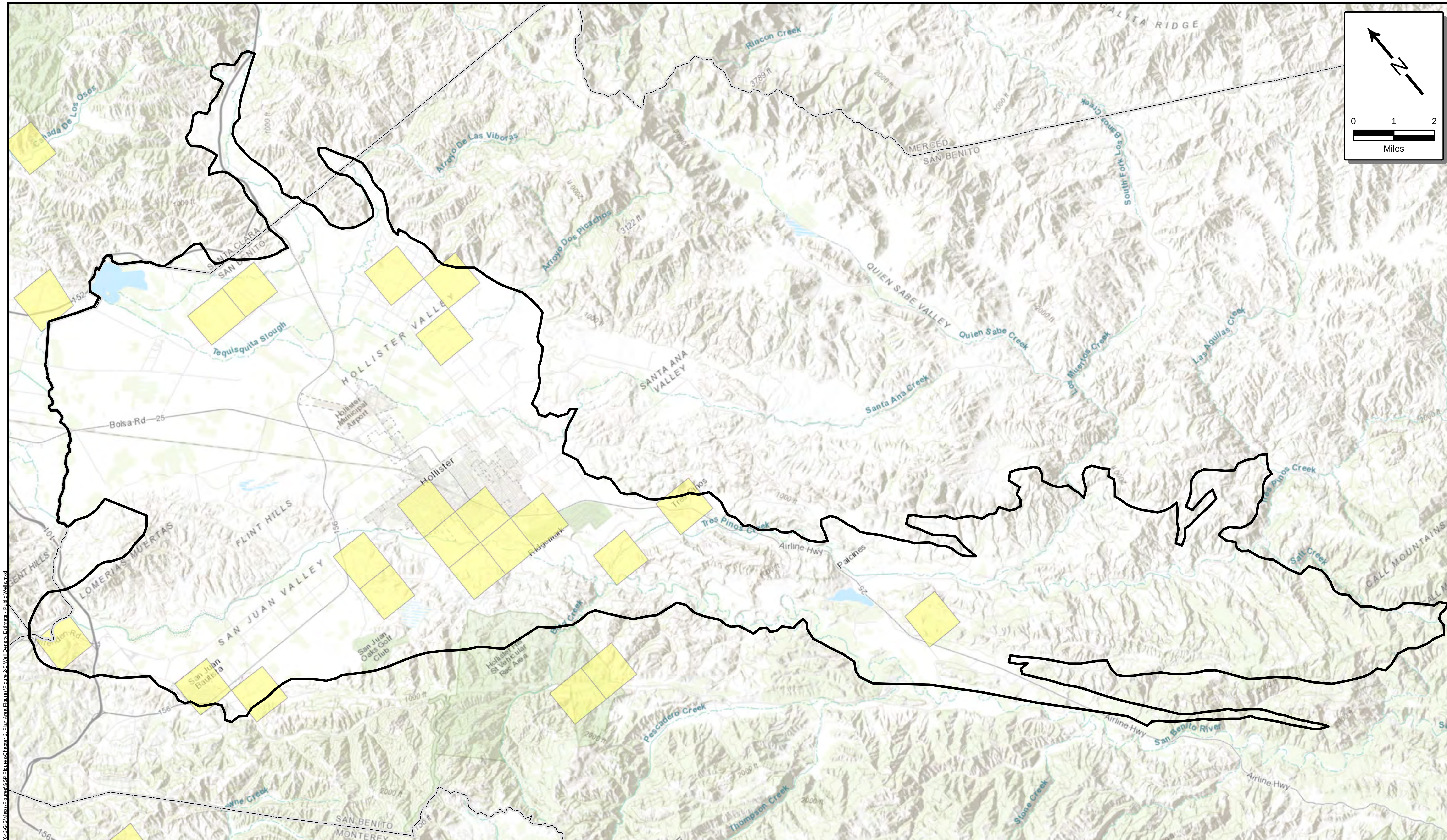
* The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. PLSS Sections are one-mile square rectangular grids of 640 miles each. All lands in the public domain are subject to subdivision by this rectangular system of surveys, which is regulated by the U.S. Department of the Interior, Bureau of Land Management (BLM).

November 2021

TODD GROUNDWATER

Figure 2-4
Estimated Density of Production Wells

Path: T:\Projects\San Benito GSP 37643\GIS\Maps\Figures\GSP Figures\Chapter 2 Plan Area Figures\Figure 2-4 Well Density Estimate - Production Wells.mxd

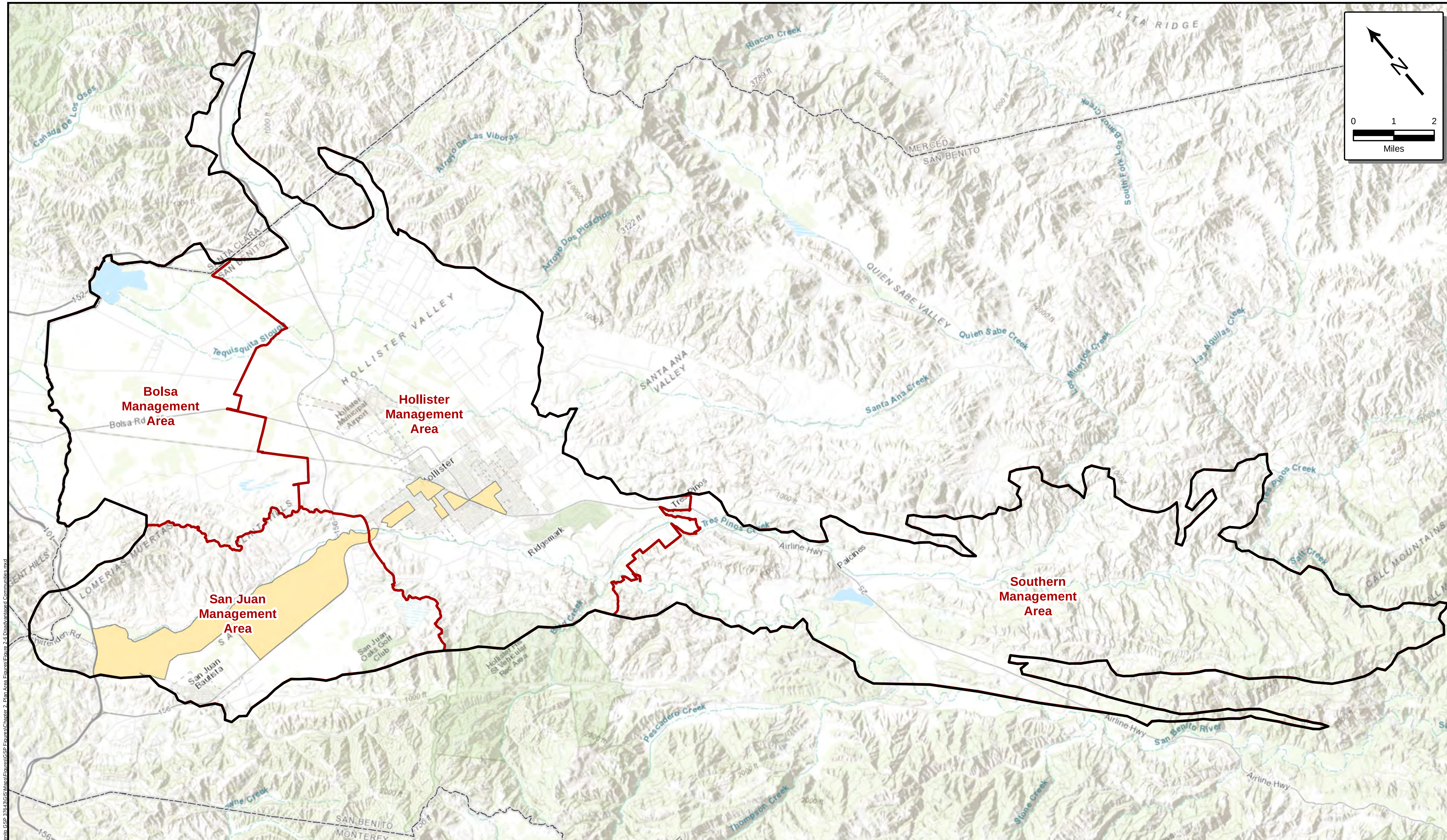


* The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. PLSS Sections are one-mile square rectangular grids of 640 miles each. All lands in the public domain are subject to subdivision by this rectangular system of surveys, which is regulated by the U.S. Department of the Interior, Bureau of Land Management (BLM).

November 2021

TODD GROUNDWATER

Figure 2-5
Estimated Density of Public Wells



■	Disadvantaged Community from 2016 and/or 2018 Census Block Groups
□	North San Benito Basin
□	Management Areas

November 2021

TODD GROUNDWATER

Figure 2-6
Disadvantaged Communities

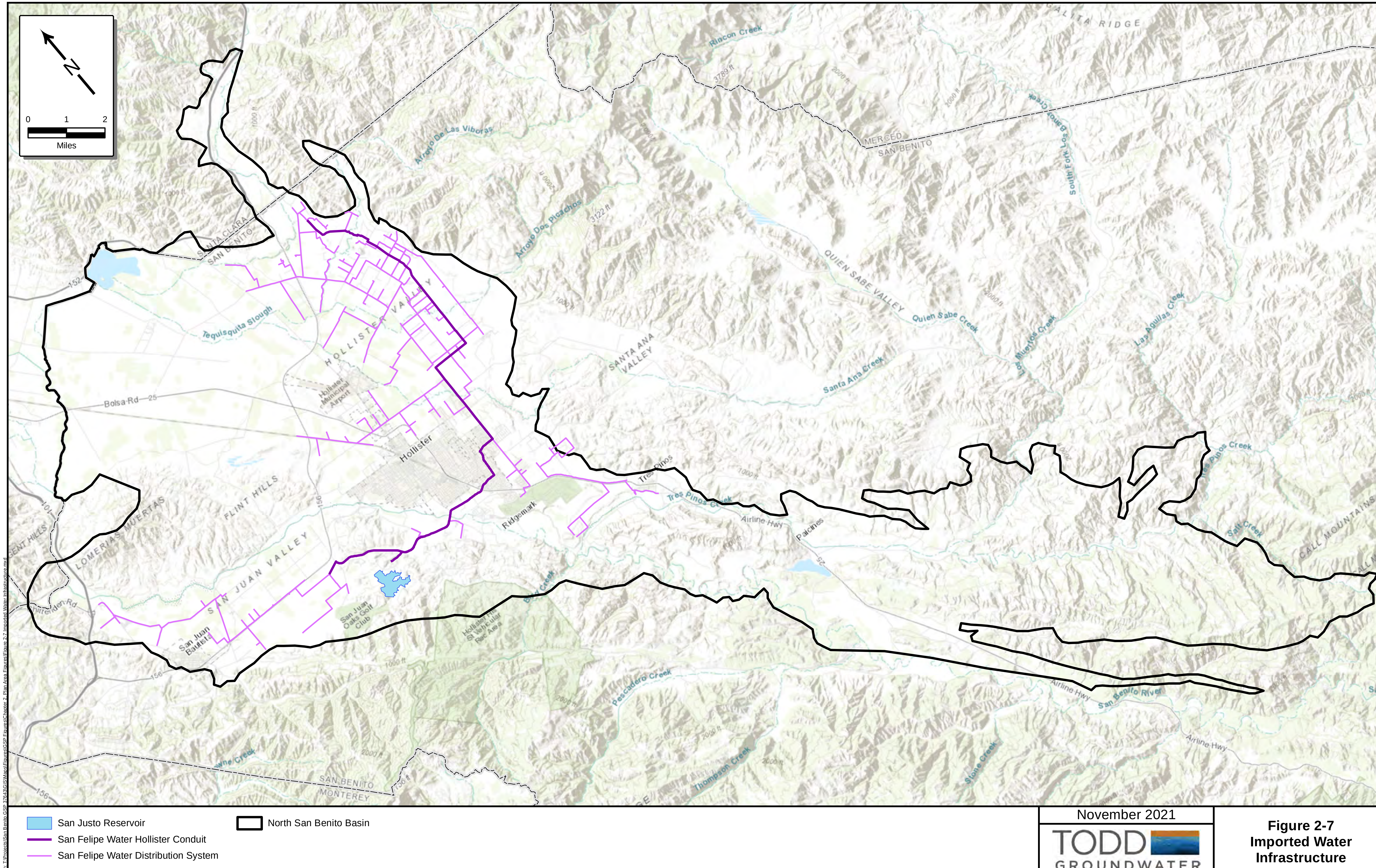
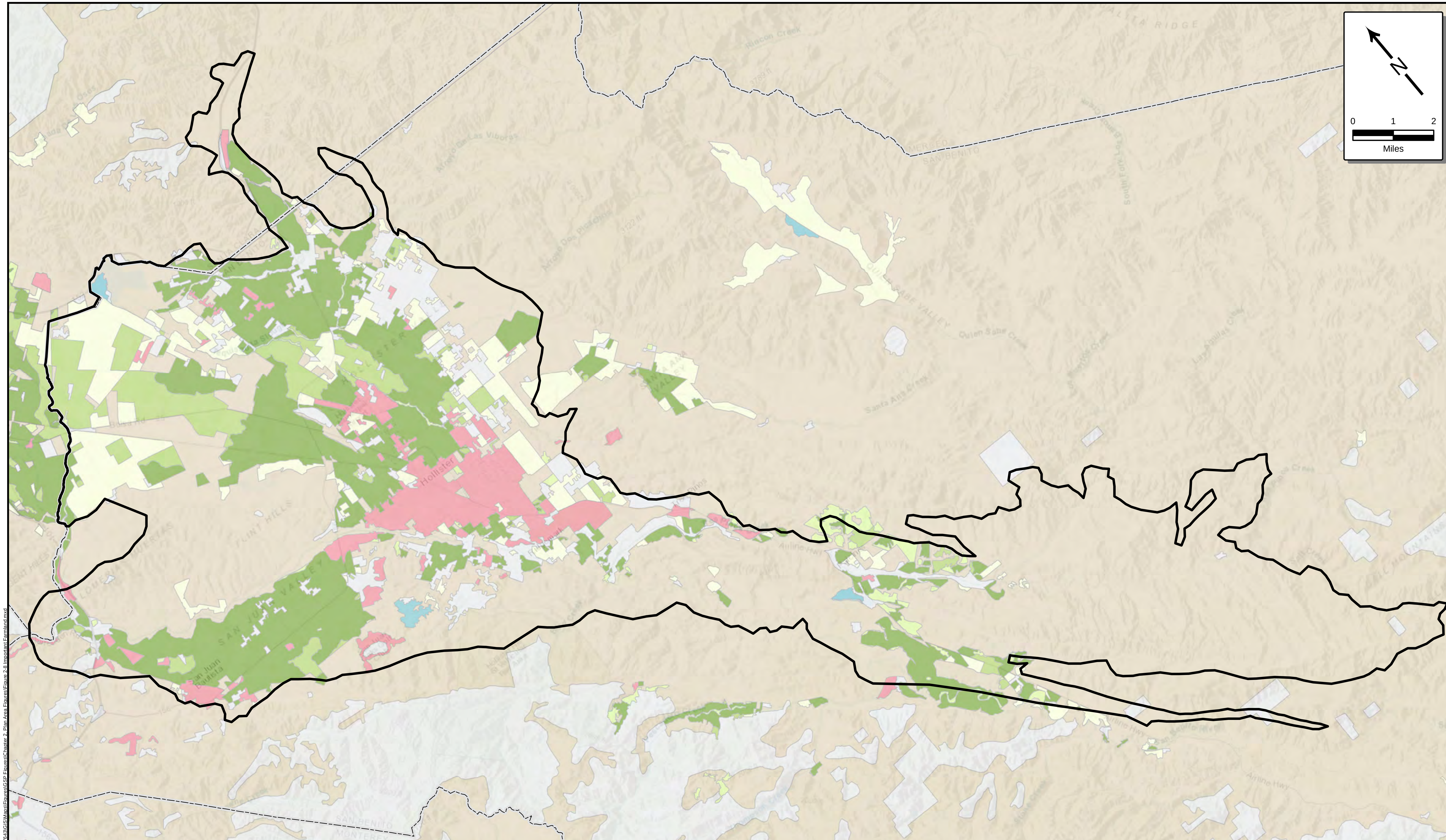


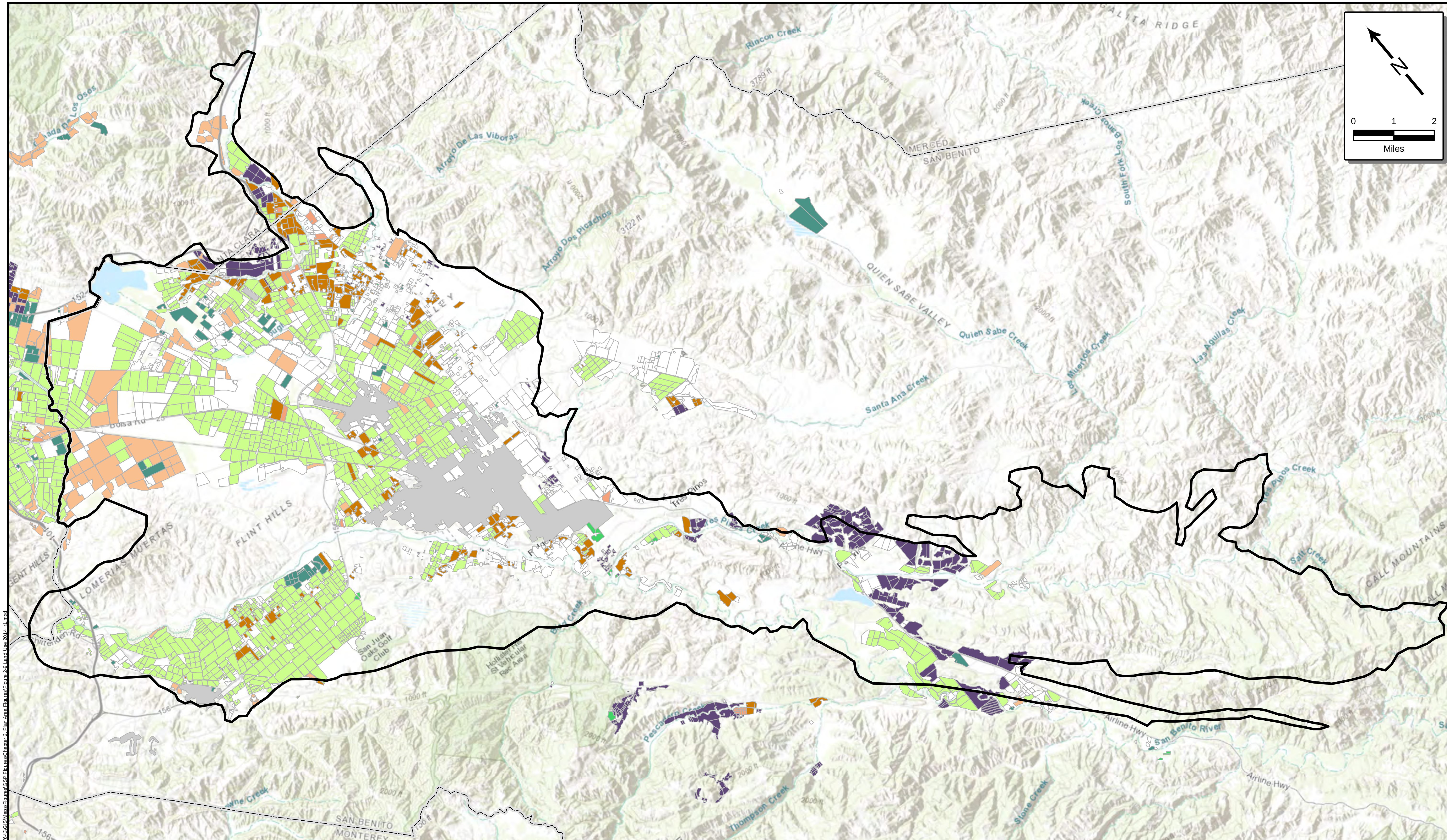
**Figure 2-7
Imported Water
Infrastructure**



November 2021

TODD GROUNDWATER

Figure 2-8
Important Farmland



Statewide Crop Mapping 2014 - *DWR Standard Legend (modified for remote sensing)*

- R | Rice
- P | Pasture
- G | Grain and Hay Crops
- T | Truck, Nursery, and Berry Crops
- F | Field Crops
- C | Citrus and Subtropical
- D | Deciduous Fruits and Nuts
- V | Vineyard
- Y | Young Perennial
- I | Idle
- NR | Riparian Vegetation
- U | Urban
- North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 2-9
Land Use 2014

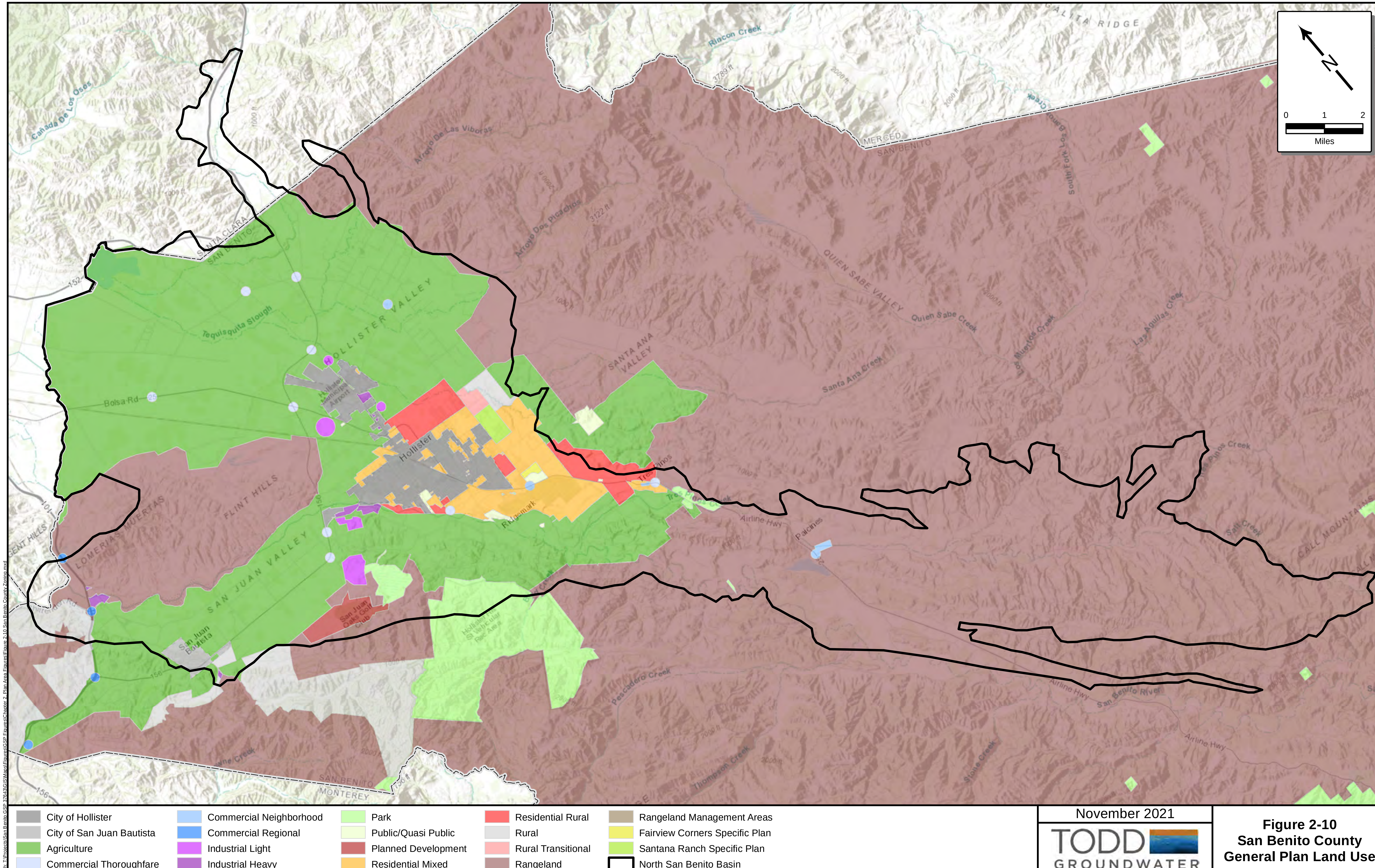
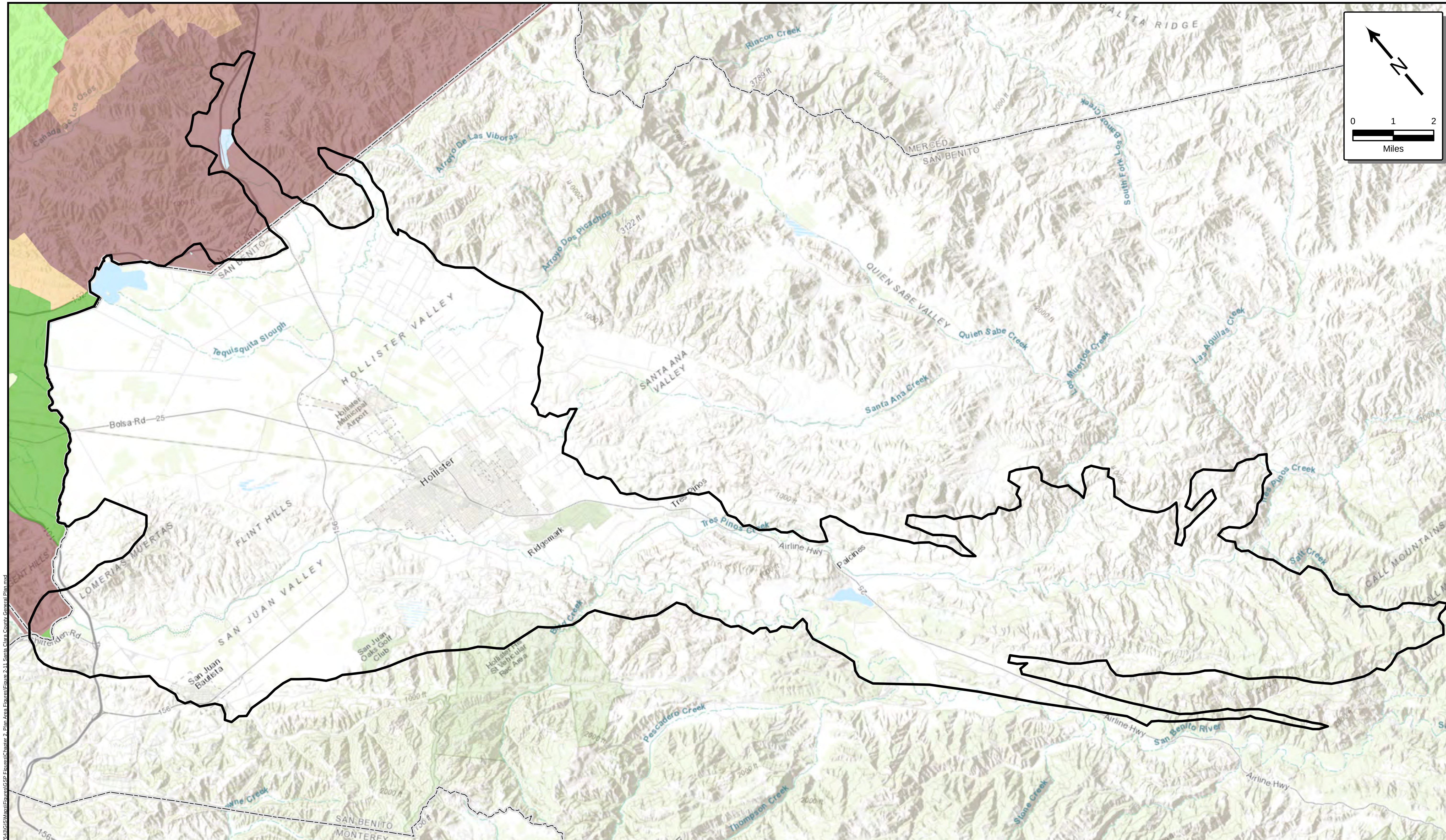


Figure 2-10
San Benito County General Plan Land Use

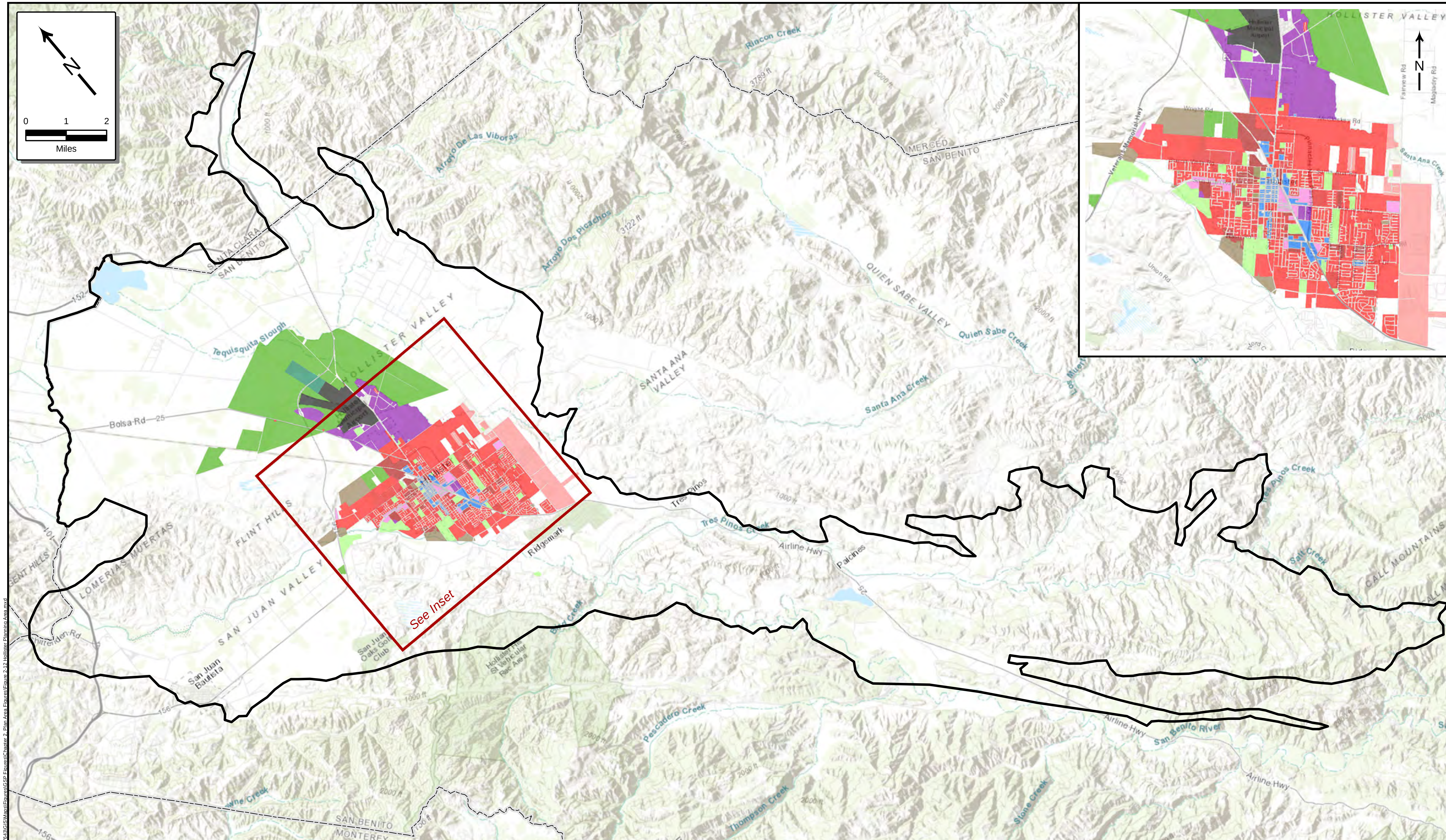


Agriculture Large Scale	Ranchlands
Public Facilities	Other Public Open Lands
Roadside Services	Hillsides
Regional Parks, Existing	North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 2-11
Santa Clara County General Plan Land Use

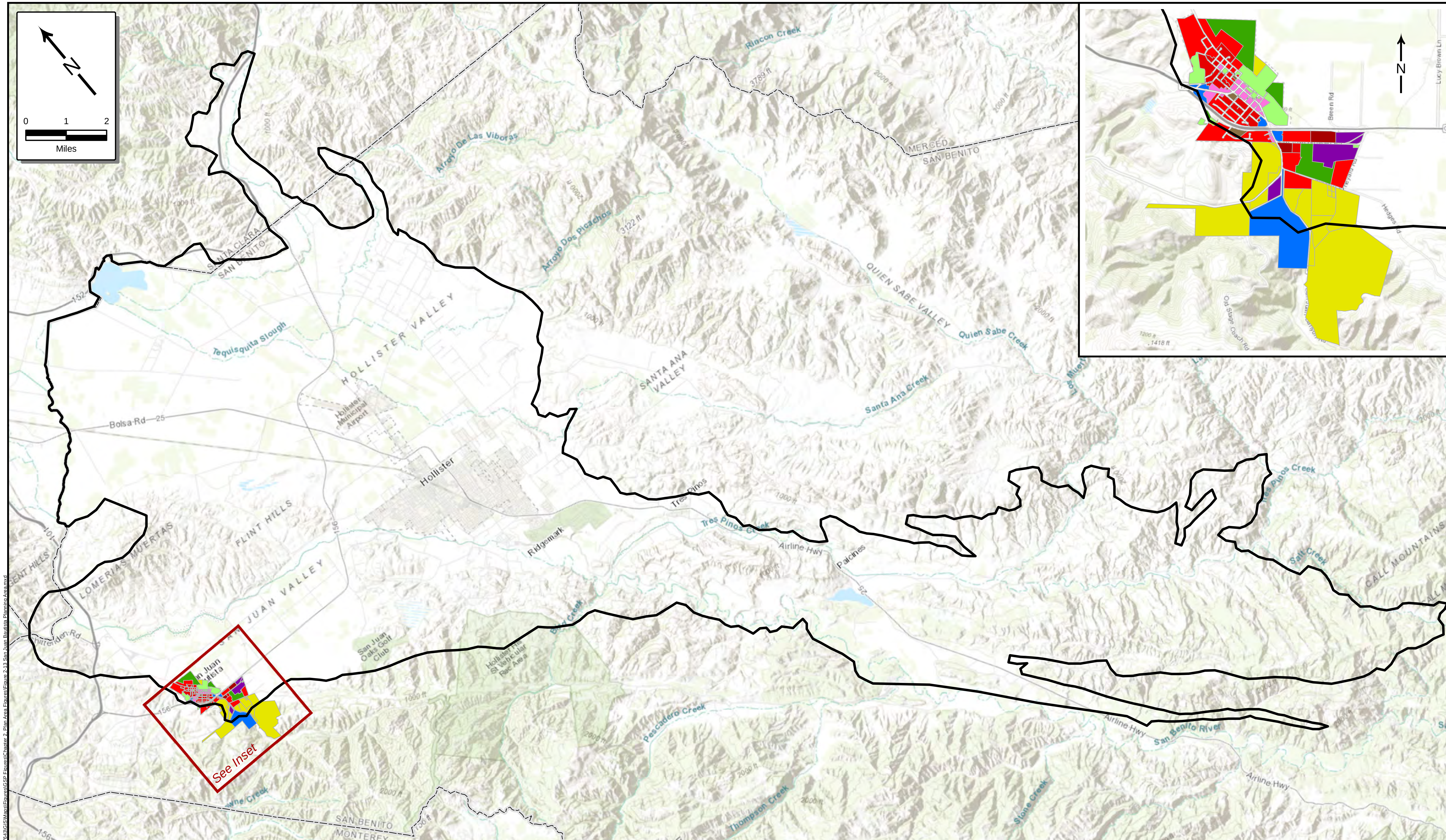


Agriculture	Industrial	Public Facility/Park	High Density Residential	North San Benito Basin
Agriculture - Industrial	Airport	Low Density and Rural Residential	Residential Estate	
Commercial	Mixed Use	Medium Density Residential	West Gateway	
			Open Space	

November 2021

TODD GROUNDWATER

Figure 2-12
City of Hollister
Planning Area



Agriculture	Mixed Use	Medium Density Residential	Other
Commercial	Public Facility/Park	High Density Residential	North San Benito Basin
Industrial	Low Density Residential	Open Space	

November 2021

TODD GROUNDWATER

Figure 2-13
City of San Juan Bautista Planning Area

3. HYDROGEOLOGIC CONCEPTUAL MODEL

This section describes the hydrogeologic conceptual model of the North San Benito Basin, including the Basin boundaries, geologic formations and structures, and principal aquifer units. The section also addresses the interaction between groundwater and surface water and discusses groundwater recharge and discharge areas. The Hydrogeologic Conceptual Model presented in this section is a summary of relevant and important aspects of the Basin hydrogeology that influence groundwater sustainability. While the Section 1 Introduction and Section 2 Plan Area establish the institutional framework for sustainable management, this section, along with Section 4 Groundwater Conditions and Section 5 Water Budget, sets the physical framework.

The hydrogeologic conceptual model and basin conditions serves to document the technical aspects of the basin's hydrogeology to create a foundation. Later sections including the water budget and sustainability criteria will refer to and rely on the technical material contained here.

3.1. Physical Setting and Topography

The North San Benito Subbasin (Basin) of the Gilroy-Hollister Groundwater Basin (DWR, 2019a) covers approximately 200 square miles situated between and including portions of the Diablo Range to the east and the Gabilan Range to the west. It is adjoined on the north by the Llagas Subbasin, which is the northern extension of the Gilroy-Hollister Basin in Santa Clara County refs.

Figure 3-1 illustrates the topography of the Basin and surrounding uplands. The Basin is a series of connected north-northwest trending structural trough valleys; these contain unconsolidated to slightly consolidated sediments with primary porosity that store and transmit significant quantities of groundwater. These formations occur not just beneath the valley floor areas but also underlie some adjacent upland areas. Consequently, the Basin boundaries are defined mostly by geology and faults, not by topography. The northern boundary with Llagas Subbasin is institutional, defined by the county line; like the northernmost North San Benito Basin, the Llagas Subbasin underlies a relatively flat valley and consists of unconsolidated alluvial sediments. Almost all extraction and use of groundwater occur in the valley floor areas, both in the Basin and adjacent Llagas Subbasin.

The northern, main portion of the Basin (including urban areas and important farmland) is broad and flat and includes the San Juan and Hollister valleys and the Bolsa area (see **Figure 3-1**). The Llagas Subbasin north of the Basin continues another 15 miles northwest in Santa Clara County and include the cities of Gilroy and Morgan Hill. The San Juan Valley is separated from the Bolsa by the Lomerias Muertas and Flint Hills, which are an upward fold of older continental semi-consolidated to consolidated deposits that rises as much as 1,100 feet above the valley floor areas.

The semi-consolidated to consolidated materials also make up the hills along the southern edges of the San Juan and Hollister Valleys. The southern Basin is mostly hilly, including Swanson's Bluff where the basin narrows north of Paicines and extensive upland watersheds of Los Muertos and middle Tres Pinos creeks. The southern basin also includes the Tres Pinos Creek and Paicines valleys associated with Tres Pinos Creek and the San Benito River.

Ground surface elevations range from approximately 200 feet above mean sea level (msl) at the northern boundary to approximately 2,400 feet above msl in the southern uplands, as shown by 1000-foot contours on **Figure 3-1**.

3.2. SURFACE WATER FEATURES

Figure 3-2 shows surface water features including rivers, streams, springs, seeps, lakes, ponds, and reservoirs. The sub-watershed boundaries that drain into and through the Basin are shown on **Figure 3-3**.

As shown, the Basin covers a portion of the Pajaro River watershed. Main tributaries to the Pajaro River include the San Benito River, Tres Pinos Creek, Santa Ana Creek, Arroyo Dos Picachos, Pacheco Creek, and Tequisquita Slough. Llagas and Uvas creeks flow into the Pajaro River from the north in Santa Clara County. The San Benito River, Tres Pinos Creek, Pacheco Creek, and Tequisquita Slough are dry over most of their lengths for much of the year, flowing mainly during wet winter conditions.

3.3. SOILS

Characteristics of soils are important factors in natural and managed groundwater infiltration (recharge) and are therefore an important component of a hydrogeologic system. Soil hydrologic group data from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (NRCS, 2018) are shown on **Figure 3-4**. The soil hydrologic group is an assessment of soil infiltration rates determined by the water transmitting properties of the soil, which include hydraulic conductivity and percentage of clays in the soil, relative to sands and gravels. The groups are defined as:

- Group A – High Infiltration Rate: water is transmitted freely through the soil; soils typically less than 10 percent clay and more than 90 percent sand or gravel.
- Group B – Moderate Infiltration Rate: water transmission through the soil is unimpeded; soils typically have between 10 and 20 percent clay and 50 to 90 percent sand.
- Group C – Slow Infiltration Rate: water transmission through the soil is somewhat restricted; soils typically have between 20 and 40 percent clay and less than 50 percent sand.
- Group D – Very Slow Infiltration Rate: water movement through the soil is restricted or very restricted; soils typically have greater than 40 percent clay, less than 50 percent sand.

The hydrologic group of the soil generally correlates with the potential for infiltration of water to the subsurface. However, there is not necessarily a correlation between the soils at the ground surface and the underlying geology or hydrogeology.

3.4. GEOLOGIC SETTING

The Basin lies within the Coast Ranges of California, a series of elongated ranges and valleys with a predominantly northwesterly trend. The Basin is structurally complex. The substantial depth of the Basin and the current topography of the land surface has resulted in part from folding of the geologic deposits. For example, the high hills that separate the Bolsa from the San Juan Valley are associated with the Sargent anticline (upward fold).

The topography is formed by folding and faulting of basement rocks in the area, leaving low-lying valleys that have been infilled with sediments. Basin fill material consists of unconsolidated to poorly consolidated alluvium of Tertiary and Quaternary age. The Quaternary alluvial deposits compose the valley floors and are the dominant geologic units in the Basin. The Basin also encompasses large areas of elevated hills composed of continental deposits. The surficial geology of the Basin and surrounding areas is shown on **Figure 3-5** (CGS, 2002).

The geologic materials that compose the Basin fill are primarily unnamed non-marine sediments of Pliocene age or younger (less than 5 million years old). The recent geologic mapping of the area by the California Geological Society (CGS) references these deposits simply by age (e.g., Puc, see **Figure 3-5**) (CGS, 2002). These formations are exposed at the land surface in the hills surrounding the valleys. In the eastern and southeastern parts of Hollister Valley, semi-consolidated deposits outcrop in the hills (e.g., Puc and Pus, see **Figure 3-5**) and are encountered in the subsurface that yield little groundwater and are commonly referred to as the San Benito Gravels of Lawson 1895.

Numerous investigators have recognized the difficulty in describing the subsurface stratigraphy of the alluvial valleys, due, in part, to sparse lithologic log data and a lack of distinctive textures and composition among the sedimentary units (Clark, 1924; Kilburn, 1972; Faye, 1974 and 1976; and LSCE, 1991). The most recent surficial geologic mapping of the Basin and surrounding area shows the Basin to include Holocene, Pleistocene, Plio-Pleistocene, and Pliocene continental deposits. These include relatively young alluvium (Q) stream gravel (Qg), basin deposits (Qb), older alluvium (Qo), and continental (QT) materials as well as mapped units of the Pliocene unnamed continental mudstone (Puc) and sandstone (Pus). Previous investigations and reports on the Basin have referred to these Pliocene deposits (Puc and Pus) as the Purisima Formation (Clark, 1924; Kilburn, 1972; Jenkins, 1973; Faye, 1974; Faye, 1976; Kapple, 1979; LSCE, 1991 and 2015; Todd, 1994a, 1994b, 2013, 2014, and 2015; JSA, 1998; and DWR, 2019a). However, the most recent surficial geologic mapping (CGS, 2002) does not include the Purisima in or around the Basin (CGS does include the Purisima Formation in other areas covered by this geologic map). Hereafter, the material mapped as Puc and Pus will be referred to as the Purisima Formation unless otherwise noted.

The surficial geology of the area surrounding the basin includes a number of named formations deposited between the Jurassic and Miocene (approximately 200 million to 5 million years old). These include the Mio-Pliocene Etchegoin Formation; the Miocene Quien Sabe Volcanics basaltic flows, breccias, intrusive andesites, and intrusive basalts; the Oligocene Vaqueros Sandstone; Eocene-Oligocene San Juan Bautista Formation; Eocene Unnamed Sedimentary rocks, Kreyenhagen Formation, Los Muertos Formation, and Tres Pinos Sandstone; Paleocene-Eocene Sedimentary rocks; Upper Cretaceous sedimentary rocks; Cretaceous Panoche Formation and multiple member of the Franciscan Complex; and Jurassic Coast Range Ophiolite Gabbro and the Hornblende Gabbro of Logan quarry. These geologic formations represent a wide variety of consolidated sedimentary, volcanic, and metamorphic rocks with low primary porosity, forming the lateral and vertical boundaries of the Basin.

3.5. FAULTS

The geology and hydrogeology of the Basin is complicated by intensive faulting and deformation along faults, most notably the Calaveras and San Andreas fault zones (LSCE 1991). As shown in **Figure 3-5**, the Calaveras Fault bisects the Hollister Valley from north to south and offsets the hills west of the Hollister Airport. It also has created San Felipe Lake, a sag pond at the north end of the valley (**Figure 3-2**).

Geologic mapping (**Figure 3-5)** indicates that the Calaveras fault consists of several parallel splinters throughout the length of the Basin. The San Andreas Fault crosses a portion of San Juan Valley but is generally west of the western boundary of the Basin.

Other faults related to the San Andreas/Calaveras system have shaped the eastern side of the Basin. Some of these faults have been mapped only in the outcropping bedrock, and fault traces across the valley floor are uncertain. These include the Ausaymas Fault (sometimes referred to as the Quien Sabe), Tres Pinos Fault, and the unnamed fault traces associated with the Lomerias Muertas and Flint Hills.

3.6. AQUIFERS

The geologic materials underlying the Basin do not fall neatly into two categories of permeability, such as bedrock and basin fill. Some upland areas (such as the Lomerias Muertas, Flint Hills, and hills in the upper Tres Pinos Creek and San Benito River drainages) are simply upward folds of the same formations that represent aquifers in the valley areas. These upland areas store and transmit some groundwater to the valley portions; in brief, the Basin includes valley areas composed of Holocene and late Pleistocene alluvial deposits with relatively high permeability and upland areas with mainly Pliocene-Pleistocene continental deposits of moderate permeability. The Flint Hills and most of the southern portion of the Basin also encompass elevated areas of relatively low permeability Pliocene continental deposits, which yield less groundwater.

The valley-fill units were deposited in alluvial fan and fluvial environments from a variety of source rocks and directions. These deposits interfinger in the subsurface, making the differentiation of discrete aquifer packages difficult on a regional basis. This also results in variable aquifer properties across the Basin, even within the generally higher permeability valley fill alluvium (LSCE, 1991; Faye, 1974; and Todd, 2013).

3.6.1. Principal Aquifers

The Holocene alluvial sedimentary sequences represent the principal aquifers; their distribution is shown on **Figure 3-5**. As shown, the principal aquifers underlie the Hollister and San Juan valleys and the Bolsa. These unconsolidated alluvial deposits consist mainly of clay, silt, sand, and gravel ranging in age from Tertiary to Holocene. The Purisima and other Pliocene deposits are presumed to be present at depth beneath the alluvial deposits. However, distinguishing these older semi-consolidated materials from younger alluvial materials in borings or geophysical logs is difficult and there is no geologic interpretation that is known and widely accepted. The oldest of the principal aquifers lie unconformably on consolidated bedrock of Jurassic, Cretaceous and early Tertiary age (Kilburn, 1972 and Todd, 2013). These unconformable contacts generally occur below the depth of groundwater wells in the Basin and accordingly, definitive information or mapping of the Basin bottom is lacking. This is discussed in more detail below.

Groundwater in the principal aquifers generally occurs in both unconfined and confined conditions. Surficial clay deposits, especially in the Bolsa area and Hollister and San Juan Valleys, create non-continuous confining layers. In the northern Hollister Valley and San Juan Valley, artesian conditions locally result in flowing wells and nuisance shallow groundwater that requires near-surface drains.

3.6.2. Secondary Aquifers

As indicated above, the Pleistocene and Pliocene age Purisima Formation and other continental (non-marine) deposits are also important aquifers within the Basin. These secondary aquifers are composed of clay, silt, sand, and gravel (LSCE, 1991; Todd 2013 and 2015). They are a thick sequence of clay, silt, sand, and gravel mapped in the southern portion of the Basin as unnamed Pliocene continental mudstone (Puc) and sandstone (Pus). In some areas of the Basin, these semi-consolidated rocks have been divided into three unnamed units, from oldest to youngest: unit 1, unit 2, and an undifferentiated unit (Kilburn, 1972; DWR, 2019a).

3.6.3. Physical Properties of Aquifers

Summary descriptions of the aquifer formation are provided below. Few reliable aquifer parameter measurements are available from wells within the Basin; accordingly, assessment of aquifer parameters has been undertaken in association with numerical model construction and calibration. The available aquifer parameter information and distribution within the Basin are described in the numerical model documentation report, North San Benito Basin Groundwater Model Update and Enhancement 2020, included in **Appendix G**.

Holocene Alluvium, principal aquifer:
The alluvium consists of unconsolidated lenticular beds of gravel, sand, silt, and clay deposited by streams as flood plain, alluvial-fan, slope-wash, and terrace deposits (Kilburn, 1972). Saturated deposits are moderately to extremely permeable. The thickness generally ranges from 0 to 300 feet (JSA, 1998).

Purisima Formation, secondary aquifer:
The Purisima Formation and other Pliocene continental deposits, while lithologically similar to the overlying alluvium, are generally more consolidated and less permeable (JSA, 1998). The Purisima Formation ranges from the surface in some areas to several thousand feet deep; in the Bolsa it is believed to directly overlie consolidated basement rocks of Jurassic age (Kilburn, 1972).

Unit 1 and Unit 2, secondary aquifer:
Unit 1 crops out and is believed to form the low hills at the north end of Santa Ana Valley and to underlie unit 2. Unit 1 is approximately 1,200 feet thick. The log of well 12S/5E-23A3 indicates the top of the unit at a depth of 420 feet at this location (Kilburn, 1972). Unit 1 is made up of clay, sand, and gravel with individual beds not more than five to ten feet thick. Unit 2 consists of three or four thick sand sequences separated by thinner clay intervals. Units 1 and 2 are not known to occur west of the Calaveras fault.

Undifferentiated Unit, secondary aquifer:
Kilburn (1972) describes the undifferentiated unit as including one or more of the following units: alluvium, older alluvium, San Benito Gravels, and alluvial-fan material that may occur in the subsurface along the front of the Diablo Range. This unit is believed to overlap and rest unconformably on an older erosion surface formed on units 1 and 2.

3.7. STRUCTURES AFFECTING GROUNDWATER

The complex depositional and tectonic history of the Basin have resulted in numerous structures that potentially affect the flow and transmission of groundwater. The primary structures affecting groundwater are lower permeability aquifer materials and faults.

As described above, the presence of lower permeability aquifers and the contacts between these aquifers and overlying primary aquifers are difficult to discern because of their similar compositions. Accordingly, no distinct aquitards are known or have been mapped at depth and the surficial geologic mapping shown on **Figure 3-5** is the best representation of the presence of these materials in the Basin.

Faulting has been indicated to affect groundwater flow within the Basin in some locations and in some conditions (LSCE, 1991 and Todd, 2015). Evaluation of groundwater elevations across fault traces has shown that large groundwater gradients sometimes exist on portions of the Calaveras Fault in the north of the Basin (LSCE, 1991 and Todd, 2015). However, evaluation of current groundwater conditions in wells on both sides of the Calaveras Fault indicate that if the fault is a barrier, then it primarily affects flow when groundwater elevations are low. Groundwater model construction and calibration also indicated relatively large vertical gradients near uncertain traces of the Ausaymas/Quien Sabe and Tres Pinos Faults (Todd, 2015). However, most of the paired wells with large vertical gradients are far apart and it is unclear if the observed gradients are the result of barriers associated with faulting, differences in lithology and well construction, or some other permeability changes.

3.8. DEFINABLE BASIN BOTTOM

The depth to consolidated Tertiary units and other bedrock units beneath the alluvium and Plio-Pleistocene sediments is not well characterized. Kapple (1979) indicates that the Quaternary-age aquifers (including the unconsolidated basin fill, San Benito Gravels, and an undifferentiated sedimentary unit) range in thickness up to 1,300 feet in the Hollister Valley. Data from exploratory oil wells indicate that basin fill sediments extend as much as 4,000 feet below the ground surface near the center of the Basin, far beyond the depths of water supply wells (Kilburn, 1972). Generalized cross sections prepared for a San Benito County Groundwater Study (LSCE, 1991) that covered a portion of the Basin generally corroborate this interpretation with alluvium estimated to average about 700 feet thick in the Bolsa area and Hollister Valley.

In the northern San Juan Valley, the alluvium appears to be thinner than in the Bolsa and Hollister Valley areas and is estimated to be about 400 feet thick. Wells deeper than this in the northern San Juan Valley may be producing water from the underlying consolidated formations (Purisima and others as indicated above). The Purisima Formation is thought to reach thicknesses in the subsurface of more than 1,500 feet in the northern portion of the San Juan Valley (Kilburn, 1972); although, most of the wells are less than 350 feet deep. No wells are known in the Flint Hills northeast of San Juan Valley; however, one well located on the west side of San Juan Valley is screened in the same continental mudstones formation that underlies the Flint Hills and is 300 feet deep.

The depth of the southern Basin is not well characterized. Several irrigation wells in the Paicines Valley penetrate alluvial deposits to depths ranging from 100 to 500 feet below ground surface (ft-bgs) (LSCE, 1991). A review of driller's logs in the area indicated an average alluvial depth of 400 feet (Todd, 2013). The alluvial thickness in the Upper Tres Pinos Creek area is thought to be less than 100 feet (LSCE, 1991); however, Pliocene or early Pleistocene continental sediments of moderate permeability underlie the remainder of the Upper Tres Pinos Creek Watershed. Based on a review of driller's logs, the average well depth in this area is about 300 feet (Todd, 2013).

LSCE (1991) reports that wells in the Tres Pinos Valley (then defined as a separate basin) encounter alluvial deposits ranging from 135 to 630 ft-bgs. California Department of Water Resources (DWR) (2019a) reports that the alluvial material is generally less than 100 feet thick. A review of the few driller's logs in the area (Todd, 2013) indicates an average depth to bedrock of 360 feet.

3.9. Cross Sections

Four hydrogeologic cross sections were constructed to characterize the thickness and distribution of aquifer sediments and to delineate the hydrostratigraphy within the Basin (**Figure 3-6**). The goals of constructing cross sections were to identify hydrogeologic structures affecting groundwater and to confirm aquifer descriptions presented above. Construction of the cross sections focused on conditions relevant to hydrostratigraphic layering in the Basin. The assessment was designed to use and combine existing information in the ArcHydro Groundwater data format that supports application of geographic evaluation tools within a Geographic Information System (GIS) platform. The information assessed in this evaluation included:

- Surficial geology
- Faulting
- Lithologic borehole logs
- Well construction logs
- Previously completed local hydrogeologic conceptualizations.

This information was collected and translated into a unified GIS compatible database structure for cross section construction and geographic evaluation. This approach allows any hydrostratigraphic structures relevant to groundwater flow in the Basin to be easily translated from GIS for use in other formats.

3.9.1. Available Data and Information

Existing datasets and information were collected from all available sources. These sources included the following:

- Surficial geology in GIS coverage format (CGS, 2002)
- Fault locations and orientations (CGS, 2002)
- Fault subsurface expressions (Wallace, 1990)
- Lithologic and well construction logs from SBCWD
- Drillers Log files from DWR
- National Elevation Dataset (NED) ground surface digital elevation model data for San Mateo and Santa Clara Counties (USGS, 2018).

These data and information sources resulted in a dataset of over 2,400 locatable wells and boreholes within and near the Basin. Of these, lithologic and construction records were digitized for 374 wells and boreholes (**Figure 3-6**). These location, lithologic, and well construction records were combined into a unified dataset covering the Basin and surrounding areas. The unified dataset is composed of a series of related tables in a geodatabase that follows the data storage conventions of ArcHydro Groundwater.

Construction of the unified database required combination of well location, lithologic, and well construction data from multiple data sources. These data sources often contained different information types. At each stage of the database construction process, care was taken to include all data from each data source. In addition, many records were included in multiple data sources, and often the records from two or more data sources had differences in locations or information for wells. Duplicate well locations or records were combined into single records preserving all information from each individual data source.

Multiple faults cross portions of the Basin, as discussed above. To portray these faults on cross sections, it was necessary to estimate orientations and approximate dip angles. Wallace (1990) includes approximate information regarding the subsurface expressions of the Calaveras and San Andreas Faults within the area of the Basin. Wallace estimates that the Calaveras generally dips 80 degrees to the east and the San Andreas dips 70 degrees to the west.

3.9.2. Cross Section Construction

The four cross section transect locations shown on **Figure 3-6** were selected based on available data to provide lithologic coverage throughout the Basin. These cross sections cross and extend slightly beyond Basin boundaries and are designated as A to A' through D to D', as indicated on **Figure 3-6**.

The datasets incorporated into the database discussed above were used to populate the cross sections for use in hydrostratigraphic correlation. These data were applied to the sections using the ArcHydro Groundwater extension to ESRI's ArcGIS Desktop software. ArcHydro Groundwater includes tools for plotting surficial geology, faults, lithologic, construction, and elevation surfaces from a two-dimensional map to two-dimensional cross sections. The wells with lithologic and construction information in the vicinity of the cross sections are shown on **Figure 3-6**. Each cross section was populated with the following datasets:

- Ground surface elevations from the county NED files
- Surficial geology
- Faults
- Well and borehole lithology and well construction from all wells within 1,000 feet of each cross section, except cross section A to A' where the few wells present were projected over larger distances.

These data were plotted to the cross sections using the ArcHydro Groundwater toolset and then used to interpret and correlate hydrostratigraphy. Lithologic data were used to interpret sand and gravel aquifer units throughout the Basin. Sands and gravels were lumped together in the interpretation. In locations where multiple lithologic logs were present on a cross section, preference was given to the closest logs. Mapped surface geology (CGS, 2002) and subsurface conditions around the faults were used to interpret the locations and relationships of older materials to one another and alluvium.

The resulting cross sections are shown individually with well construction, hydrostratigraphy, faulting, and bedrock on **Figures 3-7** through **3-10**. Areas with no well or lithologic data are blank and the transition is indicated by a dashed line. Cross section A to A' is the longitudinal profile down the length of the Basin; it is noteworthy in showing the significant topographic change from south to north and rugged character of Basin upland areas. This longitudinal profile is semi-parallel to the Calaveras Fault and intersects the Calaveras Fault zone. The other transverse cross sections illustrate the stratigraphy below the Basin's main valleys insofar as data are available.

3.9.3. Hydrostratigraphic Evaluation

The cross sections are consistent with and support the conceptual model described above. These sections show that most of the Basin is composed of a mix of interbedded silts and clays (fine grained materials) and sands and gravels (coarse grained materials) in discontinuous lenticular deposits. In general, a higher percentage of sand and gravel occurs near the San Benito River and Tres Pinos Creek, as would be expected. The cross sections also show that distinguishing the primary alluvial aquifer from the same type of materials in the older underlying aquifers is infeasible with available information. Additionally, the cross sections show that most water wells do not extend deep enough to document the full thickness of the water bearing materials that make up the aquifers of the Basin.

3.10. Recharge and Discharge Areas

Groundwater recharge occurs over the entire surface of the Basin, in varying intensities. It can be conceptualized as consisting of three components based on their footprints: areas, lines, and points. These categories and their locations are shown in **Figure 3-11**. Dispersed recharge over broad areas derives from deep percolation of rainfall and applied irrigation water beneath the root zone of plants. Estimates of this areal flux are quantified in Section 5 Water Budget, for hundreds of polygon areas representing different combinations of soil, water, and vegetation. Land use plays a significant role in the recharge flux, and the figure shows three categories of land use that generally have different magnitudes of recharge: non-irrigated natural vegetation (low), urban areas (medium), and irrigated cropland (high).

Percolation from streams is a major source of recharge to the Basin, and streams are shown as linear features on the map. Percolation from small streams in upland areas is estimated in the water balance analysis from a rainfall-runoff-recharge model, and percolation from larger streams in valley floor areas is estimated using the groundwater model.

Percolation from ponds can be represented as points at the scale of the entire Basin. SBCWD has conducted managed aquifer recharge at the Tres Pinos Pond near Tres Pinos, Union Road Pond near the San Benito River, Hollister ponds, and Frog Pond near Arroyo de Las Viboras. Percolation ponds also include wastewater treatment plant disposal ponds. The recharge map shows the locations of six wastewater percolation ponds serving San Juan Bautista, Hollister, the Ridgemark development, and Tres Pinos.

Finally, subsurface inflow to the Basin probably occurs at various locations around its perimeter. The water balance section describes how this flux was estimated by applying the rainfall-runoff-recharge model to tributary watershed areas and how it was assumed to be distributed along the Basin perimeter in the groundwater model.

Groundwater recharge can be increased through management actions and projects, termed Managed Aquifer Recharge (MAR). As described in the Plan Area (Section 2.1.4), SBCWD has a long history of percolating surface water to augment recharge, mostly in or near stream channels. MAR activities are likely to be continued and enhanced in the future; potential projects will be addressed in Section 8, Management Actions and Projects.

With regard to discharge, wells are by far the largest discharges from the Basin, and they are abundant in the urban and agricultural areas shown on the recharge map, **Figure 3-11**. Natural outflow from the Basin consists of groundwater discharge into creeks and rivers. The primary exit points are groundwater seepage into the lower ends of the Pajaro and San Benito Rivers as they approach the northwestern end of the basin and enter the bedrock canyon leading to the coast. Locations of gaining reaches of streams are mapped and discussed in Section 4.11, Interconnection of Surface Water and Groundwater.

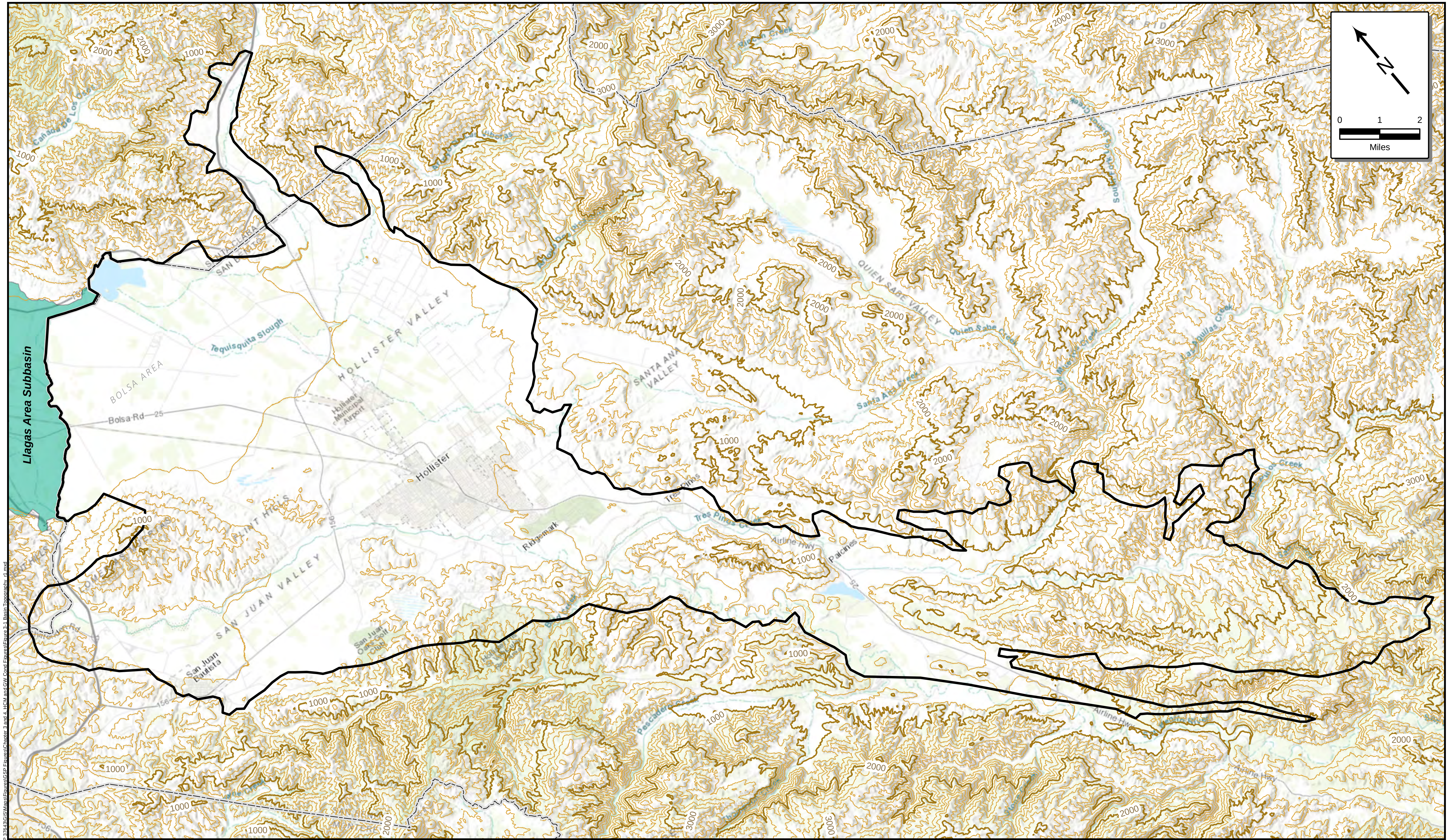
3.11. Primary Groundwater Uses

The primary groundwater uses in the Basin include municipal, agricultural, rural residential, small community water, and small commercial purposes. Municipal and agricultural demand in the Zone 6 portion of the Basin is met by a combination of imported water from the Central Valley Project (CVP) and groundwater. Outside Zone 6, water demand for all uses comes entirely from groundwater. Groundwater production for all users comes largely from the principal aquifer in the central and northern portions of the Basin. In upland areas and smaller valleys of the Basin, production comes from the principal and secondary aquifers.

3.12. Data Gaps in the Hydrogeologic Conceptual Model

The hydrogeologic conceptual model has identified gaps in available information, listed below. However, these gaps do not affect the ability to manage the Basin or demonstrate sustainability.

- The bottom of the Basin is poorly defined throughout and no mapping of the elevation of the Basin bottom exists. Significant exploratory drilling beyond the typical depth of water wells in the Basin or extensive detailed geophysical work would be required to fill this gap.
- The extent, thickness, and relationship between the principal and secondary aquifers has not been well delineated beyond surficial geologic mapping. As with the Basin bottom, filling this gap would require significant exploratory drilling and/or geophysics.
- The effect of faults on groundwater flow—which varies both geographically and vertically—is not well documented. The available groundwater monitoring wells are not appropriately located or constructed for the purpose of performing detailed high-quality evaluations of the effects of faults throughout the Basin under a variety of groundwater conditions.



North San Benito Basin

Llagas Area Subbasin of the Gilroy-Hollister Basin

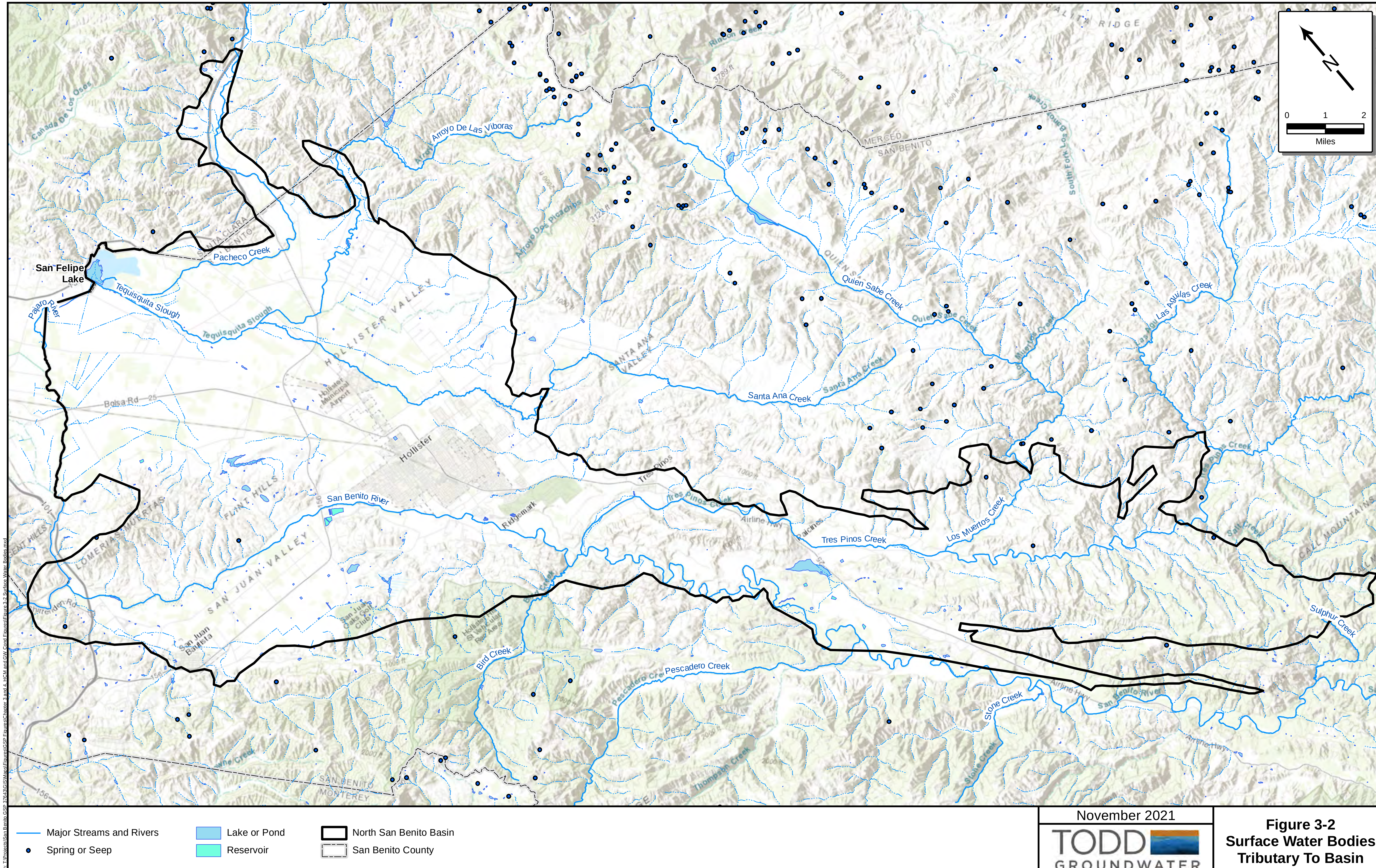
San Benito County

Topographic Contour (Bold on 1000 foot interval)

November 2021

TODD GROUNDWATER

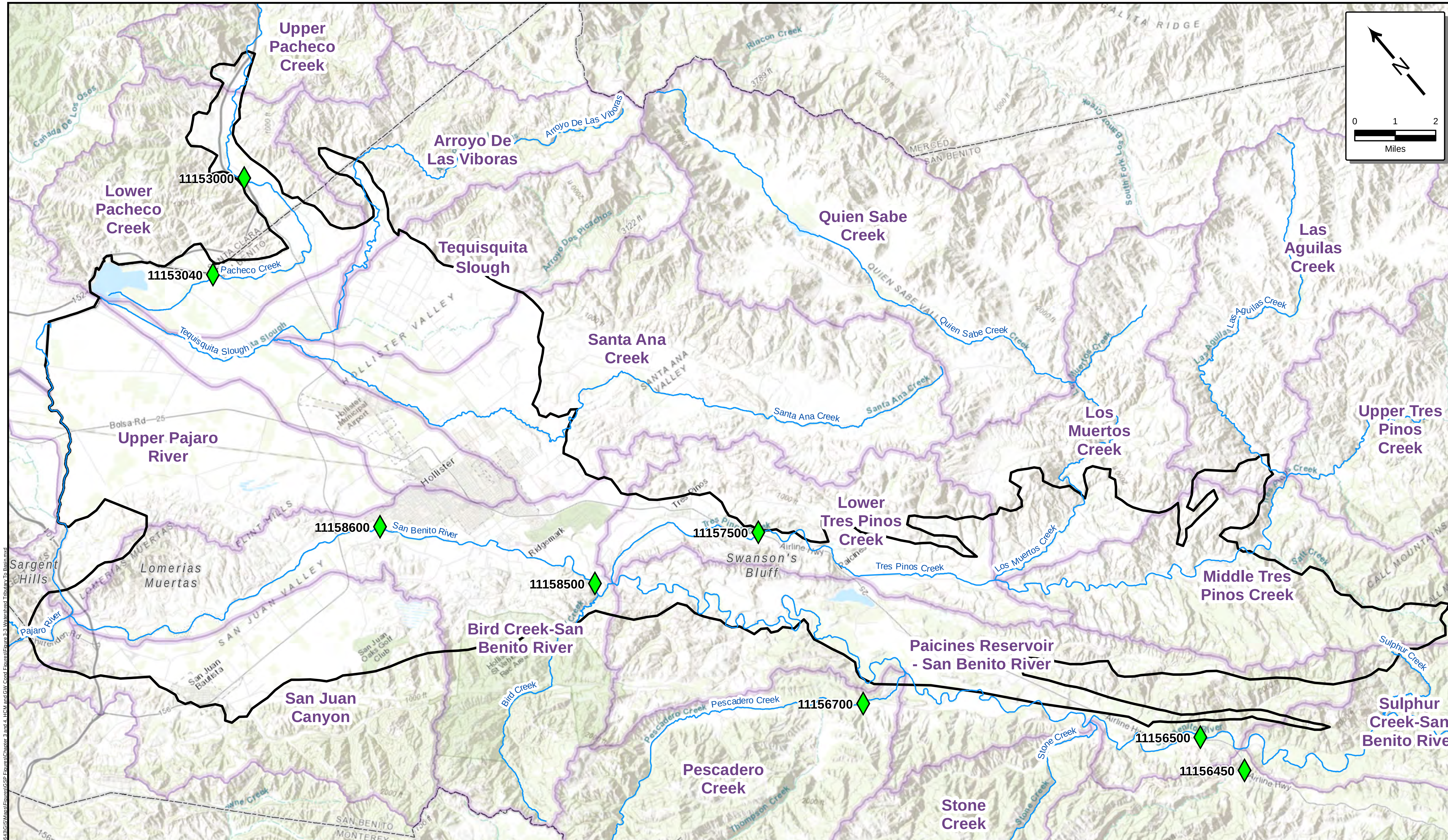
Figure 3-1
Basin Topography



November 2021

TODD GROUNDWATER

Figure 3-2
Surface Water Bodies Tributary To Basin

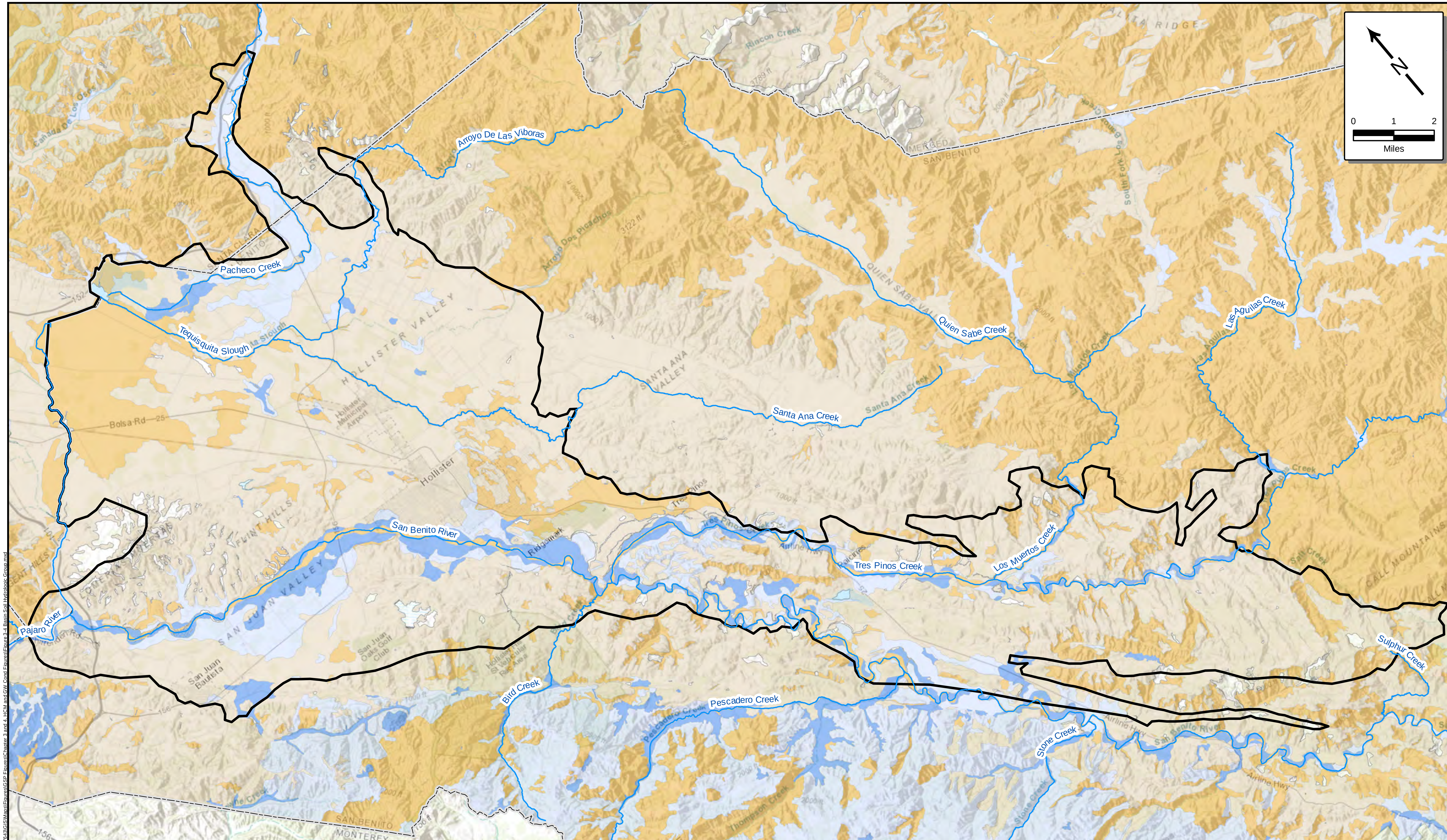


Stream Gauges in Basin
Major Stream
North San Benito Basin
Tributary Watershed Boundaries
San Benito County

November 2021

TODD GROUNDWATER

Figure 3-3
Watersheds Tributary to Basin



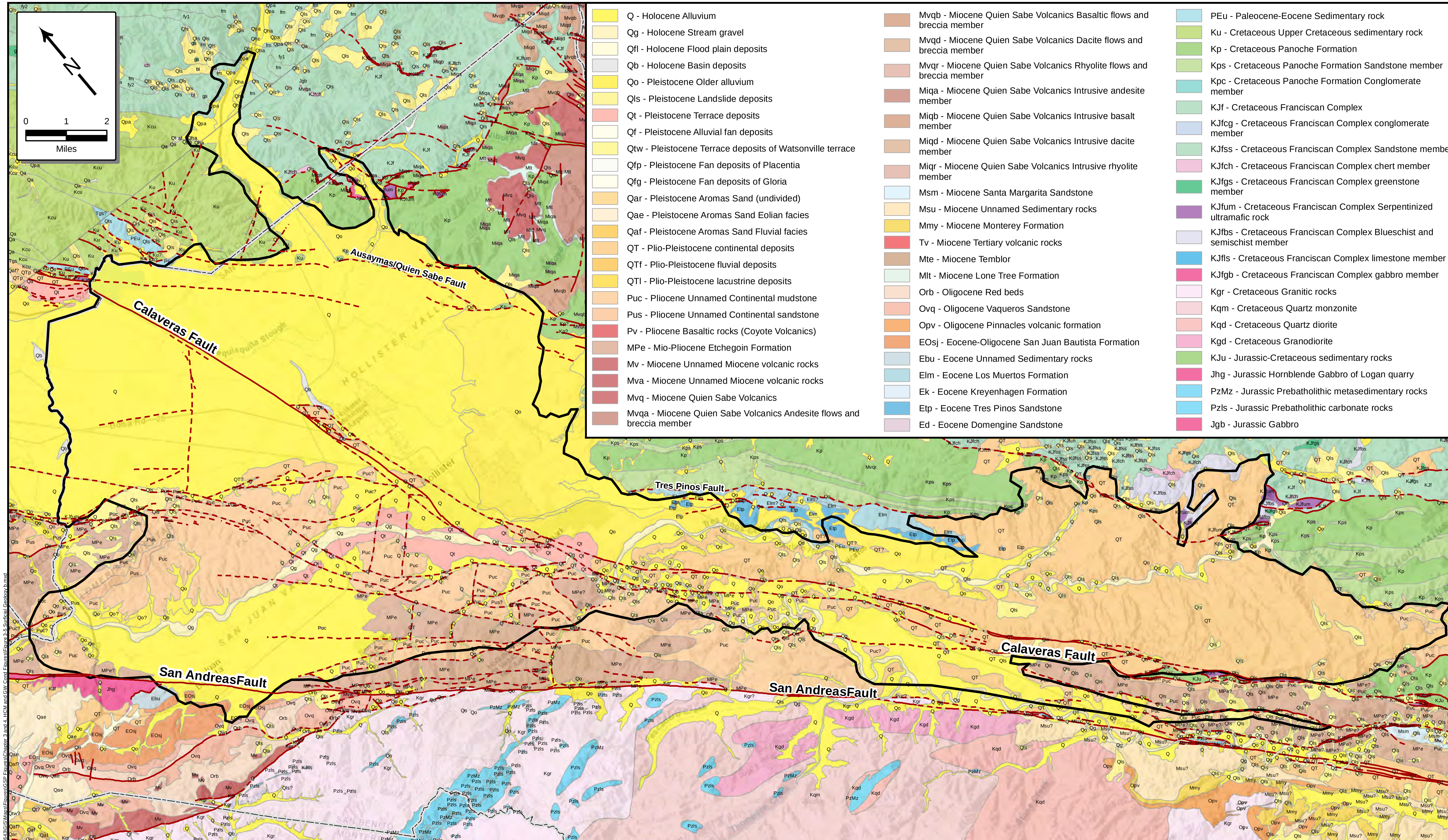
Soil Hydrologic Group

- A: High Infiltration Rate
- B: Moderate Infiltration Rate
- C: Slow Infiltration Rate
- D: Very Slow Infiltration Rate
- No Data
- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

Figure 3-4
Basin Soil Hydrologic Properties



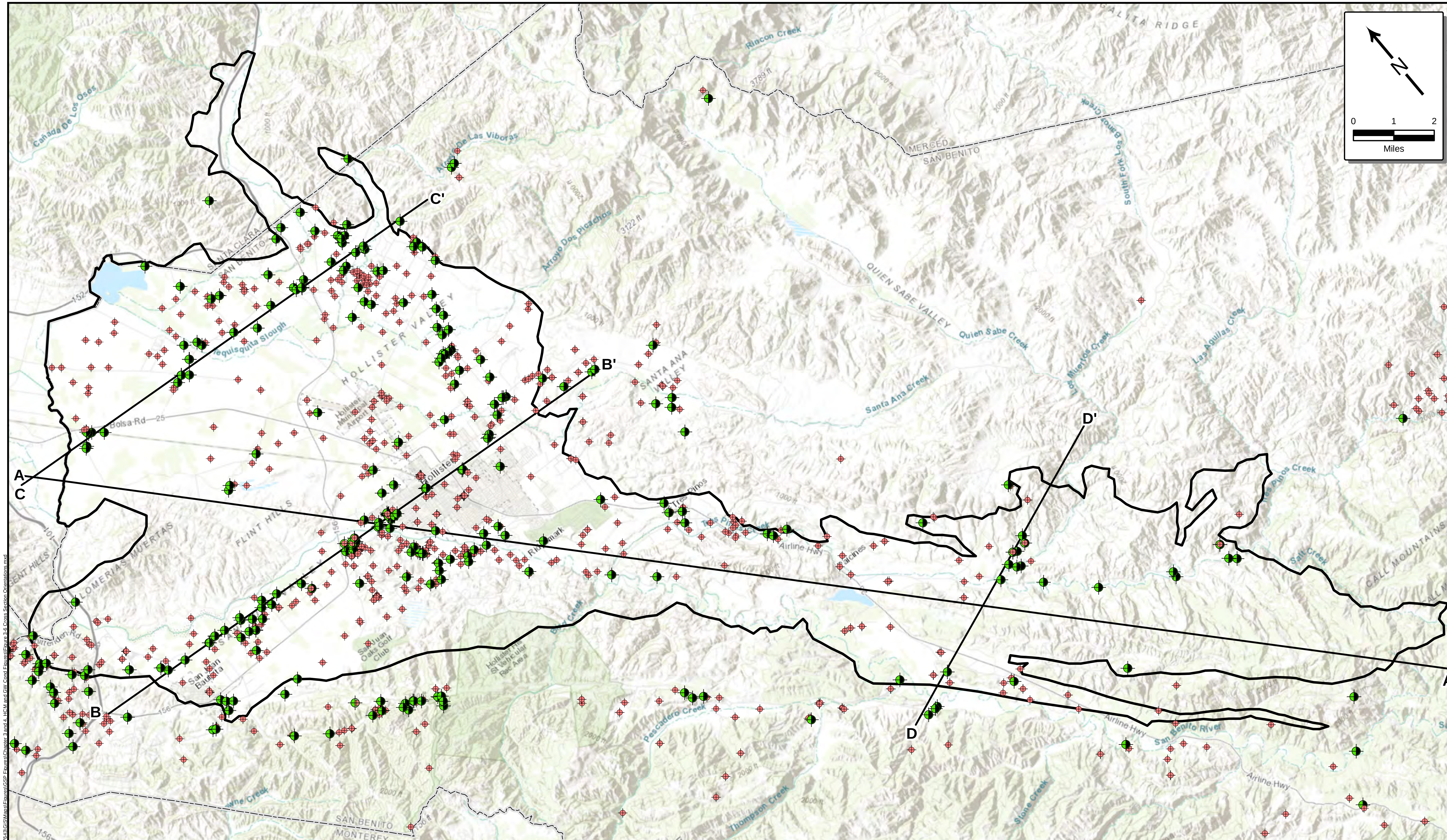
Fault Location, dashed where uncertain

North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 3-5
Surficial Geology

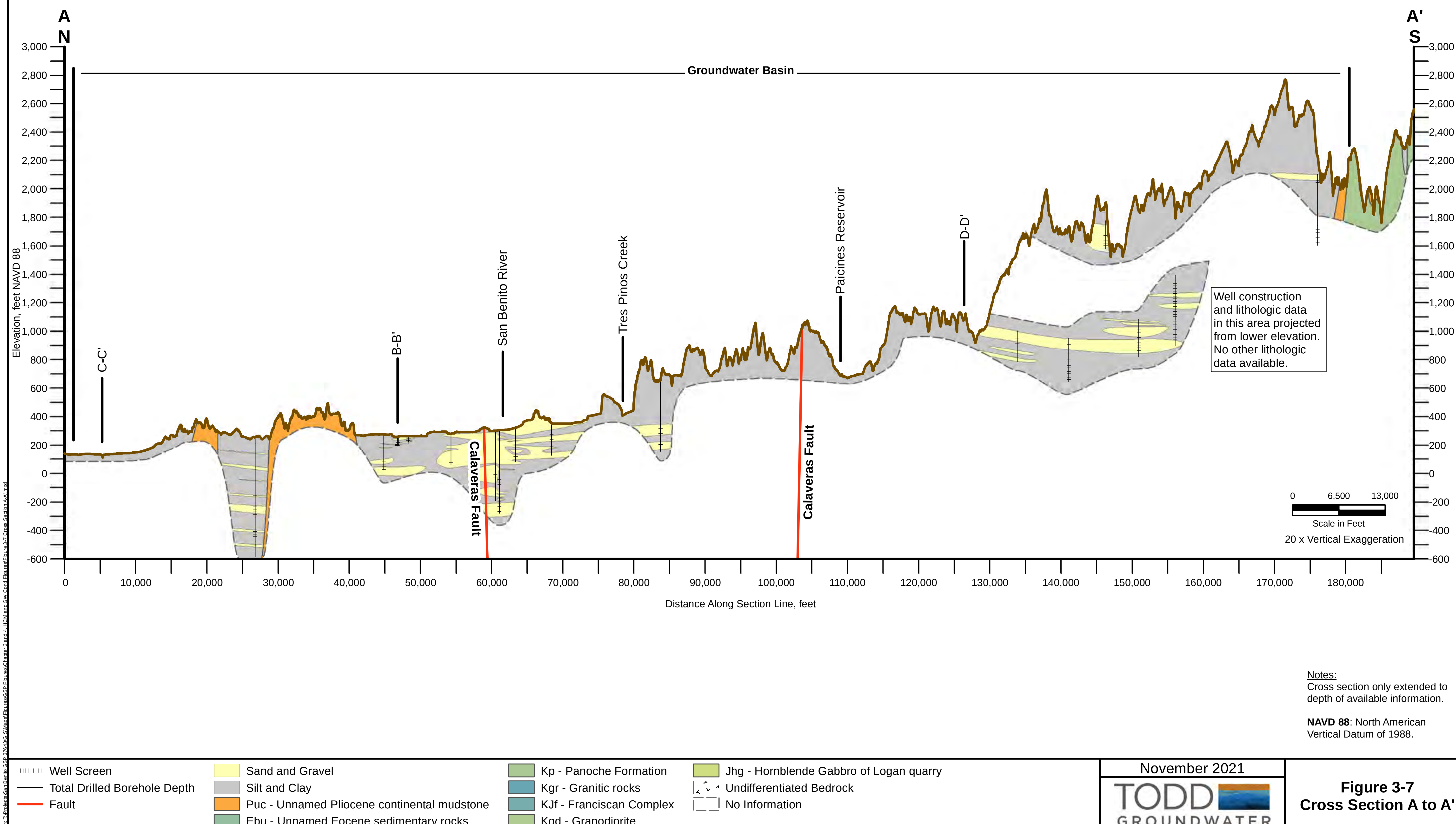


Well with Digitized Lithology and Construction Information
Well with Digitized Lithology Information
Well without Digitized Information
Cross Section Line Orientation
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 3-6
Cross Section
Line Orientations



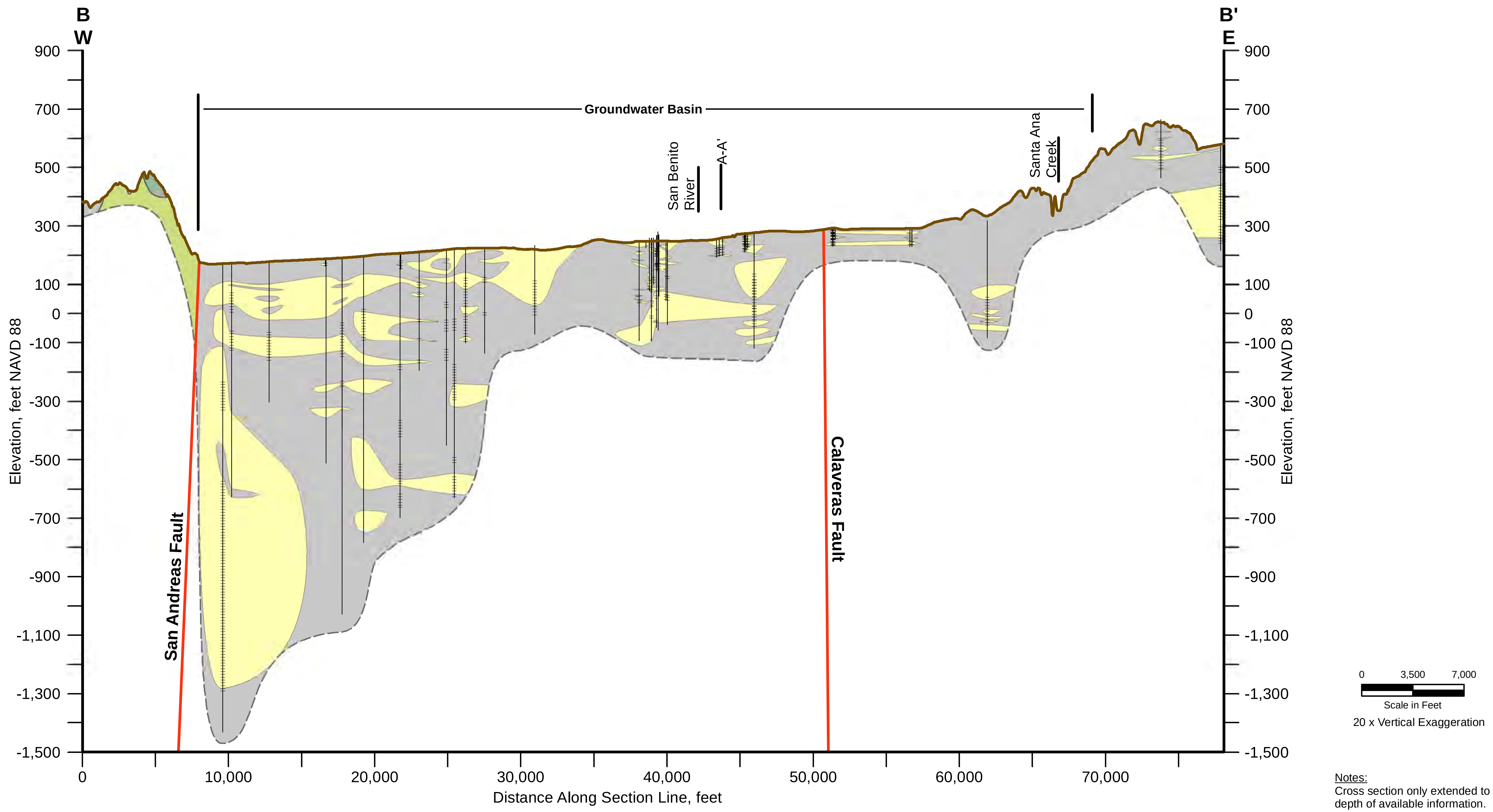
Notes:
Cross section only extended to depth of available information.

NAVD 88: North American Vertical Datum of 1988.

November 2021

TODD GROUNDWATER

Figure 3-7
Cross Section A to A'



Notes:
Cross section only extended to depth of available information.

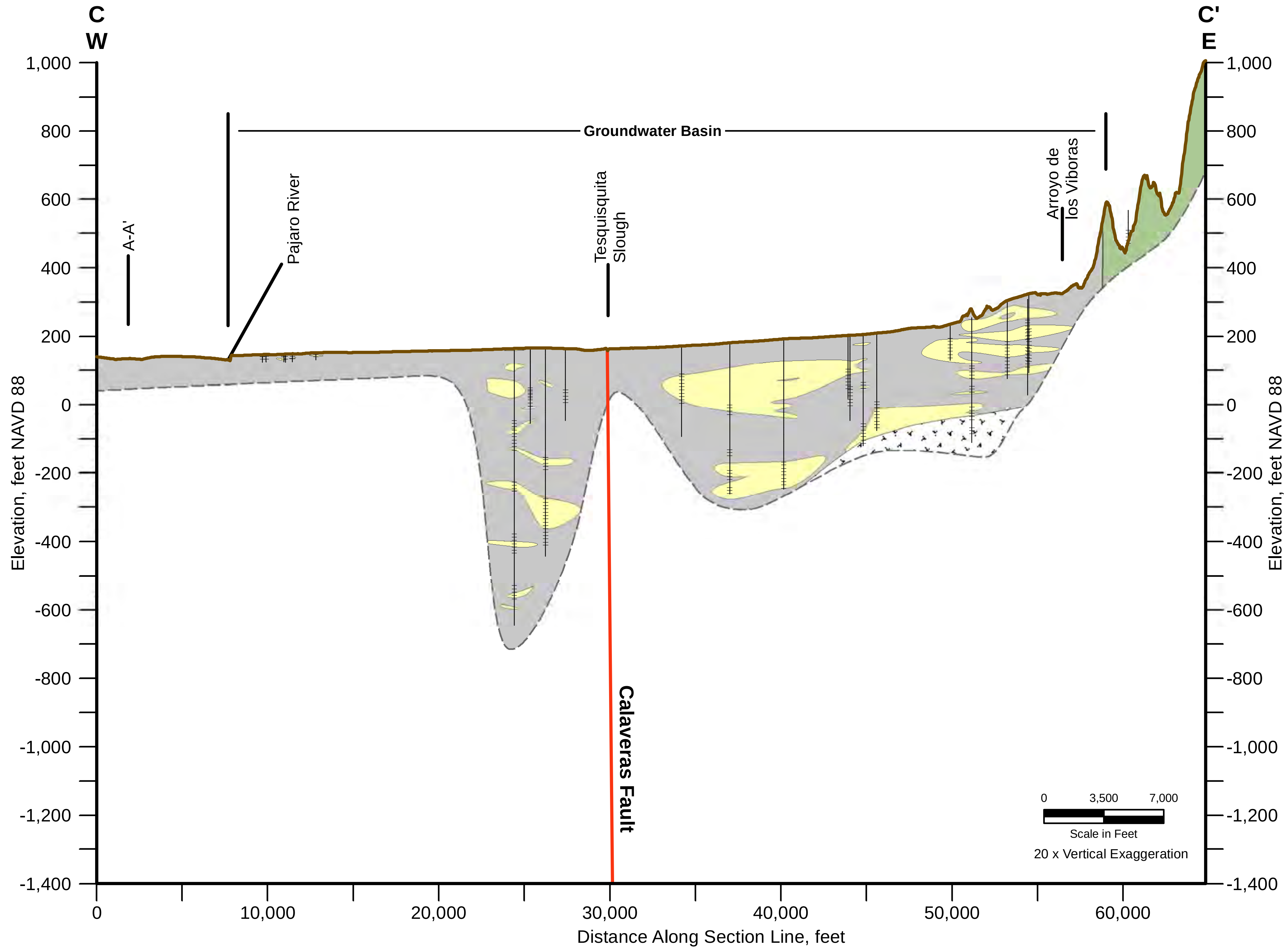
NAVD 88: North American Vertical Datum of 1988.

- Well Screen
- Total Drilled Borehole Depth
- Fault
- Sand and Gravel
- Silt and Clay
- Puc - Unnamed Pliocene continental mudstone
- Ebu - Unnamed Eocene sedimentary rocks
- Kp - Panoche Formation
- Kgr - Granitic rocks
- KJf - Franciscan Complex
- Kgd - Granodiorite
- Jhg - Hornblende Gabbro of Logan quarry
- Undifferentiated Bedrock
- No Information

November 2021

TODD GROUNDWATER

Figure 3-8
Cross Section B to B'



Notes:
Cross section only extended to depth of available information.

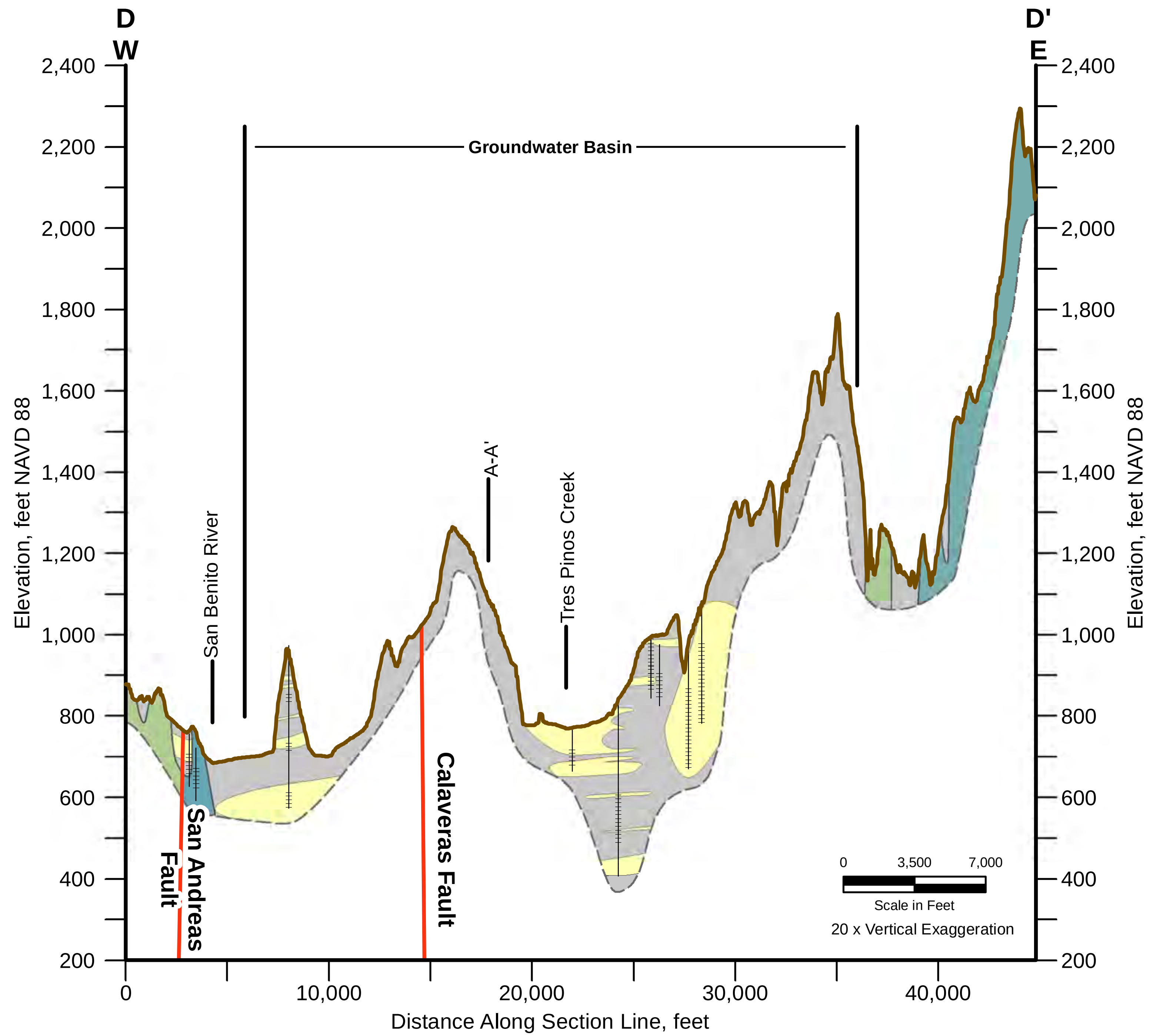
NAVD 88: North American Vertical Datum of 1988.

Well Screen
Total Drilled Borehole Depth
Fault
Sand and Gravel
Silt and Clay
Puc - Unnamed Pliocene continental mudstone
Ebu - Unnamed Eocene sedimentary rocks
Kp - Panoche Formation
Kgr - Granitic rocks
KJf - Franciscan Complex
Kgd - Granodiorite
Jhg - Hornblende Gabbro of Logan quarry
Undifferentiated Bedrock
No Information

November 2021

TODD GROUNDWATER

Figure 3-9
Cross Section C to C'



Notes:
Cross section only extended to depth of available information.

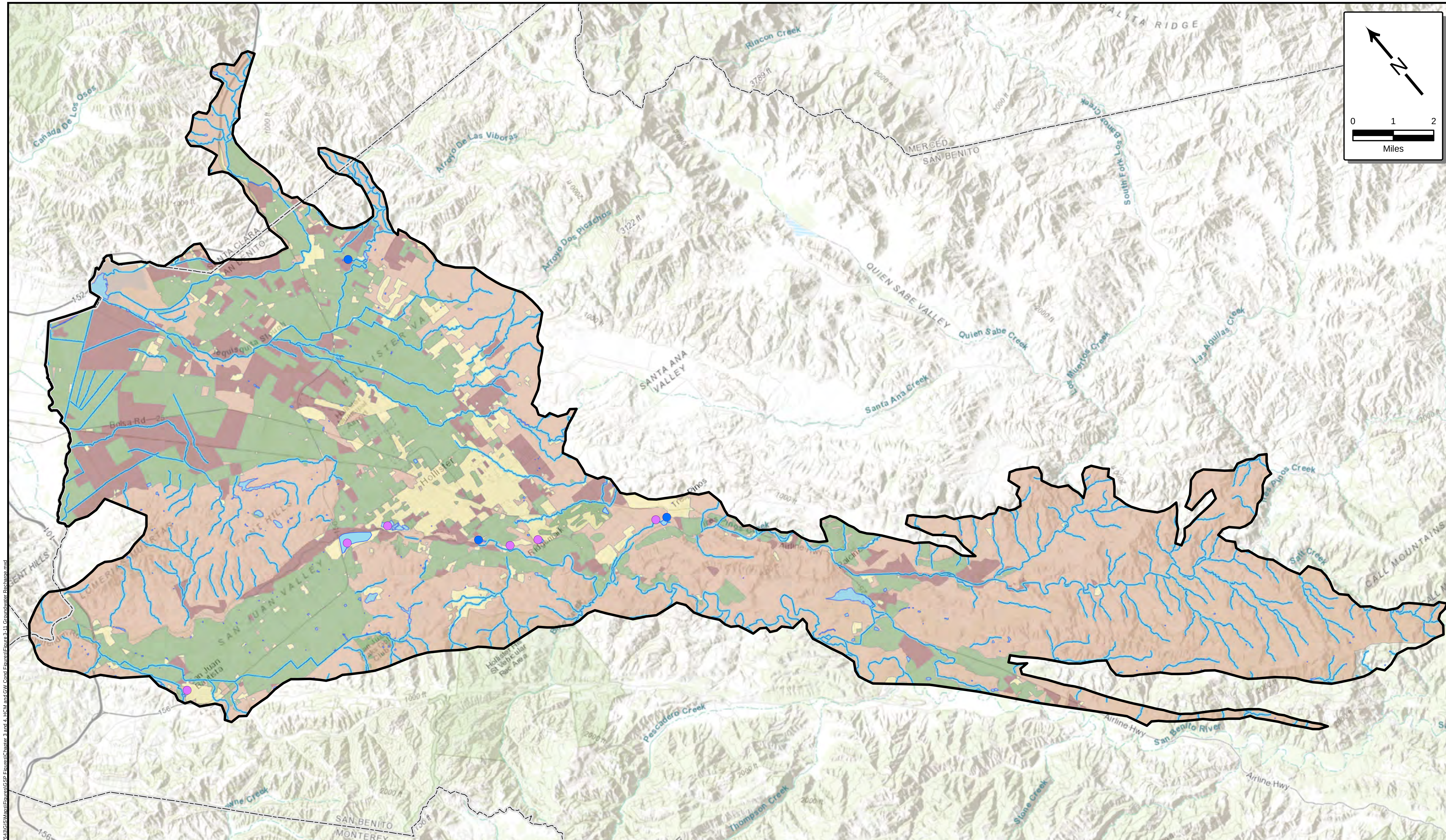
NAVD 88: North American Vertical Datum of 1988.

- Well Screen
- Total Drilled Borehole Depth
- Fault
- Sand and Gravel
- Silt and Clay
- Puc - Unnamed Pliocene continental mudstone
- Ebu - Unnamed Eocene sedimentary rocks
- Kp - Panoche Formation
- Kgr - Granitic rocks
- KJf - Franciscan Complex
- Kgd - Granodiorite
- Jhg - Hornblende Gabbro of Logan quarry
- Undifferentiated Bedrock
- No Information

November 2021

TODD GROUNDWATER

Figure 3-10
Cross Section D to D'



Recharge Ponds	Irrigated Agricultural Recharge	North San Benito Basin	
Wastewater Treatment Plant Recharge	Urban Recharge	San Benito County	
Connectors, Ditches, and Streams	Non-Irrigated Natural Vegetation Recharge		
Surface Water Bodies	Other Non-Irrigated Land Recharge		

Note:
Groundwater discharge from the Basin occurs as discharge to streams, subsurface outflow, and groundwater pumping from wells. The distribution of active wells changes over time, so wells are not shown on this map.

November 2021

TODD GROUNDWATER

Figure 3-11
Groundwater Recharge and Discharge

4. CURRENT AND HISTORICAL GROUNDWATER CONDITIONS

This section describes the current and historical groundwater conditions in the North San Benito Basin (Basin). The Sustainable Groundwater Management Act (SGMA) requires definition of various study periods for current, historical, and projected future conditions. Current conditions, by SGMA definition, include those occurring after January 1, 2015, and accordingly, historical conditions occurred before that date. A historical period must include at least 10 years. For the North San Benito Basin, which has been actively monitored and managed for decades, the development and application of the numerical groundwater flow model has been central to San Benito County Water District (SBCWD) management. The study period for the numerical model begins in water year 1975 and extends through water year 2017. This period is representative and includes droughts and wet periods, with an average annual rainfall of 12.97 inches, comparable to the long-term average of 12.9 inches (1875 to 2017). Accordingly, groundwater conditions over time are described through 2017.

Groundwater conditions are described in terms of the six sustainability indicators identified in SGMA; these include:

- Groundwater elevations
- Groundwater storage
- Land subsidence
- Groundwater quality
- Seawater intrusion (which is not likely to occur in this inland basin)
- Interconnected surface water and groundwater dependent ecosystems.

4.1. GROUNDWATER ELEVATIONS

4.1.1. Available Data

The evaluation of groundwater elevations in the Basin was conducted using groundwater elevation data obtained from several sources, including the California Department of Water Resources (DWR) Water Data Library which includes California Statewide Groundwater Elevation Monitoring (CASGEM) data, SBCWD, U.S. Geological Survey (USGS), and Valley Water. The Data Management System (DMS) contains groundwater elevation data for 254 wells from 1924 to 2018. These wells are shown on **Figure 4-1**.

4.1.2. Groundwater Occurrence

As summarized in Section 3, groundwater is present in principal and secondary aquifers that generally are not distinguished in the Basin, because of sparse lithologic log data and a lack of distinctive textures and composition to differentiate the hydrostratigraphy. Groundwater in Basin aquifers occurs under unconfined to confined conditions, and areas with artesian flowing wells have been mapped; however, insufficient data are available to define vertical zones and to provide zone-specific groundwater elevation hydrographs and maps.

4.1.3. Groundwater Elevations and Trends

Hydrographs show groundwater elevation trends over time and were prepared for all 254 wells with elevation data; these hydrographs then were reviewed to identify representative wells. The selection of representative wells was based a quantitative approach that considered hydrographs with long records characteristic of an area and distribution of wells across the Basin. In brief, all available groundwater elevation data were plotted as hydrographs and well locations were plotted on a basin-scale map. Each well was rated (low-5, medium-10, and high-15) for the following criteria:

- Location – Wells were prioritized considering broad distribution across the Basin (including potential Management Areas), availability of other wells nearby, relationship to structures (e.g. faults) affecting groundwater described in the hydrogeologic conceptual model, and location near active recharge or discharge areas.
- Ongoing/Recent monitoring – Wells were selected that are part of the active monitoring network or have recent data.
- Historical – Wells were evaluated with consideration of length of monitoring record. Wells with data before 1977 were given a high rating; wells with data only in the last five years were rated low.
- Trends – Each hydrograph was assessed for continuity of monitoring, representation of local or regional trends, and presence of outliers or unrealistic data.

The top scoring wells are shown in **Figure 4-2**. These wells are representative of local groundwater elevation conditions and are appropriate for inclusion in the Groundwater Sustainability Plan (GSP) groundwater elevation monitoring network with well-by-well definition of sustainability criteria (such as undesirable results, minimum thresholds, management objectives). With GSP development and implementation, the network of such key wells will likely need to be revised, for example to add new wells for specific purposes (shallow monitoring) or to remove wells that are not actively monitored.

Long term changes in groundwater elevations in the Basin are illustrated in these representative hydrographs (**Figures 4-3** through **4-7**). Over time, groundwater elevations have varied in response to varying precipitation, groundwater pumping, importation of water, and managed aquifer recharge programs. **Figure 4-3** shows a long-term hydrograph with a record extending back to 1935. The hydrographs in **Figures 4-4** through **4-7** show conditions since January 1975 and thus encompass the GSP study period beginning in 1976. The hydrographs are presented by recognized areas -Bolsa, Hollister, San Juan, and Southern Management Areas (MAs) to better illustrate regional responses to drought conditions and to management activities led by SBCWD.

As a matter of historical overview, groundwater elevations are estimated to have been at historical highs prior to 1913 before intensification of groundwater pumping. In many wells, historical lows occurred because of pumping coupled with the drought conditions of the late 1970s; groundwater elevations in Hollister Valley declined more than 160 feet from the estimated highs (Kilburn, 1972).

Figure 4-3 is the long-term hydrograph for a well in Hollister MA (Well 11-5-35G1, see **Figure 4-2** for location) with drought periods and other important dates highlighted. Droughts were identified using a three-year moving average of annual precipitation less than 80 percent.

As shown in **Figure 4-3**, groundwater elevations at this well generally decreased from the 1940s to the 1970s reflecting increased groundwater production and a state of overdraft. Responses to drought involved short-term declines of 30 feet or more with a decline of 50 feet in response to the extreme 1976 to 1977 drought. At that time, the Basin relied solely on groundwater (albeit recharged from local reservoirs) and groundwater elevations reached the historical low. In 1987, SBCWD began importation of Central Valley Project (CVP) water and groundwater elevations subsequently began to rise in the Hollister and San Juan valleys. Elevations also increased in Bolsa, although that area does not directly receive CVP water. A multiple year drought from 1988 through 1992 slowed the recovery of groundwater elevations because of reduced CVP imports and reduced recharge from rainfall and surface water. Following that drought, CVP imports increased, allowing reduction of groundwater pumping and recovery of groundwater elevations due to "in lieu" recharge. In addition, from 1994 to 2004, managed recharge of CVP water along stream channels (e.g., San Benito River) ranged from 1,000 AFY to over 11,000 AFY, with a total recharge volume exceeding 40,000 AF over the 11-year period. The result of in lieu and SBCWD managed aquifer recharge (MAR) programs was significant recovery. This is shown in **Figure 4-3** and occurred most notably in the Hollister and San Juan valleys where imported water is delivered, with some recovery also in Bolsa and areas south of Paicines.

With groundwater elevation recovery, SBCWD shifted its MAR program from recovery to maintenance and local management of groundwater elevations. For example, in response to the latest multiple year drought (2012 through 2015) groundwater elevations declined broadly across the Basin; this was not unexpected but reflected conjunctive management of surface water and groundwater supplies, with use of groundwater storage during drought with long term planning to replenish that storage in wet years. As illustrated in **Figure 4-3**, with the end of drought in 2016 and increased imported water allocations, groundwater elevations have recovered. Recovery occurred in most areas of the Basin over 2016 and 2017.

Given the history of the basin, recovery can be accelerated with targeted management actions in the areas with the most need, given availability of replenishment water (for in lieu or MAR) and, where MAR is practiced, accessibility to recharge sites. While the broad trends are similar across the basin, each region shows unique groundwater trends.

Figure 4-4 shows key hydrographs for the Bolsa region, which is predominantly agricultural and depends solely on groundwater pumping. Locally confined conditions in the northeast along Pacheco Creek result in artesian wells, wells with groundwater elevations above the ground surface. Groundwater elevations for wells 11-5-21E2 and 11-5-28B1 show fluctuating groundwater elevations before about 1995, reflecting responses to and recovery from droughts in the 1970s and 1980s. In recent years, elevations have risen to above ground surface with artesian conditions. Because there is no mechanism at these wells to measure elevations above ground surface, the hydrographs show elevations equal to the ground surface. Both wells (likely agricultural irrigation wells) show a strong seasonal pattern before about 1995. To the south, groundwater elevations in well 12-5-06L1 show a gradual increasing trend since 1975 and well 12-5-17D1 shows a gradual decreasing trend. The different trends in these wells, located within two miles from each other, likely reflect changing land use and pumping patterns. For example, well 12-5-17D1 with a decreasing trend may be in an area with increasing groundwater pumping. Both wells (likely irrigation wells) show a significant seasonal pattern.

Figure 4-5 shows representative hydrographs for the Hollister Valley, which encompasses diverse conditions in terms of water supply and recharge, land use and water demand, and groundwater management. The artesian well zone in the northeast Bolsa extends into the northwest Hollister Valley. The hydrograph for well 12-5-03B1 shows the similar signature with groundwater elevation fluctuations until the 1990s with groundwater elevations recovering to and remaining at ground surface elevations, as potential higher elevations are not recorded. The hydrograph for well 11-5-13D1, along the upper Pacheco Creek, is characterized by groundwater elevations that have remained steady with 2017 groundwater elevations near historical highs. This pattern likely reflects recharge from the creek and limited local pumping. Well 12-5-24N1 shows a substantial recovery of groundwater elevations from the historical lows of the late 1970s, which were near mean sea level at this well. Groundwater elevations slowly increased by 180 feet, reflecting the availability of CVP supply and reduced local pumping. The hydrograph for well 12-5-34P1, located near the San Benito River in the southern valley, shows fluctuations reflecting drought declines and recovery. In this well, groundwater elevations were at historical lows during the early 1990s and increased quickly by 90 feet within three years; the rapidity of recovery in this well likely reflects SBCWD managed aquifer recharge along the river.

Figure 4-6 shows hydrographs of selected wells in the San Juan MA. San Juan MA is characterized by agriculture supplied with groundwater and CVP water (since 1987) and by recharge activities along the San Benito River. The hydrograph for well 12-4-26G1 shows the typical fluctuations in the 1970s and 1980s, reflecting responses to and recovery from droughts. In the 1990s, the hydrograph shows a steep rise in groundwater elevations, more than 80 feet in five years. This reflects not only the effect of in lieu recharge due to CVP importation, but also rapid filling of available groundwater storage space with natural recharge and managed aquifer recharge along the San Benito River. Well 12-4-17L20 is located further downstream near the outlet of the Basin. The hydrograph shows a slight recovery over the same period in the 1990s; relative to well 12-4-26G1, the effect is muted because groundwater elevations already were near ground surface and there was no available groundwater storage capacity. The remaining hydrographs, for three wells arrayed along the southern valley, generally do not meet the selection criteria for representative wells in terms of having long, complete records that extend to the present. Despite the obvious deficiencies, these three hydrographs are the best available in this portion of the Basin and will need to suffice until a suitably long, complete, and current monitoring is developed.

Figure 4-7 shows representative hydrographs for wells in the Southern MA. Unlike the other hydrographs within elevations of 0 to 300 feet msl, these elevations range from 750 feet msl (in the Wildlife Center 5 well) in the south to around 400 feet (in well 13-6-19K1) near the confluence of the Tres Pinos Creek and San Benito River. The gradient reflects the topography of the Basin (see Cross section A to A' on **Figure 3-7**) as well as the strong northern gradient and flow direction.

Review of **Figure 4-7** indicates generally slight but widespread groundwater declines. The longest hydrograph is for well 13-6-19K1 near the confluence of Tres Pinos Creek and the San Benito River, which shows a decline of about 20 feet during the most recent drought. Hydrographs for the two wells along Tres Pinos Creek south of Paicines also show a decrease in groundwater elevations during the most recent drought and a modest recovery in recent years. The Wildlife Center 5 well experienced a decline of 40 feet and the Donati 2 well indicates a decline of 15 feet. The Schields 4 well located along the San Benito River Valley shows a decline of about 20 feet.

4.1.4. Groundwater Flow

Figures 4-8 and **4-9** are groundwater elevation contour maps constructed to examine current groundwater flow conditions using data from 2017. Contours were developed based on available groundwater elevation data for all wells.

For the purposes of this discussion, the contours were not prepared assuming local faults (most notably the Calaveras Fault) as groundwater barriers. The Calaveras Fault and others probably provide some impedance to groundwater flow; however, this effect is likely to vary over the length of the fault and with depth (and relative groundwater elevations). The numerical groundwater flow model has examined these non-linear impacts over a variety of flow conditions through calibration. More information is provided in the numerical model documentation report, Groundwater Model Update and Enhancement 2020 Report, included in **Appendix G**.

Figures 4-8 and **4-9** show groundwater contours for Spring 2017 and Fall 2017, respectively. The spring groundwater elevation map reflects seasonal highs, while the fall map reflects seasonal lows. By way of comparison, groundwater elevations in wells typically fluctuate 5 to 15 feet on a seasonal basis (**Figure 4-5**, for example) except in the Bolsa MA (**Figure 4-4**) where groundwater elevations may have seasonal fluctuations of 30 to 40 feet (Yates, 2003).

Groundwater flow generally parallels the major surface streams from the southeast and eastern portions of the Basin toward the northwestern portions and the Pajaro River. In the Bolsa MA, groundwater flow converges into areas of low groundwater elevations (indicated by closed contours such as the 100-foot contour) that are caused by groundwater pumping.

For a historical perspective, **Figure 4-10** shows the groundwater contour map from 1968 (Kilburn, 1972), prior to importation of CVP water. Relative to **Figures 4-8** and **4-9**, the 1968 map presents different basin boundaries and different interpretations of fault and geologic effects on groundwater elevations and flow. Nonetheless the 1968 map shows effects on areal groundwater elevations and flow during a period of intense groundwater pumping without imported water. As shown, in 1968 the Basin was characterized by groundwater elevation depressions not only in the Bolsa MA, but also in the Hollister and San Juan MAs; these are indicated by closed 60- and 80-foot contours with hachures. Comparison of **Figure 4-10** and **Figures 4-8** and **4-9** indicate that the groundwater depressions in Hollister and San Juan MAs have filled and general northward groundwater flow has resumed.

4.1.5. Vertical Groundwater Gradients

The current monitoring network for groundwater elevations provides little information about vertical head (groundwater elevation) gradients within the Basin. Available data are almost entirely from water supply wells, which are typically screened between 200 and 500 ft-bgs. The potentiometric head at the depth of the well screen can be different from the true water table, which is the first zone of saturation reached when drilling down from the ground surface. This was documented in a study of shallow groundwater conditions in the San Juan Valley (Yates et al., 1999). At that time, downward head gradients in several shallow-deep well pairs were in the range of 0.10 to 0.80. The maximum value for fully saturated conditions is 1.00. Larger gradients indicate that there is an unsaturated zone between the shallow well screen and the deep well screen. The study noted that when deep groundwater elevations were tens of feet lower in prior decades, shallow zones of saturation were probably hydraulically disconnected from deep aquifers and therefore unaffected by deep pumping.

Flowing wells discharge at the ground surface without the aid of a pump and are an indication of upward vertical head gradients between the depth of the well screen and the ground surface. When regional groundwater elevations recovered in the late 1990s, wells began flowing in two areas where flowing wells had been reported under near-predevelopment conditions (Clark, 1924): along Lovers Lane and Shore Road south of Pacheco Creek and in the vicinity of Prescott Lane northwest of San Juan Bautista. Although the vertical gradient at these wells is certainly upward, it has not been quantified.

Vertical head gradients are an important factor affecting the viability of riparian vegetation. As discussed in greater detail in Section 4.11.3, Riparian Vegetation, phreatophytic vegetation along streams generally survives droughts even when groundwater elevations in wells are tens of feet below the ground surface for two or more years. This suggests that some shallow zones of saturation persist even when head in deep aquifers declines. This implies the presence of large vertical head gradients within the aquifer system.

4.2. Changes In Groundwater Storage

SBCWD provides conjunctive use of groundwater and surface water sources, involving use of groundwater in storage when surface water supplies are diminished and replenishment of groundwater storage when surface water supplies are available. Accordingly, groundwater storage is characterized by changes in the short term but has been stabilized for much of the Basin for the long term, given availability of CVP supply since 1987.

SBCWD Annual Groundwater Reports (**Appendix F**) historically have assessed annual changes in groundwater storage; this has been intended to detect overdraft and, if overdraft were to occur, to track accumulated overdraft as a basis for sustainability planning. This assessment has been based on autumn to autumn comparisons of groundwater elevations (while GSP Regulations require spring to spring) and has been focused on Zone 6 and adjacent areas and thus has not addressed the entire North San Benito Basin. Nevertheless, the previous reports provided insight into groundwater storage change patterns and were an important groundwater management tool.

These storage changes were estimated based on available groundwater elevation data that are limited geographically and temporally and thus include uncertainty. In addition, the change calculations used estimated storativity (or storage coefficient, the volume of water released from storage per unit decline in hydraulic head), which is largely unknown across the Basin. In this method, the volume of groundwater storage change for a time period is calculated by multiplying the average groundwater elevation change in an area over that period by the estimated storage coefficient for the area.

Annual groundwater storage changes have also been estimated through analytical water budgets. These analytical water budgets have estimated all the inflows and outflows to the Basin, with the change in storage as the residual (inflow – outflow = change in storage). However, this method cannot account for dynamic subsurface flow conditions that result in groundwater flow into and out of the Basin, and they generally result in larger change in storage estimates than those in the water level method described above.

Both the water level and water budget methods for estimating periodic changes in storage have uncertainty associated with inherent limitations. Annual and cumulative change in groundwater storage estimates for the entire Basin have been prepared for this GSP using the numerical model. These estimates are presented in Section 5, Water Budget. The numerical model will also be used for estimating annual changes in storage in future annual reports and periodic GSP updates.

4.3. Land Subsidence and Potential for Subsidence

Land subsidence is the differential lowering of the ground surface, which can damage structures and facilities. This may be caused by regional tectonism or by declines in groundwater elevations due to pumping. The latter process is relevant to the GSP. In brief, as groundwater elevations decline in the subsurface, predominantly fine-grained deposits (such as clay and silt) can become compacted, causing the overlying ground surface to subside.

This process is illustrated by two conceptual diagrams shown on **Figure 4-11**. The upper diagram depicts an alluvial groundwater basin with a regional clay layer and numerous smaller discontinuous clay layers. Groundwater elevation declines associated with pumping cause a decrease in water pressure in the pore space (pore pressure) of the aquifer system. Because the water pressure in the pores helps support the weight of the overlying aquifer, the pore pressure decrease causes more weight of the overlying aquifer to be transferred to the grains within the structure of the sediment layer. If the weight borne by the sediment grains exceeds the structural strength of the sediment layer, then the aquifer system begins to deform. This deformation consists of re-arrangement and compaction of fine-grained units[2], as illustrated on the lower diagram of **Figure 4-11**. The tabular nature of the fine-grained sediments allows for preferred alignment and compaction. As the sediments compact, the ground surface can sink, as illustrated by the right-hand column on the lower diagram of **Figure 4-11**.

Land subsidence due to groundwater withdrawals can be temporary (elastic) or permanent (inelastic). Elastic deformation occurs when sediments compress as pore pressures decrease but expand by an equal amount as pore pressures increase. A decrease in groundwater elevations from groundwater pumping causes a small elastic compaction in both coarse- and fine-grained sediments; however, this compaction recovers as the effective stress returns to its initial value. Because elastic deformation is relatively minor and fully recoverable, it is not considered an impact.

4.3.1. Inelastic Deformation

Inelastic deformation occurs when the magnitude of the greatest pressure that has acted on the clay layer since its deposition (preconsolidation stress) is exceeded. This occurs when groundwater elevations in the aquifer reach a historically low groundwater elevation. During inelastic deformation, or compaction, the sediment grains rearrange into a tighter configuration as pore pressures are reduced. This causes the volume of the sediment layer to reduce, which causes the land surface to subside. Inelastic deformation is permanent because it does not recover as pore pressures increase. Clay particles are often planar in form and more subject to permanent realignment (and inelastic subsidence). In general, coarse-grained deposits (e.g., sand and gravels) have sufficient intergranular strength and do not undergo inelastic deformation within the range of pore pressure changes encountered from groundwater pumping.

The volume of compaction is equal to the volume of groundwater that is expelled from the pore space, resulting in a loss of storage capacity. This loss of storage capacity is permanent but may not be substantial because clay layers do not typically store significant amounts of usable groundwater (LSCE, et al. 2014). Inelastic compaction, however, may decrease the vertical permeability of the clay resulting in minor changes in vertical flow.

---

[2] Although extraction of groundwater by pumping wells causes a more complex deformation of the aquifer system than discussed herein, the simplistic concept of vertical compaction is often used to illustrate the land subsidence process (LSCE et al. 2014).

The following potential impacts can be associated with land subsidence due to groundwater withdrawals (modified from LSCE, et al. 2014):

- Damage to infrastructure including foundations, roads, bridges, or pipelines;
- Loss of conveyance in canals, streams, or channels;
- Diminished effectiveness of levees;
- Collapsed or damaged well casings; and
- Land fissures.

Inelastic subsidence has not been a known issue in the Basin. Nonetheless, its potential was recognized in the 2003 Groundwater Management Plan (Kennedy/Jenks, 2003), which established a specific water quantity criterion to manage groundwater elevations, to maintain groundwater storage, and to limit drawdown to historical low levels of about 1977 to preclude and/or minimize the potential for ground settlement (i.e., inelastic land subsidence). SBCWD management of groundwater elevations generally has been successful in meeting these objectives, except for local declines at the end of the 2012 to 2014 drought, and there have been no reports of subsidence problems.

Direct measurements of subsidence have not been made in the Basin using specialized equipment (e.g., extensometers) or using repeated measurement of benchmarks. However, two sources of subsidence data are available: interferometric synthetic aperture radar (InSAR) data that provide spatial coverage using radar images from satellites and data from University Navigation Satellite Timing and Ranging System Consortium (UNAVCO) (UNAVCO, 2021), which provides temporal land elevation measurements from thousands of globally distributed permanent stations.

4.3.2. Interferometric Synthetic Aperture Radar (InSAR)

InSAR data provided by California Department of Water Resources (DWR) on its SGMA Data Viewer (DWR 2019b) provide information on vertical displacement of the land surface across a broad area of California from May 31, 2015 to April 30, 2017; this represents current conditions as defined in this GSP. The InSAR mapping area extended across the central San Joaquin Valley and included portions of the Paso Robles Basin, Salinas Valley, and entire North San Benito Basin. **Figure 4-12** shows the mapping within the North San Benito Basin. Subsidence, measured in inches, is depicted with darker gray tones indicating land subsidence as much as six inches over the two years while lighter tones indicate land rise of up to four inches. Most of the Basin is characterized by no change to small decline (0 to -2 inches) with some areas of land rise (as much as 4 inches) mostly along basin margins and some scattered areas of decline as much as 6 inches. While no subsidence problems have been reported, the general distribution of the scattered areas of decline indicate a relationship to local groundwater pumping.

4.3.3. University Navigation Satellite Timing and Ranging System Consortium (UNAVCO)

Data are available from UNAVCO from numerous stations in San Benito County (reflecting its position along the San Andreas Fault, a major tectonic plate boundary), including eight within or near the Basin, **Figure 4-13**. The locations are shown in the inset map on **Figure 4-14** and the data are shown in the graphs as cumulative displacement (change) in inches. Seven of the eight graphs are similar and show short-term elastic variability (on the order of days) and long-term stability or upward movement that is likely tectonic. The graph for Station P242 in the Bolsa area is distinct, showing short-term variability, seasonal changes of generally two inches, and a long-term declining trend. This trend and the proximity of this station to InSAR mapped areas of land surface decline suggest inelastic subsidence related to local groundwater pumping. However, the UNAVCO data, which represent measured vertical displacement, indicate cumulative changes generally less than two inches, while the InSAR mapping suggests greater displacement over shorter periods. When additional InSAR mapping is available, spanning a longer period, detailed comparison of UNAVCO and InSAR data will be warranted.

4.4. GROUNDWATER QUALITY ISSUES

The natural quality (chemistry) of groundwater is generally controlled by the interaction between rain water and rocks/soil of the vadose zone and aquifers (Drever, 1988). As rainfall infiltrates through the soil column, changes in water chemistry occur as anions and cations are dissolved into the water. These changes are influenced by soil and rock types, weathering, organic matter, and geochemical processes occurring in the subsurface. Once in the groundwater system, changing geochemical environments continue to alter groundwater quality. A long contact time between the water and sediments may allow for more dissolution and more concentrated groundwater (Drever, 1988). The natural groundwater quality in a basin is the net result of these complex subsurface processes that have occurred over time.

The quality of groundwater in the Basin has been described as highly mineralized and of marginal water quality for drinking and agricultural purposes. The mineralized water quality is typical of other relatively small Coast Range groundwater basins and reflects the geologic formations in the Central Coast watersheds (e.g., marine sediments) and the relatively low permeability of groundwater basin sediments, which leads to long contact time with groundwater.

Groundwater in the Basin has also been impacted by human activities including agricultural, urban, and industrial land uses. State agencies with regulatory oversight for water quality in the Basin include the Central Coast Regional Water Quality Control Board (RWQCB) and the State Water Resources Control Board – Division of Drinking Water (DDW).

4.4.1. Monitoring Networks

SBCWD currently monitors a distributed network of 18 wells for water quality, shown in **Figure 4-15**. The SBCWD maintains a comprehensive water quality database, created in 2004 (Todd, 2004) with a State Local Groundwater Assistance Grant and updated every three years. The database has been regularly updated with readily available data from the SBCWD, Regional Water Quality Control Board, California State Water Resources Control Board, Tres Pinos Water District, City of Hollister, and SSCWD. Updates have been presented on a triennial basis in SBCWD Annual Groundwater Reports (e.g., Todd 2007, 2010, 2013b, 2016 and 2019). The database contains more than one million records from more than 170 water systems or regulated facilities and over 2,000 monitoring locations in the North San Benito Basin including data from Santa Clara County portions of the Basin.

The RWQCB regulates discharges from irrigated agricultural lands to protect surface water and groundwater, using a permit called a Conditional Waiver of Waste Discharge Requirements that applies to owners and operators of irrigated land used for commercial crop production. The RWQCB is focusing on priority water quality issues, such as pesticides and toxicity, nutrients, and sediments, especially nitrate impacts to drinking water sources.

San Benito landowners belong to the Central Coast Groundwater Coalition. Together with landowners in Salinas Valley, Pajaro Valley, and Llagas Subbasin, they collect water quality data and have prepared a report, *Northern Counties Groundwater Characterization* (LSCE 2015). The report summarizes nitrate concentrations from 1,105 wells in the Gilroy-Hollister Valley (including the Hollister and San Juan Valleys and the Bolsa area in the Basin). Data for the Irrigated Lands Program will be included in the SBCWD Water Quality Database for annual GSP reports.

There are 110 drinking water systems, with a total of 320 well locations in the San Benito County portion of the Basin and 2 systems with a total of 4 well locations in the Santa Clara County portion of the Basin. These stations report water quality data to the DDW. Each system monitors and reports water quality parameters to DDW and is required to participate in the Drinking Water Source Water Assessment Program (DWSAP) to assure wells are not subject to local contamination. **Figure 4-16** shows the approximate location of drinking water systems in the Basin.

4.5. OTHER STUDIES

4.5.1. Salt and Nutrient Management Plan

Consistent with the 2013 SWRCB Recycled Water Policy, a Salt and Nutrient Management Plan (SNMP) was developed for the San Benito County portion of the Basin in 2014[3] (Todd, 2014). The purpose of the SNMP is to identify sources of salts and nutrients (current and future) as context for assessing potential impacts of recycled water projects and to plan for management of salt and nutrient sources to ensure that groundwater is safe for drinking and all other beneficial uses. Beneficial uses of water and respective water quality objectives are defined by the RWQCB in the Central Coast Water Quality Control Plan (Basin Plan).

The SBCWD SNMP analysis demonstrated that the recycled water irrigation projects planned through 2021 will use less than one percent of the available TDS and nitrate assimilative capacity, namely the difference between average salt and nutrient concentrations in the Basin and the respective Basin Plan objectives. Therefore, the recycled water irrigation projects satisfy Recycled Water Policy criteria. The SNMP analysis found that recycled water use can be increased while still protecting groundwater quality for beneficial uses.

Based on the analysis, the SNMP concluded no additional implementation measures are warranted beyond those that have been implemented and those that are already planned. Nonetheless, the SNMP management process is active and ongoing, and continued water quality monitoring will ascertain the effectiveness of implementation measures.

With respect to monitoring, the Recycled Water Policy states that the SNMP should include a monitoring program that consists of a network of monitoring locations "... adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salts, nutrients, and other constituents of concern as identified in the salt and nutrient plans are consistent with applicable water quality objectives." Additionally, the SNMP is required to focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects (Todd, 2014).

---

[3] Santa Clara County areas of the Basin were not included in the nominal SNMP study area. Nonetheless, data are provided on maps, including available land use and water quality data. No recycled water projects have been planned for these areas.

The SNMP Monitoring Plan laid out a program wherein the data collected and compiled by the SBCWD are analyzed and reported to the RWQCB every three years as part of the SBCWD Groundwater Report. The analyses include time concentration plots, water quality concentration maps, and more.

4.6. Threats to Water Quality

4.6.1. Regulated Facilities

The RWQCB has regulated more than 123 facilities with soil and groundwater contamination in the Basin (119 in San Benito and 4 in Santa Clara County). Of those, 45 sites are active in (or adjacent to) the Basin (44 in San Benito and 1 in Santa Clara County). The active and inactive sites are shown on **Figure 4-17**. Data for 892 wells monitored by these facilities are currently included in the SBCWD Water Quality database and will continue to be included in the updates. These facilities range from large-scale soil and groundwater clean-up operations to leaking underground storage tanks. RWQCB files for such regulated facilities have been and will continue to be checked regularly as part of the SBCWD water quality monitoring program.

4.6.2. Septic Systems

Most residences and businesses in unincorporated areas of the Basin rely on on-site wastewater treatment (OWTS or septic systems). These represent sources of salt and nutrient loading to groundwater, as well as potential sources of other contaminants. San Benito County Department of Environmental Health is the permitting agency for septic systems and wells in San Benito County. Similarly, the Santa Clara Department of Environmental Health is responsible for OWTS in the small Santa Clara portions of the Basin. The San Benito County Department of Environmental Health maintains an inventory of septic system installations from 1953 to the present, including address and/or assessor parcel number. While it is unclear how many of these septic systems are still operating, San Benito County has thousands of permits on file.

4.6.3. Oil and Gas

The Hollister Oil and Gas Field overlies parts of the Basin near the Bolsa and San Juan regions. The location, along with a 0.5-mile buffer is shown on **Figure 4-17**. Hydrocarbons exist approximately 600 feet below the base of fresh water and is not likely to impact drinking water. A San Benito County Fracking Ban Initiative ballot question was approved by voters in November 2014. This measure was designed to prohibit hydraulic fracturing, known as fracking, and related gas and oil extraction activities, as well as other “high-intensity petroleum operations,” including acid well stimulation and cyclic steam injection. It also banned any new gas or oil drilling activity including conventional, low-intensity activity in areas of the county zoned for residential or rural land use (Aspen, 2015).

4.6.4. Non-point Sources

Nonpoint Source (NPS) pollution is defined by the SWRCB as contamination that “does not originate from regulated point sources and comes from many diffuse sources.” NPS could occur when rainfall carries contaminants to surface water ways or percolates contaminants to groundwater. One example is loading to groundwater of nitrate from agricultural or landscaping land applications.

4.7. KEY CONSTITUENTS OF CONCERN

Total dissolved solids (TDS) and nitrate are the indicator salts and nutrients and key constituents of concern (COCs) for the Basin. These constituents were selected based on feedback from groundwater users, available baseline data, impact to beneficial users, and basin objectives from other local agencies. TDS data are available for both inflows and outflows from the Basin. There is elevated natural background TDS concentrations in groundwater. This has been documented since the 1930s and has been ascribed to the subsurface sediments. In addition, TDS can be an indicator of anthropogenic impacts (e.g., infiltration of urban runoff, agricultural return flows, and wastewater disposal). The SNMP analysis of salt loading predicted stable or decreasing trends in TDS concentrations, with the exception of two areas (Bolsa and Tres Pinos Valley areas as defined in the SNMP at the time). Nitrate is the primary form of nitrogen detected in groundwater and natural nitrate levels in groundwater are generally very low. Elevated concentrations of nitrate in groundwater are associated with agricultural activities, septic systems, confined animal facilities, landscape fertilization, and wastewater treatment facility discharges. The maximum contaminant level (MCL) for nitrate (as nitrate, NO_3) is 45 milligrams per liter (mg/L). Nitrate data are available for basin inflows and outflows, and as documented in the SNMP (Todd, 2014), elevated nitrate concentrations have been a recognized, long-term concern in the Basin. The SNMP analysis of nitrate loading found that most areas had predicted small increasing trends in nitrate in groundwater.

Previous water quality studies have identified other constituents of concern including boron, chloride, hardness, metals, sulfate, and potassium (Todd, 2004). In some parts of the Basin, groundwater does not meet water quality standards for these constituents relative to the intended beneficial uses of the groundwater.

4.7.1. Water Quality Goals

The RWQCB has established General Basin Plan Objectives (GBPOs) for groundwater with municipal and domestic water supply and agricultural water supply beneficial uses in the Central Coast as shown in **Table 4-1** below. For TDS, the DDW has adopted Secondary Maximum Contaminant Levels (SMCLs); SMCLs address aesthetic issues related to taste, odor, or appearance of the water and are not related to health effects. The recommended SMCL for TDS is 500 mg/L with an upper recommended level of 1,000 mg/L, and a short-term limit of 1,500 mg/L. Elevated TDS concentrations can affect water supply suitability for irrigation uses; in general crop yields decrease above a threshold TDS value, which is crop-dependent.

The primary MCL for nitrate (as N) is 10 milligrams per liter (mg/L), or as expressed in this report, in terms of nitrate (as NO_3), the MCL is 45 mg/L. These MCLs are based on health concerns due to methemoglobinemia, or “blue baby syndrome”.

The SNMP also presented basin-specific plan objectives, as listed in **Table 4-2** below for the Hollister and Tres Pinos Subbasins (as previously defined by DWR). In addition, for the San Juan and Bolsa Subbasins, a TDS assimilative capacity benchmark of 1,200 mg/L was assigned. Ambient groundwater quality in the San Juan Bautista and Bolsa area is similar to or slightly poorer than in the Hollister area; thus, use of the same TDS objective for these subbasins is deemed reasonable. For nitrate- NO_3, a basin-specific plan objective of 22.5 mg/l was applied to Hollister Subbasin and an assimilative capacity benchmark of 45 mg/L) was applied to assimilative capacity calculations in the DWR San Juan Bautista and Bolsa Subbasins (Todd, 2014).

Table 4-1. General Basin Plan Objectives

Parameter	Units	Municipal	Agricultural
TDS	mg/L	500/1,000/1,500[1]	450
Nitrate (as NO_3)	mg/L	45	100[2]
Nitrate + Nitrite-N	mg/L	10	100 [2]

mg/L – milligrams per liter

1. Objectives for TDS are recommended SMCLs.
2. For livestock watering.

Table 4-2. Basin-Specific Basin Plan Objective

Parameter	Units	DWR Subbasin	
		Hollister	Tres Pinos
TDS	mg/L	1,200	1,000
Nitrate (as NO_3)	mg/L	22.5	22.5
Nitrogen (as N)	mg/L	5	5

4.7.2. Key Constituents in Groundwater

Table 4-3 shows current average concentrations for TDS and nitrate for the four Management Areas. The values were developed by averaging all drinking water and ambient monitoring events that occurred from water year 2015 to 2017; water quality samples from regulated facilities were not included in the analysis. These average conditions serve as a snapshot and allow a comparison of water quality conditions across the Basin.

Table 4-3. Average Constituent Concentrations by Area 2015-2017

Management Area	Nitrate (NO_3, mg/L)	Total Dissolved Solids (TDS, mg/L))
San Juan	37.1	1,806
Southern	39.4	895
Hollister	47.9	810
Bolsa	50.3	839

4.7.3. Total Dissolved Solids (TDS)

As documented in **Table 4-3**, TDS concentrations are generally high throughout the Basin and the average TDS concentrations exceed the secondary MCL for drinking water (500 mg/L).

The relatively high TDS concentrations are also indicated in **Figure 4-18**, which show TDS concentrations over time in selected wells across the Basin. While concentrations are high (e.g., exceeding 500 mg/L), recent years (2014 through 2017) are characterized by TDS concentrations that are stable or decreasing. For example, in the San Juan Valley, some wells downstream of the historical wastewater treatment ponds (e.g., MW47, see **Figure 4-15** for well location) show a general decrease in concentrations, possibly due to the reduced percolation of wastewater in recent years. However, water quality samples in this area continue to have high TDS concentrations relative to the rest of the Basin; lowest TDS concentrations are indicated in well MW42, see **Figure 4-15** for well location (in the Bolsa area).

Figure 4-19 shows the average concentrations at selected water quality monitoring wells in the Basin that have been sampled in water years 2014 to 2017 for TDS; the well locations are shown in **Figure 4-15**. Generally, the eastern and northern edges of the Basin show lower concentrations of TDS. Higher TDS areas reflect geology (e.g., fault zones and older sediments) and historical wastewater disposal among other factors. In some areas, including the Bolsa, TDS concentrations vary over time, most likely due to a local sources and variability of groundwater conditions (i.e., changes in pumping resulting in changes to groundwater flow direction).

4.7.4. Nitrate as NO_3

As documented in **Table 4-3**, average nitrate conditions are high throughout the Basin; several wells within the SBCWD monitoring network have nitrate concentrations in are above the 45 mg/L MCL for nitrate as nitrate. These areas have long histories of intensive irrigated agricultural and local wastewater disposal.

Nitrate, long identified as a COC in the Basin, has multiple and widespread sources including fertilizer application and wastewater disposal (both municipal and domestic). Given that these sources are on or near the ground surface, shallow groundwater typically is characterized by higher concentrations than deep groundwater. In fact, the highest recent concentrations occurred in shallow wells in the eastern San Juan area.

Figure 4-20 shows the average concentrations at each water quality monitoring well in the Basin that has been sampled in water years 2014 to 2017 for nitrate. **Figure 4-21** shows nitrate time concentration plots from selected monitoring wells (see **Figure 4-15** for locations). Nitrate concentrations are elevated above natural concentrations (typically less than 10 mg/L), but most samples have indicated nitrate concentrations below the MCL of 45 mg/L. With some exceptions, concentrations are relatively stable over time.

Additional review of basin nitrate concentrations was performed by Luhdorff and Scalmanini for the Irrigated Lands program. The report indicated that, for the 1,105 wells used in analysis of nitrate concentrations in the Gilroy-Hollister Valley, 26 percent had average concentrations over the MCL of 45 mg/L (this includes Llagas Subbasin in Santa Clara County, LSCE, 2015).

Water quality in the Basin has not changed significantly since the SNMP concluded that recycled water would not adversely impact water quality. With local exceptions, concentrations of nitrate and TDS remain fairly stable across the subbasin.

4.8. Other Constituents

While TDS and nitrate were selected as constituents of concern, there are other constituents that should continue to be monitored in the event future changes to the basin management affects concentrations.

4.8.1. Perchlorate and Selenium

Perchlorate and selenium in the Basin are associated with regulated facilities.

Perchlorate. Perchlorate (ClO^{4-}) is a byproduct of solid rocket fuel manufacturing and testing, munitions manufacturing, and flare and pyrotechnics manufacturing (Motzer, 2001). It can occur naturally in some fertilizers, kelp, and in caliches and playa crusts. Perchlorate compounds have relatively high water (aqueous) solubilities and densities. Once dissolved in water, the perchlorate anion becomes relatively nonreactive, very stable, and extremely mobile. The California DHS action level and the agricultural water quality limit are both 6 ug/L.

Perchlorate has been associated with three facilities in the Basin: McCormick Teledyne, Whittaker, and the Hollister WWTP. Both the former Whittaker Ordnance facility and the former Teledyne facility have been documented as using perchlorate and releasing it to the environment. Ordnance manufacturing occurred on the Whittaker site since 1957 (Acton Mickelson, 2000) while historical activities on the McCormick Teledyne site included use of perchlorate and trichloroethylene (TCE). Although more than 140 wells in the Basin have been sampled for perchlorate, 94 of those wells are located on the two sites. Offsite monitoring data downgradient of Whittaker and McCormick Teledyne are limited. Both facilities are regulated by RWQCB and perchlorate concentrations are closely monitored on and off site.

Selenium. Selenium concentrations in surface water and groundwater are generally low with concentrations below 12 ug/L, with most stream water averaging 0.2 ug/L. The MCL for Selenium is 50 ug/L, no recent samples (outside of the regulated facilities Whittaker and John Smith Landfill) have concentrations 25 to 50 ug/L.

4.8.2. Hardness

Hardness (total hardness, as $CaCO_3$) is a widespread condition in the Basin indicating that high concentrations of calcium and magnesium ions in water will form insoluble residues with soap. It is a naturally-occurring condition but can be impacted by anthropogenic sources that add calcium or magnesium to the groundwater. Hardness above about 120 to about 150 mg/L is considered hard water with objectionable properties for consumers. A value of more than 200 mg/L can result in scale deposition to pipes. Because there are no drinking water standards for hardness, the practical limitations of hard water (greater than 200 mg/L hardness) and very hard water (greater than 300 mg/L hardness) are used as guidelines for the analysis.

Groundwater is considered hard to very hard throughout most of the Basin. The only water with hardness of less than 200 mg/L is found in the east-central Basin and in the northwest along the Pajaro River.

The natural hardness of the groundwater indirectly relates to increases in groundwater salinity in localized areas due to the use of water softeners. Water softeners work by exchanging the calcium and magnesium ions with sodium ions from sodium chloride. As such, sodium and chloride are concentrated in wastewater. Because much of the wastewater is returned to the Basin through septic tank discharges or wastewater percolation ponds, water softeners have impacted groundwater (JSA, 1998).

4.8.3. Boron

Boron is naturally occurring in the Basin and associated with marine clays, thermal springs, and closed-basin evaporates; clay deposited from marine waters contains 400 to 600 mg/L of boron (Reynolds, 1972). Boron may also occur from anthropogenic sources because it is used in glass manufacturing, soaps and detergents, and flame retardants. Although there are no drinking water standards for boron, DDW has designated an action level of 1.0 mg/L. Plants are especially sensitive to boron, and agricultural standards are set at 0.7 mg/L to 0.75 mg/L. Some damage can occur to crops at even lower concentrations.

Boron has been identified as a COC in the Basin because elevated concentrations historically contributed to abandonment of orchards in Hollister Valley (Eaton et al., 1941). The highest concentrations are associated with a north-south trending band in the Hollister Valley, which is thought to be controlled by geologic conditions and may be related to changing water chemistry along a fault plane at depth.

4.8.4. Metals

Metals including iron, manganese, arsenic, and chromium are naturally occurring in North San Benito.

Arsenic. Arsenic is naturally-occurring and leaches from aquifer materials into groundwater. For California public drinking water systems, the primary MCL for arsenic is 10 µg/L. Long-term exposure to arsenic has been linked to multiple forms of cancer, while short-term exposure to high doses of arsenic can cause other adverse health effects. While there have been no exceedances of the MCL, approximately 74 samples in groundwater wells showed concentrations 5 to 10 ug/L (including SBCWD monitoring wells MW-17, MW-21, MW-42, and MW-43; locations shown in **Figure 4-15**).

Chromium. Chromium occurs in three oxidation states readily found in nature: Cr(0), which occurs in metallic or native chromium (but is rarely found); Cr(III), which occurs in chromic compounds; and Cr(VI), which occurs in chromate and dichromate compounds. Cr(VI) is also known as hexavalent chromium. Most compounds containing Cr(VI) are toxic. Most chromium concentrations in groundwater are low, averaging less than 1.0 µg/L (WHO, 2017). The MCL for chromium is 50 ug/L and the Health-Based Screening Levels (HBSLs) for Hexavalent Chromium 20 ug/L. There have been no recent exceedances of the MCL or HBSL, but approximately 144 samples in groundwater wells showed concentrations of 10 to 20 ug/L for hexavalent chromium.

Iron. In natural water, iron (Fe) is generally analyzed as total iron, which includes Fe^{3+} and Fe^{2+}. Soluble Fe^{2+} is more common in groundwater under reducing conditions, occurring at concentrations ranging from 1.0 to 10 mg/L (Manaham, 1991). The MCL is 300 ug/L and no recent sampled exceeded this limit; however, approximately 44 samples have iron concentrations within 150 to 300 ug/L.

Manganese. Manganese is generally naturally occurring and associated with iron under anaerobic conditions where the more soluble forms may occur. In general, if water has more than 0.20 mg/L, manganese will precipitate upon encountering an oxidizing environment. This will cause an undesirable taste, deposition of black deposits in water mains, water discoloration, and laundry stains (WHO, 2017). The SMCL is 50 ug/L and while eight recent wells exceeded this limit, they are located in areas of the basin with high levels of naturally occurring iron and manganese. Monitoring of manganese should continue to ensure monitored concentrations do not increase or spread in the basin.

4.9. VERTICAL VARIATIONS IN WATER QUALITY

Generally, water quality monitoring programs in the Basin do not show a distinct difference of water quality in depth, in part because most of the ambient monitoring wells have long screens. Shallow wells are generally found near regulated facilities and therefore show high concentrations of constituents representing local contamination rather than regional trends. In 2006, a nested well (funded in part by a State Local Groundwater Assistance Act grant) was completed in the Hollister Subbasin to study vertical distribution of groundwater quality in an area of elevated TDS and boron (see well AB303 in **Figure 4-15**). The nested well has five depth-specific ports: A through E from shallow to deep. Initial water quality sampling indicates elevated concentrations of sodium, chloride, TDS, and boron, with indications that deepest groundwater shows poorest quality, for example TDS approximately twice as high as the other shallower zones. Initial water quality data indicate elevated boron in all five screened zones and show a possible trend of increasing boron with depth.

These data may reveal local changes in water quality with depth but may not capture the regional vertical trends.

Impacts to shallow groundwater likely originate from some type of anthropogenic source at the ground surface such as agricultural activities (concentration of salts, fertilizers, and soil amendments), wastewater disposal, or industrial releases. Because almost all shallow water quality data in the Basin were compiled from regulated facility monitoring wells, regulated facilities are the only place that shallow groundwater could be evaluated. In some cases, impacts to shallow groundwater can be attributed to activities at the facilities; however, for some constituents, the correlation is unclear. Regulated facilities at the edges of the alluvial basin often have shallow wells in geologic formations other than basin alluvium and, as such, may exhibit different water chemistry that is independent of anthropogenic impacts. In addition, since shallow groundwater data are missing in the remainder of the Basin, it is difficult to determine whether shallow impacts are widespread. These complications limit the evaluation of shallow groundwater in the Basin and impacts at regulated facilities. Therefore, place names, and regulated facility names in this document are used as location or data source references and should not be concluded to be the source of any water quality impact unless so stated.

Based on regional geology, naturally high TDS and boron is expected at depth (Kilburn, 1972). In addition, regional shallow groundwater generally has relatively high concentrations of TDS and nitrate reflecting agricultural drainage and other anthropogenic sources.

4.10. SEAWATER INTRUSION CONDITIONS

Basin is located inland from Monterey Bay approximately 20 miles upstream from the mouth of the Pajaro River; lowest elevations (at the confluence of the San Benito River and Pajaro River) are above about 110 feet. No risk of seawater intrusion exists in the Basin given its location.

4.11. INTERCONNECTION OF SURFACE WATER AND GROUNDWATER

Interconnection of groundwater and surface water occurs wherever the water table intersects the land surface and groundwater discharges into a stream channel or spring. These stream reaches gain flow from groundwater and are classified as gaining reaches. Conversely, connection can occur along stream reaches where water percolates from the stream into the groundwater system (losing reaches), provided that the regional water table is close enough to the stream bed elevation that the subsurface materials are fully saturated along the flow path.

Groundwater pumping near interconnected surface waterways or springs can decrease surface flow by increasing the rate of percolation from the stream or intercepting groundwater that would have discharged to the stream or spring. If a gaining stream is the natural discharge point for a groundwater basin, pumping anywhere in the basin can potentially decrease the outflow, particularly over long time periods such as multi-year droughts.

Because of the long dry season that characterizes the Mediterranean climate in San Benito County, vegetation exploits any near-surface water sources, including the water table along perennial stream channels, the wet soil areas around springs, and areas where the water table is within the rooting depth of the plants. Plants that draw water directly from the water table are called phreatophytes. They are able to continue growing vigorously during the dry season and typically stand out in summer and fall aerial photographs as patches of vegetation that are denser, taller, and brighter green than the adjacent vegetation.

Three types of data available for northern San Benito County were evaluated to identify locations of interconnected surface water and groundwater: stream flow, depth to groundwater, and vegetation. Each of these data sets has limitations or inconsistencies—as described below—so they were evaluated collectively to obtain a more reliable indication of groundwater-surface water interconnection. The result is the map of stream reaches known or likely to be interconnected with groundwater shown in **Figure 4-22**. This is primarily a map of stream reaches that might be gaining flow from groundwater. Reaches that are losing but hydraulically connected to groundwater are more difficult to identify. The key resources associated with interconnection are phreatophytic riparian vegetation and reaches with perennial pools or flow, and both of those are most commonly associated with gaining reaches.

4.11.1. Stream Flow Measurements

Manual measurements of flow at multiple locations along a stream during steady flow conditions can reveal reaches that gain or lose water. This was done on multiple dates in the late 1990s and early 2000s for many of the creeks that flow across the Basin (JSA, 1999a, 1999b, 2000, and 2001; Yates et al., 1999; Yates, 2002, 2003, 2005a, and 2005b). In general, the creeks and rivers lose water except where they approach a fault or a narrow spot in the valley floor alluvium. For example, Pacheco Creek has a short gaining reach where it crosses the Ausaymas Fault at Highway 156 and a longer gaining reach as it approaches San Felipe Lake and the Calaveras Fault. Similarly, the San Benito River gains flow as it nears Highway 101 at the downstream end of the San Juan Valley. The Pajaro Rive likewise gains flow as it approaches the narrow gap at the west end of the Lomerias Muertas hills. Farther up the San Benito River, gaining flow reaches were inferred from the presence of dense riparian vegetation and topography rather than from flow measurements.

4.11.2. Depth to Groundwater

Depth to groundwater provides a general indication of locations where gaining streams and riparian vegetation are likely to be present. However, available data are of limited use for this purpose due to insufficient geographic and vertical coverage. Available data are almost entirely from water supply wells, which are typically screened 200 to 500 feet below the ground surface. The groundwater elevation (potentiometric head) at the depth of the well screen can be different from the true water table, which is the first zone of saturation reached when drilling down from the ground surface. Large downward head gradients within the aquifer system have been documented from pairs of shallow and deep wells, and upward gradients are present where there are flowing wells (see Section 4.1.5, Vertical Groundwater Gradients). The persistence of riparian vegetation through droughts also implies the occurrence of large downward gradients, as discussed below.

The second limitation is the sparse geographic distribution of groundwater elevation monitoring wells. Creeks and rivers that lose water commonly form a mound in the water table near the creek. The height and width of the mound depends on the transmissivity of the shallowest aquifer. For example, groundwater elevations in a shallow well adjacent to the Arroyo Seco in the Salinas Valley rose 5 to 10 feet more than groundwater elevations in wells 1,000 feet away when the river started flowing (Feeney, 1994). A groundwater ridge up to 12 feet high develops beneath Putah Creek in Yolo County during the flow season, but the width of this ridge was estimated to be only a few hundred feet (Thomasson et al., 1960). These examples suggest that shallow wells within 100 to 200 feet of a stream channel would be needed to confirm the presence of hydraulic connection between surface water and groundwater when groundwater elevations in deep water supply wells are within perhaps 30 feet of the river bed elevation.

Contours of depth to groundwater in fall 2017 correlate in a general way with locations of observed gaining stream reaches (**Figure 4-22**). These depth to groundwater contours were interpolated from monitored well measurement for the purpose of evaluating correlations to surface water bodies. The gaining reaches along the lower ends of Pacheco Creek, Tequisquita Slough, and the San Benito River are all where contoured groundwater elevations in wells are about 20 feet below the ground surface. Similarly, the gaining reach and riparian vegetation along the San Benito River where it approaches the Calaveras Fault coincide with relatively shallow depth to water.

4.11.3. Riparian Vegetation

Vegetation patterns along streams can also be used to map potential interconnection of surface water and groundwater because growth is more vigorous where plant roots can reach the water table. There are limitations to this approach, however. First, some plant species are facultative phreatophytes, which means they will establish and grow with or without access to the water table. An example is mulefat (Baccharis salicifolia), which in the Natural Communities Commonly Associated with Groundwater (NCCAG) map was dominant along broad, gravelly reaches of the San Benito River where shallow groundwater was not likely present (DWR et al., 2018d). More obligate phreatophytes such as cottonwood (Populus fremontii) correlated more closely with gaining stream reaches.

A second limitation is that streams that convey releases from upstream reservoirs can “irrigate” riverbank vegetation in summer, mimicking the effect of a shallow water table. In northern San Benito County, the District currently manages releases from Hernandez Reservoir to provide summer flow down the San Benito River as far as Lucy Brown Road near San Juan Bautista, when water is available to do so. Similarly, releases from Pacheco Reservoir sustain flow down Pacheco Creek as far as Highway 156 from June to October in most years (substantially less during droughts).

A third limitation is that land clearing for agriculture has reduced the width of the riparian vegetation corridor along many stream reaches to less than 100 feet. Where shallow groundwater is present, the width of the riparian vegetation corridor would typically be wider in the absence of clearing.

For the purposes of this GSP, riparian vegetation GDEs are defined as areas of dense riparian tree canopy more than one tree wide along streams where depth to groundwater is plausibly less than 30 feet. There areas were mapped from fall 2016 aerial photographs where the riparian corridor width exceeded 100 feet and tree canopy density exceeded 80 percent (see **Figures 4-22** and **4-24** for locations). The width criterion selects for areas more likely to have shallow groundwater (rather than streambank "irrigation" by a losing stream). Although riparian corridors can be as little as two tree crown diameters wide (McBride and Strahan, 1984), the ecological integrity and value of riparian vegetation as measured by macroinvertebrate diversity has been shown to increase with corridor width up to about 250 feet in northern California streams (Mahoney and Erman, 1984). Also, a minimum buffer zone for land development of 100 feet along creeks is designated in Humboldt and Ventura Counties (Woodroof and Roberts, 1984). The density criterion also tends to differentiate between phreatophytic and non-phreatophytic vegetation, based on other indicators of the presence of shallow groundwater.

4.11.4. Springs and Seeps

Wetland GDEs are defined as springs, seeps, and wetlands supported by groundwater within the Basin. The locations of these GDEs were identified by selecting from candidate sites included as springs, seeps, or wetlands in the NCCAG geodatabase. NCCAG compiled the sites from other databases based on the frequency of flooding. About half of the features are classified as seasonally flooded, which is more likely to be associated with localized ponding of rainfall runoff than discharge of regional groundwater. Accordingly, the seasonally flooded sites were omitted. Sites along stream channels were also omitted, as those areas were already addressed in the evaluation of gaining/losing stream reaches and riparian vegetation. The remaining sites were each compared with a fall 2016 high-resolution aerial photograph to verify that greener vegetation was present at the site, which is the typical effect of perennial shallow groundwater. This screening process resulted in the identification of 26 sites that could plausibly be locations of groundwater discharge. Of those, eight were in upland areas far from large wells and thus unlikely to be impacted by pumping. An additional five were stock ponds whose source of water was uncertain. Some might be excavated springs; others might be simply runoff impoundments. Vegetation around the ponds did not show evidence of a shallow water table. Finally, the stock ponds were also in upland areas where effects of pumping in the valley floor areas would likely be negligible. One of the remaining 13 sites was the Pajaro River Wetland Mitigation Bank. The others were on the upgradient side of a fault, where shallow groundwater is or could be present. Ten of those were sag ponds along the Calaveras Fault or depressions feeding into San Felipe Lake, and two were on the southwest side of the San Andreas Fault near San Juan Bautista. The locations of these 13 wetland GDEs are shown on Figure 4-22, and they could potentially be impacted by groundwater pumping.

As an empirical check of whether low groundwater elevations might have impacted the springs and seeps during the 2013 to 2014 drought, each site was examined in Google Earth aerial images for several dates between 2010 and 2016. Only four of the 25 sites appeared drier in 2016 than 2010, and three of those were along the upgradient side of the Calaveras Fault near Tequisquita Slough and San Felipe Lake. Those wet areas might have been diminished by low groundwater elevations. However, a reduction in surface inflow during the drought could possibly have caused similar effects.

4.11.5. Annual Depletion of Groundwater

The degree to which groundwater pumping depletes stream flow depends partly on groundwater elevations. When groundwater elevations are low—such as during the decades prior to surface-water importation or during prolonged droughts—vertical head gradients within the Basin exceed 1.0 in places, which means there is an unsaturated zone between shallow aquifers and deeper aquifers tapped by water supply wells. Under that circumstance, additional groundwater pumping and groundwater elevation lowering has no effect on stream flow. The rate of stream percolation is governed by the permeability of the creek bed. When groundwater elevations are very high—as occurs during wet years or sequences of wet years—stream percolation is reduced due to lack of vacant storage space within the groundwater system. This reduction in percolation is called "rejected recharge" and became noticeable beginning in the late 1990s (JSA, 2001; Yates, 2003, 2004, and 2005).

An empirical test of stream flow depletion by pumping was obtained using the groundwater model. The results are described in Section 6 "Sustainability Criteria".

4.11.6. Identification of Groundwater-Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) can include plants and animals. Species in those habitats depend on the presence of a shallow water table, pond, or stream flow. Figure 4-22 identifies potential GDEs as phreatophytic riparian vegetation and as springs and seeps, and also identifies gaining stream reaches (based on depth to groundwater). Evaluating the connection between groundwater pumping and the health of those species requires careful evaluation of biological and hydrological factors, including the role of groundwater in the life history of the species (fish passage, spawning, dry-season growth), the timing of water utilization (seasonal, drought survival), the sources of water supplying the habitat (regional groundwater discharge, seasonal wetlands, irrigation tailwater, wastewater), and the hydraulic connection between shallow and deep groundwater. These factors are considered separately for vegetation and animals, below.

4.11.7. Vegetation

Riparian vegetation GDEs are defined as phreatophytic trees and shrubs along streams where the vegetation corridor was at least 100 feet wide and consisted primarily of trees with at least 80 percent canopy coverage and where the depth to groundwater was plausibly less than 30 feet. Vegetation matching these criteria was present in fall 2016 along much of Pacheco Creek and the Pajaro River, several locations along the San Benito River, and short reaches along several smaller streams (**Figures 4-23** and **4-24**). The total area of phreatophytic vegetation was 1,650 acres. A comparison of these areas with vegetation polygons in the NCCAG vegetation map indicated that common species in the phreatophyte areas along the San Benito River (which had more thorough mapping than other streams in the Basin) are Fremont cottonwood, southwestern North America riparian, flooded and swamp forest, mulefat, valley oak (in upper stream terrace locations), and valley foothill riparian.

Phreatophytic riparian vegetation will exploit shallow groundwater throughout the dry season whenever it is available. However, the plant species have varying ability to survive on soil moisture alone if the water table drops below the bottom of the root zone, such as during a drought. Furthermore, groundwater elevations in shallow aquifers are typically more stable than groundwater elevations in deeper ones utilized for water supply. For both of these reasons, the relationship between groundwater elevations in water supply wells and vegetation health is complex.

An empirical method for relating vegetation health to groundwater elevations in wells is to compare aerial photographs of phreatophytic riparian vegetation before and after droughts. If the low groundwater elevations during the drought affected the shallow water table and plants significantly, die-back of the riparian canopy would be expected. This approach was implemented by comparing aerial photographs taken in November 2010 and October 2016, which were before and after a drought during which groundwater elevations in many wells declined 20 to 40 feet. Only a few of the areas mapped as riparian vegetation appeared to experience a reduction in vegetation coverage during the drought. Close-up aerial photographs for both dates are shown for two of these areas in **Figure 4-23**. The locations are on Tres Pinos Creek and the San Benito River (**Figure 4-22**). Examples of areas where vegetation density and/or vigor appeared to have decreased between the two dates are circled in the figure. There are no monitoring wells near site A on Tres Pinos Creek, and groundwater elevations in wells near site B on the San Benito River declined 30 feet during the drought.

The general conclusion that can be drawn from the pre- and post-drought aerial photograph comparison is that riparian vegetation tends to persist even when groundwater elevations in nearby water supply wells are 35 to 40 feet below the ground surface for a period of two years. A small percentage of phreatophytic riparian vegetation appears to die back during such drought events but later regenerates.

The relatively minor effects of groundwater declines during the 2013 to 2014 drought in northern San Benito County can be contrasted with the more pronounced effects of groundwater declines during the 1976 to 1977 drought in the Carmel Valley, a coastal basin 30 miles to the south. Groundwater elevations along a two-mile segment of the narrow alluvial valley near a cluster of large municipal wells declined only about 6 feet during summer in typical years but declined 25 to 30 feet over the two-year drought period (Kapple et al., 1984 and Kondolf and Curry, 1986). This amount and duration of decline killed most of the riparian vegetation in that area, and decay of the tree roots that normally bind the riverbank soils led to unprecedented amounts of bank erosion in subsequent peak flow events. Key differences between the two locations are that the Carmel Valley alluvial aquifer is only 80 to 100 feet thick with no confining layers, and the municipal wells were all within a few hundred feet of the river. Thus, drawdown was focused close to the river, and the groundwater elevations in the wells reflected the actual water table. In northern San Benito County, large irrigation and municipal wells are typically screened between 200 and 500 feet below the ground surface, and the stratigraphy in most places includes fine-grained layers that attenuate the effects of deep pumping on the water table in the shallowest aquifer. A study of shallow groundwater conditions in the San Juan Valley found groundwater elevation differences of up to 20 feet between a well 10 feet deep and a nearby well 89 feet deep, even in a wet year (Yates et al., 1999). At another location with a longer historical record, groundwater elevations in a well 130 feet deep were up to 40 feet lower than in a nearby well 78 feet deep. Also, pumping in northern San Benito County is not focused near streams and rivers to the extent that it is in Carmel Valley. The horizontal and vertical separation of the pumping stress in deep aquifers from the water table in the shallowest aquifer in San Benito riparian areas appears to have diminished the impact of pumping, allowing the vegetation to survive.

4.11.8. Animals Dependent on Groundwater

Animals that depend on groundwater include fish and other aquatic organisms that rely on groundwater-supported stream flow and amphibious or terrestrial animals that lay their eggs in water. Management of habitat for animals typically focuses on species that are listed as threatened or endangered under the state or federal Endangered Species Acts. That convention is followed here. The biological resources element of the 2010 San Benito County General Plan identifies three listed species that require aquatic habitat: California red-legged frog, California tiger salamander, and steelhead trout (EMC Planning Group, Inc., 2015). Critical habitat areas for those species are shown in **Figure 4-24** (USFWS, 2019a and 2019b).

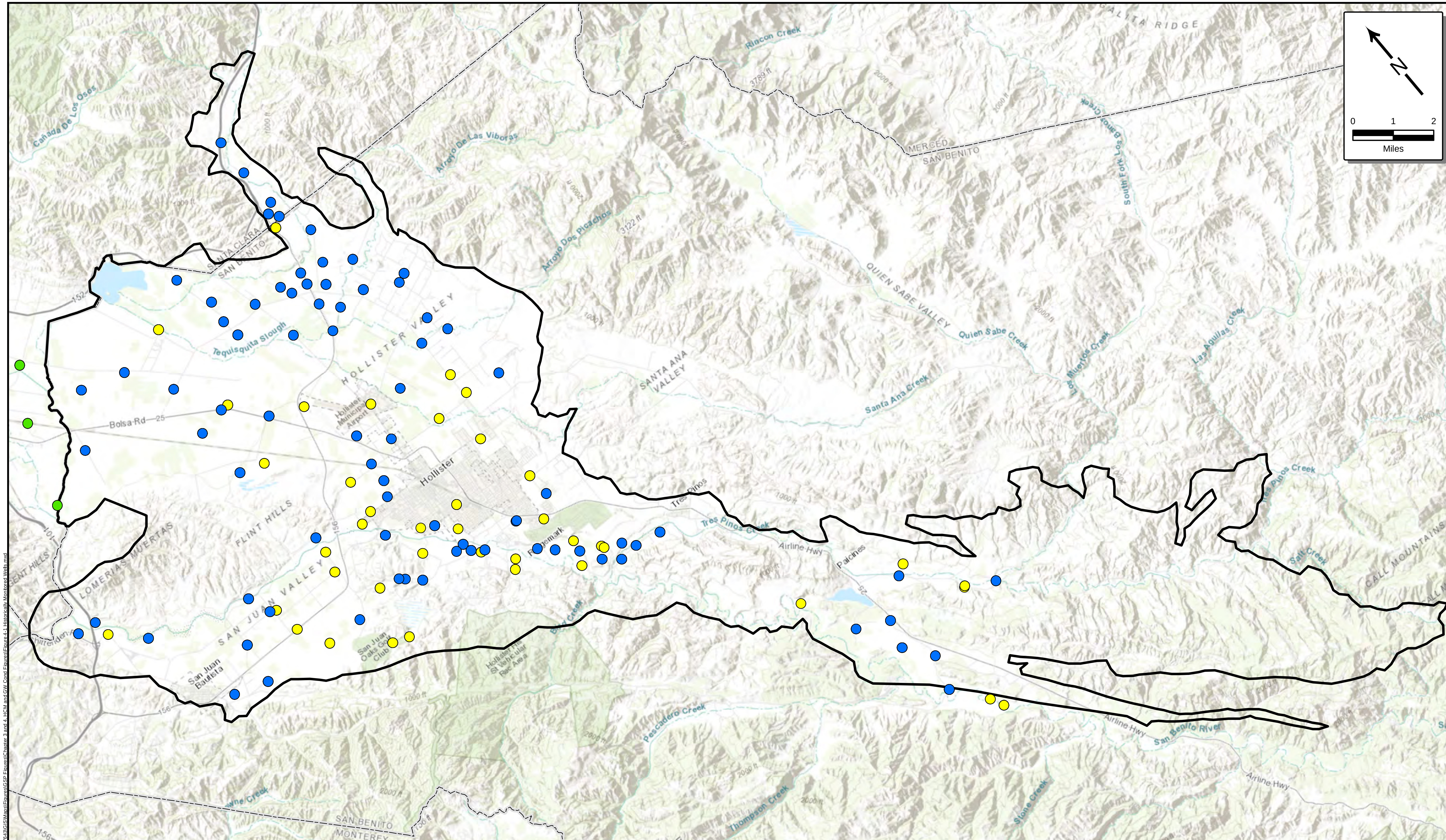
Critical habitat for red-legged frog is present along the San Benito River from Bird Creek up through the Paicines Valley, along Tres Pinos Creek between Tres Pinos Creek Valley and Southside Road, and in the hills surrounding Pacheco Creek Valley as it approaches the Hollister Valley. Red-legged frogs live in sheltered backwaters of ponds, marshes, springs, streams, stock ponds, and reservoirs. Deep pools with dense stands of overhanging willows and an intermixed fringe of cattails are considered optimal habitat. Aquatic habitat is required year-round (USFWS, 2019a). Groundwater pumping along the reaches of the San Benito River and Tres Pinos Creek within the critical habitat area could potentially decrease the area of suitable habitat along those streams or cause those areas to be intermittently dry.

There are two areas of critical habitat for tiger salamander in the Basin: a large area adjacent to San Felipe Lake and in the hills north of the lower end of Pacheco Creek and an area north of Highway 25 and east of Fairview Road that is within the Basin but generally undeveloped for agriculture or urban land uses. Tiger salamanders require aquatic habitat only seasonally—generally from November to April. They estivate (enter a dormant state) in underground burrows during the dry summer period. During the wet winter months, they spawn and live in and near pools and ponds. They prefer seasonal ponds such as vernal pools or stock ponds that are allowed to go dry (USFWS, 2019b). The seasonal character of the preferred pools indicates that they are not supported by regional groundwater discharge and therefore not affected by groundwater pumping.

Steelhead trout use creeks and rivers that cross the Basin only for passage between the ocean and spawning areas upstream of the Basin. Waterways designated as critical habitat are the San Benito River, Pajaro River, Pacheco Creek, and Dos Picachos Creek (and the reach of Tequisquita Slough that connects it to San Felipe Lake and Pacheco Creek). Adult steelhead migrate upstream from the ocean to headwaters areas to spawn, and smolts (juveniles) migrate downstream to the ocean upon reaching a certain size and maturity. Creeks and rivers crossing the Basin provide continuous hydrologic connection between the ocean and spawning areas only seasonally—primarily during and following winter storm events. The reaches within the Basin are not used as year-round rearing habitat. Adult steelhead migrate upstream between December and March, peaking in January and February (Moyle, 2002). Downstream migration of smolts occurs as winter base flow recedes in spring. This occurs earlier in southern California streams relative to northern California streams because of the shorter flow season. Migration in both directions requires that flow be continuous to the ocean and sufficiently high to provide adequate water depth for the fish to swim. Based on stream flow records for Pacheco Creek, flow becomes too low for smolt migration in April of normal years, May of wet years, and March or earlier in dry years.

The potential impact of groundwater pumping on steelhead migration is to slightly shorten the duration of windows of opportunity for migration. At the beginning of the winter flow season, percolation losses are relatively high as groundwater elevations recover. However, early-season flows are typically flashy in response to storm events, with flows that greatly exceed percolation rates. In spring, base flow recedes more gradually and usually drops below minimum migration flows before irrigation pumping ramps up for the dry season. If there is overlap between the flow season and irrigation season, flow depletion could shorten the smolt passage window. For example, if the minimum passage flow for smolt migration along Pacheco Creek were 25 cubic feet per second (cfs) measured at the gauge near Dunneville, then based on typical flow recession rates, a hypothetical 3 cfs of pumping depletion would shorten the migration window by 1 to 2 days.

Figure 4-24 identifies GDEs in terms of phreatophytic riparian vegetation and potential steelhead passage streams. Additional analysis of potential groundwater pumping impacts on vegetation and animals is included in Section 6, Sustainability Criteria.

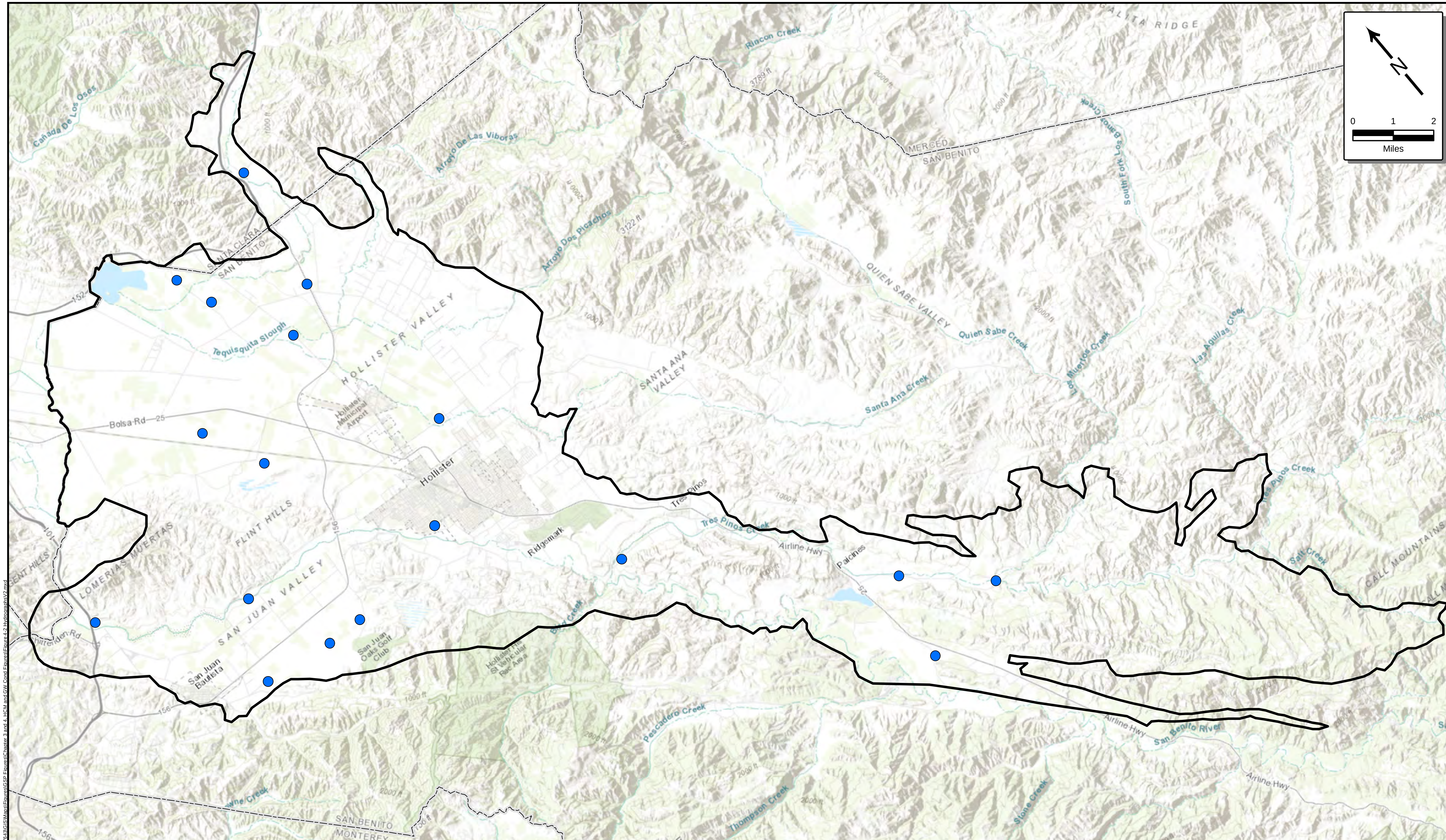


- SBCWD Monitored Wells, October 2017
- SCVWD Monitored Wells, October 2017
- Well Monitored in Prior Years and not October 2017
- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

Figure 4-1
Historically Monitored Wells

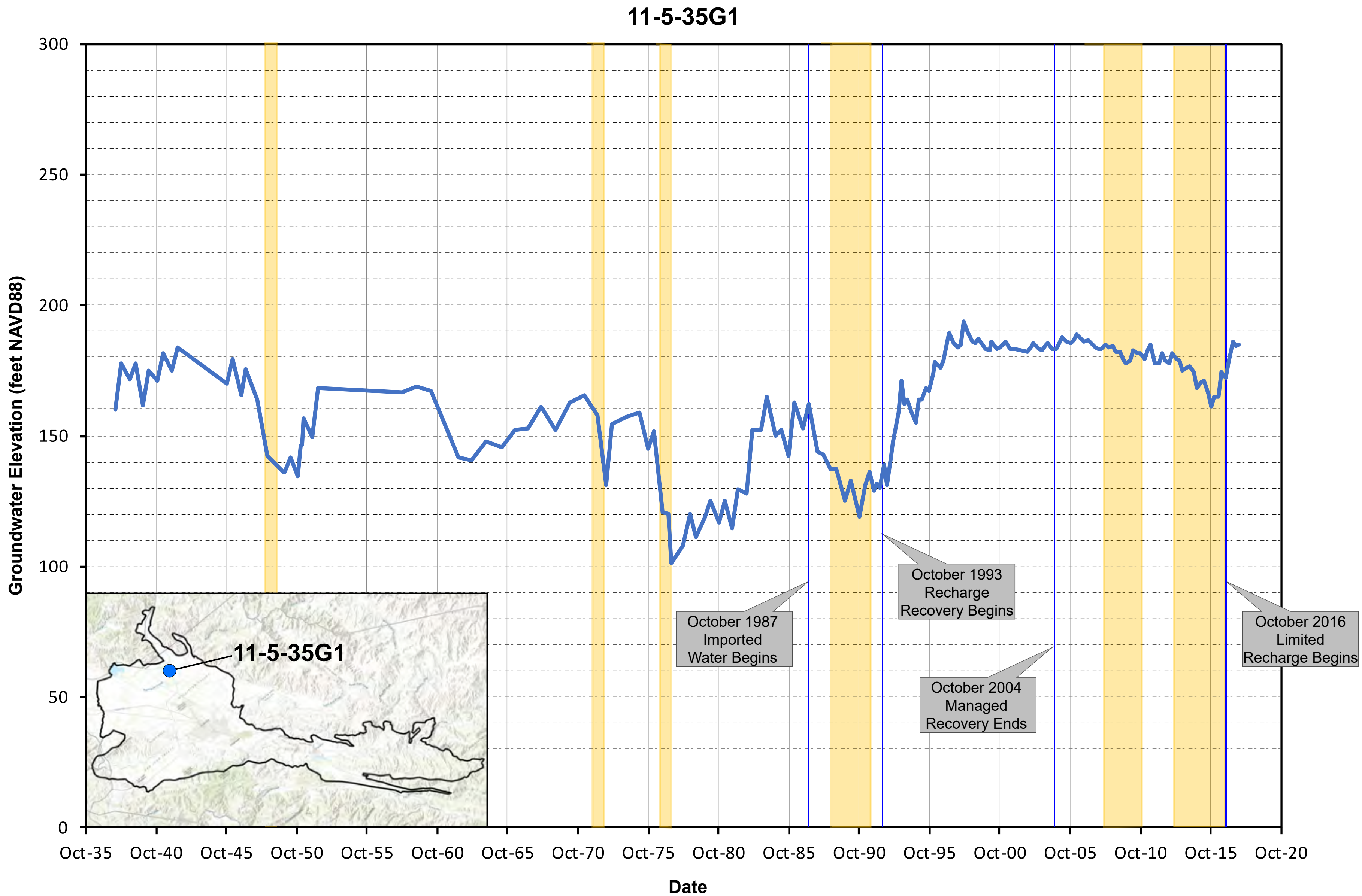


Well with Representative Hydrograph
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 4-2
Location of Wells with Representative Hydrographs

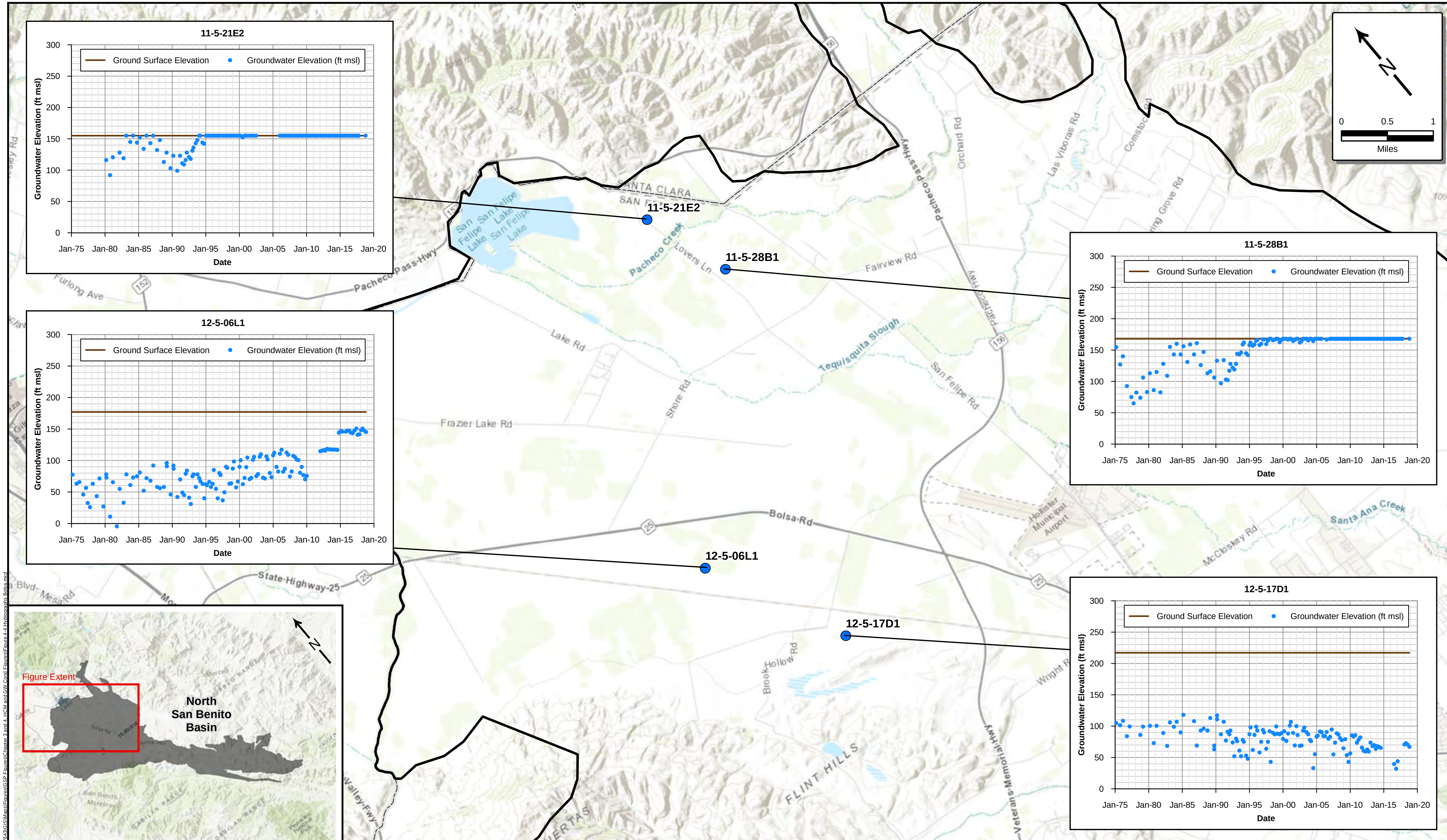


Drought Periods

November 2021

TODD GROUNDWATER

Figure 4-3
Representative Long Term Groundwater Elevations

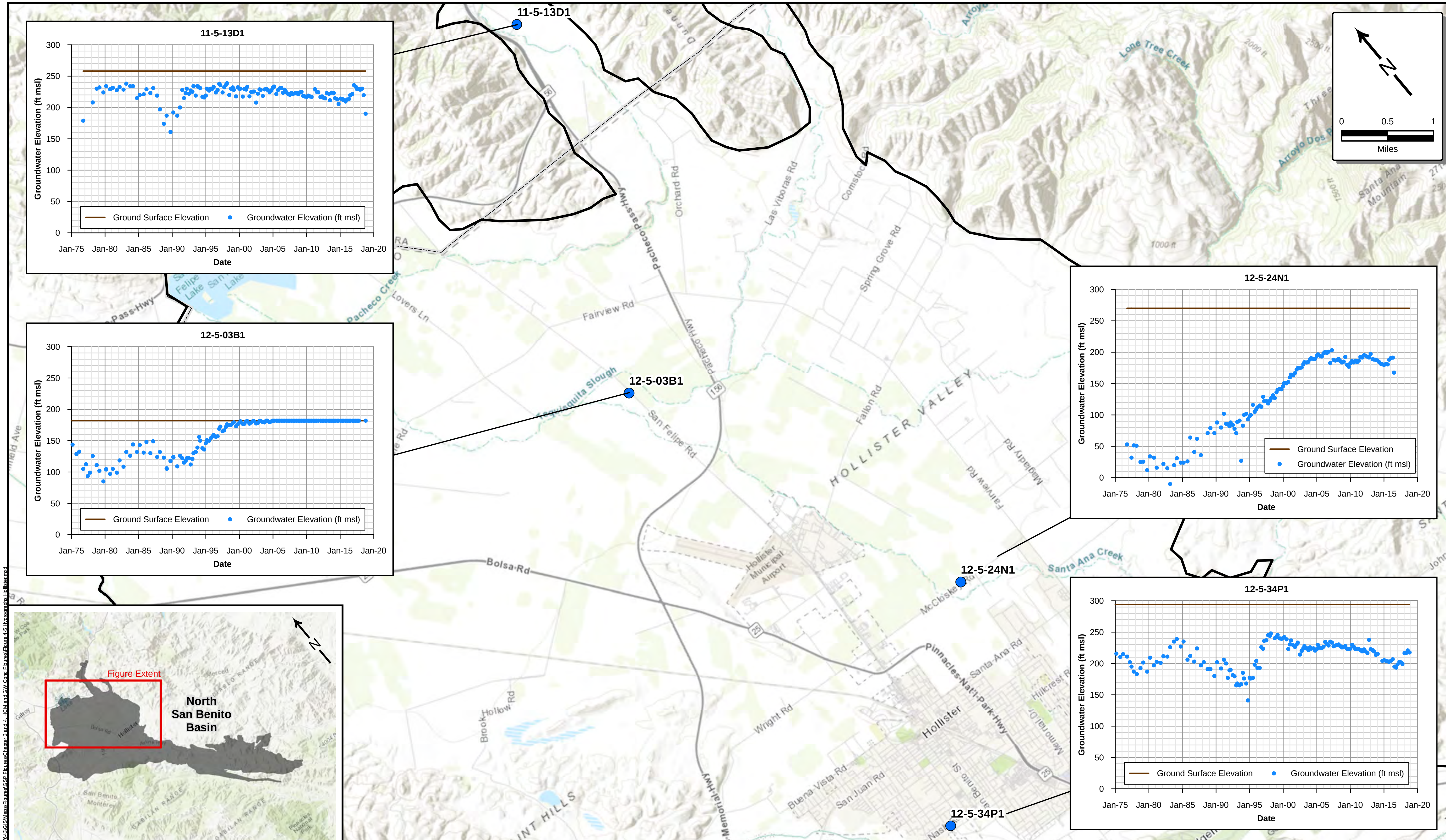


- Well with Representative Hydrograph
- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

Figure 4-4
Representative Hydrographs
Bolsa Management Area



Well with Representative Hydrograph

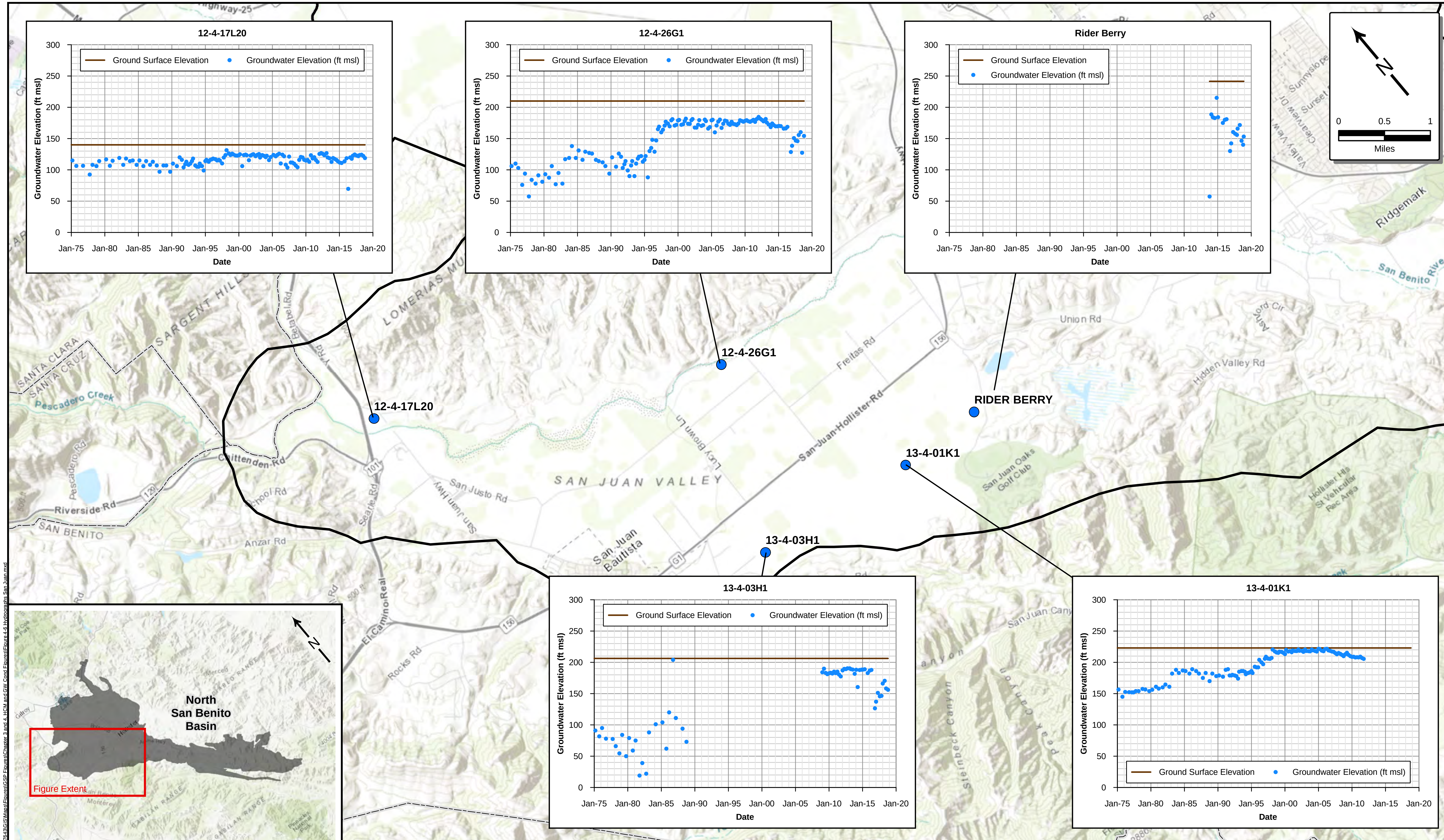
San Benito County

North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 4-5
Representative Hydrographs
Hollister Management Area



● Well with Representative Hydrograph

San Benito County

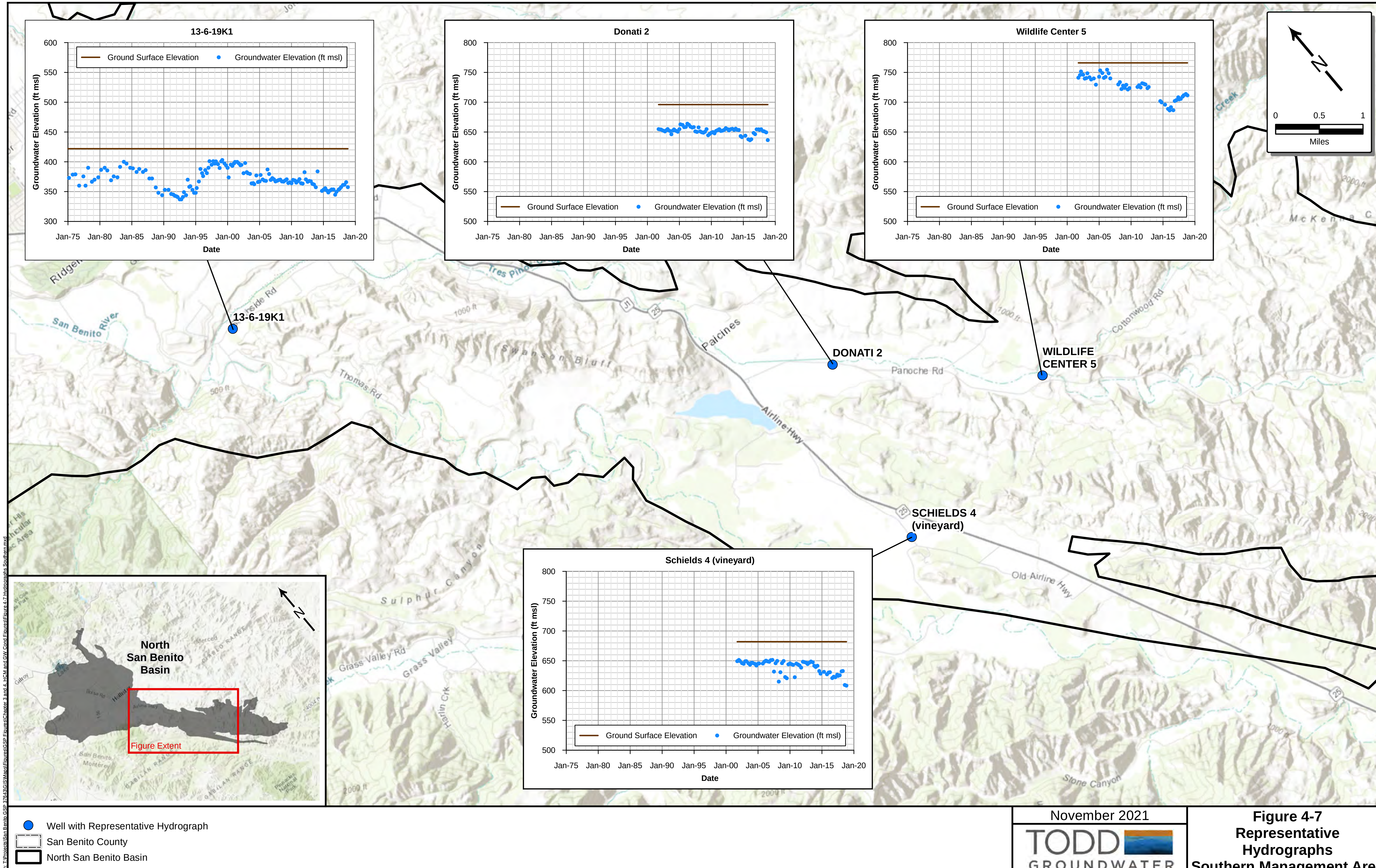
North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 4-6
Representative Hydrographs
San Juan Management Area

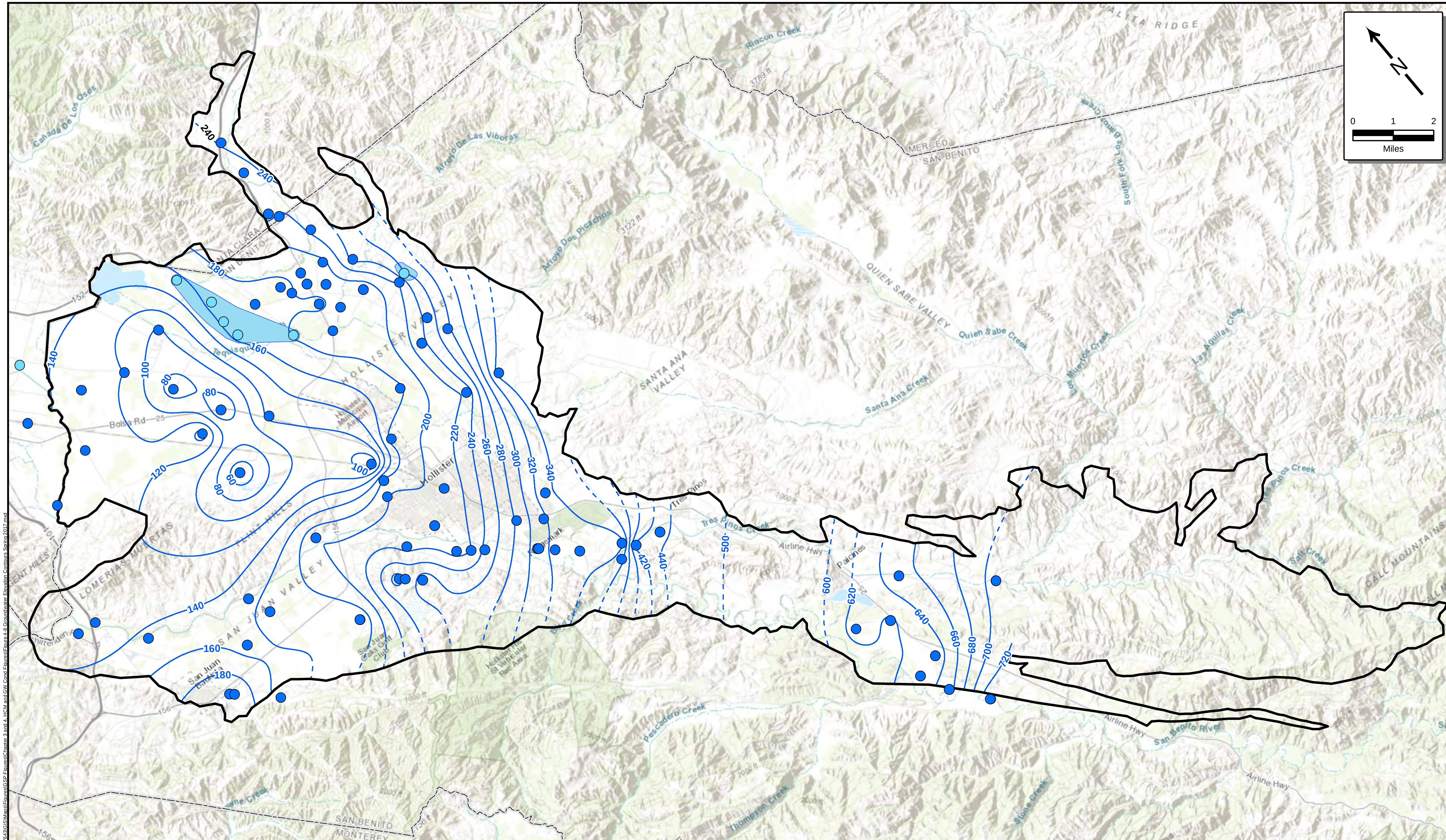
Path: T:\Projects\San Benito GSP 37\643\GIS\Maps\Figures\GSP Figures\Chapter 3 and 4_HCM and GW Cond Figures\Figure 4-6 Hydrographs San Juan.mxd



November 2021

TODD GROUNDWATER

Figure 4-7
Representative Hydrographs
Southern Management Area



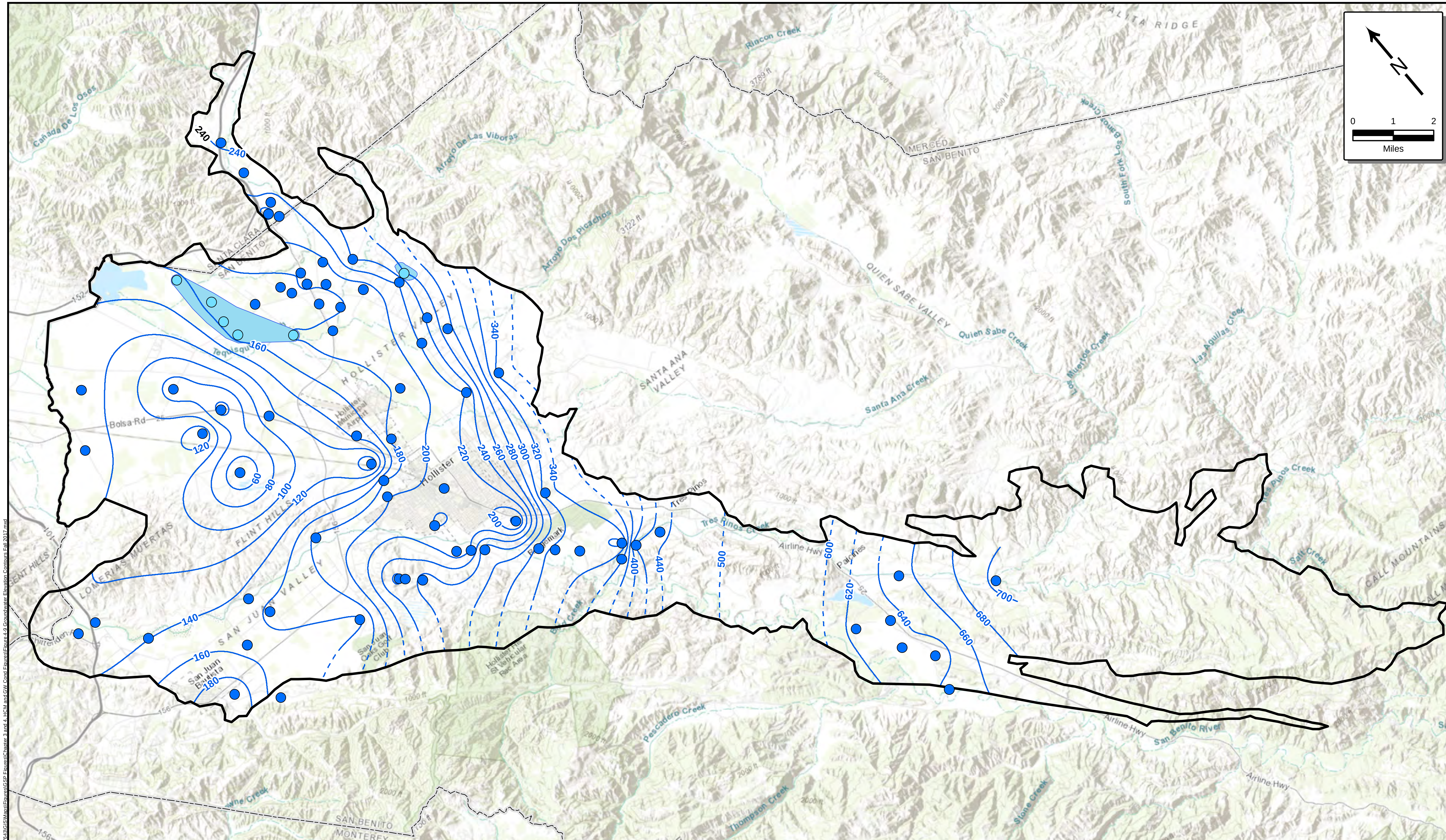
- Flowing Artesian Well, Spring 2017
- Monitored Well, Spring 2017
- 20-foot groundwater elevation contour, feet above msl
- 20-foot groundwater elevation contour, dashed where uncertain due to insufficient data
- Approximate Areas of Flowing Wells
- North San Benito Basin
- San Benito County

Note:
Groundwater elevation contours not estimated in areas of the basin with no groundwater monitoring data

November 2021

TODD GROUNDWATER

Figure 4-8
Groundwater Elevation Contours, Spring 2017



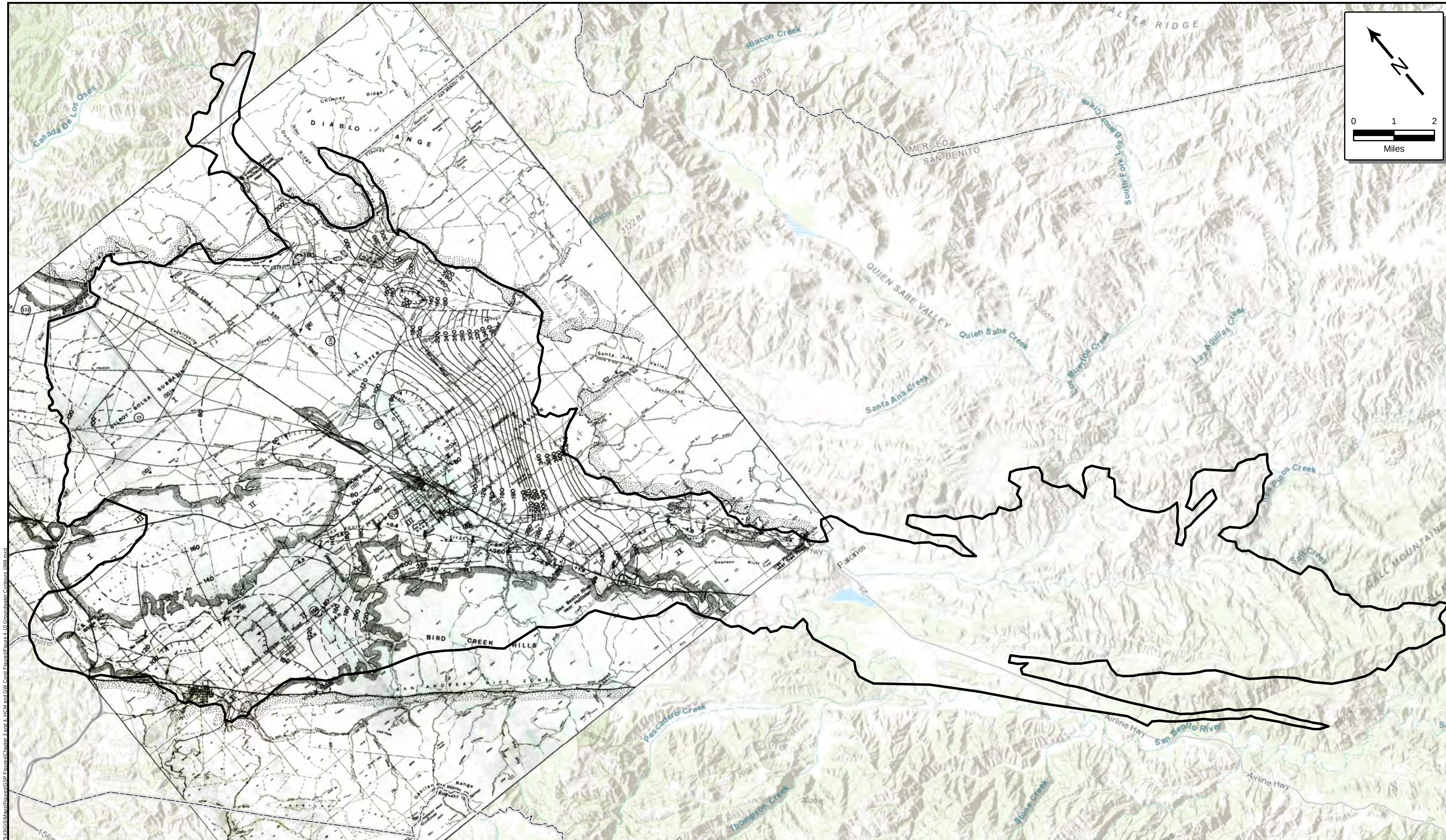
- Flowing Artesian Well, Fall 2017
- Monitored Well, Fall 2017
- 20-foot groundwater elevation contour, feet above msl
- 20-foot groundwater elevation contour, dashed where uncertain due to insufficient data
- Approximate Areas of Flowing Wells
- North San Benito Basin
- San Benito County

Note:
Groundwater elevation contours not estimated in areas of the basin with no groundwater monitoring data

November 2021

TODD GROUNDWATER

Figure 4-9
Groundwater Elevation Contours, Fall 2017



North San Benito Basin

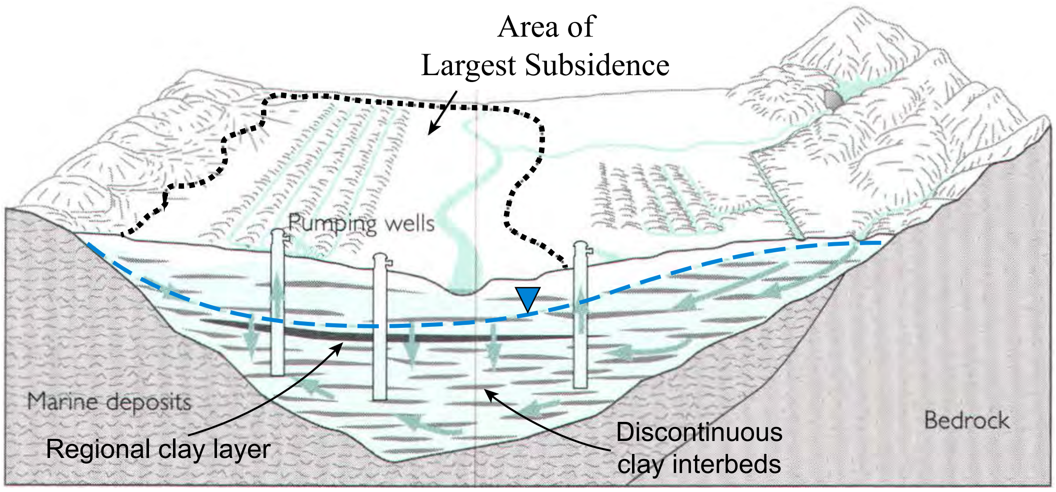
San Benito County

Groundwater elevation contours after Kilburn, 1973, Plate 6

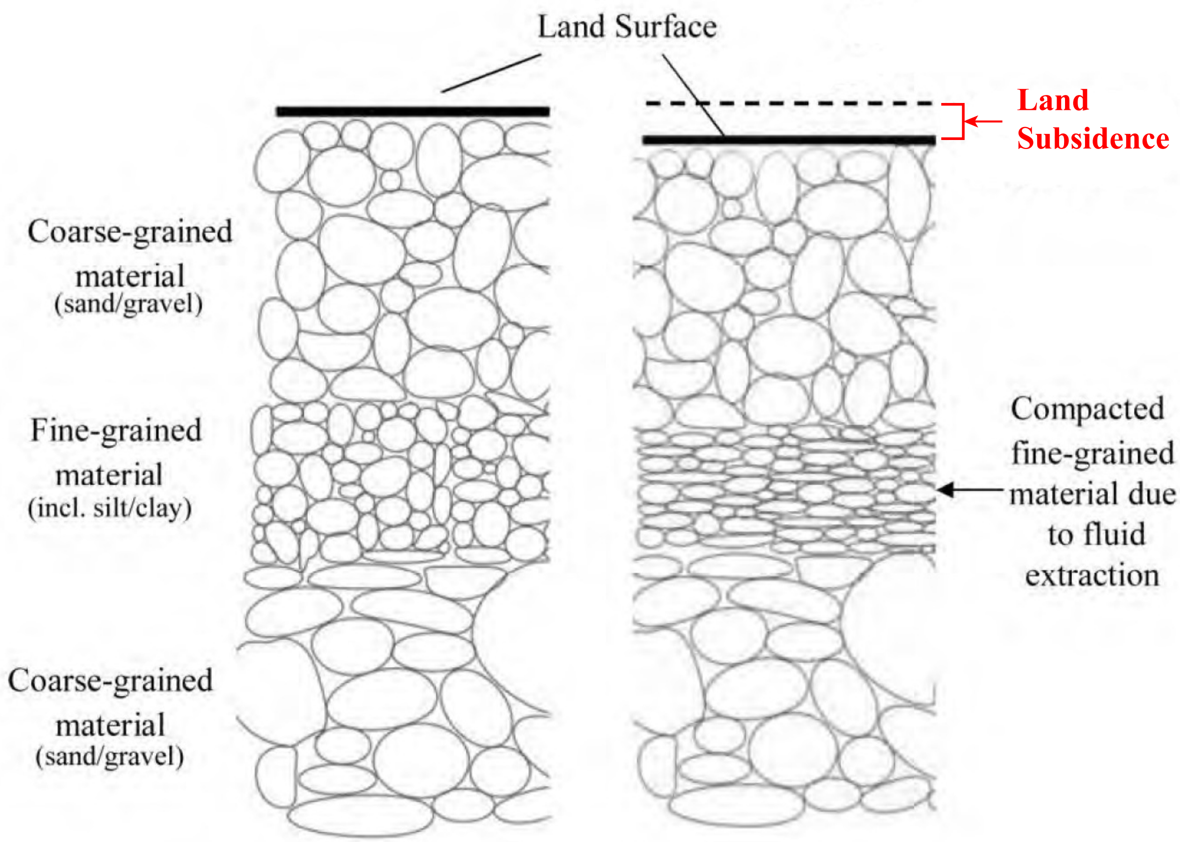
November 2021

TODD GROUNDWATER

Figure 4-10
Groundwater Elevation Contours, 1968



Source: Galloway et al., 1999.

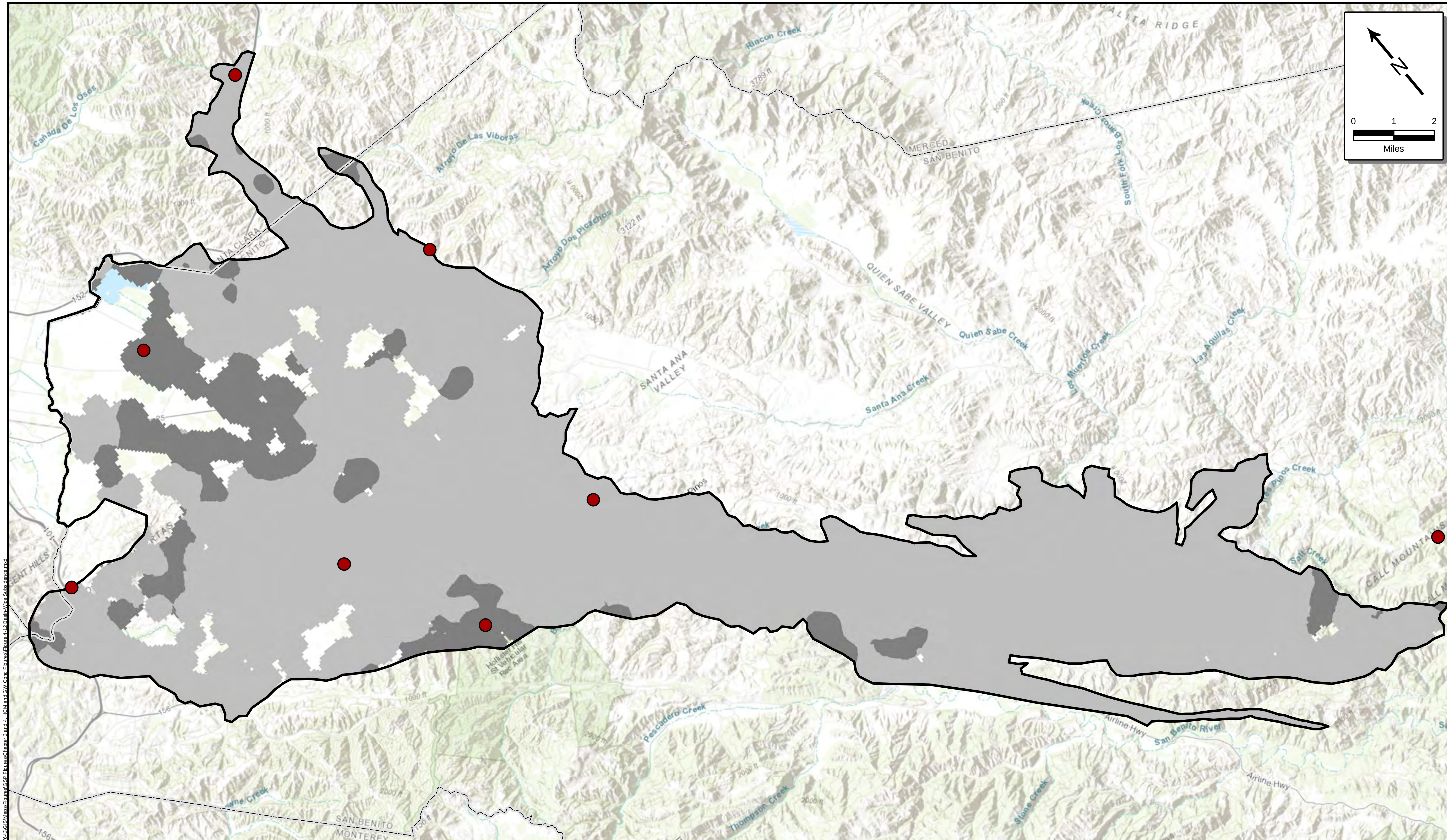


After LSCE et al., 2014.

November 2021

TODD GROUNDWATER

Figure 4-11
Concepts of
Land Subsidence

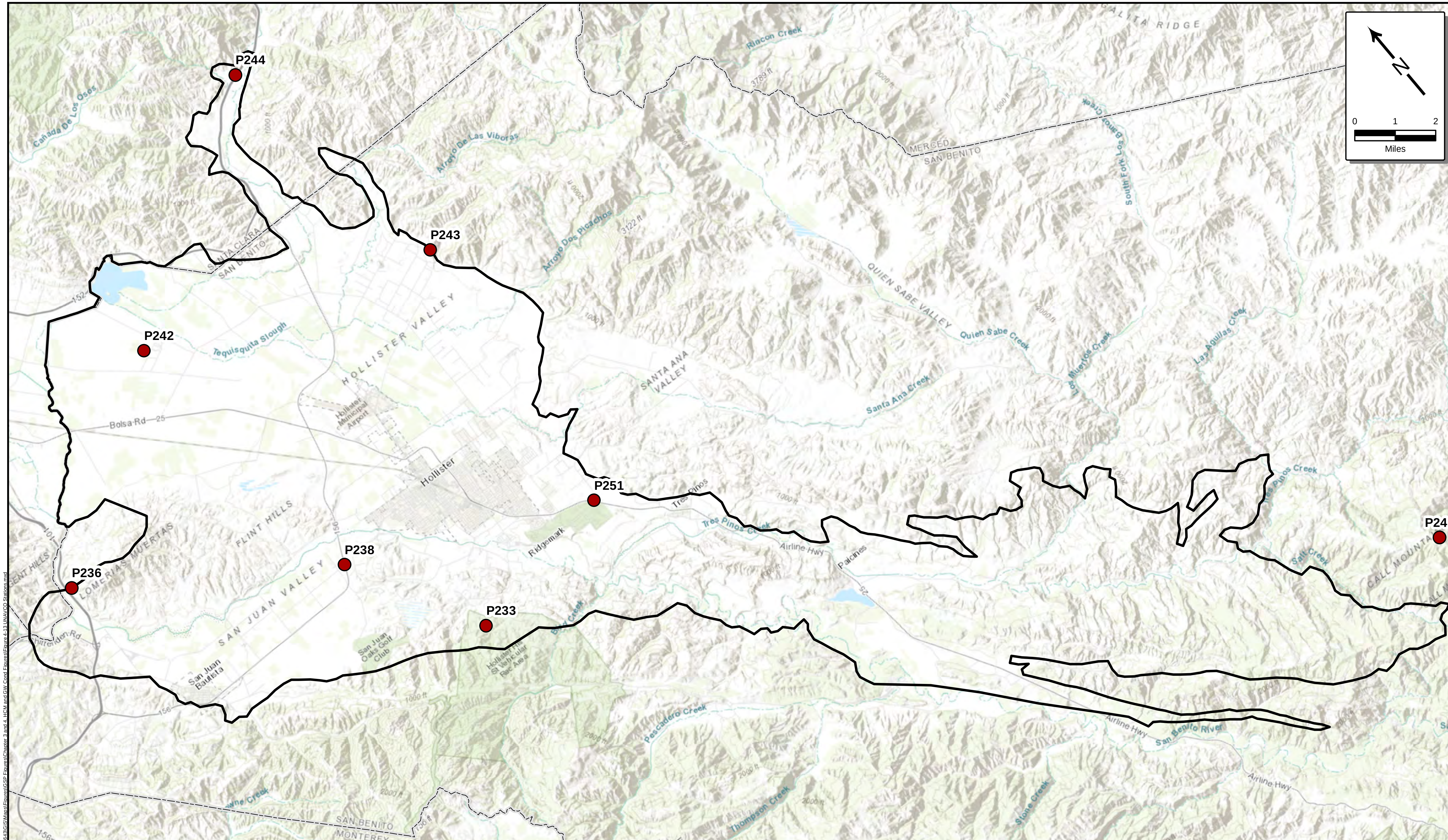


Note:
Vertical displacement data from California Department of Water Resources measured between 6/13/2015 and 9/19/2019 (Tre/Altamira).

November 2021

TODD GROUNDWATER

Figure 4-12
Basin-Wide Subsidence Estimates from Satellite Measurements

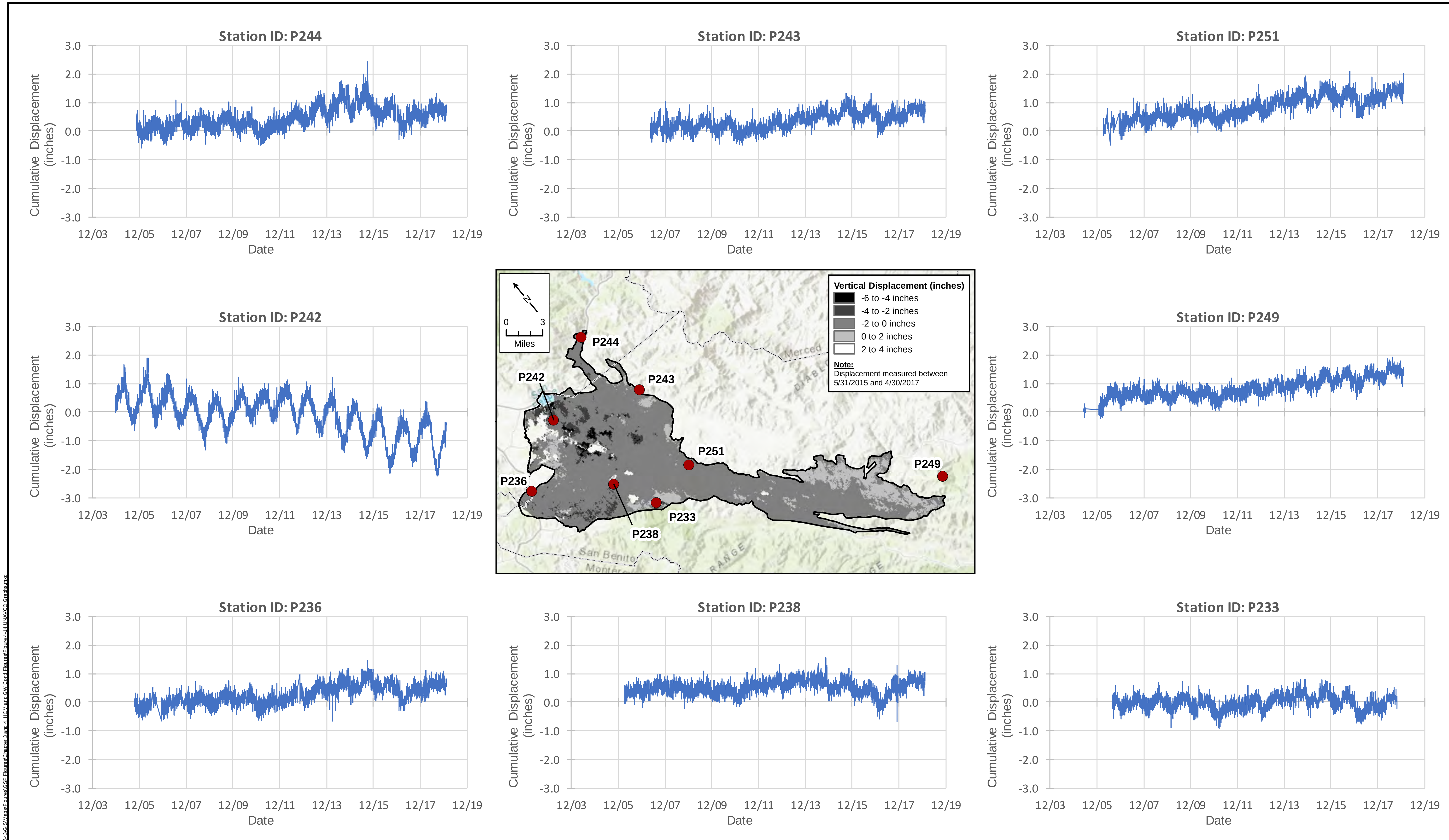


- UNAVCO Stations
- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

Figure 4-13
Ground Surface Elevation Monitoring Stations

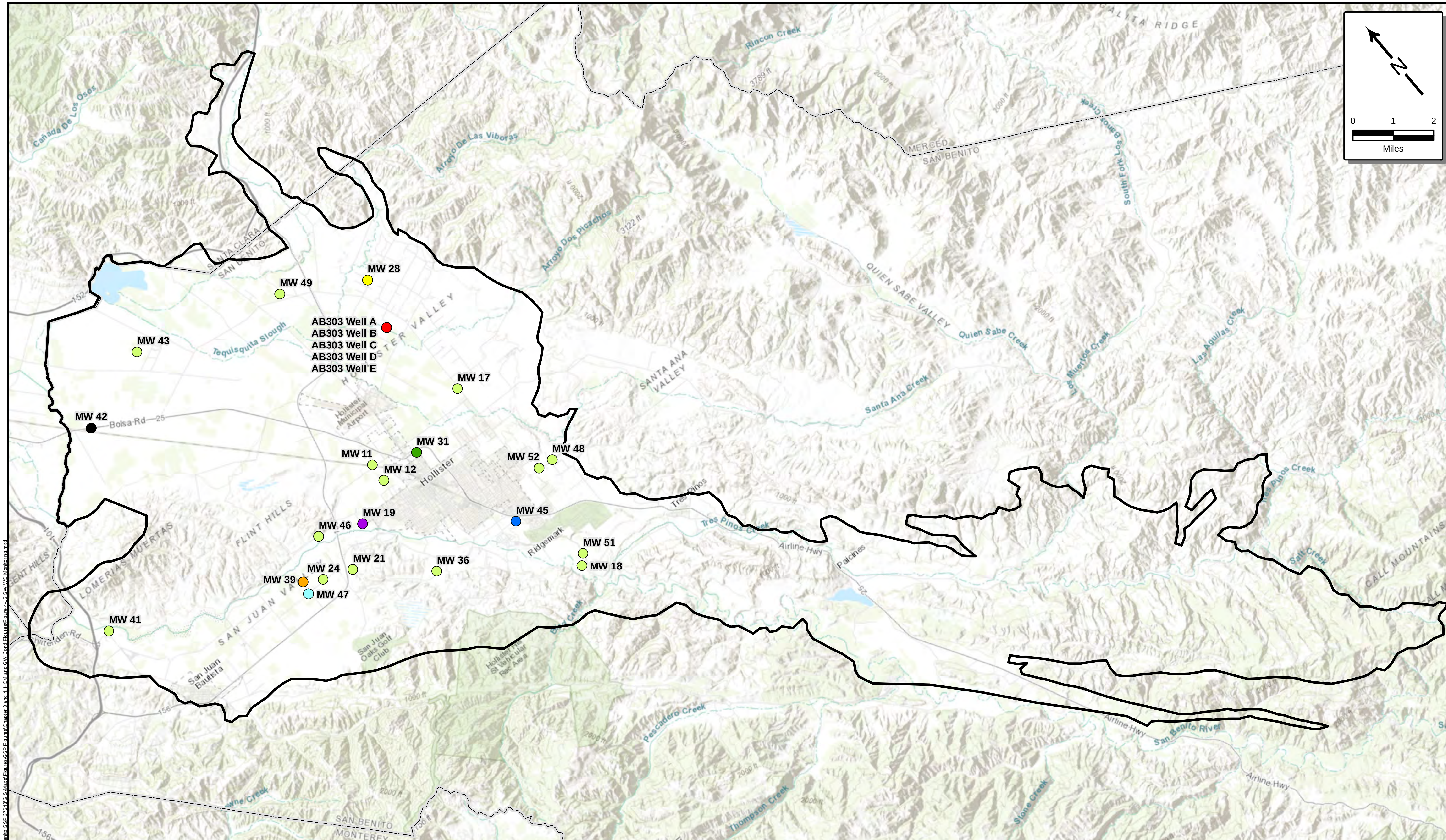


UNAVCO Stations
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 4-14
Historical Ground Surface Elevation from GPS Monitoring



Key Wells

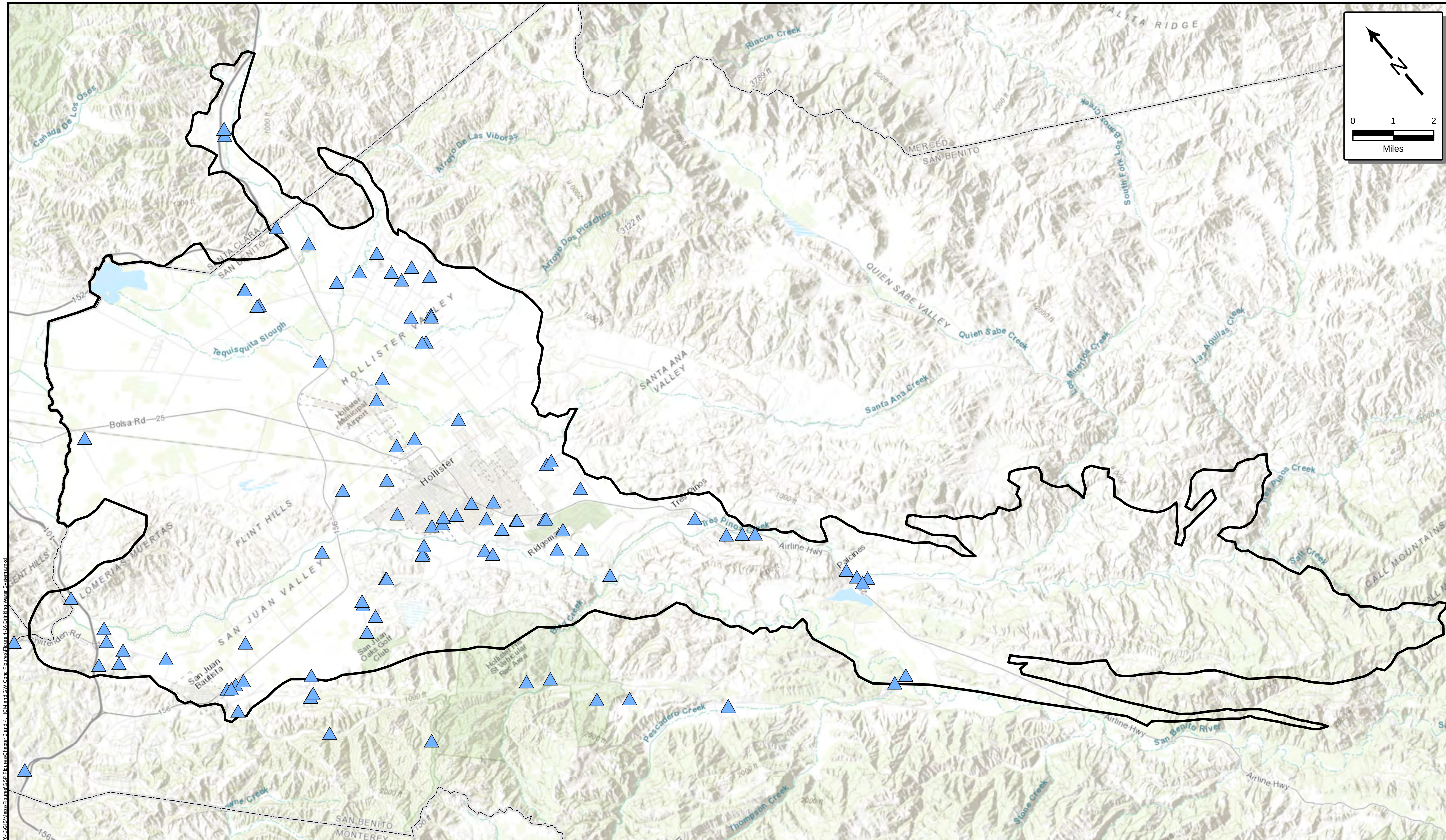
- AB303
- MW 19
- MW 28
- MW 31
- MW 39
- MW 42
- MW 45
- MW 47
- All Other Monitoring Wells

North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 4-15
SBCWD Water Quality Monitoring Network



Drinking Water Systems

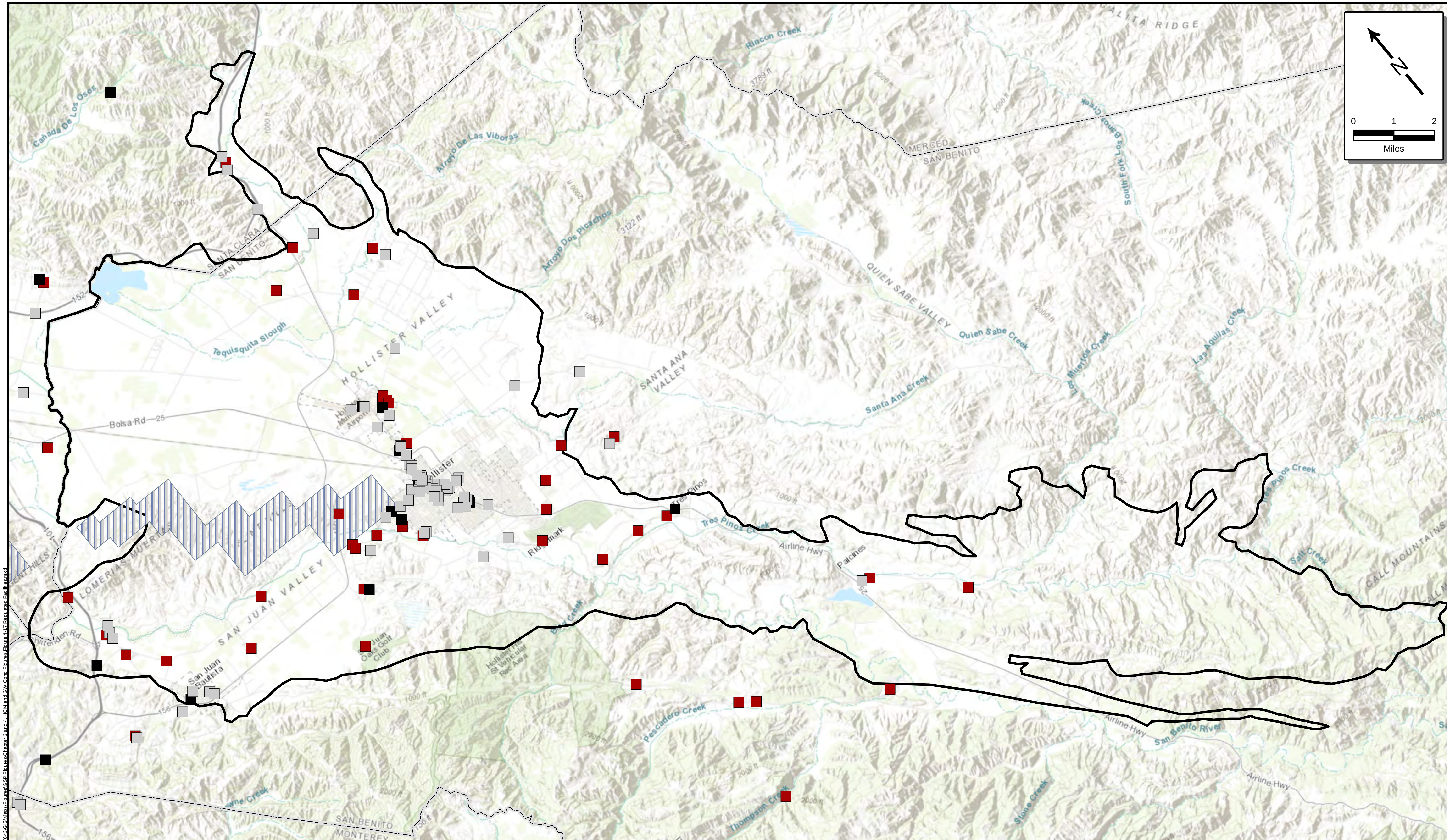
North San Benito Basin

San Benito County

November 2021

TODD GROUNDWATER

Figure 4-16
Drinking Water Systems



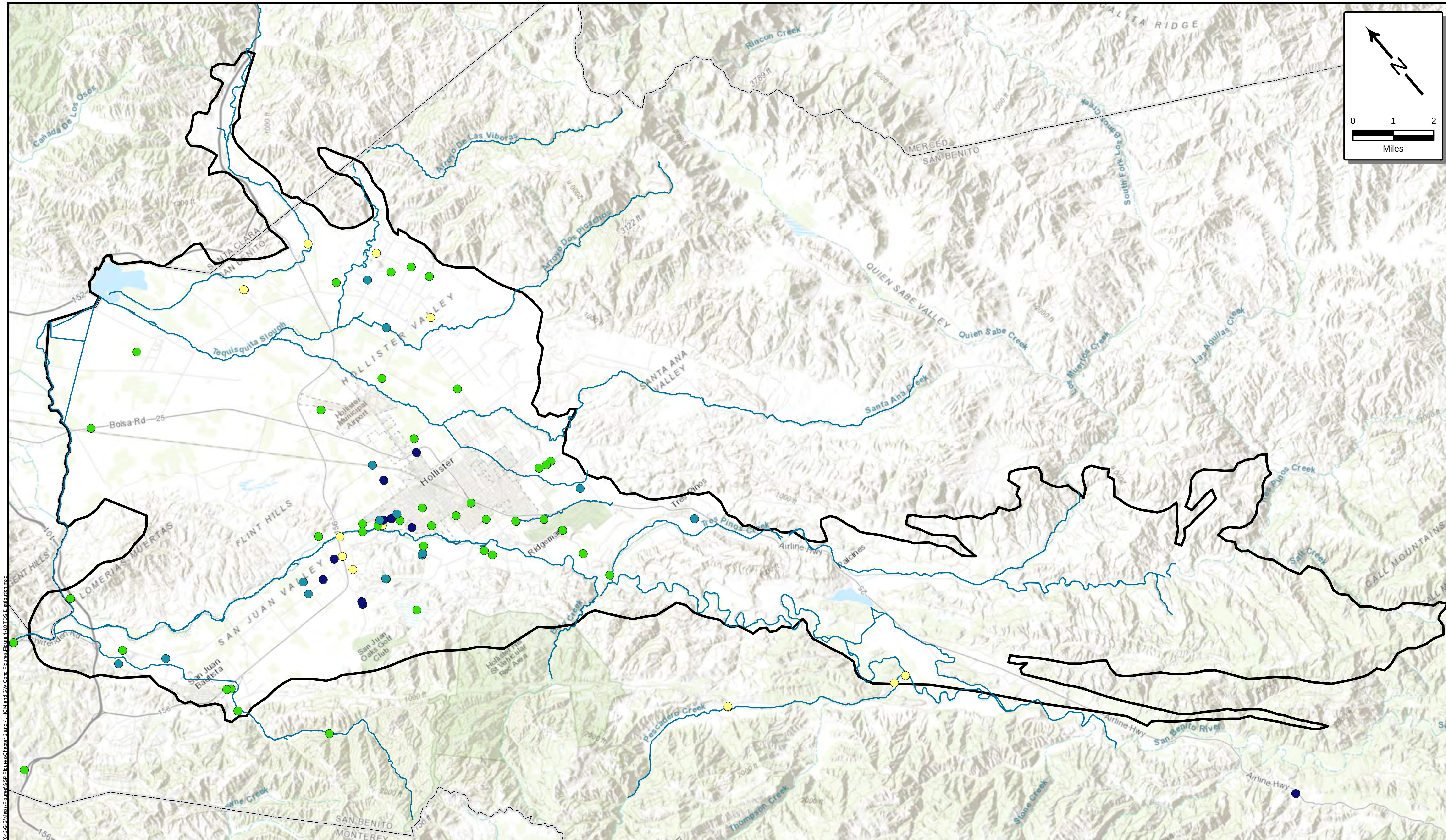
Regulated Facilities (Status)

- Open / Active
- Closed / Inactive
- Other
- Oil / Gas
- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

Figure 4-17
Location of Potential Point Sources of Groundwater Contaminants



Average TDS Concentration

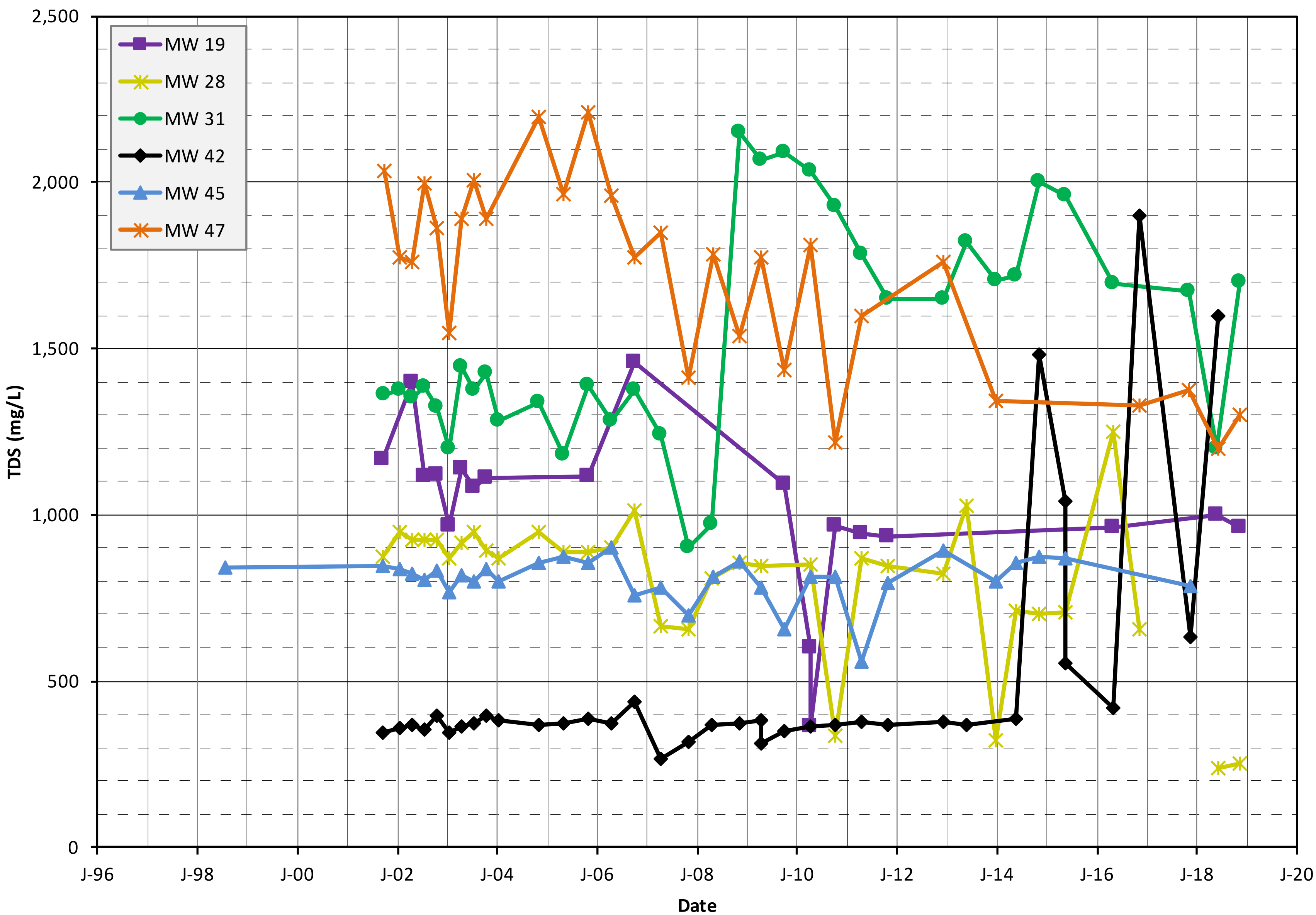
- Less than 500 mg/L
- 500 to 1,000 mg/L
- 1,000 to 1,500 mg/L
- Greater than 1,500 mg/L

- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

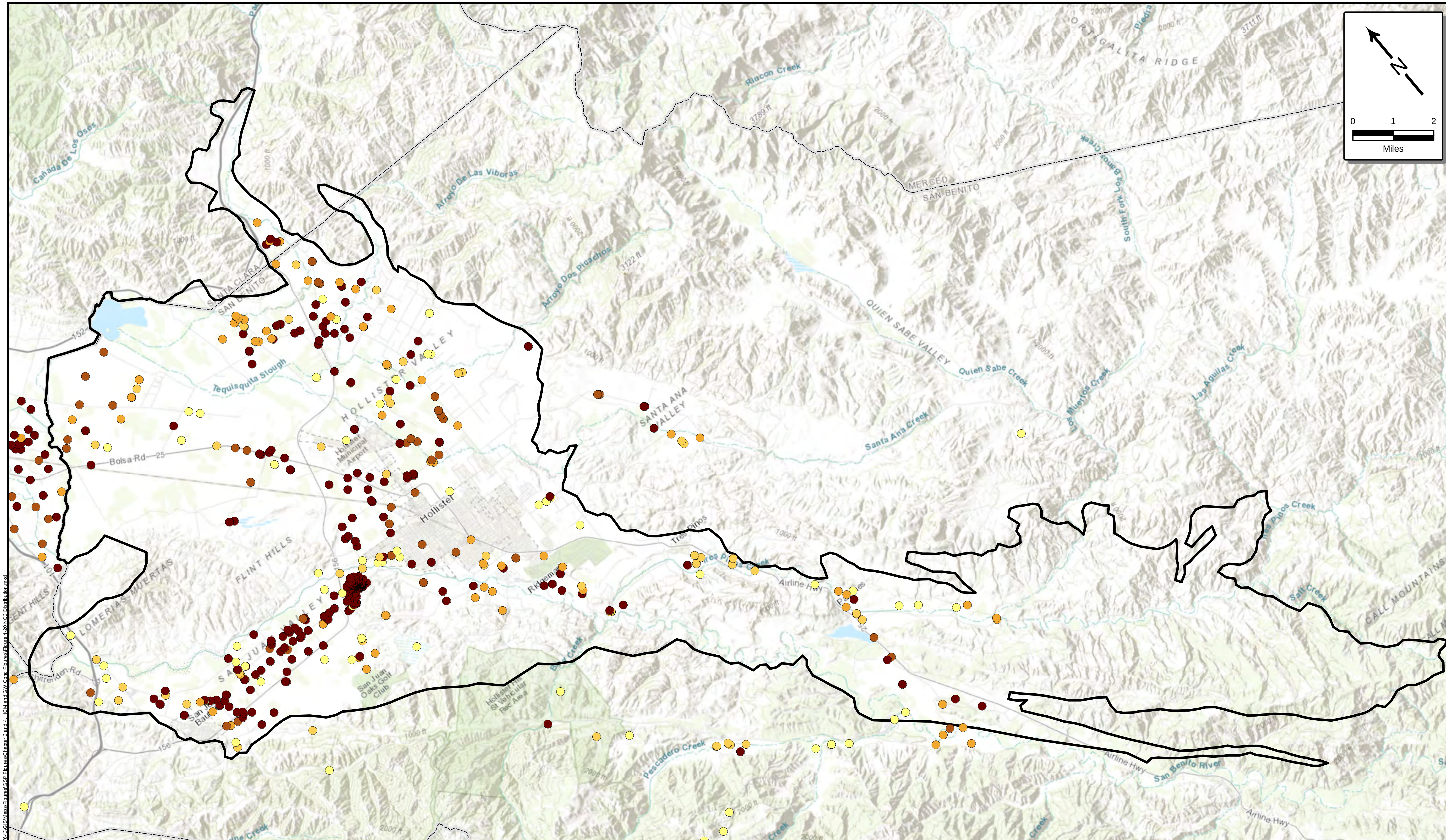
Figure 4-18
Regional Distribution of Total Dissolved Solids 2014-2017



November 2021

TODD GROUNDWATER

Figure 4-19
Total Dissolved Solids
Regional Trends



Nitrate Concentration

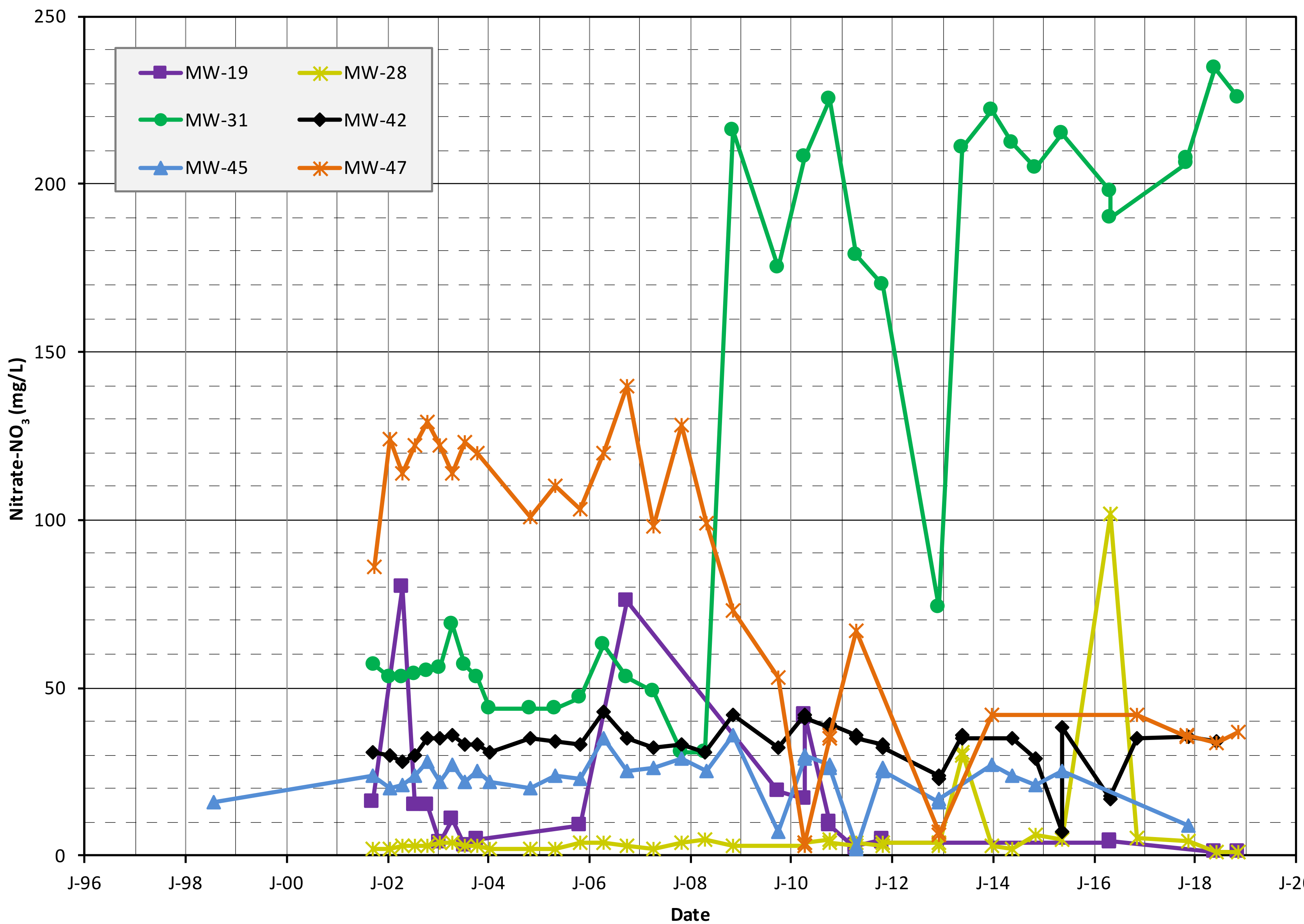
- Less than 5 mg/L
- 5 to 10 mg/L
- 10 to 20 mg/L
- 20 to 30 mg/L
- Greater than 30 mg/L

- North San Benito Basin
- San Benito County

November 2021

TODD GROUNDWATER

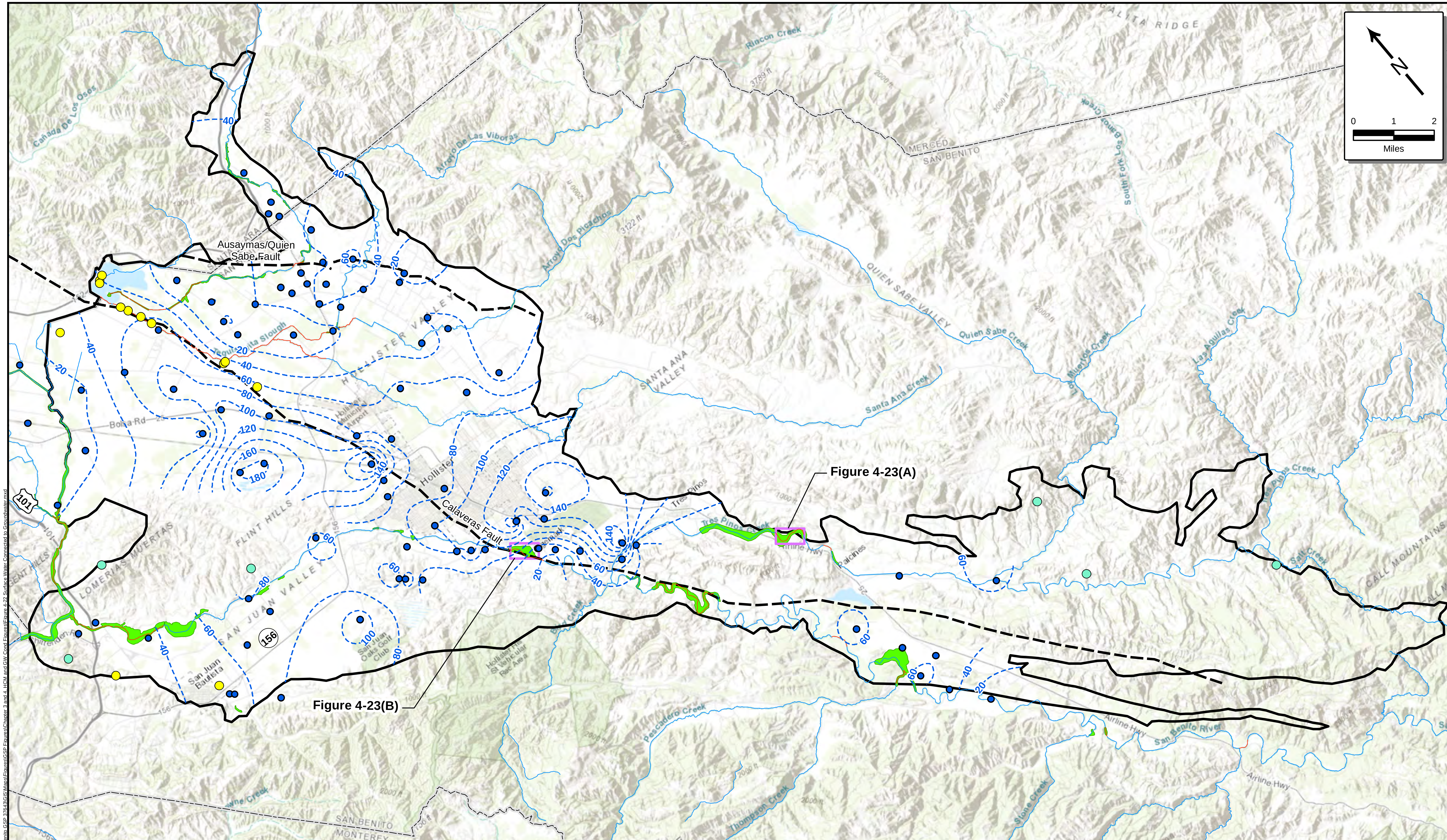
Figure 4-20
Regional Distribution of Nitrate 2014-2017



November 2021

TODD GROUNDWATER

Figure 4-21
Nitrate
Regional Trends

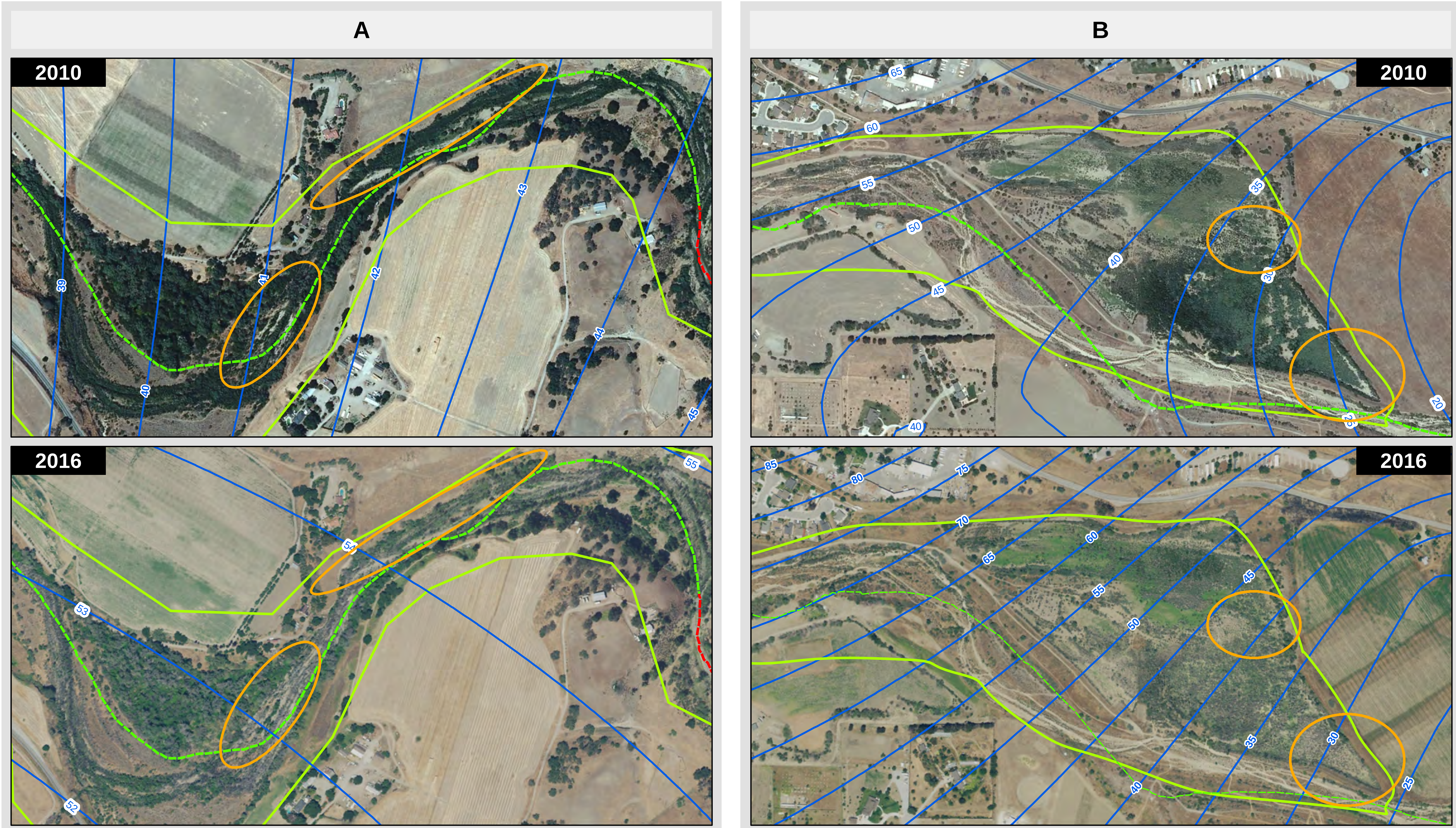


Wetland GDE
Springs and Seeps
Wells
20-foot depth to groundwater contour, feet below ground surface
Generalized Faults
Gaining Stream Reach
Losing Stream Reach
Phreatophytic Riparian Vegetation
Figure 4-23 Bounding Box
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 4-22
Surface Water Connected to Groundwater



Stream
- Gaining Reach
- Losing Reach
- Depth To Groundwater Contour
- Phreatophytic Riparian Vegetation
- Locations of decreased vegetative cover

November 2021

TODD GROUNDWATER

Figure 4-23
Vegetation Response to Drought Conditions

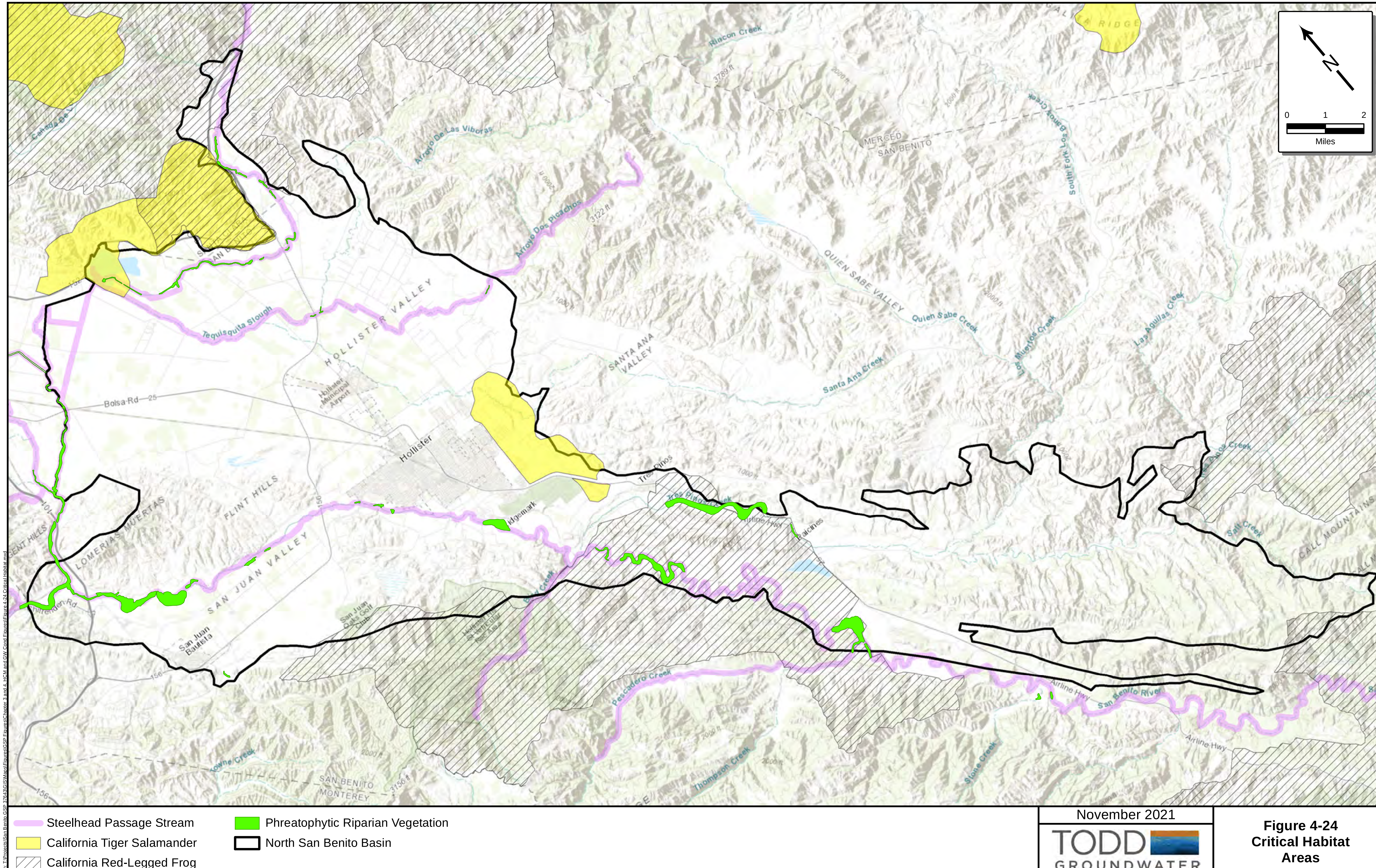


Figure 4-24
Critical Habitat Areas

5. WATER BALANCE

This section provides a quantitative assessment of the water balance (or water budget) of the North San Benito Subbasin (or Basin), including estimates of inflows and outflows for individual Management Areas (MAs). Annual balances based on historical data are presented for water years 1975-2017, and average annual balances are presented for three intervals within that period. Water balances under future conditions were simulated for an 86-year period corresponding to hydrologic conditions during water years 1922-2007. Methods of analysis are summarized below. Findings are presented in terms of surface water balances, groundwater balances, and cumulative change in groundwater storage. Sustainable yield is also discussed.

This water balance has been developed based on the numerical model. It builds on water balances previously prepared for the Annual Groundwater Reports (see **Appendix F**), but some water balance elements differ from previous estimates. This reflects not only the use of currently available data for the entire North San Benito Basin, but also the fact that the numerical model allows a dynamic and comprehensive quantification of the water balance wherein all estimated water balance elements fit together and are calibrated to groundwater level changes over time. Accordingly, the numerical model is the best tool to quantify the North San Benito water balance. It will be updated regularly through the Groundwater Sustainability Plan (GSP) process, providing a better understanding of the surface water-groundwater system and a tool to evaluate future conditions and management actions.

5.1. WATER YEAR TYPE

GSP Regulations require quantification of the water budget by water year type, which is a classification based on the amount of annual precipitation in a basin. **Figure 5-1** shows annual rainfall in Hollister from water year 1922 through 2018; the average annual amount is 13.4 inches. Water year type is intended to aid in the evaluation of information such as water level hydrographs and groundwater storage changes. **Table 5-1** documents the classification developed for North San Benito, which describes five water year types (critically dry, dry, normal, above normal, wet). The methodology for defining the water year types is based on the California Department of Water Resources (DWR) Water Budget Best Management Practice (BMPs) Document (DWR, 2016b). For North San Benito, the annual rainfall amounts in Hollister over the period of record (1922-2018) were expressed as percentages of average annual rainfall. These were then sorted into quintiles, reflecting the five categories. The sorting into quintiles resulted in the classification shown in **Table 5-1**. The water years from 1922 to 2018 were then classified using the numeric values in **Table 5-1** as illustrated in **Figure 5-1.**

The water year classification is based on local Hollister rainfall as representative of the Basin and surrounding watershed. Local precipitation is important for the overall water balance of the area. While Central Valley Project (CVP) allocations are critical to avoiding overdraft and are based on precipitation patterns in the Sierra Nevada and Central Valley, local precipitation has a larger effect by volume on the groundwater basin. Surface water recharge, deep percolation, and irrigation demand are all dependent on local rainfall.

Table 5-1. Water Year Type Classification

Water Year Type		Range of percent normal	Precipitation Range (in)
Wet	W	>130	> 17.5
Above Normal	AN	105-130	14.1 – 17.5
Normal	N	85-105	11.4 – 14.1
Dry	D	70-85	9.4 – 11.4
Critically Dry	C	<70	< 9.4
Average Rainfall 13.4 inches per year			

5.2. WATER BALANCE ANALYSIS PERIODS

GSP Regulations require evaluation of the water balance over historical, current, and future periods. The historical period must include ten recent years at a minimum and the future involves projection of 50 years of historical hydrologic conditions. For the Basin, the historical period for water balance analysis is defined over water years 1975 – 2014 and is subdivided into two distinct historical periods. These periods were selected on the basis of cumulative departure of annual precipitation in Hollister during water years 1922-2018, on land use changes, and on availability of imported CVP water. While recognizing that CVP water is not directly available to all MAs, it has been critical to the water balance of the Basin as a whole. Hence two historical periods have been defined plus current and future periods, as described below:

- **Pre-CVP Historical (1975-1988)** – The Pre-CVP Historical period represents the period before CVP water was imported into the basin. Groundwater (with some replenishment by local surface water) was the sole water supply. The average annual precipitation was close to the long-term average, at 114 percent of normal.
- **Historical Recovery (1989-2014)** – The Historical Recovery period is marked by the beginning of CVP imports to supplement groundwater. While having direct effects only on Hollister and San Juan MAs, CVP supply was critical to basin-wide recovery. The average annual precipitation was close to the long-term average, at 102 percent of normal.
- **Current (2015-2017)** – The Current period is a snapshot view of recent conditions as required by Sustainability Groundwater Management Act (SGMA) regulations. Future annual reports will examine changes that have occurred since 2015. This relatively brief period included a dry, above normal, and wet year. The average annual precipitation over those three years (16.28 inches) was 121 percent of the long-term average.
- **Future (2018-2068)** – The Future period represents conditions expected to occur over the next 50 years. The “future baseline” simulation of this period spans an 86-year period corresponding to hydrologic conditions during water years 1922-2007. Two intervals totaling 50 years were selected from that overall period as the basis for calculating average annual future water balances. This process is described in greater detail in Section 5.4.3. In general, the future baseline simulation assumes a continuation of existing land use, urban water demand, water, and wastewater treatment and CVP availability.

5.3. MANAGEMENT AREAS (MA)

As defined in the GSP Regulations, an MA is an area within a basin for which the GSP 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. The Basin has been divided into four MAs, as described in the Definition of Management Areas for North San Benito Basin GSP technical memorandum, included in **Appendix E** to the GSP. The four MAs – Southern, Hollister, San Juan, and Bolsa are shown in **Figure 5-2** and briefly described below.

5.3.1. Southern Management Area

The Southern MA is characterized by uplands and small valleys along the San Benito River and Tres Pinos Creek. Land uses are predominantly rural residential, rangeland, and agricultural (mostly truck crops and vineyards), which rely on groundwater supply provided mostly by private wells.

A key factor differentiating the Southern MA from the other MAs is access to local surface water and the absence of effects of CVP water. Pumping in the Southern MA is also distant from the adjoining Hollister MA. Most of the pumping is in Paicines and Tres Pinos Creek Valleys, which are separated from the Hollister MA by three miles of rugged terrain where there is little pumping. Groundwater in Southern MA is recharged in part by releases from Hernandez and Paicines reservoirs.

5.3.2. Hollister Management Area

The Hollister MA includes the Hollister Valley and adjacent uplands mostly to the south. The Hollister MA differs from the adjoining MAs because of its variety of land uses, multiple jurisdictions, and multiple sources of water supply. Its boundary with the Bolsa and Southern MAs follows the boundary of Zone 6. The boundary with the San Juan MA—which includes part of Zone 6—crosses the narrow point in the valley floor at the upstream end of the San Juan Valley and traces the topographic divides on either side of the gap. The Hollister Valley includes intensive agriculture, rangeland, rural residential, urban, and industrial land uses. The MA includes all or portions of the City of Hollister, Sunnyslope County Water District, Pacheco Pass Water District, Tres Pinos County Water District, Hollister Hills SVRA, and the part of Pacheco Creek Valley that extends north into Santa Clara County.

Sources of water supply include local groundwater (recharged in part by releases from Hernandez and Paicines reservoirs to the San Benito River and releases from Pacheco Reservoir to Pacheco Creek), CVP imported water, and recycled water. A small amount of CVP water also is provided by Valley Water to a few customers in Santa Clara County parts of the MA. Production wells include irrigation, domestic, and public water supply wells throughout the MA, but well density is greater in the northern half of the MA. Domestic wells are relatively dense along Fairview Road, with minimum well depths less than 150 feet.

5.3.3. San Juan Management Area

The San Juan MA includes the San Juan Valley and adjacent uplands. Important characteristics of the San Juan MA are the various land uses, multiple jurisdictions, and multiple sources of water supply. The San Juan Valley is characterized by prime farmland and intensive agriculture, while the uplands are mostly rangeland with some rural residential and industrial land uses. The MA includes most of the City of San Juan Bautista and small areas of the City of Hollister, Aromas Water District, and Santa Clara County. Sources of water supply include local groundwater (recharged in part by releases from Hernandez and

Paicines reservoirs) and CVP imported water. The MA differs from the Hollister MA primarily because of a much higher proportion of agricultural land and water use, generally poorer groundwater quality, and an absence of recycled water use.

Irrigation wells are most numerous along the axis of the valley, while domestic wells are most numerous in the vicinity of San Juan Bautista and toward Aromas on the west, where the highest densities and shallowest wells have been documented by DWR.

5.3.4. Bolsa Management Area

The Bolsa area has long been recognized for its distinct topography and groundwater conditions (e.g., Clark, 1924), although its boundaries have been defined variously by USGS, DWR, and SBCWD. As shown in **Figure 5-2,** the Bolsa is a predominantly flat, relatively low-elevation area. It shares a watershed boundary with the San Juan MA and the Zone 6 boundary with the Hollister MA. It is the only MA bounding another groundwater basin, the Llagas Subbasin in Santa Clara County. It also differs from the adjacent Hollister and San Juan MAs by not having direct access to CVP imports or managed recharge from Hernandez and Paicines Reservoirs.

Important characteristics of the Bolsa MA include the predominantly agricultural and rural land uses and complete reliance on groundwater supply provided by private wells. The Bolsa MA includes the Pajaro River Wetland Mitigation Bank (see Figure 2-1), which includes about 273 acres of lands; the amount of water use is not known.

5.4. METHODS OF ANALYSIS

Complete, itemized surface water and groundwater balances were estimated by combining raw data (rainfall, stream flow, municipal pumping, wastewater percolation) with values simulated using models[4]. Collectively, the models simulate the entire hydrologic system, but each model or model module focuses on part of the system, as described below. In general, the models were used to estimate flows in the surface water and groundwater balances that are difficult to measure directly or that depend on current groundwater levels. These include surface and subsurface inflows from tributary areas, percolation from stream reaches within the Basin, groundwater discharge to streams, subsurface flow from the Llagas Subbasin and between Management Areas, the locations and discharges of flowing wells, consumptive use of groundwater by riparian vegetation, and changes in groundwater storage.

5.4.1. Rainfall-Runoff-Recharge Model

This Fortran-based model simulates hydrologic processes that occur over the entire land surface, including precipitation, interception[5], infiltration, runoff, evapotranspiration, irrigation, effects of impervious surfaces, pipe leaks in urban areas, deep percolation below the root zone, and shallow groundwater flow to streams and deep recharge. The model simulates these processes on a daily time step for 2,768 "recharge zones" delineated to reflect differences in physical characteristics as well as basin and jurisdictional boundaries. The recharge zones cover the entire watershed tributary to the

[4] Water balance values are shown to nearest acre-foot to retain small items, but entries are probably accurate to only two significant digits.

[5] Interception refers to precipitation that does not reach the soil, but instead falls on (and is intercepted by) plant leaves, branches, and plant litter, and is subject to evaporation loss.

groundwater basin except the San Benito River watershed south of the Southern MA. Simulation of watershed areas outside the Basin provided estimates of stream flow and subsurface flow entering the Basin. San Benito River inflow to the Southern MA was obtained directly from stream gauge data. Daily simulation results were subtotaled to monthly values for input to the groundwater model. Additional details regarding the rainfall-runoff-recharge model can be found in **Appendix G**.

5.4.2. Groundwater Model

A numerical groundwater flow model of northern San Benito County was originally developed in 2002 and previously updated in 2015 (Todd Groundwater, 2015). For GSP purposes, the model footprint was expanded to cover the entire Southern MA and all of the Pacheco Creek Valley part of the basin located in Santa Clara County. Also, the simulation period was updated to include water years 1975-2017 and to reflect 2014 land use as mapped by DWR and made available via the SGMA Data Portal website. The model uses the MODFLOW 2005 code developed by the U.S. Geological Survey, with pre- and post-processing facilitated by using Groundwater Vistas, a readily available commercial software package. The model produces linked simulation of surface water and groundwater, as described below. **Figure 5-3** shows the modeled area and key features. Additional documentation of the model update and recalibration is provided in **Appendix G**.

5.4.2.1. Surface Water Module

The stream flow routing module of MODFLOW simulates flow in creeks and rivers that cross the groundwater Basin (see **Figure 5-3**). Surface flow in these streams where they enter the Basin is provided by the user (from gauged flows or the rainfall-runoff-recharge model), and the flow is routed across the Basin from reach to reach. Each model grid cell traversed by a creek or river corresponds to a reach. Along each reach mass balance is conserved in the stream, including inflow from the upstream reach and tributaries, inflow from local runoff and CVP discharges, head-dependent flow across the stream bed to or from groundwater, and outflow to the next downstream reach. Flow across the stream bed is a function of the wetted channel length and width, the bed permeability and the difference in elevation between the stream surface and groundwater at the reach cell. Wetted width and depth of the stream are functions of stream flow.

5.4.2.2. Groundwater Module

MODFLOW simulates subsurface flow by combining equations representing flow through porous sediments (the Darcy Equation) with equations that enforce conservation of mass. The equations are implemented numerically, which means they are applied simultaneously between all adjoining cells in a model grid through an iterative process. Dispersed recharge to the top layer of the model grid from deep percolation of rainfall, irrigation water and pipe leaks is obtained from the rainfall-runoff-recharge model. Bedrock inflow is also obtained from that model and simulated as a series of injection wells around the periphery of the Basin. Percolation at wastewater treatment plants is similarly simulated as shallow injection wells in model cells at the wastewater pond locations. Irrigation pumping is estimated for each recharge zone by the rainfall-runoff-recharge model and assigned to the groundwater model cell closest to the center of the recharge zone. Evapotranspiration (ET) by riparian vegetation is simulated using the MODFLOW EVT module, which allows the ET rate to decrease as the water table drops to the bottom of the root zone. Where flowing wells are present during periods of relatively high groundwater levels, MODFLOW drain cells are used to cap the simulated water levels at the ground surface elevation. Groundwater inflow from the Llagas Subbasin is simulated as a function of cell cross-sectional area, permeability, and water-level difference between the cell and the estimated external groundwater level (estimated from measured water levels near the southern boundary of the Llagas Subbasin).

5.4.3. Simulation of Future Conditions

GSP regulations §354.18(c)(3) require simulation of several future scenarios to determine their effects on water balances, yield, and sustainability indicators. The following three scenarios are prescribed:

> **Future Baseline.** This represents a continuation of existing land and water use patterns, imported water availability, and climate.
>
> **Climate Change.** This represents a continuation of existing land and water use patterns, but with anticipated effects of future climate change on local hydrology (rainfall recharge and stream percolation) and on the availability of imported water supplies.
>
> **Growth.** This scenario implements anticipated changes in land use and associated water use, such as urban expansion, new irrigated areas, and changes in crop types.

Each of these scenarios must cover a 50-year period. The groundwater model used to evaluate historical conditions simulates a 43-year period (water years 1975-2017). To obtain 50 years of analysis, future simulations were completed as back-to-back simulations of two 43-year periods: water years 1922-1964 and 1965-2007. This period takes advantage of DWR's CalSim2 simulations of CVP availability, which cover the period 1922-2003. It also includes the two largest droughts in the historical record: 1923-1935 and 1987-1992. Except for water quality, undesirable results for all sustainability indicators are most common and/or most severe during droughts.

The simulations produce 86 years of simulated water levels and water balances. For GSP compliance average water balances were calculated for the combined periods of 1922-1953 and 1982-2002, which together total 50 years. Two periods were selected instead of a single continuous period in order to include the two large droughts. The specific date windows were selected on the basis of cumulative departure graphs of Hollister precipitation and CVP availability, which are shown in **Figures 5-4 and 5-5**, respectively. For both metrics, the early period was drier than average, and the late period was wetter. When combined, average precipitation and CVP availability were within 3 percent of their long-term averages.

The following paragraphs describe how hydrologic data and model input assumptions were developed for the future baseline scenario. Preparation and results of the climate change and growth scenarios are described in Section 8 Projects and Management Actions. Specific assumptions and data included in the future baseline simulation are as follows:

- Initial water levels are simulated water levels for September 2012 from the historical calibration simulation. That year represents relatively recent, non-drought conditions.
- Land use remains the same as existing conditions. In the model these are represented by 2014 land use mapped by remote sensing methods and obtained from DWR.
- Daily precipitation in Hollister was estimated back to 1922 based on correlations with gauged precipitation in Gilroy, Watsonville, and Salinas. Daily ETo was estimated by adjusting the average ETo for each calendar month to reflect historical daily temperatures, using regressions of temperature and ETo for each calendar month.

- Small stream inflows and bedrock inflow were simulated for 1922-2007 using the rainfall-runoff-recharge model from the historical simulation, with existing land use and the above daily time series of precipitation and ETo.
- Monthly outflow from the existing Pacheco Reservoir to Pacheco Creek during 1922-2003 was simulated assuming that winter inflows are stored up to the 5,500 AF capacity of the reservoir and released during June-September at 15 cfs, as long as sufficient water remains to supply those releases.
- San Benito River inflow at the model boundary for 1922-1974 was reconstructed using simple rainfall-runoff and reservoir operations models. Linear relationships between Hollister rainfall and flows at the gauge near Willow Creek School (near the model boundary) were developed for 1941-1961, which was the period of record prior to construction of Hernandez Reservoir. In the reservoir operations model, simulated runoff from the part of the watershed tributary to the Hernandez Reservoir site was stored in winter up to the reservoir capacity of 17,500 AF and released at 50 cfs from June through August as long as water was still available. The releases (and winter spills) were combined with runoff from the unregulated part of the watershed to obtain estimated flows at Willow Creek School. This implicitly assumed that Hernandez Reservoir will be operated as it was in the past.
- Municipal and Industrial (M&I) and rural domestic pumping were assumed to remain at existing levels. Those were obtained by calculating average pumping for each calendar month during 2015-2017 and applying those averages in every year of the future baseline simulation. This implicitly assumes no growth in those water use categories.
- Wastewater percolation and recycled water use for irrigation were assumed to remain at existing levels and were calculated using the same procedure as for M&I and domestic pumping.
- Monthly delivery of CVP water was obtained from DWR's CalSim2 operations model, which produces simulated allocations for south-of-Delta contractors. The CalSim2 simulation applied existing CVP operational rules and 2030 climate conditions in CVP source areas. For GSP purposes, actual use of CVP M&I water by the City of Hollister and Sunnyslope County Water District was set equal to the smaller of 1) the CalSim2 M&I allocation, 2) the combined capacity of the Lessalt and West Hills water treatment plants (approximately 5,900 AFY), or 3) the amount of CVP water needed to achieve a 70 percent / 30 percent blend of CVP water and groundwater. Other CVP M&I users were assumed to use 1,500 AFY (which is the recent historical usage) and be reduced by the same proportion as the two municipal water purveyors in years when the CVP allocation could not meet the normal demand. In the modeling, surplus CVP M&I water in wet years was transferred to agricultural use, although in practice it would likely be percolated to groundwater. Agricultural users were assumed to always accept all of the CalSim2 agricultural water allocation.

Simulated future baseline water balances for the Management Areas are presented in the next sections, where they are compared with historical and current water balances. Simulated groundwater levels are compared with simulated water levels for other future scenarios in Section 8 Projects and Management Actions.

5.5. Surface Water Balance

This section describes and quantifies the water balance of creeks and rivers that cross the Basin. All significant inflows to and outflows from these surface water bodies are included in the water balance. The surface water balance shares two flows in common with the groundwater balance: percolation from surface water to groundwater and seepage of groundwater into surface water. Each of these is an outflow from one system and an inflow to the other.

Annual surface water balances during 1975-2017 were compiled from monthly data for each Management Area. Average annual water balances for each Management Area during each of the four analysis periods are presented in Section 5.5.3. Annual basin wide surface water balances for 1975 to 2017 are shown in **Figure 5-6** and demonstrate how most of the surface water volume simply passes through the Basin.

Change in surface water in storage is not included in water balance tables. Local surface water is stored in Hernandez and Paicines Reservoirs, and CVP water is stored locally in San Justo Reservoir. Those facilities are used primarily to buffer seasonal fluctuations in supply and demand. Over periods of years—such as the water budget analysis periods—the net change in storage in the reservoirs is very small compared to the annual inflows and outflows. Accordingly, the net change is storage has been omitted from the tables.

5.5.1. Inflows to Surface Water

5.5.1.1. Precipitation and Evaporation

Precipitation and evaporation on the land surface are accounted for in the rainfall-runoff-recharge model. Those processes are not included in the surface water balances, which address only water in stream channels and imported water. Also, precipitation and evaporation on the surface of creeks and rivers is invariably a miniscule percentage of total stream flow. These small fluxes are not included in the surface water balances.

5.5.1.2. Tributary Inflows

Tributary inflows are the flows in creeks where they enter the Basin. With two exceptions, these flows are obtained from the rainfall-runoff-recharge model and passed to the surface water module of the groundwater flow model. The two exceptions are Pacheco Creek and the San Benito River, both of which have flows that are regulated by reservoir operation. For the historical and future baseline simulations, inflows to Pacheco Reservoir generated by the rainfall-runoff-recharge model were assumed to be stored in winter up to the 5,500 AF reservoir storage capacity and released at 15 cfs during June-September or until the reservoir was emptied, whichever occurred first. For the historical simulation of the San Benito River, inflows at the model boundary were set equal to measured flows at the gauge near Willow Creek School. Those flows reflect actual historical operation of Hernandez Reservoir. For the future baseline simulation, 39 percent of the simulated runoff for the entire watershed upstream of the model area was assumed to be regulated by Hernandez Dam. Inflow in winter was stored up to the 17,500 AF storage capacity of the reservoir and released during June-August at a rate of 50 cfs as long as sufficient storage was available to do so.

Stream flows entering one Management Area from another Management Area are itemized separately so the magnitude of discharge from local tributaries can be compared with the amount of water flowing through the Management Area in major creeks and rivers.

5.5.1.3. Valley Floor Runoff

Valley floor areas are flatter than the tributary watersheds, and the amount of runoff per acre is consequently smaller. The rainfall-runoff-recharge model simulates runoff from valley floor areas, and those flows are added to the inflows of nearby stream segments in the groundwater model.

5.5.1.4. CVP Imported Water

Two Management Areas (Hollister and San Juan) receive imported water from the CVP, which is delivered to municipal and agricultural users and formerly was also percolated in local streams to enhance groundwater recharge. Little of the imported water delivered to customers ends up in the stream network, given that efficient irrigation practices and urban water conservation are widespread and provide little opportunity for losses to streams. CVP imports are included in the water balances to provide a complete picture of surface water resources that are being or could potentially be harnessed to meet local water demands.

Annual deliveries of CVP are shown in **Figure 5-7**. Deliveries of imported water began in 1988 serving almost exclusively agricultural customers. During 1988-2001, substantial amounts of CVP water were percolated in local creeks to accelerate replenishment of groundwater storage following the 1987-1992 drought and prior decades of overdraft. The recovery effort was successful, and percolation of CVP water was greatly reduced. In 2008, concerns arose over potential introduction of invasive non-native species (zebra mussels) and discharges of CVP water to local creeks were discontinued. A new strategy of percolating CVP water in off-channel ponds was initiated in 2017. Use of CVP M&I water was limited to a few commercial users and small water systems until 2003, when completion of the Lessalt water treatment plant allowed much larger quantities to be treated and included in the City of Hollister water supply. The ability to use CVP M&I water was further increased by the West Hills water treatment plant, which became fully functional in 2017. In 2018, use of M&I water totaled 5,769 AF, or 70 percent of the maximum allocation. The CVP water delivered to growers and urban users reduces the amount of pumping needed to meet their respective water demands. During dry years when CVP allocations are low, groundwater pumping increases; and the opposite occurs in wet years. Thus, conjunctive use of CVP water and groundwater is a central element of local groundwater management.

CVP water is delivered to agricultural customers in the Hollister and San Juan MAs. In many years, agricultural use of CVP water has been limited by its availability. In wet years availability sometimes exceeds the demand. Although CVP water is more expensive than groundwater, it has much better water quality and is delivered with pressure. In 2009, regulatory changes in the CVP system resulted in decreased allocations for imported water. This change combined with drought conditions significantly reduced the amount of CVP imported for agricultural use during 2009-2017.

CVP imported water stored in San Justo Reservoir seeps from the reservoir to the local groundwater. In addition, water evaporates from the surfaces. These seepage and evaporation losses remain consistent through the period of record and are not shown in the surface water balance, although seepage from San Justo Reservoir is included in the groundwater model.

5.5.1.5. Seepage from Groundwater

When the water table elevation near a stream is higher than the water surface of the stream, groundwater will seep through the stream bed and add to streamflow. This flux depends strongly on groundwater elevation and is calculated by the stream flow routing module of the groundwater model.

5.5.2. Outflows of Surface Water

5.5.2.1. Surface Outflow from Management Areas and the Basin

Surface water outflow occurs where creeks and rivers cross the downstream boundary of a management area. For example, Pacheco Creek and Tequisquita Slough cross from the Hollister to the Bolsa MA, and Tres Pinos Creek and the San Benito River cross from the Southern to the Hollister MA.

The ultimate surface water outflow from the Basin is outflow to the Pajaro River at the western end of the San Juan MA. Surface flows at the boundaries between MAs and at the downstream end of the Basin are simulated by the stream flow routing module of the groundwater model.

5.5.2.2. Surface Water Percolation to Groundwater

Percolation from streams to groundwater occurs when the water level in a stream is higher than the nearby water table and is simulated using the same equation used for groundwater seepage into streams. The direction of flow across the stream bed simply depends on whether the stream surface is higher than the water table or vice versa.

5.5.3. Summary by Management Area

5.5.3.1. Southern MA

Table 5-2 summarizes surface water balances for the Southern MA. As shown, tributary watersheds supply almost all surface water inflows to the Southern MA, with the San Benito River watershed contributing about 43 percent of those inflows. Percolation to and from groundwater are both relatively high in this Management Area, primarily because of the long reaches of the San Benito River and Tres Pinos Creek that pass through. The relatively low value of seepage from groundwater into streams during the current period is likely due to delayed recovery of groundwater levels following the 2013-2015 drought. That is, 2017 was very wet in terms of rainfall, runoff, and streamflow, but groundwater levels were still recovering from the drought. Tributary inflows and valley floor runoff were lower in the future baseline simulation than during the three historical periods because average annual rainfall over the 1922-2017 period was less than the averages during each of the three historical periods. This rainfall difference was amplified by the nonlinear relationships between rainfall, runoff, and recharge: for a given percent increase in rainfall, simulated stream flow will increase by a larger percentage.

Table 5-2. Average Annual Surface Water Balances, Southern Management Area (AFY)

	Historical			
Water Balance Items	**Pre-CVP 1975-1988**	**Recovery 1989-2014**	**Current 2015-2017**	**Future[1]**
Surface Water Inflows				
Local watershed inflows	47,603	43,347	44,614	42,061
Valley floor runoff	3,996	3,854	5,509	2,708
Inflow from other MAs	0	0	0	0
CVP imports	*0*	*0*	*0*	*0*
Seepage from groundwater	20,482	18,851	12,911	19,297
Total	**72,081**	**66,053**	**63,034**	**64,066**
Surface Water Outflows				
Outflow from Southern to Hollister MA	(43,840)	(41,599)	(37,478)	(39,540)
Percolation to groundwater	(28,241)	(24,454)	(25,556)	(24,526)
Total	**(72,081)**	**(66,053)**	**(63,034)**	**(64,066)**
Net Inflow				
Inflows (except CVP) - outflows	**0**	**0**	**0**	**0**

1. Average for 1925-1953 and 1982-2002 combined (50 years total).

As shown in the Totals and bottom row of **Table 5-2**, total surface water inflows are equal to total surface water outflows. This reflects the lack of appreciable surface water storage in the MA, even with Paicines Reservoir, such that inflows quickly become outflows relative to the time frames considered here.

5.5.3.2. Hollister MA

As shown in **Table 5-3,** summarizing the Hollister MA surface water balances, local watershed inflows (from Pacheco Creek, Arroyo de las Viboras, Arroyo Dos Picachos, and Santa Ana Creek) are similar to the amount of surface inflow from the Southern MA (Tres Pinos Creek and the San Benito River). Percolation to groundwater decreased and groundwater seepage into surface water increased from the pre-CVP historical to the recovery period because of the rise in groundwater levels as the Basin recovered. Net recharge to groundwater decreased from 31 percent of stream inflows during the pre-CVP historical period to 25 percent during the recovery and current periods. Future tributary inflows and valley floor runoff are smaller than any of the historical and current periods because of less average annual rainfall combined with the nonlinear relationship of runoff to rainfall. Future CVP use is estimated to be similar to use during the recovery period. This reflects SBCWD's increased ability to use more M&I CVP water when it is available (due to the water treatment plants) and the assumption that all agricultural allocations will be accepted and put to use.

As shown in the table, total surface water inflows equal total outflows; this is because of the lack of surface water storage in the Hollister MA.

Table 5-3. Average Annual Surface Water Balances, Hollister Management Area (AFY)

	Historical			
Water Balance Items	**Pre-CVP 1975-1988**	**Recovery 1989-2014**	**Current 2015-2017**	**Future[1]**
Surface Water Inflows				
Local watershed inflows	46,235	43,596	56,273	33,056
Valley floor runoff	3,397	3,354	4,056	2,721
Inflow from Southern MA	43,840	41,599	37,478	39,540
CVP imports	*784*	*11,963*	*6,801*	*12,308*
Seepage from groundwater	844	2,541	635	2,203
Total	**95,100**	**103,052**	**105,243**	**89,828**
Surface Water Outflows				
Outflow from Hollister to Bolsa MA	(46,803)	(49,961)	(59,370)	(41,736)
Outflow from Hollister to San Juan MA	(17,492)	(16,298)	(10,880)	(14,113)
Percolation to groundwater	(30,021)	(24,831)	(28,192)	(21,671)
Total	**(94,316)**	**(91,089)**	**(98,442)**	**(77,520)**
Net Inflow				
Inflows (except CVP) – outflows[2]	**0**	**0**	**0**	**0**

1. Average for 1925-1953 and 1982-2002 combined (50 years total).
2. CVP imports are not included in the net inflow calculation as most is delivered directly to users.

5.5.3.3. San Juan MA

Table 5-4 summarizes the surface water balances for San Juan MA. As shown, by far the largest item in the San Juan MA water balance is Pajaro River inflow from the Bolsa MA. The river hugs the downstream edge of the Basin with little net exchange with groundwater; almost all of the inflow becomes outflow. The San Benito River is the next largest surface inflow. San Juan Creek inflow is about one-fourth as large, and valley floor and nearby hillside runoff totals about half the San Juan Creek flow. There is a steady decrease in percolation to groundwater and increase in groundwater discharge to streams from each analysis period to the next, probably reflecting long-term recovery of groundwater levels. As in the other MAs, watershed inflows and valley floor runoff are smaller in the future period than in the prior periods because of less average annual rainfall combined with the nonlinear relationship between rainfall and runoff. Future CVP imports are expected to be similar to those during the recovery period due to SBCWD's increased ability to use more M&I CVP water when it is available.

Total surface water inflows equal outflows because of lack of surface water storage in the San Juan MA.

Table 5-4. Average Annual Surface Water Balances, San Juan Management Area (AFY)

	Historical			
Water Balance Items	**Pre-CVP 1975-1988**	**Recovery 1989-2014**	**Current 2015-2017**	**Future[1]**
Surface Water Inflows				
Local watershed inflows	6,220	6,004	7,950	4,491
Valley floor runoff	2,413	2,240	2,948	1,744
Inflow from Hollister MA	17,492	16,298	10,880	14,113
Inflow from Bolsa MA	51,125	56,768	62,926	43,369
CVP imports	*261*	*4,950*	*2,549*	*4,801*
Seepage from groundwater	80	637	835	1,170
Total	**77,591**	**86,898**	**88,088**	**69,688**
Surface Water Outflows				
Outflow from San Juan MA to Pajaro River	(67,873)	(75,626)	(79,483)	(59,314)
Percolation to groundwater	(9,456)	(6,321)	(6,056)	(5,573)
Total	**(77,329)**	**(81,947)**	**(85,539)**	**(64,887)**
Net Inflow				
Inflows (except CVP) – outflows[2]	**0**	**0**	**0**	**0**

1. Average for 1925-1953 and 1982-2002 combined (50 years total).
2. CVP imports are not included in the net inflow calculation as most is delivered directly to users.

5.5.3.4. Bolsa MA

As shown in **Table 5-5**, the surface water balance of the Bolsa MA is dominated by inflows from the Hollister MA (Pacheco Creek and Tequisquita Slough). The water balance does not include surface inflows from the Llagas Subbasin, which would be large but tend to simply pass through the Bolsa MA as flow in the Pajaro River. Groundwater discharge to streams occurs primarily east of the Calaveras Fault; this increased from the historical to the recovery period as a result of regional recovery of groundwater levels. Discharge was lower during the current period due to drought-depressed groundwater levels and during the future period due to generally drier conditions (less rainfall on average). Lower average annual rainfall in the future scenario resulted in lower values of almost all surface inflows and outflows relative to the three prior periods.

Total surface water inflows equal outflows because of lack of surface storage in Bolsa MA.

Table 5-5. Average Annual Surface Water Balances, Bolsa Management Area (AFY)

	Historical			
Water Balance Items	**Pre-CVP 1975-1988**	**Recovery 1989-2014**	**Current 2015-2017**	**Future[3]**
Surface Water Inflows				
Local watershed inflows	0	0	0	0
Valley floor runoff[1]	3,603	3,374	4,377	2,347
Inflow from Hollister MA	46,803	49,961	59,370	41,736
CVP imports	0	0	0	0
Seepage from groundwater[2]	4,463	6,293	3,761	2,683
Total	**54,869**	**59,628**	**67,508**	**46,765**
Outflows				
Outflow from Bolsa to San Juan MA	(51,125)	(56,768)	(62,926)	(43,369)
Percolation to groundwater	(3,744)	(2,860)	(4,582)	(3,396)
Total	**(54,869)**	**(59,628)**	**(67,508)**	**(46,765)**
Net Inflow				
Inflows (except CVP) - outflows	**0**	**0**	**0**	**0**

1. For Bolsa MA, valley floor runoff includes runoff from the northern slopes of the Lomerias Muertas and from a small strip of land in the Llagas Subbasin between the Pajaro River and the northwestern model boundary.
2. For Bolsa MA, groundwater discharge to streams includes flow modeled as discharge to hypothetical drains along the lower reaches of Pacheco Creek and Tequisquita Slough.
3. Average for 1925-1953 and 1982-2002 combined (50 years total).

5.6. GROUNDWATER BALANCE

Annual groundwater inflows and outflows for each Management Area for the entire historical and current model period (1975-2017) are shown as stacked bars in **Figures 5-8** through **5-11**. Inflows are stacked in the positive (upward) direction and outflows are stacked in the negative (downward) direction. Average annual water budgets (including inflows, outflows, and change in groundwater storage) for each MA are presented in Section 5.6.3 for the Pre-CVP Historical, Historical Recovery, Current and Future analysis periods. This section describes groundwater inflows and outflows, while section 5.7 discusses groundwater balance variations by water year type and section 5.8 discusses cumulative change in groundwater storage.

5.6.1. Inflows to Groundwater

Inflows to the groundwater flow system can be conceptualized as dispersed recharge through the land surface (such as rainfall recharge and irrigation return flow), linear sources of recharge (such as percolation from creeks and subsurface inflow along the Basin boundary) and point sources of recharge (such as wastewater percolation facilities). Most groundwater inflows to the basin are controlled by hydrologic conditions. Natural stream percolation and deep percolation from rainfall are related to the volume and distribution of rainfall. The availability of imported water similarly reflects wet and dry conditions in the source area, which for CVP water is the Sierra Nevada. Because they are related to rainfall, almost all Basin inflows are higher in wet years and lower in dry years. The water balance analysis includes several categories of inflow to the Basin, each of which is described below.

5.6.1.1. Dispersed Recharge from Rainfall and Irrigation

Dispersed recharge from rainfall and applied irrigation water is estimated by the rainfall-runoff-recharge model. The model simulates soil moisture storage in the root zone, with inflows from rainfall infiltration and irrigation, and outflows to evapotranspiration and deep percolation. Simulation is on a daily basis. In recharge zones with irrigated crops, irrigation is assumed to be applied when soil moisture falls below a certain threshold. When soil moisture exceeds the root zone storage capacity, the excess becomes deep percolation. Rainfall and irrigation water comingle in the root zone and in deep percolation. For the purposes of displaying an itemized water balance, the amount of deep percolation derived from irrigation is estimated as a percentage of the simulated irrigation quantity, and the remainder of the dispersed recharge is attributed to rainfall. In urban recharge zones, pipe leaks are included in the amount shown as rainfall recharge. Deep percolation of applied irrigation water (irrigation return flow) is generally similar from year to year, whereas rainfall percolation varies significantly on an annual basis. The one-dimensional dispersed recharge rates are multiplied by the surface area of each recharge zone (2,768 zones in total) to obtain volumetric flow rates, and those are subtotaled by Management Area. The dispersed rainfall estimates are calculated using the rainfall-runoff-recharge model and were adjusted slightly to match the total model inflow as some recharge zones overlapped Basin or management area boundaries. This allowed a more detailed itemization of the water balance but introduced minor discrepancies in the totals. In the water balance bar charts, dispersed recharge from rainfall and irrigation are shown in light blue and light green, respectively.

5.6.1.2. Percolation from Streams

Inflows to the stream network in the surface water module of the groundwater model include a combination of gauged flows (for the San Benito River at the upstream end of the Southern MA only), simulated runoff from tributary watersheds and valley floor areas obtained from the rainfall-runoff-recharge model, and historical amounts of CVP water percolated in local streams. The effects of Hernandez Reservoir operation on San Benito River flows are included in the gauged flows, and the effects of Pacheco Reservoir on Pacheco Creek inflows were estimated by applying simple rules for seasonal storage and release. The effects of storage in the small Paicines Reservoir on San Benito River flows in the Southern MA were not considered. The surface water module simulates percolation from streams reach by reach along each stream that crosses the basin. Percolation is affected by groundwater levels. When groundwater levels are high there is less storage space available to receive stream percolation and overall percolation goes down. This phenomenon is known as “rejected recharge” and has been observed in field data as well as model results. It means that streams can provide high rates of recharge during the recovery period following a drought but not overfill the groundwater basin.

5.6.1.3. Reclaimed Water Percolation

Percolation of reclaimed water in wastewater disposal ponds occurs in two Management Areas (San Juan and Hollister) at facilities operated by the City of Hollister, SSCWD, and Tres Pinos County Water District (see **Figure 3-11** or **5-3** for locations). Discharges from the San Juan Bautista wastewater treatment plant flow are not included. These discharges occur to a small channel along the southwestern edge of San Juan Valley. That channel has little interaction with groundwater because it is southwest of the San Andreas Fault over much of its length. The remaining reach to San Juan Creek and the Pajaro River is underlain by clay soils that also do not support significant seepage fluxes to or from the channel. Wastewater releases to the City, SSCWD, and Tres Pinos ponds are measured directly. Percolation is assumed to be the plant inflow less net evaporation and amounts of wastewater recycled for irrigation use. Additional percolation may occur around rural residential septic systems. For the numerical model, it is assumed to be negligible as the volumes would be small and spread out all over the basin.

In the groundwater model, reclaimed water percolation and percolation of CVP water as incidental leakage from San Justo Reservoir are both simulated as shallow injection wells. Percolation of CVP water in off-channel recharge ponds has occurred in Hollister and San Juan MAs. The amounts have been relatively small and are not included in the groundwater model or water balance tables.

5.6.1.4. Subsurface Groundwater Inflow

Three types of subsurface inflow are listed separately in the water balance tables. Subsurface inflow from external basins occurs only in the Bolsa MA, where flow enters from the adjacent Llagas Subbasin. This is simulated as a head-dependent flow that varies depending on simulated groundwater levels near the boundary (lower water levels increase the simulated inflow rate). Along the rest of the Basin perimeter, small amounts of subsurface inflow results from recharge percolating through fractured bedrock in tributary watershed areas. This process is simulated by the rainfall-runoff-recharge model. Bedrock inflow is simulated as shallow injection wells along the perimeter of the Basin. Finally, subsurface flow occurs across the management area boundaries within the Basin. These flows are extracted from the groundwater model using the ZoneBudget post-processing utility program. In the water balance bar charts, Llagas inflow, bedrock inflow, and inflow from other Management Areas are shown in yellow, gray, and dark green, respectively.

5.6.2. Outflows from Groundwater

Major outflows from the Basin are pumping (agricultural, municipal, industrial, and domestic), groundwater seepage into streams, subsurface outflow, and evapotranspiration by riparian vegetation.

5.6.2.1. Pumping by Wells

Agricultural. Agricultural pumping is much larger than the other types and is listed separately in the water balance tables and shown in green on the water balance bar charts (**Figures 5-8** through **5-11**). Agricultural pumping is dependent not only on cropping patterns and irrigation practices, but also on the volume of CVP imports and the amount and timing of rainfall. Spring rains decrease total irrigation demand, and growers adjust pumping to compensate for wet weather and the availability of CVP imports. Agricultural groundwater pumping in the model and water balance tables is simulated by the rainfall-runoff-recharge model. When simulated soil moisture falls below a specified threshold in a recharge zone with irrigated crops, irrigation is assumed to be applied and to refill soil moisture to capacity. Irrigation not derived from CVP water or recycled water is assumed to be from groundwater. In the groundwater model, the agricultural pumping associated with each zone is located at the center of the zone.

Agricultural pumping in Zone 6 is also monitored by SBCWD by recording the operating time of pump motors and multiplying that by a measured discharge rate. Previous studies have found that the pumping estimates obtained by this method are significantly smaller than the estimates obtained by simulating crop water demand and soil moisture. The simulation approach improved model calibration during the 2014 model update, and that approach is retained in the current model.

Reliable measurements of agricultural pumping are a recognized data gap. Given the large range or uncertainty and the model sensitivity to the volume and location of agricultural pumping, evaluation is needed of alternative methodologies for accurately evaluating agricultural pumping.

Municipal, Industrial and Domestic. Municipal pumping by City of Hollister and SSCWD is in the Hollister MA, with additional pumping by San Juan Bautista in San Juan MA. Pumping by major municipal providers is measured, as is pumping by smaller community water systems and self-supplied commercial and industrial facilities within Zone 6. Actual pumping and well locations are used in the numerical model. Additional pumping for potable use at rural residences and agricultural buildings was estimated by inventorying the number and locations of those buildings on aerial photos. This domestic pumping is assigned to 200 hypothetical wells near building locations. This pumping is shown in the charts as pink in **Figures 5-8** through **5-11**.

5.6.2.2. Subsurface Outflow

Subsurface outflows were calculated using the groundwater model by the same methods used to simulate subsurface inflows. In the water balance tables and charts, shown in **Figures 5-8** through **5-11,** subsurface outflow to external basins (dark blue) is shown separately from outflow to other Management Areas (orange).

5.6.2.3. Groundwater Discharge to Streams

Discharges from the groundwater basin to surface water bodies are simulated by the groundwater model based on stream bed wetted area and permeability and on the amount by which the simulated groundwater elevation in a model stream cell is higher than the simulated surface water elevation. This occurs in all Management Areas, but notably where Pacheco Creek and Tequisquita Slough approach the Calaveras Fault, where the Pajaro River approaches the downstream end of the Bolsa MA, and along the San Benito River at the downstream end of the San Juan MA. The relatively large amounts of simulated groundwater discharge to streams in the Southern MA is balanced by high amounts of percolation from streams. The San Benito River and Tres Pinos Creek transition from gaining to losing at various locations in the Southern MA. This outflow is shown in the water balance charts in a red color in **Figures 5-8** through **5-11**.

5.6.2.4. Riparian Evapotranspiration

The presence of dense, vigorous trees and shrubs along a stream channel is often a sign that the roots of the vegetation extend to the water table and have access to groundwater throughout the dry season. Plants that draw water directly from groundwater are called phreatophytes. Stream reaches with this type of vegetation were mapped from Google Earth aerial photos, and the width of the vegetation corridor was used to obtain the total area of phreatophyte evapotranspiration (ET). The rate of groundwater withdrawal was estimated as the difference in simulated ET when the vegetation was assumed to be non-irrigated (subsisting only on rainfall) versus irrigated (accessing all water needed to meet potential ET). In the groundwater model, riparian ET is a function of water table depth, decreasing from unrestricted water use when the water table is at the ground surface to zero when it is 15 feet or more below the ground surface. This reflects a reasonable range of root depth distribution for a mix of riparian shrub and tree species. Riparian ET is shown with a blue color on the water balance bar charts in **Figures 5-8** through **5-11**.

5.6.3. Summary by Management Area

5.6.3.1. Southern MA

Figure 5-8 and **Table 5-6** summarize groundwater balances for the Southern MA. The Southern MA includes long reaches of the San Benito River and Tres Pinos Creek as they first enter the groundwater basin. The dominant land use is natural grassland and shrubs. Given that, the major inflows to and outflows from groundwater are dominated by percolation from streams and groundwater discharge into streams. As shown on **Figure 5-8** and **Table 5-6**, percolation from surface water accounts for more than 70 percent of inflow and discharge to streams represents more than 50 percent of outflow. Percolation from stream channels into the Southern MA is significantly higher in wet years than dry years. As illustrated in **Figure 5-6**, wet-year inflow from streams can average four times more than in critically dry years. Similarly, outflow to streams varies substantially. Agricultural pumping in the Management Area remains steady at approximately 6,700 AFY. The small amount of inflow from the Hollister MA is an artifact of local deviations in the boundary alignment relative to the prevailing flow gradient, which is from the Southern MA to the Hollister MA. The relatively large increase in groundwater storage during the current period reflects groundwater recovery following the 2013-2015 drought and concurrent decrease in groundwater discharge to streams. Under future baseline conditions average annual rainfall is less than during the prior periods (reflecting the difference between historical measured or estimated rainfall during 1922-1974 versus 1975-2017). Stream flow and rainfall recharge are both nonlinear functions of rainfall, such that a percentage decrease in rainfall will produce a larger percentage decrease in runoff and recharge. However, the reduction in recharge from streams and rainfall is balanced by changes in other inflows and outflows so that the average annual storage change for the future baseline scenario is close to zero.

Table 5-6. Average Annual Groundwater Balance, Southern Management Area (AFY)

Water Balance Items	Historical		Current	Future[2]
	Pre-CVP 1975-1988	Recovery 1989-2014	2015-2017	
Groundwater Inflow				
Subsurface inflow from external basins	0	0	0	0
Percolation from streams	28,241	24,454	25,556	24,526
Bedrock inflow	1,601	1,693	684	1,119
Dispersed recharge from rainfall[1]	5,810	5,954	8,595	4,439
Irrigation deep percolation	597	576	659	624
Reclaimed water percolation	0	0	0	0
Inflow from Hollister MA	940	954	941	822
Total inflow	**37,189**	**33,632**	**36,434**	**31,530**
Groundwater Outflow				
Subsurface outflow to external basins	0	0	0	0
Wells - M&I and domestic	(53)	(126)	(143)	(142)
Wells – agricultural	(6,626)	(6,396)	(7,157)	(6,911)
Groundwater discharge to streams	(20,482)	(18,851)	(12,911)	(19,297)
Riparian evapotranspiration	(1,675)	(1,572)	(1,563)	(1,587)
Outflow to Hollister MA	(3,328)	(3,357)	(3,215)	(2,991)
Total outflow	**(32,163)**	**(30,304)**	**(24,988)**	**(30,928)**
Net Change in Storage	**5,026**	**3,328**	**11,446**	**603**

1. Dispersed recharge volumes adjusted from pre-processor to match model inflows.
2. Average for 1925-1953 and 1982-2002 combined (50 years total).

5.6.3.2. Hollister MA

Groundwater balances for the Hollister MA are summarized in **Figure 5-9** and **Table 5-7**. As shown on **Figure 5-9**, inflows to the Hollister MA are largely from deep percolation of precipitation and percolation of surface water (i.e., San Benito River and others). Both sources are much larger (more than double) in wet years than in normal or dry years. Percolation from streams is relatively high and groundwater discharge to streams is relatively low when groundwater levels are low, such as in the Historical and Current periods (due to prior overdraft and to drought, respectively). As shown in **Table 5-7**, groundwater inflow from bedrock in tributary watersheds was considerably lower during the current period than the other periods. This was because bedrock inflow is relatively slow and reflects average hydrologic conditions over the preceding several years. During the three-year current period it was still depressed from the 2013-2015 drought.

The outflow from Hollister is dominated by agricultural pumping (more than 65 percent of total outflow), followed by outflow to other MAs (more than 15 percent). Agricultural pumping was relatively high in the Current period due to reduced allocations of CVP water during the 2013-2015 drought (see **Figure 5-9**). Future agricultural groundwater pumping is expected to be about the same as it was during the Recovery period. M&I pumping increased from the Pre-CVP Historical to Recovery period reflecting a growing population but decreased in the current period reflecting the new treatment capacity to replace groundwater with CVP water for M&I uses. Future M&I pumping is higher than current pumping because of reduced long-term average CVP allocations, but wastewater percolation remains about the same. Outflow to other MAs was relatively low during the Current period, probably because the drought-related reduction in CVP use caused a greater increase in groundwater pumping (and hence decrease in groundwater levels) in the Hollister MA relative to the Bolsa MA. This would decrease the water level gradient and reduce the flow. The average annual decline in storage in the Future period is small relative to total inflows and outflows and is probably within the range of uncertainty of the overall water balance. For example, simulated storage change for the overall 1922-2007 period was positive (see Section 5.8).

Table 5-7. Average Annual Groundwater Balances, Hollister Management Area (AFY)

	Historical			
Water Balance Items	**Pre-CVP 1975-1988**	**Recovery 1989-2014**	**Current 2015-2017**	**Future[2]**
Groundwater Inflow				
Subsurface inflow from external basins	0	0	0	0
Percolation from streams	30,021	24,831	28,192	21,671
Bedrock inflow	4,075	4,115	427	3,143
Dispersed recharge from rainfall[1]	19,455	18,336	23,709	17,414
Irrigation deep percolation	4,747	4,511	5,132	4,761
Reclaimed water percolation	1,250	1,841	2,603	2,486
Inflow from Southern MA	7,033	6,455	6,371	6,043
Total inflow	**66,580**	**60,089**	**66,434**	**55,517**
Groundwater Outflow				
Subsurface outflow to external basins	0	0	0	0
Wells - M&I and domestic	(3,885)	(6,905)	(4,424)	(5,627)
Wells - agricultural	(39,049)	(38,278)	(45,458)	(38,411)
Groundwater discharge to streams	(844)	(2,541)	(635)	(2,203)
Riparian evapotranspiration	(173)	(174)	(118)	(158)
Outflow to Bolsa and San Juan MAs	(10,294)	(9,439)	(8,717)	(10,176)
Total outflow	**(54,245)**	**(57,337)**	**(59,351)**	**(56,575)**
Net Change in Storage	**12,336**	**2,752**	**7,083**	**(1,058)**

1. Dispersed recharge volumes adjusted from pre-processor to match model inflows.
2. Average for 1925-1953 and 1982-2002 combined (50 years total).

5.6.3.3. San Juan MA

The groundwater balances for San Juan MA are shown on **Figure 5-10** and **Table 5-8**. Inflow to San Juan MA is mostly deep percolation of rainfall and irrigation water (31-39 percent) and percolation from the San Benito River and San Juan Creek (25-36 percent) followed by inflow from the Hollister MA (16-22 percent). As illustrated in **Figure 5-10**, wet-year percolation from surface water and rainfall can average almost 30,000 AFY compared to only 3,000 AFY in critically dry years.

Relative to inflow, groundwater outflow is relatively steady and consists mainly of agricultural pumping (80-86 percent). As in the Hollister MA, average pumping decreased from the Pre-CVP Historical to the

Recovery period due to CVP imports and increased in the Current period due to drought-related reductions in CVP supplies. Groundwater discharge to the San Benito River increased from the Historical to the Current periods as groundwater levels recovered. This discharge is important as a means of removing salts from the basin and limiting long-term increases in groundwater salinity. Average annual storage change was positive during the Historical and Current periods due to long-term recovery of groundwater levels. Future storage change is expected to average around zero, in the baseline simulation.

Table 5-8. Average Annual Groundwater Balances, San Juan Management Area (AFY)

Water Balance Items	Historical		Current 2015-2017	Future[2]
	Pre-CVP 1975-1988	Recovery 1989-2014		
Groundwater Inflow				
Subsurface inflow from external basins	0	0	0	0
Percolation from streams	9,456	6,321	6,056	5,573
Bedrock inflow	774	1,328	1,110	1,140
Dispersed recharge from rainfall[1]	8,239	7,703	9,585	7,039
Irrigation deep percolation	2,151	1,924	1,942	2,161
Reclaimed water percolation	609	1,441	1,843	1,734
Inflow from Hollister and Bolsa MAs	5,239	4,188	4,026	4,910
Total inflow	**26,469**	**22,904**	**24,563**	**22,557**
Groundwater Outflow				
Subsurface outflow to external basins	0	0	0	0
Wells - M&I and domestic	(581)	(917)	(476)	(652)
Wells - agricultural	(17,936)	(16,588)	(17,490)	(18,364)
Groundwater discharge to streams	(80)	(637)	(835)	(1,170)
Riparian evapotranspiration	(740)	(959)	(1,065)	(1,042)
Outflow to Bolsa MA	(1,451)	(1,546)	(1,578)	(1,686)
Total outflow	**(20,790)**	**(20,645)**	**(21,444)**	**(22,914)**
Net Change in Storage	**5,679**	**2,259**	**3,118**	**(357)**

1. Dispersed recharge volumes adjusted from pre-processor to match model inflows.
2. Average for 1925-1953 and 1982-2002 combined (50 years total).

5.6.3.4. Bolsa

The annual groundwater inflows and outflows for the Bolsa MA are shown on **Figure 5-11** and **Table 5-9**. The largest source of inflow is rainfall recharge, but it varies greatly by year type: accounting for over half of total inflow during a wet year like 2017 and only 7 percent during a dry year like 2013. Rainfall recharge is relatively low in the Future period because average annual rainfall is smaller and the nonlinear relationship between rainfall and recharge causes an even larger decrease in recharge on a percentage basis. Subsurface inflow from the Hollister MA is relatively stable at around 5,000 AFY.

As described in the Management Area section, Bolsa does not receive CVP imported water and thus relies on groundwater pumping, which is 64-81 percent of total outflow. The area of irrigated cropland increased in the past decade, resulting in the increase in pumping from the Recovery to the Future period. The even higher amount during the Current period is the result of drought conditions. The recent increase in irrigated area combined with minor changes in parameters used to estimate irrigation demand resulted in agricultural pumping estimates in the current model that are larger than estimates previously presented in annual groundwater reports. The next largest outflow is discharge to streams (including water from tile drains and flowing wells listed in the table as "shallow discharge to streams"), which accounts for 11-26 percent of total outflow. This outflow increases noticeably in wet years.

Table 5-9. Average Annual Groundwater Balances, Bolsa Management Area (AFY)

Water Balance Items	Historical		Current 2015-2017	Future[2]
	Pre-CVP 1975-1988	Recovery 1989-2014		
Groundwater Inflow				
Subsurface inflow from external basins	4,176	3,761	5,940	5,088
Percolation from streams	3,744	2,860	4,582	3,396
Bedrock inflow	0	0	71	0
Dispersed recharge from rainfall[1]	11,756	11,088	16,184	8,431
Irrigation deep percolation	1,427	1,395	2,257	2,863
Reclaimed water percolation	0	0	0	0
Inflow from Hollister and San Juan MAs	4,560	4,740	4,415	4,954
Total inflow	**25,662**	**23,844**	**33,448**	**24,733**
Groundwater Outflow				
Subsurface outflow to external basins	(34)	(42)	(17)	(21)
Wells - M&I and domestic	(9)	(22)	(24)	(24)
Wells - agricultural	(15,860)	(15,467)	(24,017)	(19,958)
Groundwater discharge to streams	(4,463)	(6,293)	(3,761)	(2,683)
Riparian evapotranspiration	(251)	(256)	(192)	(213)
Outflow to San Juan MA	(2,699)	(1,995)	(2,350)	(1,877)
Total outflow	**(23,315)**	**(24,076)**	**(30,362)**	**(24,775)**
Net Change in Storage	**2,347**	**(232)**	**3,087**	**(42)**

1. Dispersed recharge volumes adjusted from pre-processor to match model inflows.
2. Average for 1925-1953 and 1982-2002 combined (50 years total).

5.7. VARIATION IN WATER BUDGET BY WATER YEAR TYPE

In each MA, the contribution from each source of inflow varies in response to hydrological conditions. Accordingly, **Table 5-10** shows the average annual water balance during the Historical and Current analysis (1975-2017) based on water year type (wet, above average, normal, dry, and critically dry). In general, inflows respond to changes in hydrological conditions, but outflows remain dominated by pumping that is fairly consistent across all water year types. In all MAs, inflow varies greatly from high volumes of inflow in wet years to minimal volumes of inflow during critically dry years. The result is that the basin gains groundwater storage in wet years and loses storage in dry years.

Table 5-10. Inflows and Outflows by Water Year Type (AFY)

	Water Year Type				
	Wet Year	**Above Normal**	**Normal**	**Dry**	**Critically Dry**
Southern MA					
Inflow	63,081	37,081	27,131	21,120	13,260
Outflow	(32,601)	(32,234)	(27,040)	(30,576)	(27,319)
Change in Storage	30,480	4,847	92	(9,456)	(14,059)
Hollister MA					
Inflow	96,071	68,817	51,562	45,374	33,891
Outflow	(51,522)	(54,785)	(58,933)	(58,394)	(62,151)
Change in Storage	44,549	14,032	(7,371)	(13,020)	(28,260)
San Juan MA					
Inflow	40,008	26,688	17,776	15,978	12,018
Outflow	(18,178)	(20,105)	(21,943)	(21,774)	(23,388)
Change in Storage	21,831	6,584	(4,167)	(5,796)	(11,369)
Bolsa MA					
Inflow	35,787	26,246	21,417	19,395	17,488
Outflow	(28,731)	(25,193)	(21,595)	(21,931)	(21,177)
Change in Storage	7,056	1,054	(178)	(2,536)	(3,689)

5.8. CHANGE IN GROUNDWATER STORAGE

The water balance tables show two estimates of storage: the difference between total inflows and total outflows, and the amount simulated by the groundwater model.

Figure 5-12 shows the cumulative change in storage from the model for the four Management Areas for the Historical and Current periods, 1975-2017. The amount of groundwater in storage fluctuated over the simulation period. Groundwater storage was at its lowest near the beginning of the simulation because of overdraft during the preceding decades and an intense drought during 1976-1977. For Hollister and San Juan MAs, groundwater storage increased significantly when imported water deliveries begin in 1988. With decreased groundwater pumping, managed aquifer recharge, and several wet years in the 1990s, groundwater storage increased rapidly in these two MAs and has remained relatively steady since 1998. As discussed in Section 4.1.3, the recovery of groundwater levels and storage in those Management Areas provided a buffer for the recent drought of 2013-2015, allowing local groundwater users to pump groundwater without severe declines.

Evaluation of storage change in the Southern MA is less certain because of the scarcity of hydrogeologic and monitoring data to correctly estimate the initial storage in 1975. The rapid increase in storage during the 1990s resulted primarily from wet years during that decade (no CVP water is delivered to this MA), but the overall long-term increasing trend is likely the result of having underestimated the 1975 water levels. The model gradually added water to storage until the simulated water-level surface in upland areas achieved a balance between recharge rates and estimated aquifer permeability and storativity.

Groundwater storage in the Bolsa MA remained relatively steady during 1975-2017. In wet years, high rainfall recharge tended to be balanced by greater groundwater discharge to streams. There were also some compensating effects among different parts of the Management Area. East of the Calaveras Fault, some hydrographs showed water levels rising several tens of feet until intersecting the land surface elevation in the mid-1990s, then leveling out. In contrast, hydrographs west of the fault declined through about 1988, rose to the mid-1990s, then generally leveled out. A few hydrographs in that area have exhibited slight long-term declining trends, and the model calibration slightly overestimated some of those declines.

Figure 5-13 shows cumulative storage changes in each of the Management Areas under simulated future conditions. These are the results of a continuous 86-year simulation corresponding to hydrologic conditions during 1922-2007. As indicated on the figure, fifty years were extracted from the simulation results to represent future baseline conditions for water balance calculations. Imported CVP water was assumed to be available throughout the Future period in amounts simulated by DWR's CalSim2 model. Average availability over the Future period was less than during the Recovery period, but the results indicated sufficiency to prevent overdraft.

Conjunctive operation of local groundwater with CVP imports nevertheless resulted in substantial groundwater storage declines during droughts followed by recovery in wet years. This can be seen during the simulation intervals corresponding to historical hydrology during 1923-1934 and 1987-1992. Those droughts produced large cumulative deficits in local rainfall and CVP deliveries and large cumulative decreases in groundwater storage. CVP allocations to agricultural users in the Basin dropped to about 8,900 AFY and 4,600 AFY during the two droughts, respectively, compared to the long-term average of 17,600 AFY. There was a large simulated increase in groundwater pumping to compensate for the decreased CVP deliveries. This caused cumulative storage declines of 165,000 AF in the Hollister MA and 65,000 AF in the San Juan MA during the 1923-1934 drought (121,000 AF and 52,000 AF during 1987-1992). However, simulated storage in both of those areas recovered to pre-drought levels within 6-10 years.

The Southern MA and to a lesser extent the Bolsa MA also experienced cumulative storage declines during the drought periods, but those were due solely to decreased rainfall and stream recharge. In those Management Areas, simulated storage also recovered during the 6-10 years following the droughts.

5.9. Estimate of Sustainable Yield

The sustainable yield is defined as the volume of pumping that the basin can sustain without causing undesirable effects. It is not a fixed or inherent natural characteristic of a groundwater basin. Rather, it is influenced by land use activities, importation of water, wastewater and stormwater management methods, and the locations of wells with respect to interconnected streams. The estimate of sustainable yield presented in this section reflects the current status of those variables and evaluates whether there would be a long-term increase or decrease in basin storage if those conditions continued over a 50-year Future period with local hydrology and CVP imports (per CalSim2) corresponding to 1925-1953 and 1982-2002.

A long analysis period is needed to evaluate yield because of changes in the relative amounts of recharge and pumping from normal or wet conditions to droughts and back again. In basins like this one where groundwater and surface water supplies are used conjunctively, groundwater storage is expected to decline during droughts and recover afterwards. In a dry year when imported supplies are generally limited, the volume of groundwater pumped is generally higher. This increased pumping can be sustained for limited periods of time as long as the basin is subsequently replenished. In wet years when rainfall recharge is relatively high, imported supplies are more available and groundwater pumping is generally reduced, recharge exceeds pumping and storage recovers. Therefore, the evaluation of long-term storage trends needs to span one or more complete wet-dry-wet climate cycles. The two-part period of years selected for the future baseline simulation includes complete drought and recovery cycles for the 1923-1935 drought and 1987-1992 drought, which were the two largest droughts in terms of effect on simulated water levels.

The estimate of sustainable yield was based on the future baseline simulation. It is a forward-looking estimate that incorporates current land use, CVP operating rules, and other management activities. To evaluate a sustainable yield, the average pumping that occurred during the 1925-1953 and 1982-2002 periods of the future baseline simulation was calculated. Average annual pumping by Management Area and type of use in the future baseline simulation is as shown in **Table 5-11** and totals 90,089 AFY.

If the simulation showed a net decline in groundwater storage over the simulation period, the sustainable yield would be less than the amount of pumping in the simulation, and vice versa. In the future baseline simulation, net change in groundwater storage was essentially zero (see **Tables 5-6** through **5-9**). Specifically, average annual storage change was +/- 1% for Hollister, San Juan and Bolsa MAs and 3% for Southern MA, which is within the range of uncertainty in the modeled water balance.

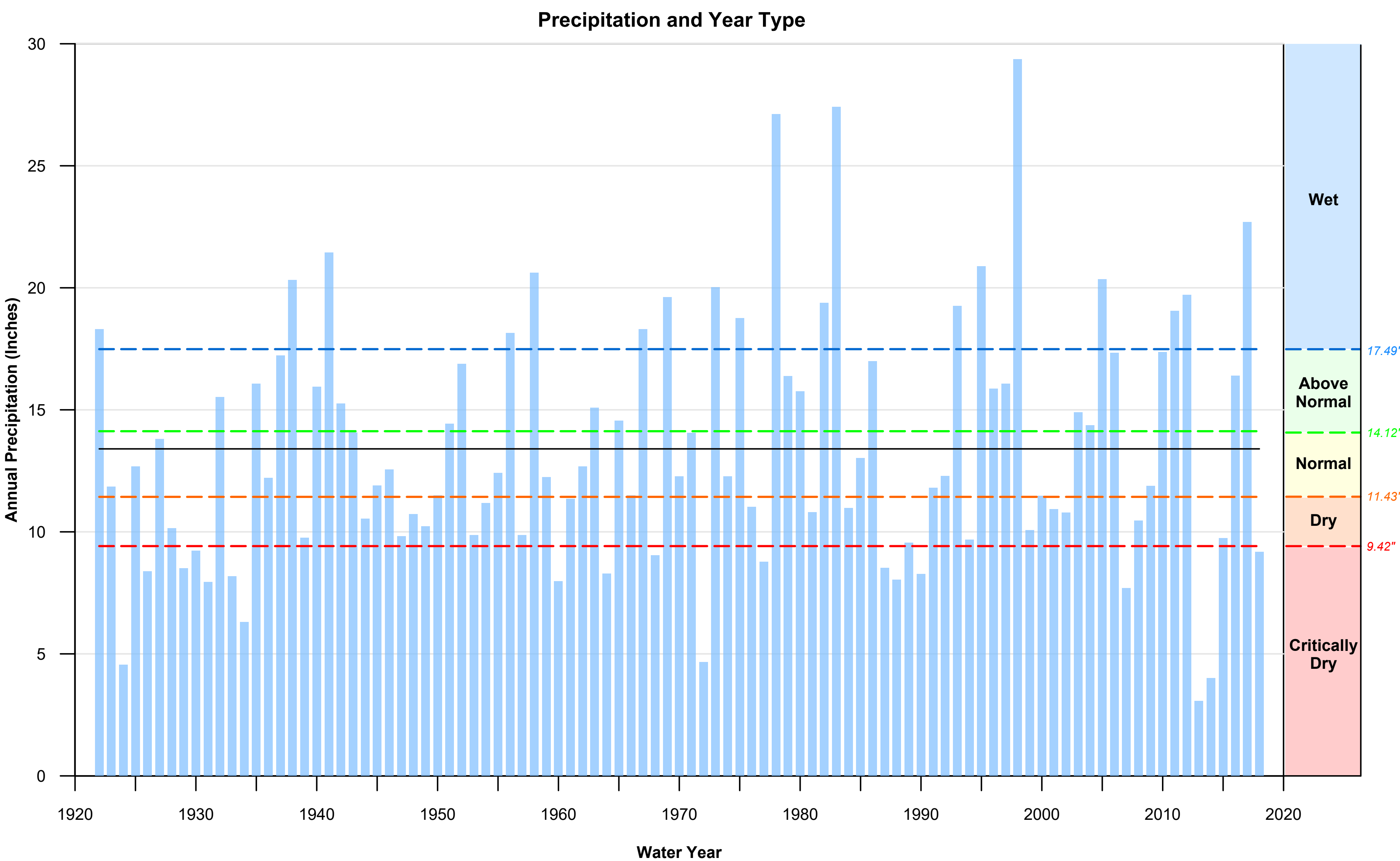
Therefore, average annual groundwater pumping in the future baseline simulation is the best available estimate of sustainable yield.

This long-term average sustainable yield reflects a continuation of existing conditions. Significant changes in management (e.g., the recent completion of additional treatment capacity for imported water) or significant climate changes (e.g., reduction in precipitation) would affect the yield of the basin. Accordingly, sustainable yield is not a fixed number.

Moreover, the definition of sustainable yield refers to undesirable results, which are quantified through the sustainability criteria (i.e., minimum thresholds and measurable objectives) and have important ramifications for overall sustainable yield. Accordingly, this sustainable yield value is a broad indicator. It indicates no overdraft based on the water budget, but it must be interpreted through evaluation of undesirable results.

Table 5.11 Average Annual Pumping (AFY) by Management Area, Future Baseline

Management Area	Future Baseline		
	Agricultural Pumping	M&I Pumping	TOTAL
Southern	6,911	142	7,053
Hollister	38,411	5,627	44,038
San Juan	18,364	652	19,017
Bolsa	19,958	24	19,982
Total	**83,643**	**6,446**	**90,089**



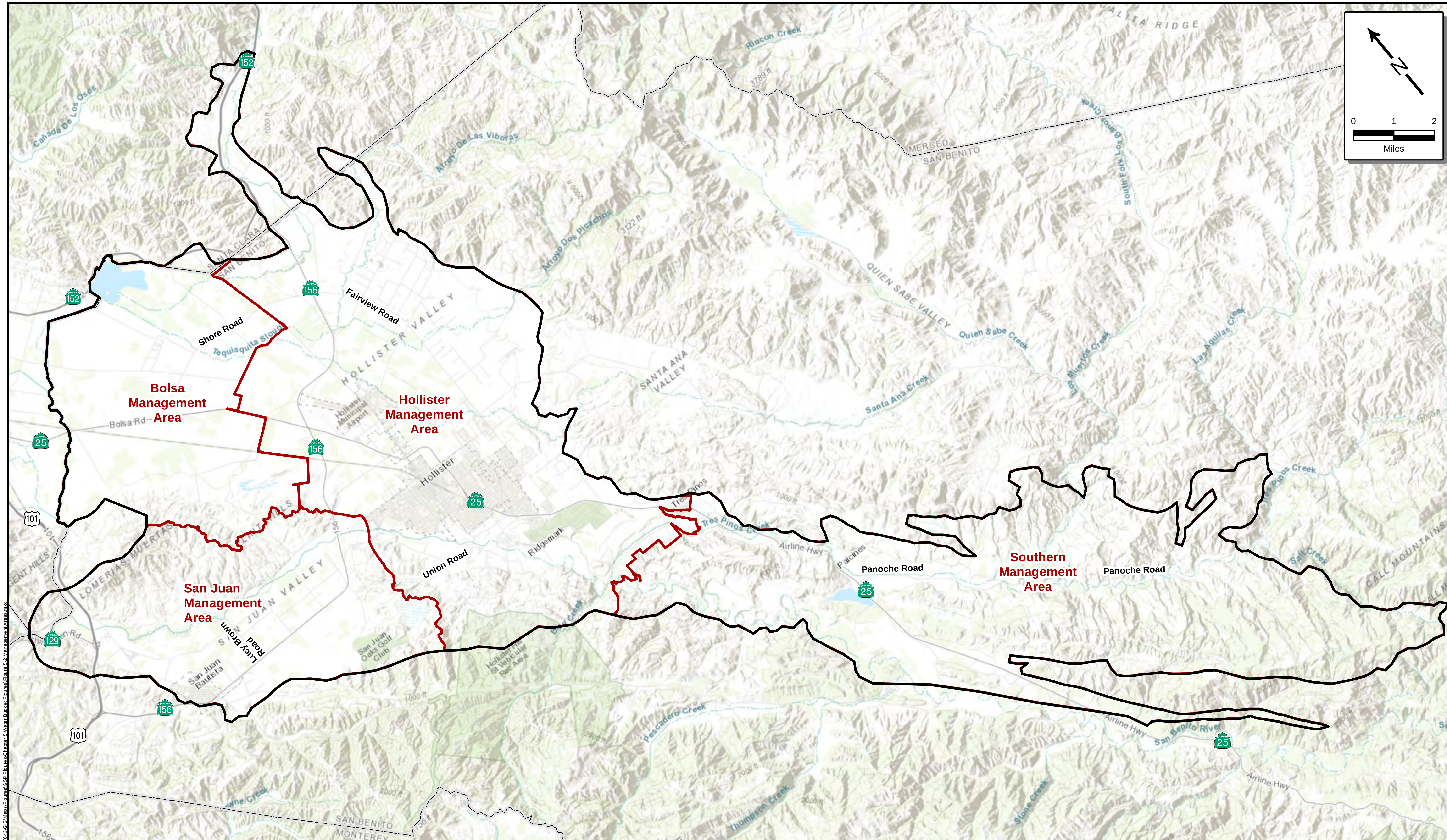
Average Annual Precipitation (13.40")
Precipitation

November 2021

TODD GROUNDWATER

Figure 5-1
Annual Precipitation

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 5-1 Annual Precipitation_r2.gpj



North San Benito Basin

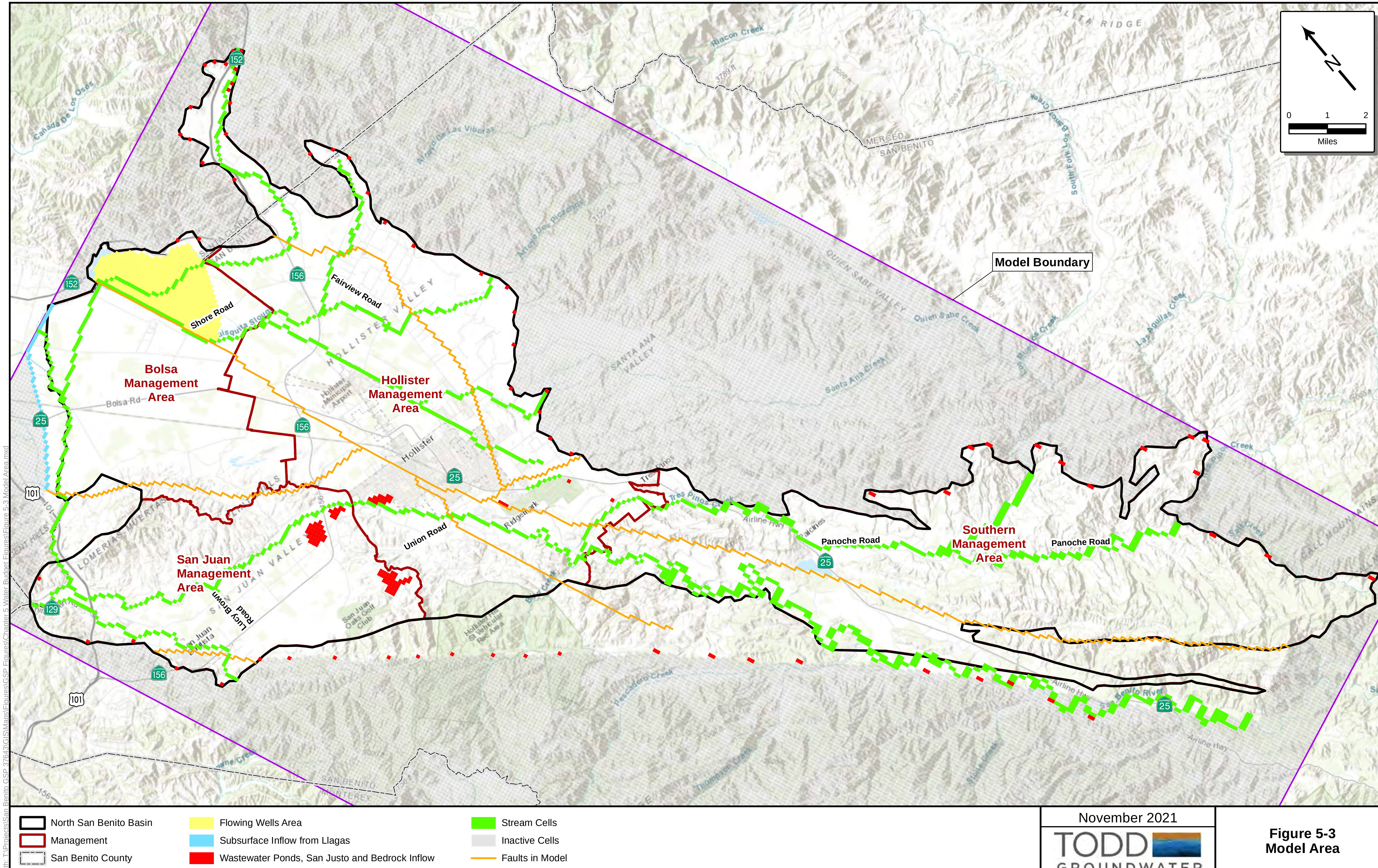
Management Areas

San Benito County

November 2021

TODD GROUNDWATER

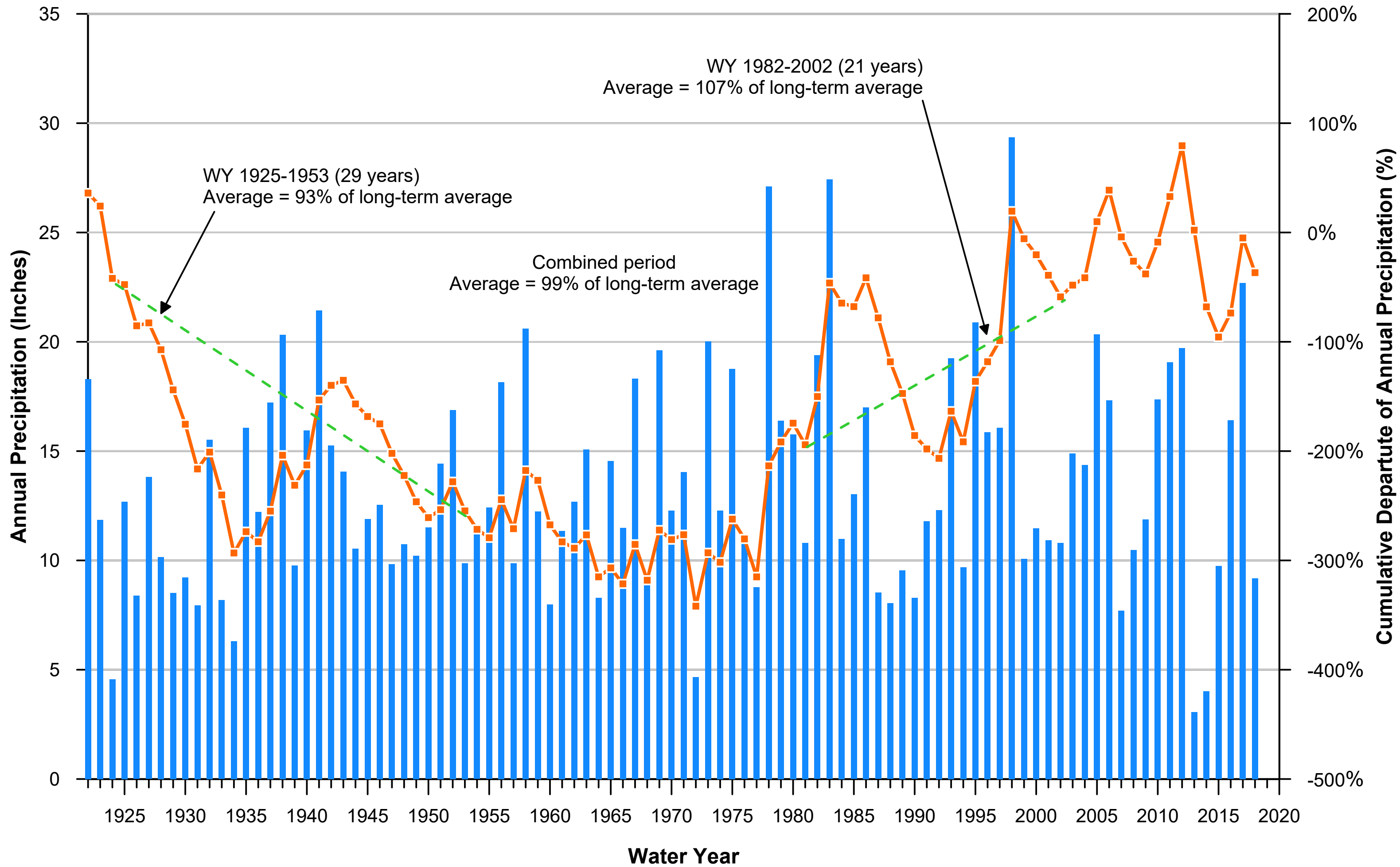
Figure 5-2
Management Areas



November 2021

TODD GROUNDWATER

Figure 5-3
Model Area



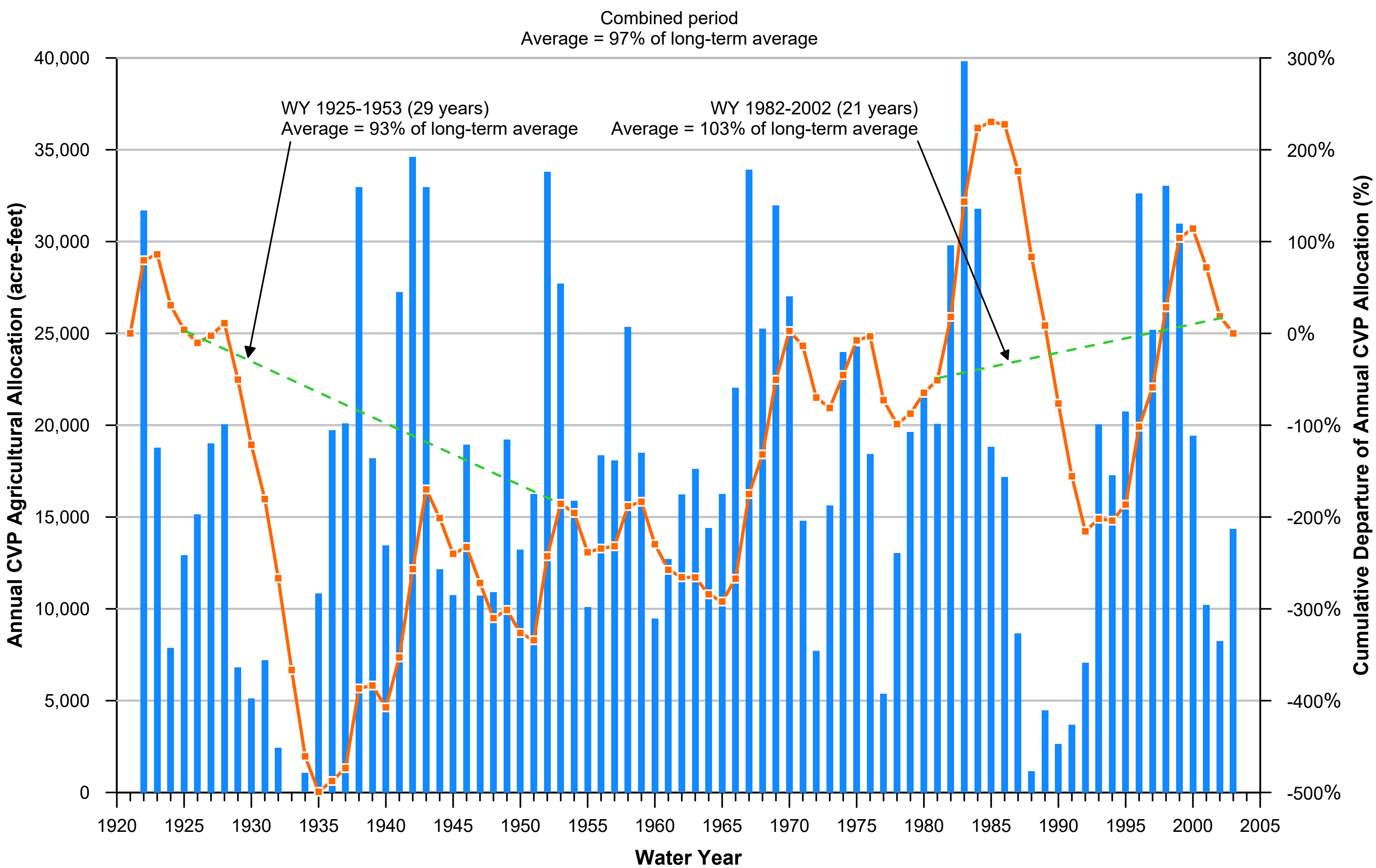
Precipitation
Departure

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 5-4.gpj

November 2021

TODD GROUNDWATER

Figure 5-4
Cumulative Departure of Precipitation



(Simulated CVP availability from CalSim2 model)

Annual CVP Agricultural Allocation

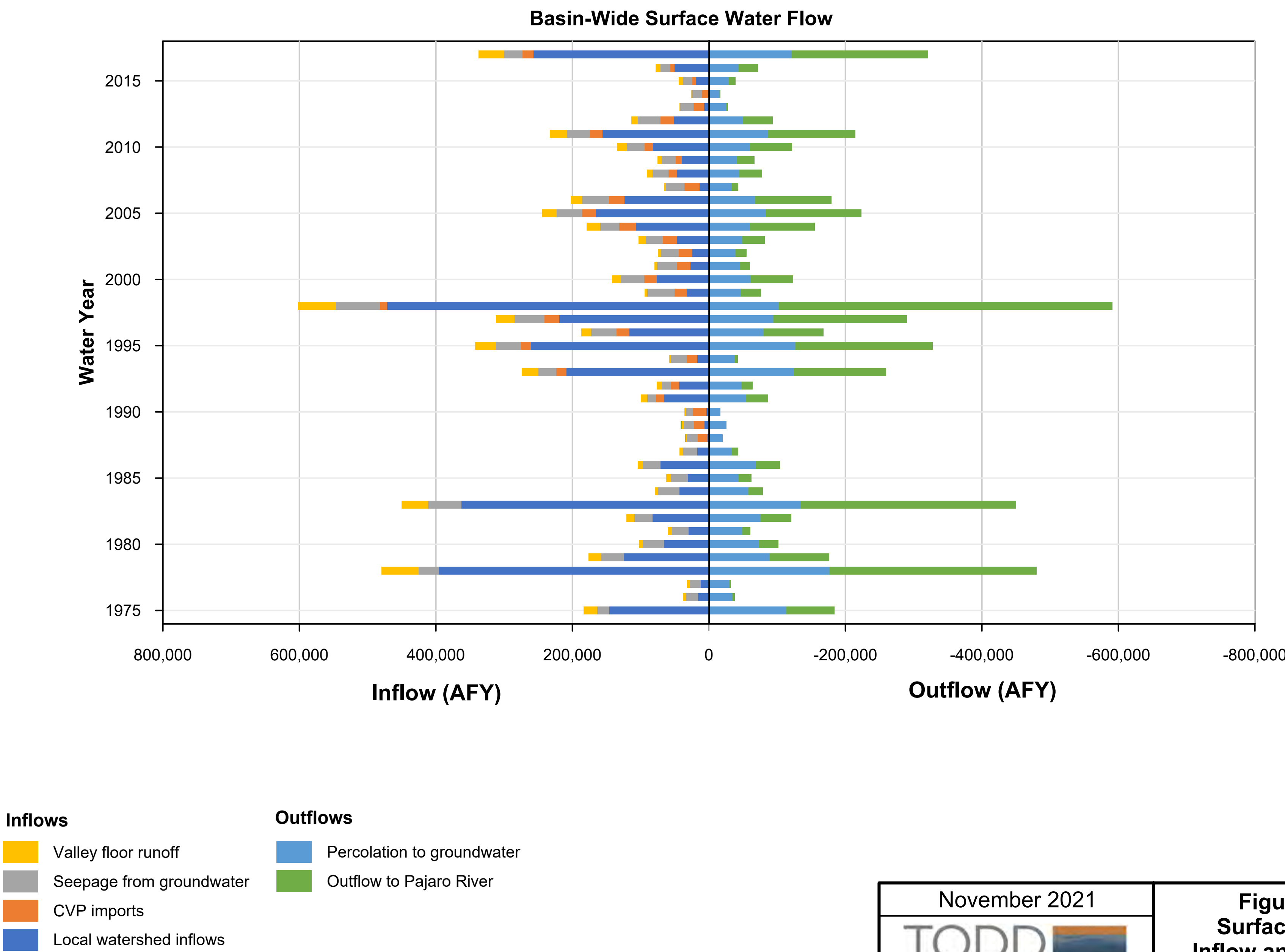
Departure

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure5-5.gpj

November 2021

TODD GROUNDWATER

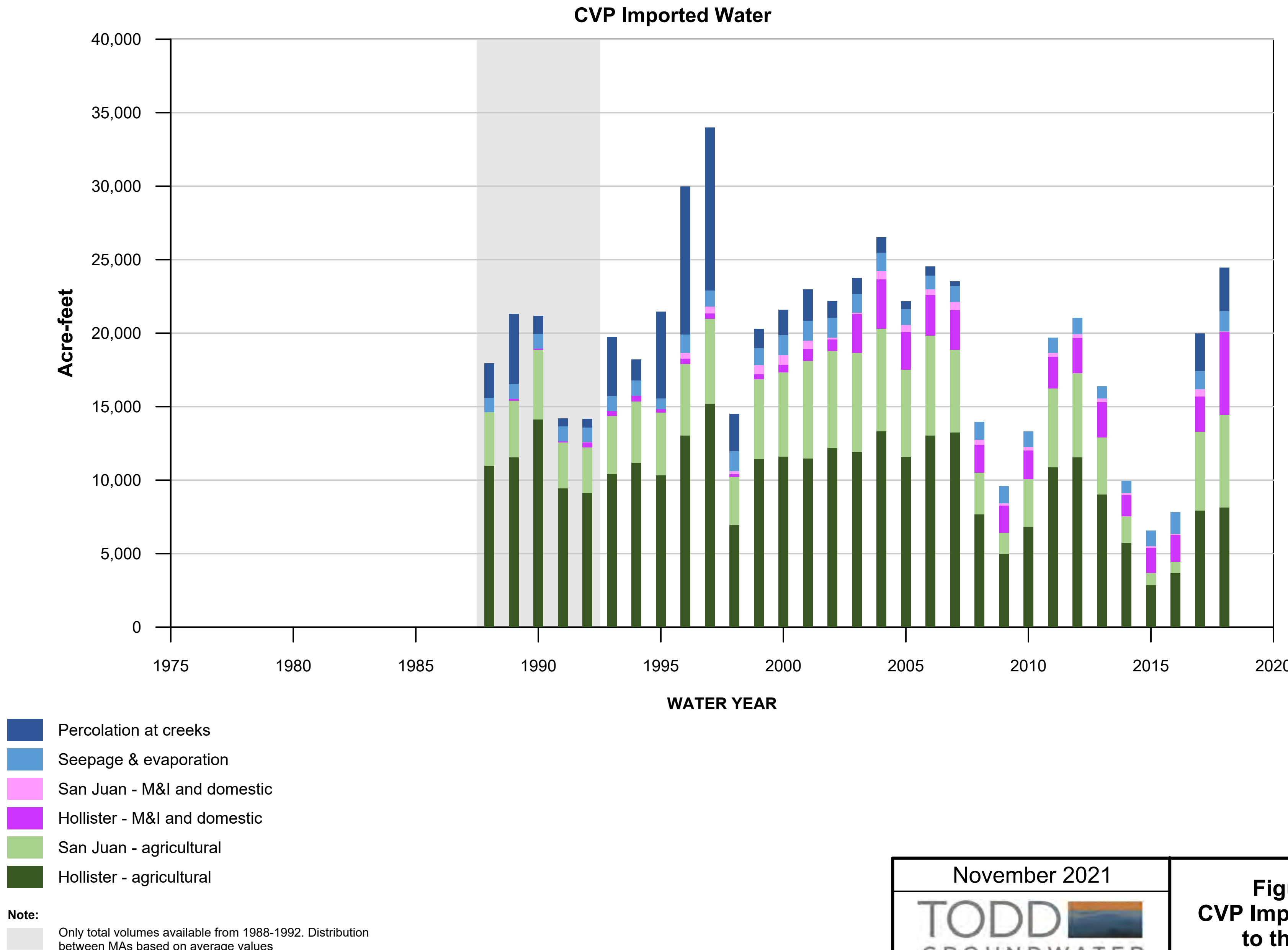
Figure 5-5
Cumulative Departure of CVP Availability



November 2021

TODD GROUNDWATER

Figure 5-6
Surface Water Inflow and Outflow of the Basin

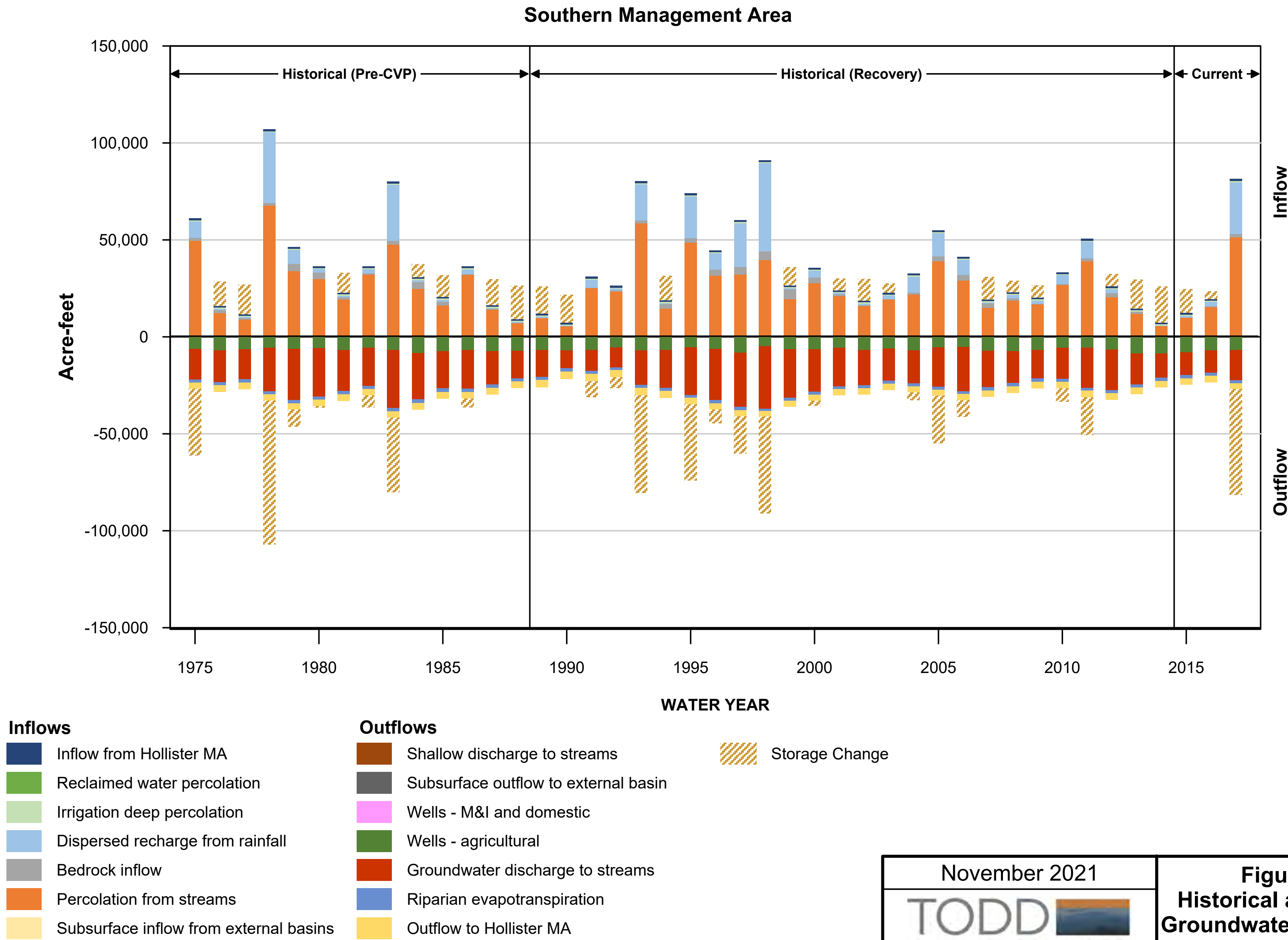


Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure5-7 CVP Imported Water.gpj

November 2021

TODD GROUNDWATER

Figure 5-7
CVP Imported Water to the Basin

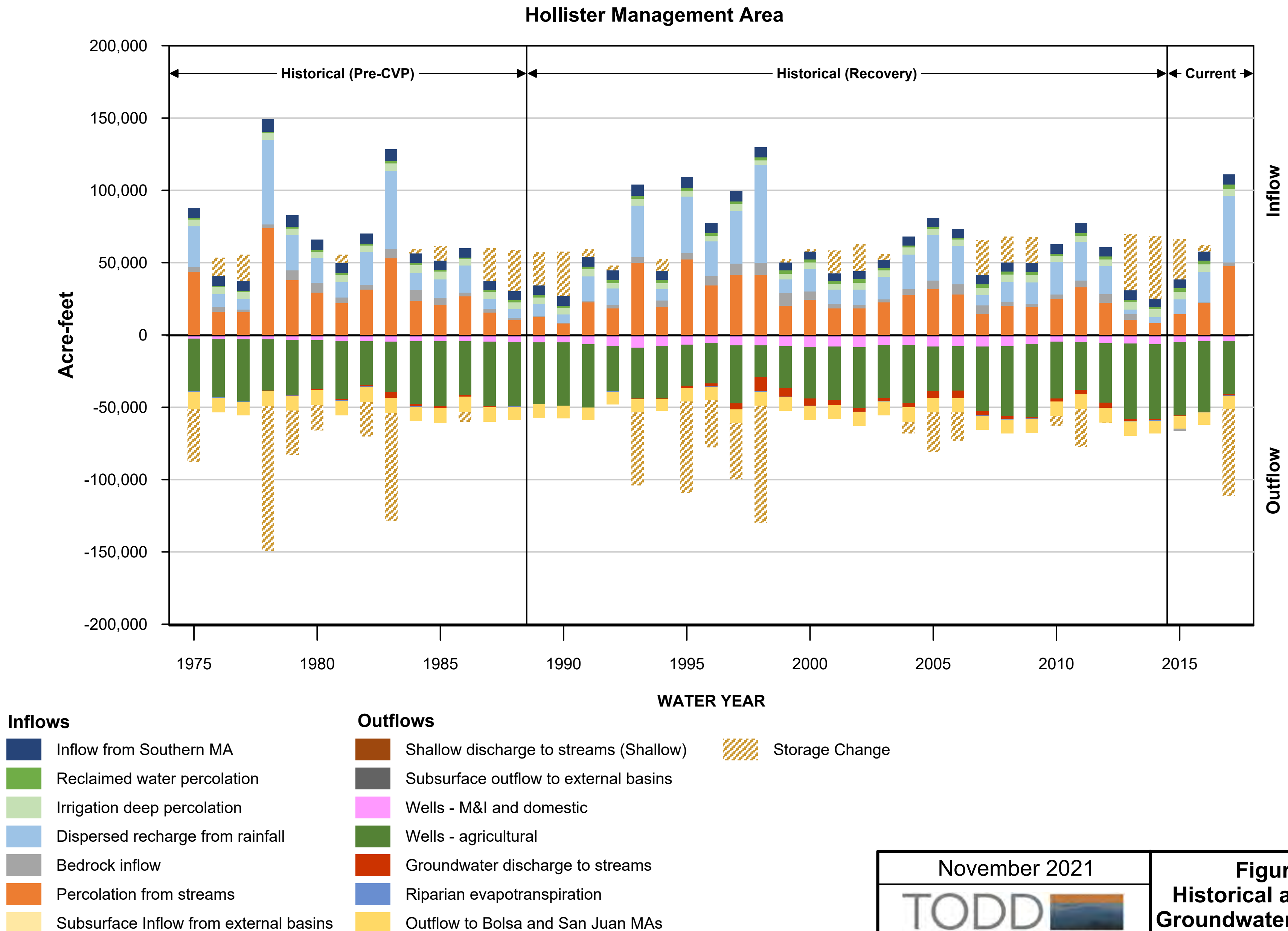


Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure5-8 Water Balance Southern Management Area.gpj

November 2021

TODD GROUNDWATER

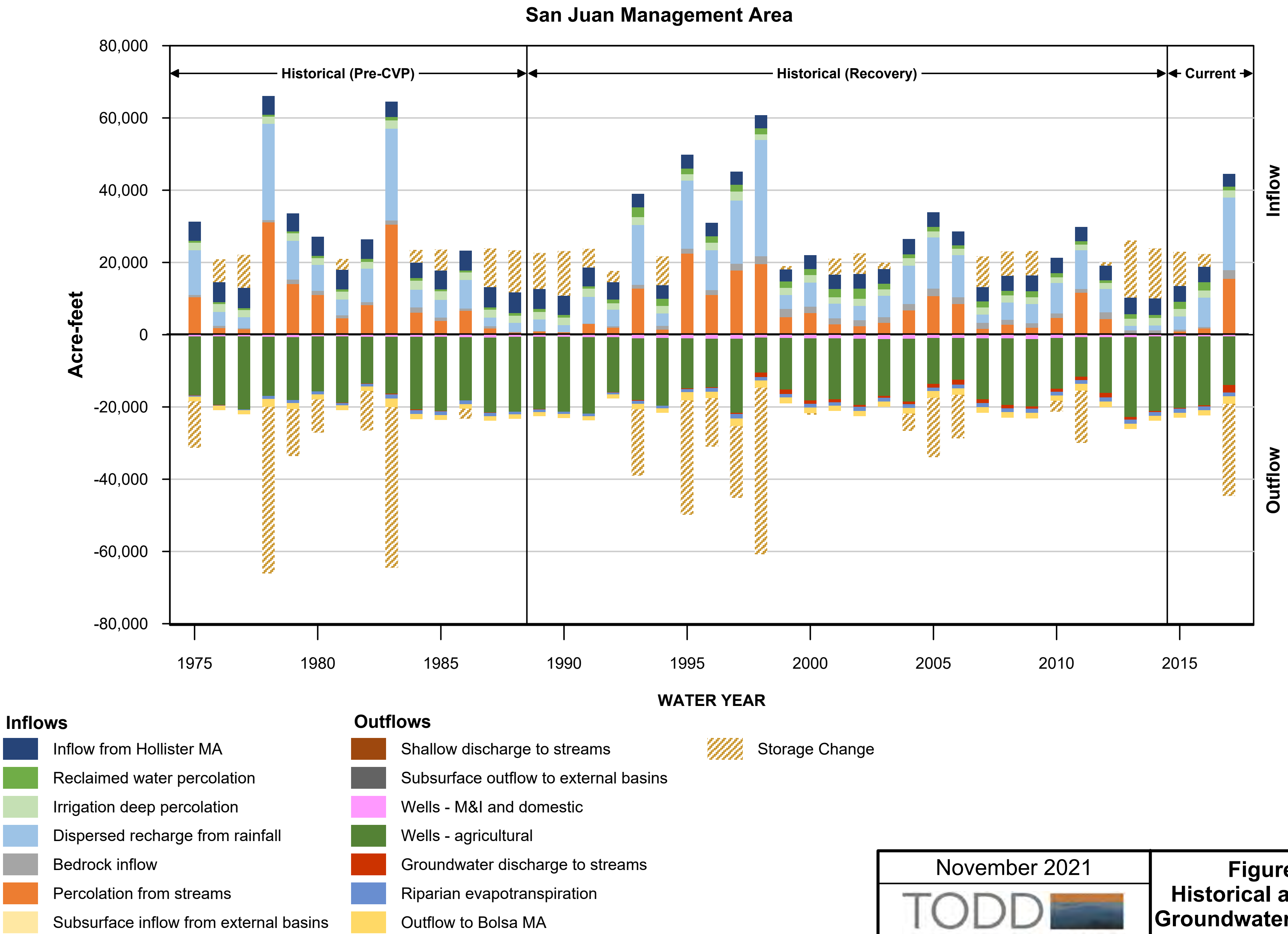
Figure 5-8
Historical and Current Groundwater Inflows and Outflows Southern MA



November 2021

TODD GROUNDWATER

Figure 5-9
Historical and Current Groundwater Inflows and Outflows Hollister MA

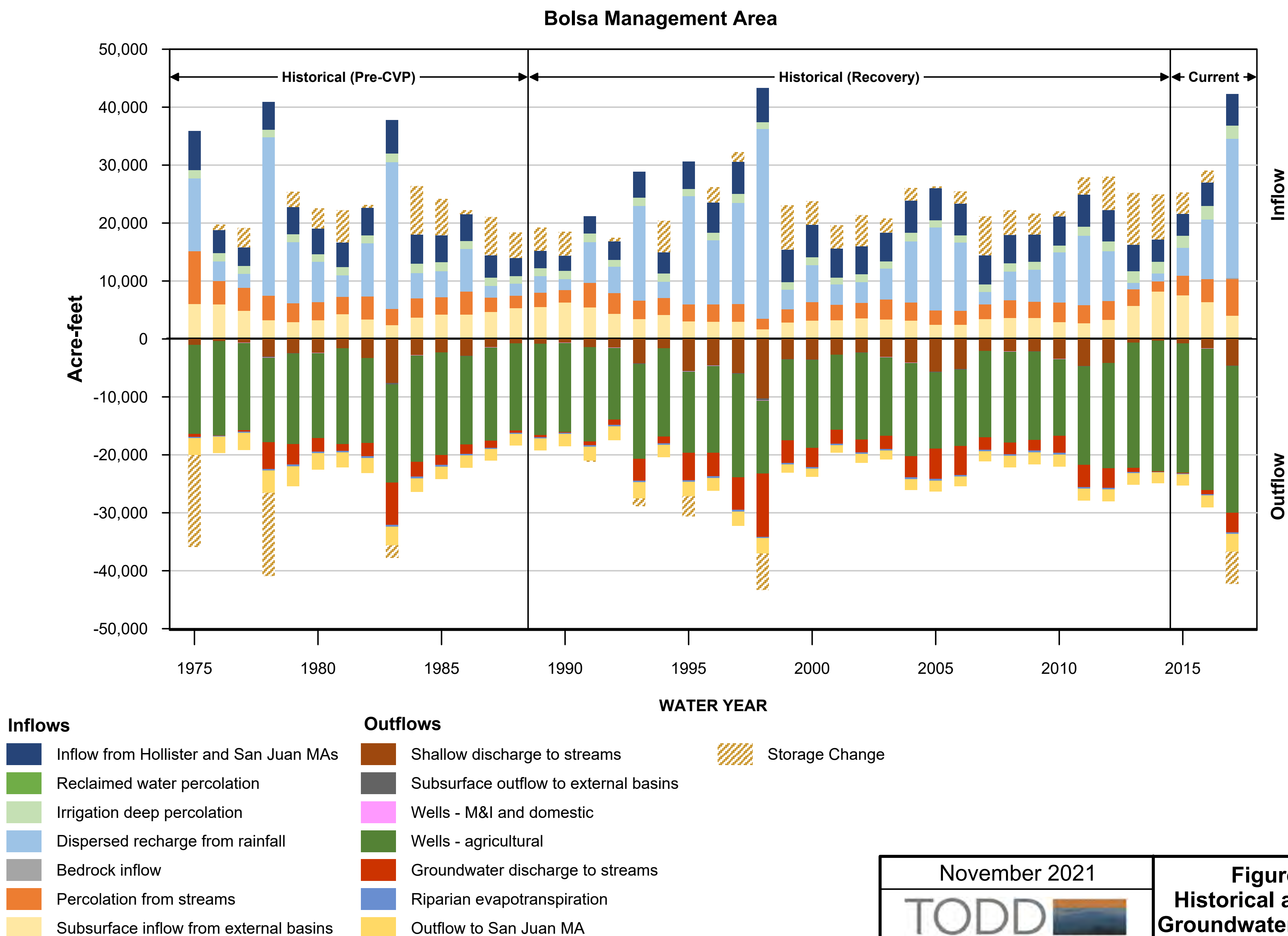


Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure5-10 Water Balance San Juan Management Area.gpj

November 2021

TODD GROUNDWATER

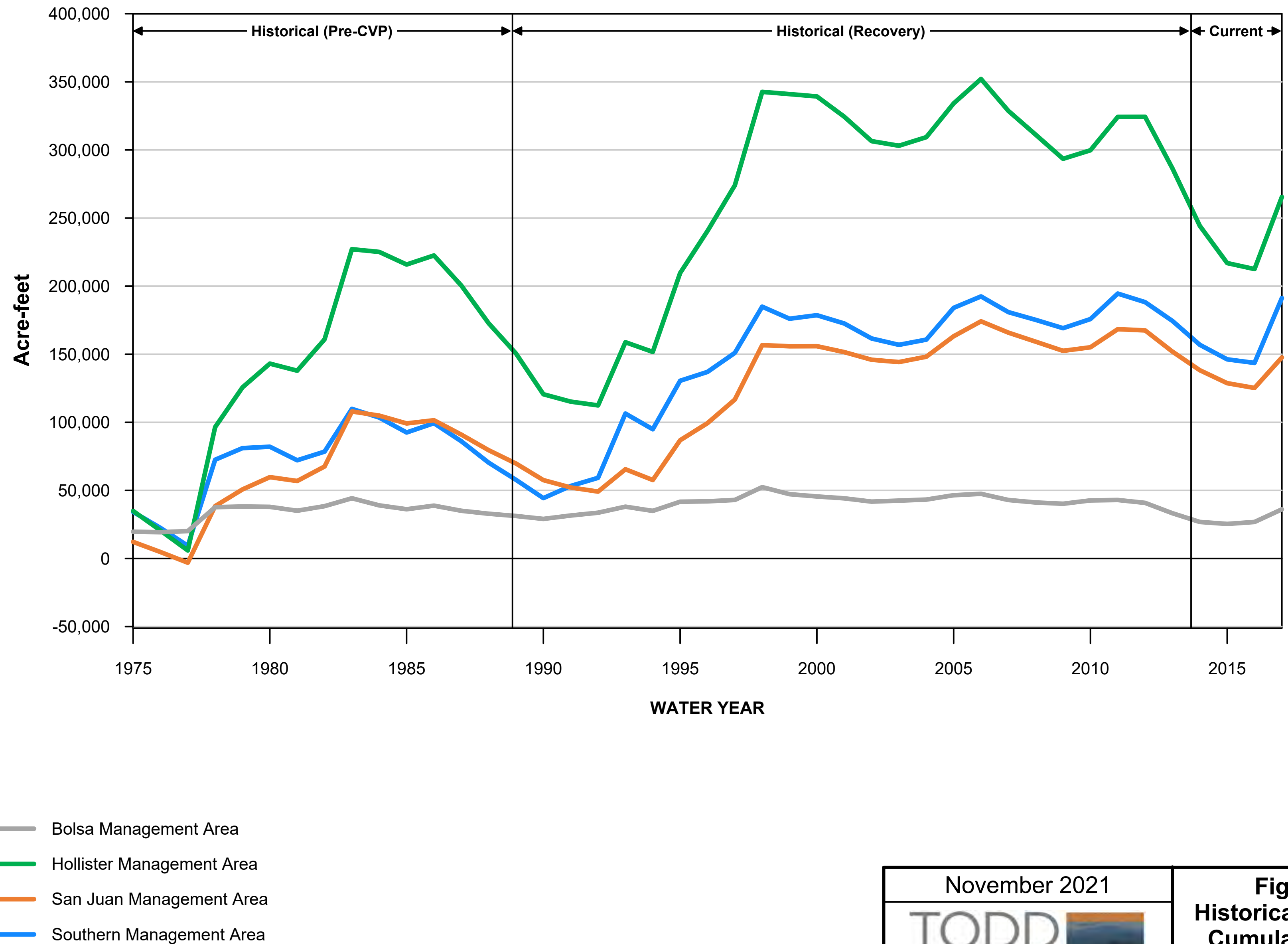
Figure 5-10
Historical and Current Groundwater Inflows and Outflows San Juan MA



November 2021

TODD GROUNDWATER

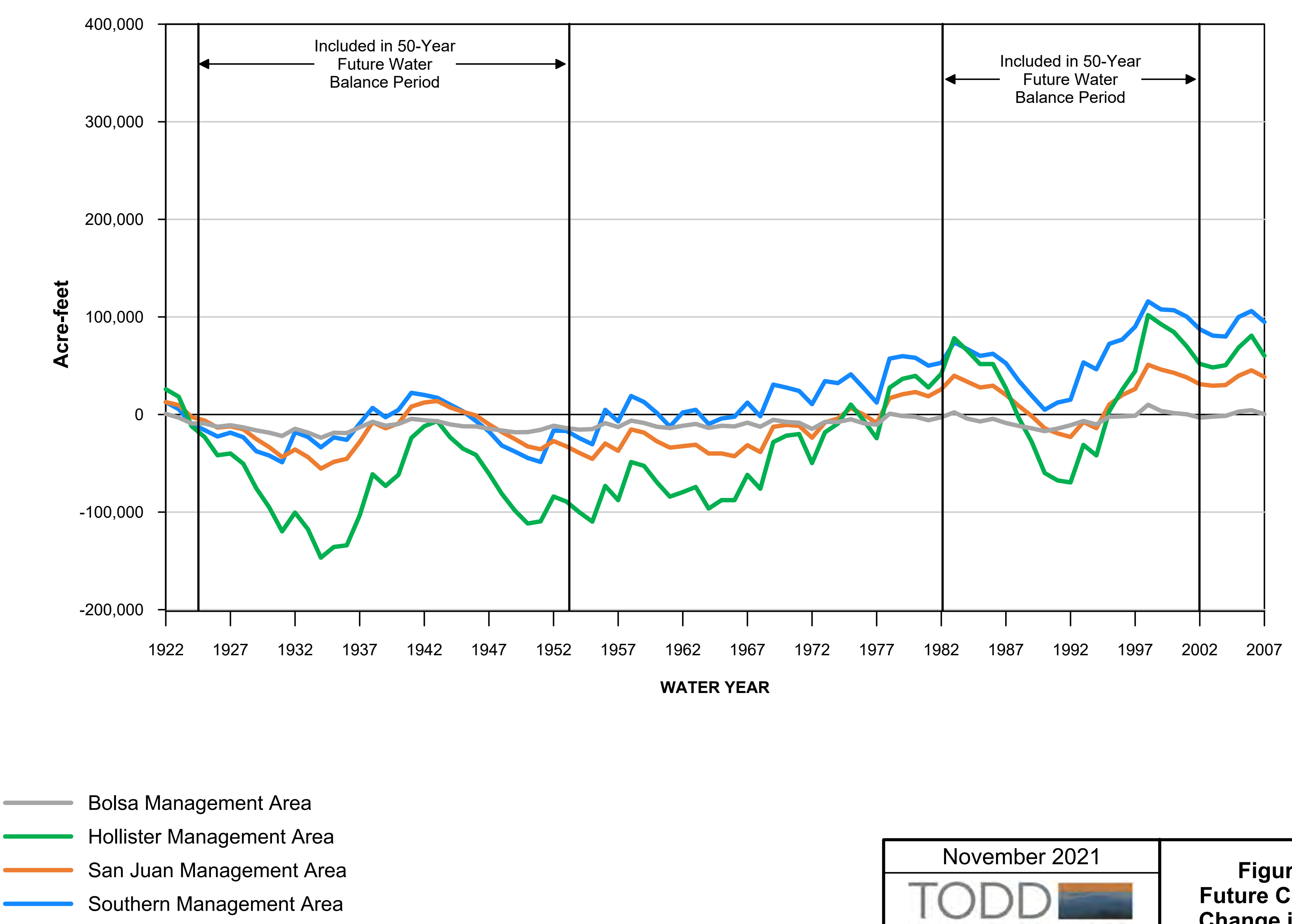
Figure 5-11
Historical and Current Groundwater Inflows and Outflows Bolsa MA



November 2021

TODD GROUNDWATER

Figure 5-12
Historical and Current Cumulative Change in Storage



November 2021

TODD GROUNDWATER

Figure 5-13
Future Cumulative Change in Storage

6. SUSTAINABLE MANAGEMENT CRITERIA

The Sustainable Groundwater Management Act (SGMA) defines sustainable management as the use and management of groundwater in a manner that can be maintained without causing *undesirable results*, which are defined as significant and unreasonable effects caused by groundwater conditions occurring throughout the basin:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

For these sustainability indicators[6], a Groundwater Sustainability Plan (GSP) must develop quantitative sustainability criteria that allow the Groundwater Sustainability Agencies (GSAs) to define, measure, and track sustainable management. These criteria include the following:

- Undesirable Result – significant and unreasonable conditions for any of the six sustainability indicators.
- Minimum Threshold (MT[7]) – numeric value used to define undesirable results for each sustainability indicator.
- Measurable Objective (MO) – specific, quantifiable goal to track the performance of sustainable management.
- Interim Milestone – target value representing measurable groundwater conditions, in increments of five years, set by the GSAs as part of the GSP.

Together, these sustainability criteria provide a framework to define sustainable management, delineate between favorable and unfavorable groundwater conditions, and support quantitative tracking that identifies problems promptly, allows assessment of management actions, and demonstrates progress in achieving the goal of sustainability.

---

[6] If one or more undesirable results can be demonstrated as not present and not likely to occur, a GSA is not required to establish the respective sustainability criteria per GSP Regulations §354.26(d); in the inland North San Benito Basin seawater intrusion is not present and not likely to occur.

[7] The abbreviations for Minimum Threshold (MT) and Measurable Objective (MO) are provided because these terms are used often; however, the full unabbreviated term is used when helpful for clarity or when included in a quotation.

6.1. SUSTAINABILITY GOAL

The sustainability goal can be described as the mission statement of the GSAs for managing the basin; it embodies the purpose of sustainably managing groundwater resources and reflects the local community's values—economic, social, and environmental. The sustainability goal for the North San Benito Groundwater Basin, stated below, was developed through discussion at several public meetings of the Technical Advisory Committee (TAC) and at the March 24, 2020 public workshop.

6.1.1. Description of Sustainability Goal

The goal of the GSAs in preparing this GSP is to sustain groundwater resources for the current and future beneficial uses of the North San Benito Basin in a manner that is adaptive and responsive to the following objectives:

- to provide a long-term, reliable, and efficient groundwater supply for agricultural, domestic, and municipal and industrial uses
- to provide reliable storage for water supply resilience during droughts and shortages
- to protect groundwater quality
- to prevent subsidence
- to support beneficial uses of interconnected surface waters, and
- to support integrated and cooperative water resource management.

This goal is consistent with SGMA and is based on information from the Plan Area, Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Balance sections that:

- Identify beneficial uses of North San Benito Basin groundwater and document the roles of local water and land use agencies.
- Describe the local hydrogeologic setting, groundwater quality conditions, groundwater levels and storage, and inflows and outflows of the basin.
- Document the ongoing water resource monitoring and conjunctive management of groundwater, local surface water, recycled water, and especially imported water sources that help protect groundwater quality and maintain water supply.

6.1.2. Approach to Sustainability Indicators

The approach to assessing the sustainability indicators and setting the sustainability criteria has been based on 1) review of available information from the Plan Area, Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Balance sections of the GSP and 2) discussions with North San Benito stakeholders and local agency representatives, for example at TAC meetings and workshops.

This approach has developed since mid-2018 and generally began with definition of what an undesirable result is; this initially has been exploratory and qualitative and based on plain-language understanding of what *undesirable* means. Potential minimum thresholds have been explored in terms of when, where, how long, why, under what circumstances, and what beneficial use is adversely affected. This step identified seawater intrusion as not present and not likely to occur.

Beyond a qualitative identification of undesirable, the approach to defining sustainability indicators varies among the undesirable results. Several of the undesirable results are directly or indirectly related to groundwater levels, including conditions related to groundwater storage, subsidence, and interconnected surface water. The definition began in terms of groundwater levels in individual wells but has recognized that storage depletion, subsidence, and impacts on connected surface water occur as water levels decline. As a result, the sustainability criteria for those indicators are interrelated across space and time, coordinated and as consistent as is reasonable and as available data allow.

The consideration of the causes and circumstances of undesirable results is an important one in North San Benito particularly for groundwater quality because general mineral quality (e.g., total dissolved solids (TDS), iron and manganese, boron, etc.) is naturally poor throughout much of the basin and has been poor for decades. Sustainable management is all about use and management of groundwater without *causing* undesirable results but does not necessarily include reversing natural undesirable conditions. Moreover (per SGMA §10727.2(b)(4)), a GSP may but is not required to address undesirable results that occurred before and have not been corrected by the SGMA benchmark date of January 1, 2015.

While native groundwater quality is poor, salt and nitrate loading are recognized as potential sources of groundwater quality deterioration throughout much the basin. Such loading has been occurring for more than 100 years, however changes in groundwater quality at depth (where groundwater typically is pumped) will lag behind the salt and nutrient loading at the ground surface by decades to centuries. This means that groundwater quality monitoring data can be misleading, sustainability criteria potentially could be reactive to decades-old land use conditions and insensitive to the future, and the effects of management activities will not be seen for decades. Given all that, implementation of management actions is recognized as needed and such actions will be helpful in the long term.

Another important aspect to defining sustainability criteria has been considering what we know and more importantly what we do not know about undesirable results that may be detected or may potentially occur in North San Benito. From a big picture perspective, the North San Benito Basin is demonstrably well managed—historical groundwater level declines and overdraft have been reversed, subsidence generally has not been perceived, groundwater storage has been managed such that recent drought impacts have been minimized, significant local groundwater quality degradation due to wastewater disposal is being reversed, and inter-connected surface water and Groundwater-dependent ecosystems (GDEs) are being maintained. While water resource monitoring has been useful and adaptive, significant data needs and uncertainties exist. Because groundwater conditions are regarded generally as good and because considerable uncertainties exist, the process of setting sustainability criteria has been directed toward open discussion of uncertainties, in-depth identification of data needs and the means to fill them, and a strong intention for flexibility and adaptive management.

The intent is to quantify and qualify sustainability criteria such that they guide good management without setting off false alarms or triggering costly, ineffective, or harmful management actions.

6.1.3. Summary of Sustainable Management Criteria

This section documents the six sustainability criteria as relevant to North San Benito Basin and as guided by the Sustainability Goal. As documented in this section, the basin has been and is being managed sustainably relative to all criteria (except seawater intrusion, which is not relevant). Accordingly, sustainability does not need to be achieved, but it does need to be maintained through the planning and implementation horizon. This will involve continuation and improvement of existing management actions—most notably import of Central Valley Project (CVP) water and its conjunctive use with groundwater. It also will include improvement and expansion of management actions and monitoring; these are addressed for each sustainability criterion's Measurable Objective in a subsection, Discussion of Monitoring and Management Measures to be Implemented.

While the North San Benito Basin has been managed sustainably, the following sustainability criteria are defined in this section because potential exists for undesirable results.

- The Minimum Threshold relative to **chronic lowering of groundwater levels** is defined at designated Key Wells by historical groundwater low levels adjusted to provide reasonable protection to nearby wells. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in 60 percent or more of the Key Wells (e.g., three of five wells) in each Management Area. The Measurable Objective is to maintain groundwater levels above the MTs and to maintain groundwater levels within the historical operating range.
- The Minimum Threshold for **reduction of storage** for all Management Areas is fulfilled by the minimum threshold for groundwater levels as proxy. The Measurable Objective for storage is fulfilled by the MT for groundwater levels, which maintains groundwater levels within the historical operating range.
- The Minimum Threshold for **land subsidence** is defined as a rate of decline equal to or greater than 0.2 feet in any five-year period. This has been considered in terms of a potential cumulative decline equal to or greater than one foot of decline since 2015; 2015 represents current conditions and the SGMA start date. The extent of cumulative subsidence across the basin will be monitored and evaluated using InSAR data. Subsidence is closely linked to groundwater levels and it is unlikely that significant inelastic subsidence would occur if groundwater levels remain above their minimum thresholds.
- The Minimum Thresholds for **degradation of water quality** address nitrate and TDS for each MA. The MT for nitrate is defined initially as the percentage of wells with concentrations exceeding the nitrate Maximum Contaminant Limit (MCL) (45 mg/L) based on current conditions (2015-2017). The MT for TDS is defined initially as the percentage of wells with concentrations exceeding the TDS value of 1,200 mg/L based on current conditions. The Measurable Objectives for both are defined as maintaining or reducing the percentage of wells with median concentrations exceeding the MTs.
- The Minimum Threshold for **depletion of interconnected surface water** is the amount of depletion associated with the lowest water levels during the 1987-1992 drought, with some adjustments made for wells with groundwater levels lower in 2016 than in 1992. Undesirable results would occur if more than 25 percent of monitored wells within 1 mile of a shallow water table reach along the Pajaro River, Pacheco Creek, San Benito River, or Tres Pinos Creek had static spring water levels lower than the lowest static spring water level during 1987-1992.

6.2. CHRONIC LOWERING OF GROUNDWATER LEVELS

Chronic lowering of groundwater levels can indicate significant and unreasonable depletion of supply, causing undesirable results to domestic, agricultural, or municipal groundwater users if continued over the planning and implementation horizon. As a clarification, drought-related groundwater level declines are not considered chronic if groundwater recharge and discharge are managed such that groundwater levels recover fully during non-drought periods.

Declining groundwater levels directly relate to other potential undesirable effects (for example regarding groundwater storage, land subsidence and interconnected surface water); these are described in subsequent sections. Effects on well users are described here.

Groundwater elevation trends in North San Benito Basin are documented in Groundwater Conditions Section 4.1; hydrographs of representative wells are presented for each MA. North San Benito is not characterized by overdraft with widespread chronic groundwater level declines. However, long-term hydrographs (e.g., **Figure 4-3**) show historical overdraft that was reversed in the late 1980s and early 1990s with importation of CVP water. Since that time, groundwater levels in broad areas of the basin (e.g., in Hollister and San Juan MAs) have been maintained at relatively high levels because of the availability of CVP supply. In addition, while groundwater level declines still occur with dry and critically-dry years, recent drought-related declines in these areas have not been as rapid or deep as in previous droughts. Other areas of the North San Benito Basin, including portions of Bolsa and Southern MAs, experienced record lows during the most recent drought. However, San Benito County was not marked by reports of significant water level decline impacts to shallow production wells.

6.2.1. Description of Undesirable Results

As groundwater levels decline in a well, a sequence of increasingly severe undesirable results will occur. These include an increase in pumping costs and a decrease in pump output (in gallons per minute). With further declines, the pump may break suction, which means that the water level in the well has dropped to the level of the pump intake. This can be remedied by lowering the pump inside the well, which can cost thousands of dollars. Chronically declining water levels will eventually drop below the top of the well screen. This exposes the screen to air, which can produce two adverse effects. In the first, water entering the well at the top of the screen will cascade down the inside of the well, entraining air; this air entrainment can result in cavitation damage to pump. The other potential adverse effect is accelerated corrosion of the well screen. Corrosion eventually creates a risk of well screen collapse, which would likely render the well unusable. If water levels decline by more than about half of the total thickness of the aquifer (or total length of well screen), water might not be able to flow into the well at the desired rate regardless of the capacity or depth setting of the pump. This might occur where the thickness of basin fill materials is relatively thin. While describing a progression of potential adverse effects, at some point the well no longer fulfills its water supply purpose and is deemed to have "gone dry." For the purposes of this discussion, a well going dry means that the entire screen length (to the bottom of the deepest screen) is unsaturated.

For purposes of setting a Minimum Threshold, undesirable results are defined as a well going dry. This appears to be a low standard and not protective of private wells; but this is an initial definition to start the analysis. The rationale is summarized as follows with more explanation in the following sections:

- Accurate information on the location, elevation, status, and construction of most local supply wells is not readily available for detailed consideration of the range of adverse effects; analysis was initiated with the simple concept of exposure of the entire screen length, "going dry."
- During the recent drought, reports were lacking of shallow production wells going dry because of drought conditions; because of this, some flexibility exists for purposes of analysis. No private wells have been reported to have water shortages in the California Department of Water Resources (DWR) led *Household Water Supply Shortage Reporting System* (DWR 2021).
- Responsibility for potential undesirable results to shallow wells is shared between a GSA and a well owner; there is a reasonable expectation that a well owner would construct, maintain, and operate the well to provide its expected yield over the well's life span, including droughts.
- As discussed below, MTs are initially set at historical groundwater level lows and then adjusted upward to be protective.

6.2.2. Potential Causes of Undesirable Results

For North San Benito Basin, the primary potential cause of groundwater level undesirable results would be reduction of surface water supplies and associated reduction in groundwater recharge (in lieu and direct). This would potentially include disruption of Hernandez Reservoir releases for recharge that could have direct consequences for the Southern, Hollister, and San Juan MAs. More significantly, reduction of imported CVP water could have direct adverse impacts on agricultural and municipal water users in Hollister and San Juan MAs and serious overdraft impacts on groundwater users throughout Hollister, San Juan, and Bolsa MAs. Undesirable results also can occur because of increased demand for groundwater that exceeds available supply; this is most problematic in portions of North San Benito that do not have access to developed surface water supplies (i.e., areas not in Zone 3 or Zone 6).

Given that the North San Benito Basin is not characterized by basin-wide chronic groundwater level declines, then the undesirable results of a well losing yield, having damage, or "going dry" represent a more complex interplay of causes and shared responsibility.

Some of the potential causes are within GSA responsibility; most notably, a GSA is responsible for groundwater basin management without causing undesirable results such as chronic groundwater level declines. SGMA also requires that a GSA address significant and unreasonable effects caused by groundwater conditions *throughout the basin.* This indicates that a GSA is not solely responsible for local or well-specific problems and furthermore that responsibility is shared with a well owner. A reasonable expectation exists that a well owner would construct, maintain, and operate the well to provide its expected yield over the well's life span, including droughts, and with some anticipation that neighbors also might construct wells (consistent with land use and well permitting policies). In North San Benito, some concern exists that some recent wells might be relatively shallow because they were constructed during a period when groundwater levels have been maintained at relatively high levels.

6.2.3. Definition of Undesirable Results

As context, the North San Benito Sustainability Goal has the objective to provide a long-term, reliable, and efficient groundwater supply for agricultural, domestic, and municipal and industrial uses.

In that light, the definition of undesirable results would be the chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. This is defined by groundwater conditions occurring throughout the basin, with a focus on wells in the North San Benito Basin. This definition also recognizes that chronic lowering of groundwater levels could affect groundwater flow to or from the hydraulically connected Llagas Subbasin, and thereby potentially affect their ability to maintain sustainability.

As documented in Groundwater Conditions Section 4.1, analysis of hydrographs reveals that North San Benito County is not characterized by basin-wide chronic groundwater level declines. While affected at times by drought, groundwater levels in broad areas of the basin have been maintained at relatively high levels because of the availability of CVP supply. Moreover, San Benito County has not been marked by reports of significant water level decline impacts to shallow supply wells. In the absence of reported well problems, it can be concluded that undesirable results for the chronic lowering of water levels are not occurring in North San Benito and that the basin is managed sustainably relative to groundwater levels. This finding is consistent with the water budget analyses for the MAs that indicate (within the range of uncertainty) balanced inflows and outflows into the future.

6.2.4. Potential Effects on Beneficial Uses and Users

Groundwater is the major source of supply in the GSP Area and supplies wells for agricultural, municipal, industrial, and domestic beneficial uses. Groundwater has been and is being used for the range of beneficial uses, even during drought, and with reasonable operation and maintenance by well owners.

6.2.5. Sustainable Management Criteria for Groundwater Levels

The general approach to defining sustainability criteria (minimum thresholds and measurable objectives) for groundwater levels has involved selection of representative monitoring wells (Key Wells), review of groundwater level data, and review of supply well location/construction information to gage potential undesirable effects on wells. Specifically, this has included evaluating historical low levels in Key Wells. This approach is founded on the idea that undesirable results were not reported when groundwater elevations were at their minimum values and therefore returning to those minima should not cause undesirable results in the future. However, the approach also recognizes that some wells did not exist at the time of historical lows (e.g., in the late 1970s), were not constructed to operate effectively under such conditions, and could be at risk with future low-water levels.

6.2.5.1. Selection of Key Wells

The approach includes selection of existing wells in the San Benito County Water District (SBCWD) monitoring program to represent nearby supply wells. Sustainability criteria would be defined for each of these Key Wells and each would be monitored for groundwater levels with respect to MTs and MOs. The Key Wells have been identified by reviewing groundwater level hydrographs from all currently monitored wells and selecting wells that have a long, reliable, and recent record of groundwater level monitoring, that represent local or regional trends, and that together provide a broad geographic distribution for each Management Area and the Basin as a whole. The distribution of these wells also has been reviewed with respect to maps showing density of wells across the Basin (e.g., **Figure 2-2**). These wells are production wells, which is not optimal for monitoring; on the other hand, they are generally representative of production wells.

Groundwater level data and hydrographs of each Key Well have been reviewed to identify the all-time lowest groundwater elevation at each Key Well. As discussed in Groundwater Conditions Section 4.1.3, historical minima in many wells occurred in the late 1970s and early 1980s, but in some areas (e.g., Southern MA), the historical lows were recorded with the most recent drought.

The identified historical low at each Key Wells (i.e., historical maximum depth to water) represents the first approximation of a minimum threshold, with the realization that the final selection of the MT for a Key Well could be adjusted upward to be more protective of nearby supply wells.

6.2.5.2. Evaluation of Existing Wells with Construction Information

Figure 6-1 shows the locations of the selected Key Wells along with locations of existing supply wells in their vicinity. Each of the existing wells (shown on the map as a colored dot) has a known location and elevation, and documented construction details in a District database. These wells are relatively recent and can be presumed to be active supply wells; they have been analyzed as a basis to refine the MTs.

By way of background, information on local supply wells has been recorded on Water Well Drillers Reports and is available mostly as paper or scanned copies. However, accurate data on the location and elevation of most wells is not available and the status of many (older) wells is not known. In addition, construction information on most wells has not been entered into databases where it can be analyzed readily. This represents a data need that was evaluated early in this GSP process, with a subsequent effort focused on SBCWD well record files; SBCWD has been the well permitting agency in San Benito County since 2004 and its files contain considerable information including well locations by Assessor's Parcel Number (APN). This effort involved accurately locating wells (many of which are shallow domestic wells) and digitizing the respective construction information.

As a result, accurate digitized data are now available for 169 wells across the basin; these are the wells shown as colored dots on **Figure 6-1**. As noted previously, these wells are recent, may be presumed to be active, and—because they were drilled after basin recovery—may be relatively shallow. Accordingly, these wells are deemed to be representative of other existing wells (without known construction information) and to be protective with regard to groundwater level declines. In brief, these existing 169 wells have been assigned to the closest Key Well as indicated by the color groupings. Well assignments have been made without respect to MA boundaries (for example, see Southern-Hollister MA boundary). This helps to make sure that minimum thresholds in each MA are protective of neighboring MAs.

As discussed in Sections 6.2.1 and 6.2.2, groundwater level declines involve a continuum of potential impacts that range from those effects not noticed by the well owner to those that are noticed and reasonably handled by the well owner. For purposes of this GSP, unreasonable results occur when a well goes dry, in other words, the entire screen length (to the bottom of the deepest screen) is unsaturated.

For each of the 22 groupings of wells around the key wells, the bottom of screens for the wells was then compared with the historical low groundwater level in the respective Key Well (i.e., maximum depth to groundwater in feet below ground surface). This allowed enumeration of how many wells theoretically would go dry at that historical low level, followed by adjustment upward of this first-approximation MT level until almost no wells go dry. Justification of the adjustments include the following:

- Upward modification in part of the Bolsa MA with few candidate Key Wells and existing wells with construction information, to address the increased uncertainty about potential impacts.
- Upward modification in areas of the historical Hollister pumping depression, recognizing that groundwater levels are unlikely to be so deep, given reasonable CVP supply.
- Upward adjustment to be protective in the San Juan Economically Disadvantaged Area.

Table 6-1 presents the MT levels for each of the 22 Key Wells and summarizes the potential effects on the 169 nearby wells with construction information. As shown, 5 of 169 wells (3%) are predicted to go dry (as defined herein) if groundwater levels in the Key Wells decline to the upward-adjusted low levels. It is emphasized that such predictions are based solely on the limited available data, analysis, and assumptions described above and are not intended to represent projections into the future. As noted, reports of wells historically going dry are lacking despite recent drought; future improvements in monitoring and data are discussed in Section 7 Monitoring Network.

6.2.6. Minimum Thresholds

According to GSP Regulations Section 354.28(c)(1) the minimum threshold for chronic lowering of groundwater levels must be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. MTs for chronic lowering of groundwater levels are to be supported by information on the rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin. However, as documented in the Groundwater Conditions Section 4.1.3, groundwater levels are not chronically declining in North San Benito. While groundwater levels decline in dry and critically-dry years, they have recovered in normal, above normal, and wet years. Groundwater levels in several Southern Area Key Wells were at historical lows after 2015 (thereby defining the respective MT) but all have since recovered.

Under current conditions, groundwater levels in Key Wells are above the MTs and no undesirable results are known to occur. Nonetheless, MTs have been developed because the potential exists for chronic lowering of groundwater levels.

Using recent and reliable information on the construction of existing supply wells, the MT levels shown in **Table 6-1** are protective of most supply wells, based on available information. The MTs are based on historical low groundwater levels or levels that are higher. Because of this, the MTs are not only protective of local wells but also would help minimize potential impacts on groundwater flow to or from other area, such as Llagas Subbasin. Based on historical lows, the MTs account for historical groundwater level variations, and consideration has been given to supporting basin management flexibility, for example to avoid setting off false alarms or triggering costly, ineffective, or harmful management actions. However, MTs have been not adjusted downward at this time, although periods of record for some groundwater level hydrographs are short and may not include actual historical lows that could recur.

Table 6-1. Minimum Thresholds for Groundwater Levels

Key Well	MA	Historical Maximum Depth to Water (ft-bgs*)	Bottom of Deepest Well Screen in Shallow Nearby Wells with Construction Information (ft-bgs)	Minimum Threshold Depth to Water in Key Well (ft-bgs)	Reason for Adjustment to Reduce Potential Impacts	Nearby Wells with Construction Information: Number of Impacted Wells / Total Nearby Wells	Nearby Wells with Construction Information: Percent of Wells Impacted
11-4-25H2	Bolsa	153.22	148	145	Few nearby wells, uncertain impacts	0 / 3	0%
11-5-21E2	Bolsa	63	180	63	No change	0 / 2	0%
11-5-28B1	Bolsa	102	150	102	No change	0 / 8	0%
12-5-06L1	Bolsa	176.5	580	176	Rounded	0 / 1	0%
12-5-17D1	Bolsa	185	300	185	No change	0 / 4	0%
11-5-13D1	Hollister	97	160	97	No change	0 / 2	0%
11-5-35G1	Hollister	104	100	104	No change	1 / 18	6%
12-5-03B1	Hollister	96	440	96	No change	0 / 2	0%
12-5-24N1	Hollister	280	140	160	Area of historical pumping depression	2 / 24	8%
12-5-34P1	Hollister	153	120	150	Area of historical pumping depression	2 / 26	8%
12-6-06L4	Hollister	64	120	64	No change	0 / 20	0%
13-6-19K1	Hollister	109	140	109	No change	0 / 9	0%
12-4-17L20	San Juan	47.5	200	47	Rounded	0 / 6	0%
12-4-26G1	San Juan	152.5	180	152	Rounded	0 / 14	0%
13-4-01K1	San Juan	75	NA	75	No change	0 / 0	0%
13-4-03H1	San Juan	185	157	155	Economically Disadvantaged Area	0 / 7	0%
Rider Berry	San Juan	111.4	180	110	Rounded	0 / 2	0%
Donati 2	Southern	59.74	400	59	Rounded	0 / 1	0%
Ridgemark 5	Southern	45.15	335	45	Rounded	0 / 1	0%
Ridgemark 7	Southern	136.45	200	136	Rounded	0 / 2	0%
Schields 4	Southern	73.74	215	73	Rounded	0 / 2	0%
Wildlife Center 5	Southern	79.74	97	79	Rounded	0 / 15	0%
TOTAL						**5 / 169**	**3%**

*ft-bgs: feet below ground surface

The MTs shown in **Table 6-1** were developed making good use of available data. However, data needs exist and thus the MTs include some uncertainty as summarized below:

- The geographic distribution of wells in the groundwater level monitoring program is uneven. While broad "blank" areas on **Figure 6-1** generally are areas with few wells anyway (supply or monitoring), additional Key Wells would be beneficial.
- Current Key Wells are production wells that were not sited or designed for monitoring and may not be accurately representative of nearby supply wells as a matter of short historical record, distance, topographic, and groundwater gradients between the Key Well and supply well, or respective screen settings.
- Information on vertical groundwater gradients is lacking and groundwater levels in shallow wells may not be represented adequately by relatively deep Key Wells.
- The specific location, status, and construction of most existing private wells is not known, or the information is not readily available (in databases).

These data needs have been recognized and are being addressed in this GSP as follows:

- Mapping and prioritization of geographic gaps in the monitoring program with subsequent identification of existing wells that can be added to the program.
- Installation of new dedicated monitoring wells as part of the Dedicated Monitoring Well Program (funded by a Sustainable Groundwater Management Round 3 Grant) with incorporation into the monitoring program; these are wells sited and designed to support the groundwater level monitoring program (among other objectives) and to become Key Wells.
- Continuation of the process to accurately locate existing supply wells and to digitize well information including construction.

The benefits of these efforts will accrue over the next few years and will support review and update of the MTs in the Five-Year GSP Update in 2027.

6.2.6.1. Minimum Thresholds and Criteria for Undesirable Results

Undesirable results are based on exceedances of MT levels and must be defined not only in terms of how they occur (see Section 6.2.2 Potential Causes of Undesirable Results), but also when and where. By definition, undesirable results are not just drought-related but chronic and are not just local but basin-wide.

The distinction between drought and chronic declines may not be clear when declines are occurring, particularly during drought when it is not known whether subsequent years will bring recovery. Moreover, effects of declining levels on individual well owners may be real problems, whether or not they represent basin-wide sustainability issues.

The SBCWD groundwater level monitoring program generally has been quarterly, with Valley Water (SCVWD) data sharing and with annual report preparation following the autumn monitoring event at the end of the water year. The annual report also provides information on climate, local surface water conditions, imported water availability, groundwater levels and storage, and in the future will document groundwater extraction. Accordingly, groundwater level monitoring and annual reporting provides an early warning system that allows response by the GSAs and local groundwater users. From this perspective, two consecutive exceedances in each of two consecutive years is regarded as indicating when an undesirable result is occurring. The exceedances would be measured at a Key Well as part of the regular quarterly monitoring. It should be noted that GSA responses do not have to wait for two years and may involve a staged response as in urban water shortage contingency plans.

While undesirable results relate to groundwater conditions throughout the basin, the North San Benito Basin has been organized into four MAs. As discussed in Section 5.3, this reflects the fact that the Basin includes a 30-mile-long series of linked valleys and that MAs have distinct land use mixes, water supply sources, management, and groundwater level trends. Groundwater level MTs are established separately for each MA, because the groundwater histories are distinct, albeit linked. As a result, undesirable results could occur in one MA and not the others. At this time, the Key Wells are fairly distributed across the MAs (disregarding areas with few wells), but relatively few, and even within MA boundaries, could be responding more to local problems than MA-wide sustainability issues. Accordingly, undesirable results are indicated to be occurring in a MA when sixty percent or more of the Key Wells have had the two consecutive exceedances in each of two consecutive years.

To summarize for the North San Benito Basin:

> The **Minimum Threshold** for defining undesirable results relative to chronic lowering of groundwater levels is defined at each Key Well by historical groundwater low levels adjusted to provide reasonable protection to nearby existing wells. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in sixty percent or more of the Key Wells in each Management Area.

6.2.6.2. Relationship of Minimum Threshold to Other Sustainability Indicators

The establishment of MTs also needs to consider potential effects on other sustainability indicators. These indicators are discussed later in this section; the following are brief discussions.

- **Groundwater Storage**. The MTs for groundwater levels are protective of groundwater storage. These MTs are defined in terms of historical groundwater low levels and groundwater storage has recovered since historical lows; it is not being depleted. Groundwater storage has changed, with drought-related declines followed by recovery. The major concern expressed in the Sustainability Goal is to have reliable storage for drought or storage; the MTs for groundwater levels will maintain groundwater levels and thus storage, too.
- **Seawater Intrusion.** There is no possibility of seawater intrusion in North San Benito. Accordingly, there is no seawater intrusion minimum threshold and no relationship with other minimum thresholds.
- **Subsidence.** Subsidence is closely linked to groundwater levels. It is unlikely that significant inelastic subsidence would occur if groundwater levels remain above historical levels, which have been used to define groundwater level MTs. Accordingly, the minimum threshold for groundwater levels is consistent with and supportive of the objective to prevent subsidence undesirable results.
- **Water Quality.** General relationships are recognized, for example that contaminants may be mobilized by changing groundwater levels or flow patterns. Maintenance of groundwater levels above historical low levels and within historical ranges would minimize any effects on maintenance of water quality at or above minimum thresholds. The groundwater quality issues

in North San Benito Basin are associated primarily with salt and nutrient loading and not likely to be affected by groundwater levels or flow within historical ranges.

- **Interconnected Surface Water.** The set of monitoring wells used to evaluate interconnected surface water overlaps with the set of Key Wells used for the groundwater levels minimum threshold. In general, the groundwater elevation MTs for interconnected surface water are similar to or higher than those for groundwater levels; the higher MTs would be controlling for spring quarterly measurements.

6.2.6.3. Effect of Minimum Threshold on Sustainability in Adjacent Areas

The Bolsa MA in the North San Benito Basin is adjacent to the Llagas Subbasin in Santa Clara County. Groundwater flows are generally south, from the Llagas Subbasin into the Bolsa MA, although there is evidence of occasional flows from the Bolsa MA into the Llagas Subbasin. (see Groundwater Conditions, **Figures 4-8** and **4-9**) with some drainage into the Pajaro River. The groundwater level MTs would support maintenance of groundwater levels above their respective MTs in Bolsa. This in turn will support maintenance of groundwater levels in Llagas Subbasin.

The North San Benito Basin is upstream of the Pajaro Valley Subbasin; the two are linked by flows in the Pajaro River. The MTs for the North San Benito Basin represent current conditions; establishment of MTs and maintenance of groundwater levels would not affect the ability of the Pajaro Valley GSA to achieve or maintain sustainability.

6.2.6.4. Effect of Minimum Threshold on Beneficial Uses and Users

Groundwater is the major source of supply in the GSP Area and supplies wells for agricultural, municipal, industrial, and domestic beneficial uses and users. The MTs are based generally on historical lows, which recognizes that groundwater has been and is being used reasonably for the range of beneficial uses even during drought, and with reasonable operation and maintenance by well owners. The MTs include upward adjustment to be more protective of relatively recent wells that may not have been constructed to operate under low-level historical conditions. The MTs quantify undesirable results as involving two consecutive exceedances in each of two consecutive years, which provides early warning of declining groundwater levels.

6.2.6.5. Relationship of Minimum Threshold to Regulatory Standards

No federal, state, or local standards exist for groundwater levels.

6.2.6.6. How Management Areas Can Operate without Causing Undesirable Results

The establishment of MTs has been consistently conceived and applied across all four Management Areas. MTs are based on historical low levels (with some adjustments), which did not occur at the same time across all MAs. Nonetheless, all represent maintenance of groundwater levels within a historical range during which the MAs have been managed without causing known undesirable results in other MAs.

6.2.6.7. How the Minimum Threshold will be Monitored

Monitoring for the groundwater levels MT will be conducted as part of the SBCWD quarterly groundwater level monitoring program, data, and analytical results are presented in the Annual Groundwater Reports. The SBCWD monitoring program includes wells in the Pacheco Valley in Santa Clara County; Valley Water (SCVWD) shares data from its monitoring in the Llagas Subbasin.

6.2.7. Measurable Objectives

Measurable Objectives are defined herein as an operating range of groundwater levels, allowing reasonable fluctuations with changing hydrologic and surface water supply conditions and with conjunctive management of surface water and groundwater. The groundwater level MTs represent the bottom of the operating range and are protective of well owners and groundwater users. The top of the operating range is generally where the water table approaches the soil zone and ground surface, except where groundwater and surface water are inter-connected, or groundwater dependent ecosystems exist. Section 6.7 addresses these areas and potential undesirable results with Depletions of Interconnected Surface Water. With these important exceptions, the top of the operating range is below the soil zone, thereby minimizing potential agricultural drainage problems.

> The **Measurable Objective** is to maintain groundwater levels above the groundwater level MTs (as quantified above or the interconnected surface water MTs, whichever is higher at the relevant measurement event), and to maintain groundwater levels within the operating range as defined in this section.

The relevant groundwater level MT values that numerically define the Measurable Objectives are listed in Tables 6-1 and 6-6. Groundwater conditions with respect to chronic groundwater level declines are already sustainable. Therefore, no interim milestones are needed to achieve sustainability by 2042.

6.2.7.1. Discussion of Monitoring and Management Measures to be Implemented

Data needs and sources uncertainties have been identified in this section, including for example, the lack of reliable and accessible information on private well construction and the uncertainties associated with using production wells for Key Wells. Monitoring improvements are discussed in Section 7 Monitoring Network, including results of the Dedicated Monitoring Well Program initiated in June 2020.

Management actions to maintain groundwater levels have been ongoing and effective for decades. These actions (consistent with the Sustainability Goal objective to support integrated and cooperative water resource management) have included developing local surface water for percolation, acquiring imported CVP water for direct use and managed aquifer recharge, providing recycled water for irrigation, and other conjunctive use operations. Relevant to this is the Managed Aquifer Recharge Study initiated in June 2020 and incorporated into Section 8 Projects and Management Actions. SBCWD also has education and outreach programs to promote water use efficiency and to reduce water demand.

In addition, to minimize construction of new wells with insufficient well depth, SBCWD will provide outreach to local well drillers and prospective well owners, for example, through its website and well permitting process. Such outreach will inform well drillers about the MTs for groundwater levels. This will likely involve description of the MTs and Key Wells, provision of information (for example, a general map of MT depths to water) to guide well drillers, and explanation of the potential risks of shallow wells.

6.3. REDUCTION OF GROUNDWATER STORAGE

Groundwater storage is the volume of water in the basin[8]; it provides a reserve for droughts or surface water supply shortages. The minimum threshold for reduction of groundwater storage is the volume of groundwater that can be withdrawn from a basin or management area without leading to undesirable results. Undesirable results would involve insufficient stored groundwater to sustain beneficial uses through drought or shortage. The storage criteria are closely linked to groundwater levels, but unlike the other sustainability criteria, the reduction of groundwater storage criteria is not defined at individual monitoring sites but is evaluated as a volume on a management area or basin-wide basis. The sustainability indicator for groundwater storage addresses the ability of the groundwater basin to support existing and planned beneficial uses of groundwater even during drought and surface water supply shortage.

Change in groundwater storage (either reduction or increase) can be evaluated with two main methodologies; one method uses groundwater level change data from wells with application of a storage coefficient and the other method involves an accounting of all the inflows and outflows and computation of change in storage according to the water budget equation (inflows-outflows=change in storage).

For the management areas of the North San Benito Basin, the water budget has been calculated using the numerical model, as described in Water Balance Section 5. In brief, this has included analyses of the cumulative change in storage for each of the MAs for the historical and current period, 1975-2017, and for simulated future conditions (see **Figures 5-12** and **5-13**). The water budget analyses have shown the effects of drought and shortage and the subsequent recoveries; these indicate that groundwater storage in North San Benito Basin has not been reduced and that the basin is sustainably managed relative to storage. The water budget inflows and outflows have been balanced over the long term; furthermore, as indicated in Section 6.2, water supply wells have not been reported as going dry in North San Benito Basin.

6.3.1. Description of Undesirable Results

Given that North San Benito Basin has a balanced water budget without long-term storage reduction, the undesirable result associated with inadequate groundwater storage would be an insufficient supply to support beneficial uses during droughts. Storage is related to groundwater levels, thus, undesirable results associated with storage would likely be accompanied by one or more undesirable results associated with groundwater levels, including reduced well yields, subsidence, and depletion of interconnected surface water.

6.3.2. Potential Causes of Undesirable Results

For groundwater storage in North San Benito Basin, the basic cause of undesirable results would be an imbalance of the water budget, such that outflows exceed inflows resulting in reduction of groundwater storage. This imbalance could be caused in turn by reduced surface water supplies and associated groundwater recharge (in lieu and direct). Such reduction could potentially include 1) disruption of

[8] This terminology is consistent with GSP Regulations, recognizing that the amount of groundwater *in* storage is the key variable and is distinct from groundwater storage capacity.

Hernandez Reservoir releases (with direct consequences for the Southern, Hollister, and San Juan MAs) or 2) reduced CVP water imports with direct adverse impacts on agricultural and municipal water users in Hollister and San Juan MAs and serious overdraft impacts on groundwater users throughout Hollister, San Juan, and Bolsa MAs. Undesirable results also could occur because of changes in land use causing increased demand for groundwater; this would be most problematic in portions of North San Benito without access to developed surface water supplies (i.e., areas not in Zone 3 or Zone 6).

6.3.3. Definition of Undesirable Results

Undesirable results are defined in light of the Sustainability Goal for the North San Benito Basin, which includes an objective to provide reliable storage for water supply resilience during droughts and shortages. Accordingly, the definition of potential undesirable results for storage reduction includes consideration of how much storage has been used historically (i.e., operating storage) and how much stored groundwater reserve is needed to withstand drought.

In thinking about conceptual operating storage or groundwater reserves, it is important to bear in mind that these are not the total amount of groundwater that could potentially be extracted from the basin. Most wells are in the range of 150 to 500 feet deep. The basin is hundreds of feet thick in most places, and up to 4,000 feet in some places (see Section 3.8). Additional groundwater storage could be utilized, with the foremost assumption that withdrawals and reduction are followed by commensurate recharge and recovery. This could occur as part of enhanced conjunctive use programs.

6.3.4. Potential Effects on Beneficial Uses and Users

Groundwater is the major source of supply in the GSP Area and supplies wells for agricultural, municipal, industrial, and domestic beneficial uses. Reduction of groundwater storage would reduce access to that supply with adverse effects on the community, economy, and environmental setting of North San Benito. However, groundwater has been and is being used for the beneficial uses, even during drought.

6.3.5. Sustainable Management Criteria for Groundwater Storage

The general approach to defining sustainability criteria for groundwater storage has involved review of historical cumulative change in storage and expected future storage declines during droughts. Review of historical change in storage is revealing about how much storage has been used in each MA, effectively defining an *operating storage*. Similarly, examination of cumulative storage change for future baseline conditions is instructive about the *groundwater reserves* needed to withstand future droughts.

6.3.5.1. Description of Historical Cumulative Change in Storage: 1975-2017

Figure 6-2 shows the cumulative change in storage by management area for historical and current conditions (1975-2017) as simulated by the numerical model. Starting from an assigned value of zero at the end of 1974, the storage change in each year is added to the cumulative total of the preceding years. Wet periods appear as upward trends in the cumulative total and droughts appear as downward trends. Cumulative storage reached its minimum for all four MAs in 1977, because the 1976-1977 drought occurred shortly after the start of the simulation period. This was followed by periods of increasing storage reflecting wet years and/or CVP imports and decreasing storage due to droughts. The storage volume change over the historical period from 1975 through 2017 is an indication of the operating storage, namely how much storage has been utilized in the context of a sustainable water budget. Observations about the historical operating storage for each of the MAs are as follows:

Hollister MA. Groundwater storage accumulated from 1977 to 1983; this accumulated storage subsequently was tapped during the prolonged drought of 1987 through 1992 (six years). After 1992, storage accumulated rapidly with a series of mostly wet and above normal water year types and delivery of CVP water for direct use and for recharge. Accumulated storage reached a maximum of 352,000 AF in 2006. Severe drought (including CVP cutbacks) from 2012 through 2016 was marked by storage decrease. Storage declines associated with the major droughts were about 110,000 AF. Nonetheless, storage at the end of 2017 was 265,000 AF greater than in 1975.

San Juan MA. The pattern of cumulative storage change for San Juan MA is like that of Hollister MA but less in magnitude. San Juan MA is smaller in area than Hollister, did not have as large a historical pumping depression as Hollister MA, and therefore did not have as much storage capacity that could be filled. Accumulated storage reached a maximum of 174,000 AF in 2006. With a similar storage history as in Hollister MA, storage declines associated with the major droughts were about 45,000 AF. Overall, storage in 2017 was 148,000 AF more than in 1975.

Southern MA. As discussed in Water Balance Section 5.8, evaluation of storage change in the Southern MA is less certain because of the scarcity of data to correctly estimate the initial storage in 1975 as a starting point for the model simulation. Nonetheless, the rapid increase in storage during the 1990s realistically reflected wet years during that decade (no CVP water is delivered to this MA) and reached a maximum of 150,000 AF in 2011. The simulated response of Southern MA to recent drought is informative for future planning; the major drought of 2012 through 2016 was marked by storage loss of almost 51,000 AF. Despite drought declines, cumulative storage increased by 147,000 AF from 1990 through 2017.

Bolsa MA. In contrast to the other MAs, groundwater storage in the Bolsa MA remained relatively steady during 1975-2017, reflecting various factors including its fine-grained sediments and considerable groundwater inflows along the perimeter of the MA. Maximum cumulative storage was 52,000 AF in 1998. Response to drought has involved gradual storage declines; the major 2012-2016 drought was marked by storage loss of about 17,500 AF. While storage change overall was small in Bolsa MA, cumulative storage in 2017 was 36,000 AF greater than in 1975.

In all four MAs, simulated storage recovered during the 6 to 10 years following the droughts, indicating that the drought declines were within the operating storage and not a sign of overdraft.

6.3.5.2. Description of Cumulative Change in Storage: Future Baseline Conditions

Examination of cumulative storage change for future baseline conditions is instructive about groundwater reserves to withstand future droughts. Future changes in storage were obtained from the future baseline modeling, which was described in Water Budget Sections 5.2 and 5.4.3. That modeling simulates hydrologic conditions (including CVP availability) for an 86-year period corresponding to water years 1922-2007. It assumes a continuation of existing land use, urban water demand, water, and wastewater treatment and CVP availability. Most importantly, this simulation includes complete drought and recovery cycles for 1923-1934 and 1987-1992, which were the two largest historical droughts in terms of cumulative declines in water levels and storage. Water Balance Section 5.9 describes how the initial estimate of sustainable yield is based on the same future baseline simulation described here.

Figure 6-3 shows the cumulative change in storage for future baseline conditions as simulated by the numerical model. The large cumulative storage declines during 1923-1934 and 1987-1992 resulted from concurrent decreases in rainfall recharge, stream percolation and CVP deliveries, accompanied by increased pumping to compensate for the reduction in CVP availability.

The largest simulated drought-related storage decline from the future baseline simulation is shown for each management area in **Table 6-2**; these are the "design droughts" for planning purposes. Also shown for comparison is the maximum cumulative storage increase after 1975. As illustrated in **Figure 6-2**, the maximum occurred in Hollister and San Juan MAs in 2006, in Bolsa in 1998, and in Southern MA in 2011. In all four management areas, maximum cumulative storage increase is 2.1 to 2.7 times greater than the largest anticipated storage decline during a future drought. There were minor differences among the MAs with respect to which drought period had the largest cumulative decline. The 1923-1934 decline was the largest for all of the areas except the Southern MA. In the Southern and Bolsa MAs, cumulative storage for the latter drought reached a minimum in 1990 instead of 1992.

Table 6-2. Groundwater Storage During Future Droughts

Management Area	Largest Simulated Future Drought		Maximum Cumulative Storage Increase from 1975, AF*	Ratio of Maximum Storage to Future Drought Decline
	Hydrologic Period	Cumulative Storage Decline, AF		
Hollister	1922 – 1934	165,000	352,000	2.1
San Juan	1922 – 1934	65,000	174,000	2.7
Southern	19–7 - 1990	57,000	150,000	2.6
Bolsa	1922 – 1934	21,000	52,000	2.5

*Except Southern MA, which was from 1990 to reduce uncertainty from lack of historical data.

The maximum cumulative storage increase (operating storage) and cumulative storage declines (groundwater reserves) described in **Table 6-2** do not represent the total groundwater storage that could potentially be used in the basin without incurring undesirable results; while not quantified, that volume is significantly greater.

6.3.6. Minimum Threshold

Undesirable results relative to groundwater storage have not occurred in North San Benito and numerical modeling of future conditions indicate that groundwater storage can continue to be operated within historical limits. Nonetheless, the potential for reduction of groundwater storage exists (probably involving disruption of surface water supply) and thus this section considers minimum thresholds for storage. According to GSP Regulations, the minimum threshold for storage is to be defined as the maximum groundwater volume that can be withdrawn without leading to undesirable results.

However, GSP Regulations allow the use of the groundwater level sustainability criteria (MTs and MOs) as a proxy for groundwater storage, provided that the GSP demonstrate a correlation between groundwater levels and storage. Groundwater levels and storage are closely related. This is demonstrated by comparison of groundwater level and storage trends, which reveal the same patterns of historical overdraft, response to drought and recovery. The relationship of levels and storage is embodied in the calibrated numerical model.

The rationale for using groundwater levels as a proxy metric for groundwater storage is that the groundwater level MTs and MOs are sufficiently protective to ensure prevention of significant and unreasonable results relating to storage. In brief, groundwater level MTs have been defined to protect relatively shallow supply wells (see Section 6.2.6) and are based on the following:

- A broad geographic distribution of Key Wells that are representative of basin production wells.
- MTs that are based on 1977 groundwater levels, consistent with analyses of storage change.
- Analysis of existing wells with construction information and setting of MTs to avoid drying up these wells.
- MTs are relatively shallow; as shown in **Table 6-1**, all MTs are less than 200 feet deep while production wells in North San Benito are generally 150 to 500 feet deep.
- Groundwater level MTs include two consecutive exceedances in each of two years, providing early warning for storage changes, while also involving sixty percent or more of the Key Wells in Management Area, thus involving a broad area, consistent with storage change.

As a practical matter, the availability of groundwater storage will be constrained by water levels (including groundwater level proxies for depletion of interconnected surface water) and given all the above, the MTs for groundwater levels (see Table 6-1) are more than sufficiently protective of groundwater storage.

To summarize for the North San Benito Basin:

> The **Minimum Threshold** for storage for all Management Areas is fulfilled by the minimum threshold for groundwater levels. The **Minimum Threshold** for defining undesirable results relative to chronic lowering of groundwater levels is defined at each Key Well by historical groundwater low levels adjusted to provide reasonable protection to nearby existing wells. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in sixty percent or more of the Key Wells in each Management Area.

The Sustainability Goal for the North San Benito Basin includes an objective to provide reliable storage for water supply resilience during droughts and shortages. Use of groundwater levels as a proxy also fulfills that objective. No additional MT definition is needed.

6.3.6.1. Relationship of Minimum Threshold to Other Sustainability Indicators

The MT for storage is related to other sustainability indicators as follows.

- **Water Levels.** The cumulative storage was estimated as the cumulative increase since 1975. This is consistent with the minimum thresholds for groundwater levels, also based on water levels from the mid-1970s (with local adjustments). The minimum thresholds for groundwater levels are protective of relatively shallow wells; therefore, these levels are protective of and serve as a proxy for groundwater storage and the provision of reliable storage for drought and shortage.

- **Seawater Intrusion.** There is no possibility of seawater intrusion in North San Benito basin. Accordingly, there is no minimum threshold and no relationship with other minimum thresholds.

- **Subsidence.** Subsidence is linked to groundwater levels. Because the storage reduction minimum threshold would not cause water levels to drop below their minimum thresholds, it would not interfere with the subsidence minimum threshold.
- **Water Quality.** Maintenance of groundwater storage within historical ranges would minimize any effects on water quality relative to water quality minimum thresholds. Groundwater quality issues in North San Benito Basin are associated primarily with salt and nutrient loading and not likely to be affected by groundwater storage within historical ranges.
- **Interconnected Surface Water.** The minimum thresholds for depletion of surface water flow are linked to historical groundwater levels near river reaches with shallow groundwater. Those water levels are generally equal to or higher than the minimum thresholds for water levels in those areas. Thus, it is more likely that the interconnected surface water threshold would constrain storage utilization rather than vice versa.

6.3.6.2. Effect of Minimum Threshold on Sustainability in Adjacent Areas

The North San Benito Basin is adjacent to the Llagas Subbasin in Santa Clara County. As stated in its 2016 Groundwater Management Plan, SCVWD (Valley Water) has previously estimated the operational storage capacity of the Llagas Subbasin to range between 152,000 and 165,000 AF. The operational storage capacity is less than total storage capacity because it accounts for the avoidance of adverse impacts. The estimate is based on the product of specific yield, area, and the elevation difference between high and low groundwater surfaces. Groundwater level data for 1982-1983 were used for the high levels and 1976-1977 for low levels (the same as used for North San Benito).

Groundwater flow directions are normally from southern Llagas Subbasin into the Bolsa MA (see Groundwater Conditions, **Figures 4-8** and **4-9**) with some drainage into the Pajaro River. The groundwater level MTs for North San Benito would support maintenance of groundwater levels and storage within the historical range in Bolsa and this in turn will support maintenance of operational groundwater storage in Llagas Subbasin. Similarly, outflow to the Pajaro River would be maintained within the historical range by the MT, which would not affect the ability of the Pajaro Valley GSA to achieve or maintain sustainability.

6.3.6.3. Effect of Minimum Threshold on Beneficial Uses and Users

Beneficial uses and users of groundwater storage include maintenance of interconnected surface water and associated GDEs and agricultural, municipal, industrial, and domestic groundwater users. The MTs for groundwater levels are based generally on historical lows, which recognizes that groundwater has been and is being used reasonably for the range of beneficial uses even during droughts. The storage minimum threshold is consistent with the water level minimum threshold, which means that available storage will be adequate to supply beneficial uses as long as water levels remain above their minimum thresholds.

6.3.6.4. Relationship of Minimum Threshold to Regulatory Standards

Other than SGMA, no federal, state, or local standards exist for reduction of groundwater storage.

6.3.6.5. How Management Areas Can Operate without Causing Undesirable Results

A storage change in one MA would be associated with a change in water levels. That change could affect groundwater flow between that MA and an adjoining one. The boundary flow would only change if storage and water levels in the adjoining MA did not experience a similar change. The only anticipated change in land use or pumping patterns that might alter the relative storage fluctuations among the MAs during future droughts would be an increase in Southern MA pumping to supply new irrigated acreage. However, that increase is expected to be small relative to storage changes in the adjoining Hollister MA and not jeopardize groundwater availability in that MA. Therefore, no incompatibility among MAs with respect to storage declines is anticipated.

6.3.6.6. How the Minimum Threshold will be Monitored

Monitoring for the groundwater levels MT, which is the proxy for storage, will be part of the SBCWD Groundwater Level Monitoring Program. Data and analytical results, including assessment of change in storage, are presented in the Annual Groundwater Reports.

6.3.7. Measurable Objectives

Measurable Objectives would be defined as an operating range of groundwater storage, allowing changes in groundwater storage with varying hydrologic and surface water supply conditions and as with conjunctive management of surface water and groundwater. The groundwater level MTs provide a protective historical low level that corresponds to the minimum threshold for storage, which would ensure that groundwater storage is in a historical operating range. This is prudent and reasonable, especially given the realization that considerable additional storage underlies portions of the basin. The Five-Year GSP Update could include consideration of using more of this storage locally as part of ongoing conjunctive use while also protecting shallow wells.

> The **Measurable Objective** for storage is fulfilled by the MT for groundwater levels, which maintain groundwater levels within the historical operating range.

Groundwater conditions with respect to depletion of groundwater storage are already sustainable. Therefore, no interim milestones are needed to achieve sustainability by 2042.

6.3.7.1. Discussion of Monitoring and Management Measures to be Implemented

Management actions to prevent chronic reduction of groundwater storage and to provide groundwater reserves for drought will be the same actions for maintenance of groundwater levels. No other specific management actions for storage have been identified and no specific implementation is warranted.

6.4. LAND SUBSIDENCE

Subsidence has not been a known issue in the North San Benito Basin and undesirable results have not been reported. Nonetheless, the potential has been recognized for subsidence that could occur as a result of groundwater pumping and groundwater level declines, typically in areas underlain by thick layers of fine-grained alluvial sediments.

As described in Section 4.3, available information on vertical land displacement (subsidence) includes Global Positioning System (GPS) data using satellites: interferometric synthetic aperture radar (InSAR) and University Navigation Satellite Timing and Ranging System Consortium (UNAVCO). InSAR data provide mapping of ground surface elevations across the basin, presented at regular (generally monthly) intervals. UNAVCO data represent GPS measurements at selected permanent ground stations, which provide long-term temporal measurements.

The InSAR data (as of May 2020) include two datasets, TRE Altamira InSAR Dataset and National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) InSAR Dataset. The NASA JPL provides data from May 2015 to April 2017, while the TRE Altamira provides annual and total vertical displacement data beginning in June 2015 and in monthly intervals thereafter until September 2019. While these are short periods of record, both datasets indicate local areas of subsidence in portions of the Bolsa, Hollister, and San Juan MAs. Given the short records of these datasets, small vertical displacements (0 to -2 inches), and patchy distribution of areas, these data have not been analyzed systematically to identify specific areas that might be subject to long-term subsidence. As datasets are updated and refined by DWR, that will be planned for the future.

The UNAVCO data provide temporal measurements at established ground stations. Most of the UNAVCO stations are along the basin margins and/or at higher topographic elevations, better suited to track tectonic movements than groundwater-related subsidence. However, there is one UNAVCO ground surface elevation monitoring station located in a low lying alluvial portion of the basin (in Bolsa MA at Frazier Lake Air Park). As shown in **Figure 6-4**, GPS data from this monitoring station (P242) shows seasonal elastic variability (generally two inches or less) and a long-term declining trend that suggests local inelastic subsidence related to groundwater pumping. While data are limited, subsidence also is indicated by comparison of the pattern of land subsidence trends at P242 with groundwater level trends in nearby wells. This subsidence apparently is local (see **Figure 4-12**), and at the UNAVCO station, amounted to about two inches over the past 15 years.

Data are limited not only on groundwater-related subsidence, but also potentially associated pumping and groundwater levels. SGMA allows groundwater level data to be used as a proxy for subsidence; however, relationships between pumping, groundwater levels, and subsidence have not been determined to support that. Subsidence information from DWR (InSAR) and UNAVCO will be reviewed as it becomes available.

In brief, subsidence is a potential risk, and the Sustainability Goal includes an objective to prevent subsidence; this recognizes that inelastic subsidence is irreversible. However, it can be prevented by maintaining groundwater levels above historical lows. Insofar as data are available, subsidence prevention is supported by the minimum threshold for groundwater levels, which is equal to or above historical minimum levels.

6.4.1. Description of Undesirable Results

Land subsidence is the differential lowering of the ground surface, which can damage structures and hinder surface water drainage. Potential undesirable results associated with land subsidence due to groundwater withdrawals include the following:

- Potential differential subsidence affecting the gradient of surface drainage channels, locally reducing the capacity to convey floodwater and causing potential drainage problems and ponding.
- Potential differential subsidence damaging facilities or affecting the grade of infrastructure such as pipelines, airport runways, railroads, roads, and highways.
- Potential subsidence around a production well, disrupting wellhead facilities or resulting in casing failure.
- Potential non-recoverable loss of groundwater storage as fine-grained layers collapse.

None of these undesirable results has been observed in North San Benito Basin. However, subsidence may be subtle and cumulative over time. Accordingly, the potential for future subsidence cannot be ruled out if regional groundwater levels were to decline below historical lows and minimum thresholds.

6.4.2. Potential Causes of Undesirable Results

As described in Section 4.3, subsidence may be caused by regional tectonism or by declines in groundwater elevations due to pumping. Regarding the former, three UNAVCO sites bracket but are outside of the Southern MA (see **Figure 4-13**); these show relatively frequent but small changes (generally less than one inch in a year) and a generally rising trend that suggests regional tectonic rise. In contrast, inelastic subsidence associated with groundwater pumping and level declines would generally show a long-term downward trend, with greater subsidence occurring during times of groundwater level decline (e.g., drought) and a flattening trend with no recovery during times of rising groundwater levels and reduced pumping (e.g., wet years).

In brief, as groundwater levels decline in the subsurface, dewatering and compaction of predominantly fine-grained deposits (such as clay and silt) can cause the overlying ground surface to settle. Land subsidence due to groundwater withdrawals can be temporary (elastic) or permanent (inelastic). While elastic deformation is relatively minor, fully recoverable, and not an undesirable result, inelastic deformation involves a permanent compaction of clay layers that occurs when groundwater levels in a groundwater basin decline below historical lows. This causes not only subsidence of the ground surface, but also compaction of sediments and loss of storage capacity.

Given the above, the potential for problematic land subsidence is affected by the proportion, overall thickness, and configuration of fine-grained sediments (with greater proportions and thicknesses suggesting greater potential). Because of the variability of local sediments, subsidence also is likely to be geographically variable. Moreover, the potential for subsidence is affected by the history of groundwater level fluctuations, such that areas with previous groundwater level declines may have already experienced some compaction and subsidence.

The potential for subsidence, considering hydrogeologic factors, varies among Management Areas. Notably in Southern Area, subsidence potential is not likely significant, given the relatively high portion of coarse-grained materials (which are less susceptible to subsidence) along the San Benito River and Tres Pinos Creek. Available InSAR mapping shows minimal vertical displacements and data from nearby UNAVCO stations do not show downward displacement in Southern MA.

6.4.3. Potential Effects on Beneficial Uses and Users

The lack of any reports of undesirable results is an indication of no noticeable effects; San Benito landowners are informed and aware of subsidence problems in the Central Valley that cause the above bulleted effects. Nonetheless, some subsidence could have occurred because of historical groundwater level declines without being noticed. This could have contributed to drainage or flooding problems, which are the affected by multiple and sometimes more noticeable factors including variable weather, changes in streams and drainage systems, land use changes in the watershed, erosion, and sedimentation. Accordingly, continued tracking of subsidence and efforts to prevent subsidence are warranted.

6.4.4. Minimum Threshold

According to the GSP regulations Section 354.28(c)(5) the minimum threshold for land subsidence is defined as the rate and extent of subsidence that substantially interferes with surface land uses. This section first addresses the rate at which subsidence substantially interferes with surface land uses and then describes how available InSAR data can be used to measure rate and extent across the basin.

> The **Minimum Threshold** for **subsidence** is defined as a rate of decline equal to or greater than 0.2 feet in any five-year period. This has been considered in terms of a cumulative decline equal to or greater than one foot of decline since 2015; 2015 represents current conditions and the SGMA start date.

The 1-foot criterion is reasonable based on standards for flooding and drainage and on empirical data for well casing collapse:

- Ground floor elevations are recommended or required to be at least 1 foot above the Base Flood Elevation in some jurisdictions (see for example Federal Emergency Management Agency, 2003).
- The minimum freeboard along roadside ditches is often required to be 1 foot above the maximum anticipated water level (see for example County of Santa Clara, 2007).
- In the southwestern part of the Sacramento Valley, where documented cumulative subsidence has reached several feet, video surveys of 88 undamaged wells and 80 damaged wells showed that casing damage was uncommon in wells where subsidence was less than 1 foot (Borchers et al., 1998).

Subsidence impacts can be relatively rapid and noticeable. However, in North San Benito, any subsidence has been slow and not noticed and if occurring in the future, is likely to be gradually cumulative as would be its undesirable results. Accordingly, the 1-foot decline since 2015 is an appropriate criterion, with the understanding that it will be re-evaluated in the 2027 GSP Update.

This is generally equivalent to a rate of decline equal to or greater than 0.2 feet in any five-year period. The five-year period is selected as consistent with preparation of Five-Year Updates of the GSP and allows for data review and evaluation over several years. The amount of decline of 0.2 feet recognizes measurement and mapping error in the InSAR data (as of 2015 to 2018), which has been estimated at 0.1 foot (Brezing, 2020). Accordingly, the MT incorporates reasonable uncertainty. DWR has been adjusting InSAR mapping to focus on stable reflectors (such as roads and buildings) and thereby improve accuracy.

Based on available data and using the above criterion, significant and unreasonable subsidence has not occurred since 2015 in the North San Benito Basin. Moreover, it is unlikely that the criterion will be exceeded. UNAVCO monitoring of station P242 indicates cumulative inelastic subsidence of about two inches over the past 15 years.

The extent of cumulative subsidence across the basin will be monitored using the InSAR satellite-based data that DWR has been providing on the SGMA Data Portal website. The data consist of a closely-spaced grid of elevation points; as data are compiled at each point over time, temporal trends may become apparent. As described in more detail in Section 6.4.4.6, these data will be reviewed to identify any occurrence and extent of subsidence. These values for cumulative elevation change will then be compared annually with the minimum threshold criterion.

6.4.4.1. Relationship of Minimum Threshold to Other Sustainability Indicators

Subsidence is closely linked to groundwater levels. It is unlikely that significant inelastic subsidence would occur if groundwater levels remain above their minimum thresholds. The water level minimum thresholds, generally based on historical lows or higher levels, do not interfere with managing the other sustainability indicators to remain above their respective MTs, as described in Section 6.2.

The subsidence MT would have little or no effect on other MTs. Specifically, subsidence MTs would not result in significant or unreasonable groundwater elevations, would not affect pumping and change in storage, would not affect groundwater quality, or result in undesirable effects on connected surface water.

6.4.4.2. Effect of Minimum Threshold on Sustainability in Adjacent Areas

The North San Benito Basin is adjacent to the Llagas Subbasin in Santa Clara County. Groundwater flow directions are from southern Llagas Subbasin into the Bolsa MA (see Groundwater Conditions, **Figures 4-8** and **4-9**) with some drainage into the Pajaro River. The subsidence MT has little or no effect on groundwater elevations, which would be managed relative to groundwater level MTs.

The North San Benito Basin is upstream of the Pajaro Valley Subbasin; the two are linked by flows in the Pajaro River. The MTs for the North San Benito Basin represent current conditions; establishment of MTs and maintenance of groundwater levels would not affect the ability of the Pajaro Valley GSA to achieve or maintain sustainability.

6.4.4.3. Effect of Minimum Threshold on Beneficial Uses and Users

Subsidence problems have not been reported in North San Benito Basin, but subsidence remains a potential undesirable result that may contribute incrementally to reduced drainage, increased flooding, or other undesirable results. The effects of establishing the numerical subsidence MT are beneficial because they support a greater chance of detecting subsidence, supporting management actions to maintain groundwater levels, and preventing significant subsidence.

6.4.4.4. Relationship of Minimum Threshold to Regulatory Standards

There are no federal, state, or local standards specifically addressing subsidence. There are standards for flood depth, floodplain encroachment, freeboard in ditches, and canals and slopes of gravity-flow plumbing pipes. These vary somewhat from jurisdiction to jurisdiction, but they are generally similar and were used as the basis for selecting the MT (see details in Section 6.4.4).

6.4.4.5. How Management Areas Can Operate without Causing Undesirable Results

The MTs are consistently conceived and applied across all four Management Areas. The possibility remains that potential subsidence in the Southern MA is not significant; tracking and analysis of InSAR mapping over the next five years (until five-year update) may be revealing about that. Meanwhile, maintenance of groundwater levels at or above historical lows will tend to maintain current conditions between the successive MAs from upstream to downstream.

6.4.4.6. How the Minimum Threshold will be Monitored

The minimum threshold will be monitored using the UNAVCO site-specific and InSAR areal data. Cumulative subsidence will be monitored using the InSAR satellite-based geodetic data that DWR has been providing on the SGMA Data Portal website. The data are "raster" data sets consisting of a grid of elevation points spaced approximately 300 feet apart. The data sets have had considerable "noise," meaning that adjacent points may very different readings at the scale of 1-2 inches. Some of this apparently random variation might have been due to agricultural activities, and some might be due to inherent measurement error associated with atmospheric conditions; DWR has been addressing these issues in its recent mapping. The InSAR data will be evaluated to identify any occurrence and areal extent of subsidence. As data are provided over the next few years, this evaluation will involve review of temporal InSAR data to discern seasonal elastic fluctuations and potential inelastic declines; the UNAVCO data provided at Station P242 would be a useful guide. In addition, any areal extent will be examined; this may involve smoothing of elevation changes over the InSAR grid to summarize the results to a spatial scale at which subsidence would plausibly occur. The cell values for cumulative elevation change will then be compared with the minimum threshold criterion.

6.4.5. Measurable Objectives

The Sustainability Goal includes the objective to prevent subsidence. Accordingly, the Measurable Objective is conceptually zero subsidence while acknowledging measurement error and other uncertainties. Undesirable subsidence results have not occurred, and accordingly, no interim milestones are defined.

6.4.5.1. Representative Monitoring

It is assumed that the UNAVCO and InSAR subsidence monitoring programs will continue for the foreseeable future and InSAR data will be available from the DWR website. The GSP monitoring program for subsidence will involve annual download of UNAVCO and InSAR data with analysis for signs of cumulative inelastic subsidence.

6.4.5.2. Discussion of Management Actions to be Implemented

Management actions to prevent subsidence will be coordinated with actions relative to maintenance of groundwater levels. These actions involve maintaining groundwater levels above historical low water levels and will prevent significant inelastic subsidence. No other specific management actions for subsidence have been identified and no specific implementation is warranted.

6.5. Seawater Intrusion

Seawater intrusion does not occur in the North San Benito Basin because of its inland location. According to the GSP Regulations, the GSP is not required to establish criteria for such undesirable results that are not likely to occur. Accordingly, the remaining discussion in this section does not address seawater intrusion.

6.6. Degradation of Water Quality

Degraded water quality can impair water supply and affect human health and the environment. Impacts to drinking water supply wells can result in increased sampling and monitoring, increased treatment costs, use of bottled water, and the loss of wells. As described in Groundwater Conditions Sections 4.7 and 4.8, elevated concentrations in drinking water of some constituents, such as nitrate, can adversely affect human health. Impacts to agricultural supply can include reduced yields, the need to change irrigation methods/sources, and other economic effects. Discharge of degraded groundwater can harm ponds, wetlands, and associated ecosystems (e.g., eutrophication).

Consideration of the causes and circumstances of water quality conditions is important in North San Benito because general mineral quality (e.g., TDS, iron and manganese, boron, etc.) is naturally poor throughout much of the basin, has been poor for decades, and nonetheless has been used for beneficial purposes including irrigation, municipal, and domestic purposes. Sustainable management is about use and management of groundwater without causing undesirable results but does not necessarily include reversing natural undesirable conditions. According to SGMA (§10727.2(b)(4)), a GSP may—but is not required to—address undesirable results that occurred before and have not been corrected by the SGMA benchmark date of January 1, 2015.

While native groundwater quality is poor, salt and nitrate loading also are recognized as sources of groundwater quality deterioration. Such loading has been occurring for more than 100 years; however, changes in groundwater quality at depth (where groundwater typically is pumped) will lag behind the salt and nutrient loading at the ground surface by decades to centuries (Fogg et al., 1999). This means that groundwater quality monitoring data can be misleading, sustainability criteria based on such data potentially could be reactive to decades-old land use conditions and insensitive to the future, and the effects of management activities may not be seen for decades. Nonetheless, data needs are recognized in the GSP, and monitoring program improvements will be identified and implemented.

Given all that, the sustainability goal—to protect groundwater quality—is not to reverse undesirable water quality conditions by 2042 but rather to prevent circumstances wherein future management activities might make water quality worse and insofar as possible to improve water quality in the long run. Implementation of management actions is recognized as needed now and, whether or not the results are perceptible in the short term, such actions will be helpful in the long term.

6.6.1. Potential Causes of Undesirable Results

The quality of groundwater in North San Benito Basin is characterized as highly mineralized, reflecting natural hydrogeologic processes (see Groundwater Conditions Section 4.4). Groundwater also has been affected by human activities including agricultural, rural, urban, and industrial land uses. While contaminant sources of groundwater quality degradation exist, these are effectively regulated as described in Groundwater Conditions Section 4.6 and regularly tracked as part of the SBCWD monitoring program.

As described in the Groundwater Conditions Section 4.7, TDS and nitrate are constituents of concern for the Basin. While there are elevated natural background TDS concentrations in groundwater, TDS also is an indicator of human impacts including infiltration of urban runoff, agricultural return flows, and wastewater disposal. Natural nitrate levels in groundwater are generally very low, and elevated concentrations are associated with agricultural activities, septic systems, confined animal facilities, landscape fertilization, and wastewater treatment facility discharges.

Other potential constituents of concern in North San Benito include perchlorate, selenium, hardness, boron, iron, manganese, arsenic, and chromium. As described in Groundwater Conditions Section 4.8, these represent diverse issues relative to representing potential causes of undesirable results.

- Perchlorate and selenium in the North San Benito Basin are associated with regulated facilities. As part of its regular monitoring program, SBCWD compiles and reviews data from regulated sites on a triennial basis. Regulated sites are listed and identified on a map (see Figure 4-17), and concentration data are reviewed with reference to MCLs. This recognition of regulated facilities and regular review is effective in minimizing potential undesirable results that could occur because of project or management actions that would spread contamination. The GSAs have established, collaborative relationships with regulatory agencies.
- Hardness is a naturally occurring and widespread condition that represents a concern mostly because it prompts residential use of water softeners that cause salt loading to wastewater. While hardness is regularly tracked, the salt loading issue is being addressed by various water resource management programs including the Hollister Urban Area Water Project and the SNMP (see Section 2.1.4.3).
- Boron, iron, manganese, arsenic, and chromium are naturally occurring in North San Benito Basin. Elevated concentrations have been mapped (for example, boron and manganese) and/or found to be associated with depth. In North San Benito, groundwater management activities generally have resulted in stabilized, relatively high groundwater levels since the late 1970s without the major changes in groundwater levels or flow directions that would potentially mobilize these constituents. While a potential could arise because of intensification of groundwater pumping or management actions, no significant or unreasonable effects are known to have occurred and are considered unlikely.

Sustainable criteria have not been developed in this GSP for these constituents because they are already managed under existing programs or because they are naturally occurring and unlikely to be affected by GSP management actions. Nonetheless, monitoring of these constituents will be continued, project and management actions will be planned in light of potential effects, and sustainable criteria can be developed as needed for a constituent during a regular five-year review.

6.6.2. Description of Undesirable Results

The processes and criteria relied on to define Undesirable Results included review of available data and information summarized in the Plan Area and Groundwater Conditions sections and discussions with North San Benito stakeholders and local agency representatives.

Undesirable Results are defined in the GSP Regulations (§354.26) as occurring when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin. The GSA is not responsible for local problems or degradation caused by others. While the North San Benito Basin includes regulated facilities with soil and groundwater contamination (see Groundwater Conditions Sections 4.4 and 4.6.1), these sites are under regulatory oversight by State agencies; the GSA does not have the mandate or authority to duplicate these programs. Nonetheless, SBCWD historically has cooperated with these agencies and checks regulator files regularly as part of its water quality monitoring program. In addition, this GSP avoids management actions that would spread groundwater contamination through managed aquifer recharge, pumping, or other activities.

In fact, SBCWD historically has conducted management actions and programs (often in cooperation with other agencies) to improve groundwater quality. As documented in Plan Area Section 2.1.4.3, these activities have included percolation of high-quality surface water, treatment of imported surface water for municipal use (which improves wastewater quality), wastewater treatment plant improvement and water recycling, and programs to reduce urban and agricultural salt and nutrient loading.

6.6.3. Potential Effects on Beneficial Uses and Users

Groundwater is the major source of supply in the GSP Area and supports a range of beneficial uses: agricultural, municipal, rural, and environmental. Reflecting the agricultural orientation of the GSP area, all land and property owners, residents, businesses, employees, farmers, and visitors are potentially affected by groundwater quality with respect to its specific use. Beneficial uses of water and respective water quality objectives are defined by the Central Coast Regional Water Quality Control Board (RWQCB) in the Basin Plan. For TDS and nitrate, these are tabulated in the GSP Groundwater Conditions (Section 4.7 Key Constituents of Concern); this section indicates that water quality in the Basin is naturally mineralized and affected by human activities and has not been shown to change significantly. While the limitations of monitoring are known, it is also recognized that groundwater has been and is being used for the range of beneficial uses with reasonable accommodation by users. This recognition does not preclude or ignore a desire by the community or intent of local agencies including the GSAs to improve local groundwater quality.

6.6.4. Sustainable Management Criteria for Groundwater Quality

The definition of an Undesirable Result due to degraded water quality—TDS and nitrate concentrations—was evaluated in the context of historical, existing, and potential future conditions in each MA. A major consideration in this evaluation is the reality of historical salt and nitrate loading to shallow portions of the principal aquifers. In deep alluvial basins such as North San Benito, there is typically a delay of decades for solute loading at the land surface to noticeably affect groundwater quality at the depths tapped by water supply wells. The amount of such legacy loading is not known nor is the rate at which it is moving down. (Substantial scientific investigation and years of monitoring would be needed to get reliable estimates.) Accordingly, water quality sampling included in the Groundwater Conditions section and/or most recent SBCWD Triennial Groundwater Quality Update (Todd, 2019) does not likely reflect the current, improved land use practices and water management activities. In the long run, implementation of such best management practices will reduce loading relative to what would have happened otherwise.

Moreover, monitoring of water quality in water supply wells over the next 20 years is not an appropriate means of tracking or verifying sustainability because water quality will primarily reflect loading that occurred prior to 2015 and likely get worse over that period regardless of active measures to reduce salt and nitrate loading. In light of this lag and the difficulties in quantifying it, the GSAs will conduct scientific investigations and improve monitoring (Section 6.6.6.2 identifies such measures).

For the decision to set sustainable management criteria, SGMA poses two basic questions: were undesirable results occurring as of the SGMA baseline of January 2015? And is there a potential for future undesirable results? The first question is currently un-answerable with any certainty because the groundwater system has not yet fully responded to recent changes in wastewater quality and agricultural loading. However, a potential for undesirable results during the next 20 years is undeniable as legacy loading arrives at deeper aquifers. Accordingly, consistent with SGMA, criteria must be set for groundwater quality.

GSP regulations require that the minimum threshold for degraded water quality be based on "the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the agency to be of concern for the basin" (§354.28(4)). The number of supply wells are considered here for the minimum threshold. This is because the issues of concern in North San Benito are focused on regional nitrate and salt loading, data are insufficient to define plumes or volumes of water, and the position of an isocontour is not applicable.

Notwithstanding the problem of legacy loading and the inherent limitations of water quality monitoring, best available data on groundwater quality were examined to develop MTs for TDS and nitrate in each MA. Two data sets are identified from the monitoring programs described below. As indicated below, both monitoring programs present limitations for setting MTs now, but also provide a foundation for adaptive management that is protective of groundwater quality while defining additional management actions (e.g., scientific study of vertical distribution of constituents) and monitoring program improvements (e.g., improved well network).

6.6.4.1. SBCWD Water Quality Monitoring Program

SBCWD established the water quality monitoring program for the protection of beneficial uses, understanding of human and natural factors that affect water quality, and support for groundwater management decisions (Todd, 2004). SBCWD has regularly monitored groundwater and surface water sites. Some of the wells are included to track and respond to local problems and the remainder are included to represent regional conditions. The network of wells historically has been focused on the Hollister and San Juan areas with only about 20 wells (see Groundwater Conditions **Figure 4-15**) but is in the process of being expanded to encompass the entire basin (Todd, 2019). The wells generally are sampled quarterly to a minimum of annually with lab analysis for general minerals, physical parameters, and selected constituents of concern. Accordingly, this data set can be used to detect a range of problems quickly, to track trends, allow geochemical investigation, and support focused management actions. In addition, the network includes the nested well in Hollister MA, a dedicated monitoring well that samples from five depth zones thus providing information on vertical distribution of constituents in this area.

6.6.4.2. Triennial Update Data

Once every three years, SBCWD compiles, reviews, and summarizes all available information on water quality in the basin. The most recent Triennial Update is provided in the 2019 Annual Groundwater Report (Todd, 2019) incorporated here by reference and in **Appendix E**. The triennial update incorporates all available data from SBCWD, other local agencies, and State agencies. The data include information from the RWQCB Irrigated Lands Regulatory Program that collects and synthesizes data (focused on nitrate but including TDS) from numerous agricultural growers in the Central Coast Groundwater Coalition. Accordingly, the Triennial Update provides a relatively large set of nitrate and TDS data from numerous wells widely distributed across the basin.

Table 6-3 summarizes the number of wells sampled for nitrate and TDS during Current Conditions as defined in this GSP. As shown, the number of sampled wells is relatively large even on a Management Area basis and can support statistical analysis. Limitations of this data set include the uneven and potentially shifting distribution of sampled wells across the basin, lack of information on the vertical zone being sampled (well construction information), relatively less frequent sampling schedule and absence of historical record, variable data availability on specific constituents and parameters, and multiple sources of information from programs with differing objectives and procedures. These limitations present significant uncertainties to the GSA and stakeholders who are required to establish quantitative, measurable criteria and then comply with them, with real-world consequences.

Nonetheless, the Triennial Update data set provides a snapshot and overview of TDS and nitrate, which supplements the SBCWD monitoring program and can be used to identify useful wells to improve the SBCWD program.

Table 6-3. Triennial Update Data Set, Number of Wells with Nitrate or TDS Data, 2015-2017

Constituent	Number of Wells with Data, 2015-2017				
	Bolsa MA	San Juan MA	Hollister MA	Southern MA	Total
Nitrate (as NO_3)	35	81	121	19	256
Total Dissolved Solids	31	63	108	11	213

6.6.5. Minimum Thresholds

Minimum Thresholds are presented for nitrate and TDS for each of the MAs using the best available information, namely the Triennial Update data set which includes all known relevant data, including the data generated by the SBCWD Water Quality Monitoring Program. As summarized above, the limitations of this data set are recognized, and additional investigations and monitoring program improvements will be presented in this GSP for planned implementation. With adaptive management in mind, MTs may be revised to rely more on the SBCWD program in the future with regular reference to Triennial Updates as needed.

The MTs for nitrate and TDS quantify current conditions (2015 through 2017) based on available monitoring data. However, recognizing the problem of legacy loading and the inherent limitations of water quality monitoring, the approach of the GSP is to proceed with measures to reduce loading of nitrate and salts. While actions taken today may not yield measurable benefits by 2042, in the more distant future they will lower concentrations of nitrate and TDS below what they otherwise would have been without GSA actions. This strategy can be viewed as a “best management practices” approach as opposed to a “monitor and respond” approach.

Water quality monitoring nevertheless serves two useful purposes. First, it will eventually confirm whether concentrations begin leveling off as intended. Second, it can detect local sources of degradation that impact groundwater quality more strongly and rapidly than the slow, dispersed loading from agricultural activities. Early detection of local impacts can enable appropriate actions to halt further contamination before the impacts become severe or widespread.

6.6.5.1. Minimum Threshold for Nitrate (NO_3)

Table 6-4 summarizes current conditions for nitrate in reference to the MCL for nitrate in drinking water, 45 mg/L, which also is the Basin Plan Objective for municipal use. Current conditions for each MA are expressed in terms of the percent of wells with concentrations over 45 mg/L. To compute the percent of wells, nitrate sampling results were compiled for each well over the period 2015 through 2017. For wells with one sample, the single value was used; for wells with two samples, the average value was used; and for wells with three or more values, the median value was used. Accordingly, each well was represented by one value. This was followed by computation of the percentage of wells with concentrations exceeding 45 mg/L.

This process of summarizing current conditions makes use of all available data. However, it is important to note that this data set does not represent a monitoring program designed by SBCWD. It also is recognized that the data are not representative of water supply conditions throughout the basin because the geographic distribution of wells is uneven and information from shallow and deep wells are combined. Monitoring program improvements will be implemented as part of the GSP to improve the data set (see Section 6.6.6.2) and provide a more reasonable basis for sustainability criteria.

Table 6-4. Summary of Current Conditions for Nitrate (NO_3)

MCL and Basin Plan Objective	Minimum Threshold - Percent Wells with Concentration over 45 mg/L, Current Conditions, 2015-2017			
	Bolsa MA	San Juan MA	Hollister MA	Southern MA
45 mg/L	11%	26%	14%	5%

As documented in **Table 6-4**, each MA includes wells yielding water with nitrate concentrations exceeding the MCL. Of the four MAs, the Southern and Bolsa MAs have the fewest wells exceeding the MCL and San Juan MA has the highest percentage, reflecting historical wastewater discharge and likely legacy nitrate loading from fertilizer use. While recognizing the number of wells affected by high nitrate concentrations, there has been historical and ongoing groundwater use with reasonable accommodation by users and accordingly, these conditions are considered sustainable.

Despite the significant uncertainties, the following MT is presented as a starting point for maintenance and planned improvement of groundwater quality for the 2042 deadline for sustainability.

> The **Minimum Threshold** for nitrate for each MA is defined initially as the percentage of wells with concentrations exceeding the nitrate MCL (45 mg/L) based on current conditions (2015-2017).

This MT is presented with full recognition of data needs and uncertainties, and with commitment incorporated in this GSP to investigate nitrate and salt loading under current conditions (including vertical distribution in shallow zones) and to implement management actions for reduction of nitrate and salt loading without delay.

Given the above definition, the MTs for nitrate in each MA are expressed in **Table 6-4**. These MTs refer to the numeric MCL and Basin Plan objective, honor the non-degradation policy, and quantify current conditions based on available data. As described in the following section, Measurable Objectives, the approach is to implement management actions that will maintain or reduce nitrate concentrations in the future. If the MT is exceeded (i.e. the percent of wells with concentrations above the MCL increases), additional study is necessary to determine if the increase is the result of management actions (including groundwater pumping, recharge, etc.), legacy loading, or a changing data set.

6.6.5.2. Minimum Threshold for Total Dissolved Solids

Table 6-5 summarizes current conditions for TDS with reference to the 1,200 mg/L Basin-Specific Basin Plan Objective for the previously defined Hollister Area[9]. This value is far from ideal (e.g., with reference to the recommended 500 mg/L for drinking water and 450 mg/L for agriculture, see **Table 4-1**), but reflects the widespread conditions of elevated TDS concentrations in groundwater.

As with nitrate, computation of the percent of wells in **Table 6-5** involved compilation of sampling results for each well over 2015 through 2017. For wells with one sample, the single value was used; for wells with two samples, the average was used; and for wells with multiple values, the median was used, such that each well was represented by one value. This was followed by computation of the percent of wells with TDS concentrations exceeding 1,200 mg/L.

This process makes use of all available data. However, this data set does not represent a monitoring program designed by SBCWD. In addition, the data are not representative of water supply conditions throughout the basin because the depths and geographic distribution of wells is uneven. Monitoring program improvements will be implemented as part of the GSP to improve the data set and provide a more reasonable basis for sustainability criteria.

Table 6-5. Summary of Current Conditions for Total Dissolved Solids (TDS)

General Basin Plan Objective	Minimum Threshold - Percent Wells with Concentration over 1,200 mg/L, Current Conditions, 2015-2017			
	Bolsa MA	San Juan MA	Hollister MA	Southern MA
1,200 mg/L	26%	45%	24%	27%

As documented in **Table 6-5**, each MA includes wells yielding water with TDS concentrations exceeding 1,200 mg/L. Of the four MAs, the Hollister and Bolsa MAs have the fewest wells exceeding the MCL. Southern MA has a relatively high percentage, despite its location upstream of the remainder of the basin and its limited areas of intensive land use (it is mostly rangeland); this likely reflects the uneven distribution of the few monitoring sites (only 11 per **Table 6-3**) and possibility of local degradation, and the natural, mineralized quality of local groundwater. San Juan MA has the highest percentage, representing the cumulative effects of mineralized natural quality, historical wastewater discharge, and legacy salt loading from evaporative concentration. While recognizing the number of wells affected by high TDS concentrations, there has been historical and ongoing groundwater use with reasonable accommodation by users and therefore, these conditions are considered sustainable.

---

[9] Basin-specific Basin Plan Objectives also include a 1,000 mg/L value for the previously-defined Tres Pinos Valley Basin, which was considered here as a criterion. However, this value pertains to only five square miles of the North San Benito Basin and was deemed not representative.

Despite the uncertainties, the following MT is presented as a starting point for maintenance and planned improvement of groundwater quality for the 2042 deadline for sustainability.

> The **Minimum Threshold for TDS** for each MA is defined initially as the percentage of wells with concentrations exceeding the TDS value of 1,200 mg/L based on current conditions (2015-2017).

As with nitrate, this MT is presented with full recognition of data needs and uncertainties, and with the commitment incorporated in this GSP to investigate nitrate and salt loading under current conditions and to expedite management actions for reduction of nitrate and salt loading.

Accordingly, the TDS MTs for each MA are expressed in **Table 6-5**. These MTs refer to the numeric Basin Plan objective, honor the non-degradation policy, and quantify current conditions based on available data. Given historical and ongoing groundwater use, these conditions are considered sustainable. As described in the following section, Measurable Objectives, the approach is to implement management actions that will maintain or reduce nitrate concentrations in the future.

As with Nitrate, if the MT is exceeded (i.e. the percent of wells with concentrations above 1,200 mg/L increases), additional study is necessary to determine if the increase is the result of management actions (including groundwater pumping, recharge, etc.), legacy loading, or a changing data set.

6.6.5.3. Relationship of Minimum Threshold to Other Sustainability Indicators

Three of the other sustainability indicators (groundwater level declines, storage depletion, subsidence) are directly linked to groundwater levels, while the sustainability indicator for connected surface water-groundwater dependent ecosystems is related to a rate or volume of surface water depletion, also linked to groundwater levels. The MTs for water quality are not known to be directly related to specific groundwater levels or fluctuations in groundwater levels. Nonetheless, general relationships are recognized, for example that contaminants may be mobilized by changing groundwater levels or flow patterns. Accordingly, the water quality MTs will help guide potential projects that alter groundwater levels or flow.

6.6.5.4. Effect of Minimum Threshold on Sustainability in Adjacent Areas

The North San Benito Basin is adjacent to the Llagas Subbasin in Santa Clara County. Groundwater flow directions are normally from southern Llagas Subbasin into the Bolsa MA (see Groundwater Conditions, **Figures 4-8** and **4-9**) with some drainage into the Pajaro River. Given the likelihood of continued relatively low elevations in Bolsa, groundwater flow is likely to remain unchanged and groundwater quality in North San Benito is unlikely to affect Llagas.

The North San Benito Basin is upstream of the Pajaro Valley Subbasin; the two are linked by flows in the Pajaro River. The MTs for the North San Benito Basin represent current conditions; establishment of MTs and maintenance of such conditions (which reflect native quality and legacy loading) would not affect the ability of the Pajaro Valley GSA to achieve or maintain sustainability.

As consideration beyond the requirements of this section, some management actions to improve groundwater quality in North San Benito (for example enhancing outflow of poor-quality groundwater) could potentially have adverse impacts downstream. However, potential impacts of management actions and projects will be addressed through CEQA. Overall improvement of North San Benito groundwater quality through other management actions (e.g., increased CVP percolation with maintenance of outflow) would be beneficial.

6.6.5.5. Effect of Minimum Threshold on Beneficial Uses and Users

The establishment of the MTs reflects the current condition of the MAs relative to nitrate and TDS concentrations, insofar as available data and monitoring allow us to know. Establishing the MTs represents no change and recognizes that groundwater has been and is being used reasonably for the range of beneficial uses. The MTs represent a quantified starting point for protection of groundwater quality and for projects and management actions to improve groundwater quality, consistent with a best management practices approach.

6.6.5.6. Relationship of Minimum Threshold to Regulatory Standards

The MTs have been established with direct reference to regulatory standards, most notably the Basin Plan Objectives set by the RWQCB, while recognizing that current nitrate and TDS concentrations in many wells do not meet regulatory standards. Because of legacy loading, improvements relative to regulatory standards may be difficult to demonstrate.

6.6.5.7. How Management Areas Can Operate without Causing Undesirable Results

The establishment of MTs has been consistently conceived and applied across all four Management Areas. For all MAs, the goal is to protect groundwater quality and all MTs are based on available information on current conditions. It is not known if the current status represents equilibrium conditions between the successive MAs from upstream to downstream and change may occur between them. The MAs were established to aid in implementation and operation of management actions and projects, which will include actions to improve groundwater quality in all MAs.

6.6.5.8. How the Minimum Threshold will be Monitored

The GSP is using the best available information, namely data from the SBCWD Water Quality Monitoring Program and Triennial Update. The SBCWD Monitoring Program will be improved and expanded to include a broader and even distribution of sampled wells across the basin and more information on the vertical distribution of constituents, along with its regular sampling schedule, historical records, and data on specific constituents and parameters. Through adaptive management, this SBCWD program may become the primary basis for MT tracking with reference to Triennial Updates.

6.6.6. Measurable Objectives

The sustainability goal is to protect groundwater quality, with general objectives of maintaining groundwater quality, preventing circumstances where future management activities might make water quality worse, and improving groundwater quality in the long run. In setting Measurable Objectives, a key issue is legacy loading, where the amount of historical loading is not known nor is the rate at which it is moving down to affect deep pumping zones. Because of the uncertainties associated with legacy loading, the use of water quality monitoring to track or verify sustainability needs to be tempered with a broad margin of operational flexibility. This margin should acknowledge the possibility (and even likelihood) that monitoring could indicate undesirable results—those stemming from past practices—while present reductions in loading are not yet perceptible.

6.6.6.1. Description of Measurable Objectives

Measurable Objectives are defined in this GSP using the same metrics and monitoring data as used to define Minimum Thresholds and are established to maintain or improve groundwater quality. Given the significant uncertainties presented by legacy loading and by data limitations, a reasonable margin of safety includes the possibility of “negative” monitoring results while positive progress is being made.

The **Measurable Objective for nitrate** is defined as maintaining or reducing the percentage of wells with median concentrations exceeding the nitrate MCL (45 mg/L) based on conditions documented in the Triennial Updates.

The **Measurable Objective for TDS** is defined as maintaining or reducing the percentage of wells with median concentrations exceeding the TDS value of 1,200 mg/L based on conditions documented in the Triennial Updates.

Measurable Objectives will be evaluated in increments of five years and the numeric values will be presented with comparison to the Current Conditions. This comparison will be discussed in the context of actual progress in implementing measures to improve monitoring and management.

6.6.6.2. Discussion of Monitoring and Management Measures to be Implemented

The strategy of this GSP is to identify and implement monitoring and management measures to reduce nitrate and salt loading. Monitoring and management actions already undertaken are summarized in Plan Area Section 2.1.4. and would be continued, most notably including the following:

- Hollister Urban Area Water Project water treatment plants that allow expanded use of CVP water and thereby improve wastewater quality.
- Hollister Urban Area Water Project for wastewater treatment improvements (nitrate reduction) and water recycling.
- Hollister Urban Area Water and Wastewater Master Plan and San Benito Water Resources Association program to reduce salt loading from water softener use.
- RWQCB Irrigated Lands Regulatory Program, which requires nitrate budgeting for most irrigated fields in San Benito County.

Additional **monitoring measures** include the following:

- Additional investigations and monitoring of nitrate and salt loading, most notably monitoring and analysis of the vertical distribution and migration of these constituents in the subsurface, with a focus on shallow groundwater conditions that reflect recent and current loading.
- Improvements to the SBCWD monitoring network including additional monitoring wells (including dedicated wells and shallow wells), improved distribution of sites and better representation of basin conditions geographically and vertically.
- Development of a systematic response program as part of the SBCWD Monitoring Program to address localized water quality problems (including significant short-term constituent increases and rising trends) with analysis to identify cause(s), outreach and education, and cooperation with the appropriate regulatory agency.

Additional **management measures** include the following:

- Increased percolation of good quality CVP water and local surface water, including additional managed aquifer recharge projects.
- Development of a stormwater recharge program including cooperation with local agencies to prepare a Storm Water Resource Plan, with identification of opportunities to increase recharge using local storm runoff.
- Analysis of basin outflows relative to salt management.

- Collaboration with UC Extension toward reduced nitrate and salt loading by agriculture.
- Enhanced cooperation with the County and local agencies on regulation of water softeners and wastewater treatment/disposal including onsite wastewater treatment systems (OWTS or septic systems).
- Enhanced outreach to North San Benito County stakeholders (including disadvantaged communities) on groundwater quality issues.

6.6.6.3. Description of Reasonable Pathway

Implementation of this GSP will include regular updates on a five-year basis. This will include evaluation of Measurable Objectives with comparison to Current Conditions (2015-2017) and to conditions documented in successive Triennial Updates. Because groundwater quality conditions are considered sustainable, interim milestones toward sustainability are not relevant. These comparisons will be discussed in the context of actual progress in implementing measures to improve monitoring and management.

A first step along the pathway will be analysis of the triennial data set used to establish criteria. A subset of the wells will be selected considering factors such as: uniform geographic representation, availability of well depth information, and continuity from one triennial period to the next. This first step will be completed during the first five years of GSP implementation.

The Management Actions and Implementation Plan sections of this GSP are intended to provide additional detail on the scope, scheduling, and estimated costs of the measures to be implemented.

6.7. Depletions of Interconnected Surface Water

This section builds and extends the discussion in Section 4.11, Interconnection of Surface Water and Groundwater. That section provided information on surface water-groundwater connections (both seasonally and with wet years and drought), identification of potential GDEs (e.g., with The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset), distribution of riparian vegetation, and identification of animal species that rely on groundwater-supported streamflow, most notably steelhead trout (see Figures 4-22 and 4-24)

6.7.1. Description of Undesirable Results

If a stream is hydraulically connected to groundwater, pumping from nearby wells can reduce the amount of stream flow by intercepting groundwater that would have discharged into the stream or by inducing seepage from the stream. Undesirable results associated with stream flow depletion include reduced quality and quantity of aquatic and riparian habitats and reduced water supply to downstream users. Conceptually, adverse habitat impacts can result from decreased rainfall, decreased stream flow and lowered groundwater levels. These variables are highly correlated in time: droughts include rainfall reductions, decreased stream flows, and lowered groundwater levels at a time when habitat impacts are usually the most severe. Furthermore, droughts and wet periods are a natural feature of California's climate and are associated with waxing and waning of habitat conditions.

6.7.2. Potential Causes of Undesirable Results

This section presents extensive analysis of the key variables as they relate to riparian vegetation and steelhead trout migration along major waterways in the North San Benito Basin. It draws on basic data and on a simulated change in regional groundwater pumping using the basin-wide groundwater flow model introduced in Section 5 Water Budget. The specific objective was to isolate and quantify the effects of groundwater pumping and levels on GDEs, namely riparian vegetation extent and vigor and on passage opportunity for migrating fish.

6.7.2.1. Pumping

While recognizing that undesirable depletion of surface water is likely the result of multiple factors, a key question remains regarding the specific effect of pumping. The numerical model was applied to address this question. The effects of pumping on interconnected surface water were simulated as a global 10 percent reduction in groundwater pumping in the future baseline simulation. The 86-year future baseline simulation represents hydrologic conditions corresponding to water years 1922-2007 with existing land use, water use, and estimated CVP water availability. Theoretically small increases and decreases in pumping from existing amounts would have roughly equal but opposite effects on water levels and stream flow. A 10 percent increase in pumping could have been simulated instead of a decrease. The simulation would continue to run, but there would be no results for the dry cells and slightly distorted results for active cells near the dry area. The results with decreased pumping are compared with the future baseline simulation to evaluate the effects of changes in pumping. The reduction was applied uniformly to all types of pumping and in all time steps. This is not a proposed management action and is not entirely realistic. It simply illustrates the marginal effect of a change in pumping from current conditions. The 10 percent reduction in pumping amounted to 9,150 AFY, which is equivalent to a continuous flow of 12.6 cfs. No corresponding changes were made to return flows from irrigation and wastewater.

6.7.2.2. Rainfall

Hydrologic and vegetation conditions at the beginning and end of a major wet period were compared to identify the effects of hydrologic variables on vegetation. A cumulative departure graph of annual precipitation in Hollister (see **Figure 5-4**) showed that October 1992 was at the end of a major drought and the start of a major wet period that ended in April 1998. Vegetation conditions and groundwater levels were compared between those two dates to identify correlations between the variables.

6.7.2.3. Groundwater Levels

A central question in the relationship between groundwater levels and riparian vegetation is the rooting depth of phreatophytic plant species, which are ones that extend roots to the water table and extract groundwater during the dry season when soil moisture is depleted. A survey of riparian ecology literature (mostly studies in more arid regions of the southwestern United States) indicated that rooting depths for common California riparian phreatophytes such as cottonwood, mulefat, sycamore, and various willow species are mostly in the range of 2-13 feet (The Nature Conservancy, 2019a). Other trees such as box elder and valley oak are commonly associated with streams but at higher elevations with depths to water of up to 30 feet (Griggs, 2009). However, those species do not necessarily use the water table. The presence of dense, lush riparian trees along some stream reaches in San Benito County is an indication that the vegetation is accessing the water table. For this analysis, a water table depth of 20 feet is used as an estimate of the maximum depth accessed by riparian vegetation[10].

---

[10] A 15-foot depth to water is used in the model to simulate riparian ET flux, most of which is within that range. The 20-foot depth to water used here conservatively captures a slightly larger area within which pumping might plausibly affect riparian vegetation.

Several data problems confound the comparison of water levels and vegetation distribution. The first is that currently available water level data are from water supply wells with screened intervals far below the ground surface (often more than 150 feet). Vertical water level gradients are common in developed alluvial basins because recharge occurs at the water table while pumping is from greater depths. This creates downward head gradients. Downward vertical gradients of 0.028 to 0.145 ft/ft were documented for eight shallow-deep well pairs in the San Juan Valley in October 2002 (Yates, 2003). Thus, a depth to water of 20 feet in wells probably corresponds to a smaller depth to the true water table in the root zone. A second issue is that the ground elevation at wells near streams is typically 10-15 feet higher than the bottom of the creek channel. That is, wells are not drilled in the channel itself but on higher terraces or floodplains next to the channel. As a result, a depth to water of 30 feet in a well could correspond to a depth to water of 15-20 feet in the channel itself. A third complexity is the facultative rooting depths of many species, which means that they will grow deeper roots where the water table is deeper. In other words, if the water table is consistently only 5 feet below the ground surface, phreatophytes will only grow roots to a depth of 5 feet. If the water table is consistently deeper, the plants will extend their roots deeper, up to a point that for this analysis is estimated to be 20 feet. For many species, the maximum rate of root elongation is known for seedlings but uncertain for mature shrubs and trees.

A sustained rise in groundwater elevations can also impact riparian vegetation. Raising the water table elevation in an area of established riparian vegetation will tend to shift the vegetation zones through mortality and regeneration over a number of years. There may be mortality of species that prefer slightly larger depths to water (sycamore, box elder, oak), with regeneration in adjoining areas of higher ground. Meanwhile, the areas with shallow water table depths would likely be colonized by species suited to those conditions, such as willow or cottonwood (Strahan, 1984).

Hydrographs of simulated groundwater levels during the second half of the simulation period are shown for twelve wells along the Pajaro River, Miller Canal, Pacheco Creek, and the San Benito River in **Figure 6-5** (see **Figure 6-6** for well locations). Each graph shows future baseline water levels and water levels with the 10 percent reduction in pumping. Historical water levels are also shown to allow a general comparison of simulated future conditions with the range of historical water levels.

Along the Pajaro River and Miller Canal, water levels at the depths of well screens (model layer 3) under the baseline simulation are mostly greater than 40 feet below the ground surface (well 11-4-34A1 in **Figure 6-5**, for example). In the reduced pumping model simulation, water levels increased by 5-10 feet in summer, with no change in winter. Layer 1 water levels are generally less than 20 feet below the ground surface along the Pajaro River, which is consistent with the presence of healthy mature riparian trees along that waterway. Upstream of the Calaveras Fault (at San Felipe Lake) shallow and deep groundwater levels are both less than 20 feet below the ground surface, and flowing wells are present in winter and wet years (see for example well 11-5-28B1 in **Figure 6-5**). The summer baseline depth to water in wells increases upstream, typically exceeding 20 feet upstream of San Felipe Road (well 11-5-26R3 in **Figure 6-5**). Simulated decreased pumping raised water levels 1-2 feet in winter and up to 5 feet in summer in this area. Upstream of the Ausaymas Fault (at Highway 156), the effect of reduced pumping is small: 0-2 feet in summer, decreasing to 0-1 foot near Casa de Fruta (wells 11-5-24C1 and 11-5-12E1 in **Figures 6-5**). The baseline depth to water along this reach is consistently less than 20 feet except during droughts, when it increased to 50-60 feet at all of the wells, even with the pumping reduction. The water level decline during droughts is due primarily to down-valley drainage of groundwater rather than to pumping. Overall, the reach of the Pajaro-Pacheco corridor where vegetation is most likely to be affected by pumping-related water level changes is probably between San Felipe Road and Highway 156.

Along the San Benito River, the simulated pumping reduction raised water levels from the Pajaro River up to about Bixby Road by roughly 3 feet during droughts and by negligible amounts in other years. Water levels in wells are consistently less than 20 feet below the ground surface, and some flowing wells are present in wet years (wells 12-4-17L20 and 12-4-21M1 in **Figure 6-5**). In the eastern half of the San Juan Valley and continuing up the river to the Calaveras Fault (near Union Road), baseline depths to water are consistently greater than 30 ft (wells 12-4-26G1 and 13-5-4G1 in **Figure 6-5**). The pumping reduction raised water levels by up to 10 feet during droughts, but such a change would not be expected to affect riparian vegetation because of the large depth to water. Baseline groundwater levels are shallower along a three-mile reach upstream of the fault, not quite to the Tres Pinos Creek confluence. In that area, water levels are consistently less than 20 feet below the ground surface, and the pumping reduction had little effect except to raise water levels by up to 2 feet during major droughts (for example, well 13-5-11Q1 in **Figure 6-5,** near Hospital Road). Farther upstream, the pumping reduction had very little effect, raising water levels by up to 2 feet during major droughts and by negligible amounts at other times. Measured water levels throughout the Paicines Valley have almost all been more than 20 feet below the ground surface, with increasing depths toward the upstream end of the valley. Raising those water levels by 2 feet would not substantially increase the extent of riparian vegetation, which is present at narrow gaps in the alluvium where depth to water is relatively small. In summary, the San Benito River reach with phreatophytic vegetation most likely to be affected by changes in pumping would be the reach above the Calaveras Fault near Hospital Road. In the other reaches, the pumping effects are small and the reduced pumping simulation did not significantly change the amount of time that water levels are within versus below the estimated rooting depth of 20 feet.

The effect of groundwater levels on riparian vegetation was also investigated by mapping areas where the depth to water was less than 20 feet in October 1992 and April 1998 of the historical calibration simulation. The results are shown in **Figure 6-6**. Although deep groundwater levels rose by tens of feet between 1992 and 1998 in many parts of the basin, shallow groundwater levels increased only slightly. It should be noted that the simulated water levels are for model layer 1, which is quite thick in places and therefore might have water levels lower than the true water table. Major stream reaches in the shallow water table areas include the Pajaro-Pacheco corridor up to San Felipe Road and from Casa de Fruta to the upstream end of the basin. Under the wetter 1998 conditions, patches of shallow groundwater were also present along Pacheco Creek between Hwy 156 and Walnut Avenue. Along the San Benito River, depths to water less than 20 feet were present downstream of Lucy Brown Road, along the 3-mile reach upstream of Hospital Road, in patches covering about half of Paicines Valley, and along most of Tres Pinos Creek between Los Muertos Creek and Tres Pinos.

The stream reaches with shallow water levels, layer 1 depth to water less than 20 feet, were very similar for 1992 and 1998, even as the deep groundwater levels increased tens of feet. This supports a conclusion that pumping-related changes in water levels occurred almost entirely where depth to water already exceeded 20 feet in both 1992 and 1998 and therefore would not have a large impact on riparian vegetation.

Given the small differences in the extent and elevations of shallow groundwater levels between 1992 and 1998, the simulated riparian evapotranspiration (ET) flux would be expected to also be similar. The Southern and San Juan MAs accounted for about 80 percent of simulated basin-wide ET flux, and the annual values did not exhibit prominent trends associated with droughts and recovery periods. In the Hollister and Bolsa MAs, ET flux declined by about half during 1987-1992 and recovered by 1998. The combined declines during 1987-1992 amounted to about eight percent of normal basin-wide ET. This relatively small effect is consistent with the water-level changes and suggests that negative water balances during droughts are primarily absorbed by storage changes away from shallow groundwater areas.

6.7.2.4. Air Photos, NDVI and NDMI

Aerial photographs can be used to detect changes in the occurrence of riparian vegetation, such as clearing by in-channel gravel mining, scour by flood events, and regeneration in bare soil areas. Examination of Google Earth images from 1985 to 2018 confirmed the decrease in mining activity from the 1990s to the 2000s, particularly near the lower end of the San Benito River. The extent and density of riparian vegetation increased noticeably in that area following the cessation of mining. Air photos also revealed drought-related vegetation die-back at one location along Tres Pinos Creek that was verified in the field. In general, however, the distribution and density of riparian vegetation visible in aerial photographs has remained about the same over the past several decades.

A reconnaissance level survey of riparian trees in the North San Benito basin was made on April 10, 2019 to look for signs of die-back or mortality lingering from the 2012-2015 drought. Locations that were surveyed included Pacheco Creek at Hwy 156, Walnut Ave and Casa de Fruta; Tres Pinos Creek near the downstream end of Tres Pinos Creek Valley (0.6 mile south of the Highway 25 bridge); San Benito River near Hospital Road and San Juan Bautista; and the Pajaro River near Highway 101. With the exception of the Tres Pinos Creek site, tree mortality during the 2012-2015 drought did not appear to have been above normal. Along Pacheco Creek near Highway 156, for example, about 10 to 20 percent of standing trees had died in recent years, but the living trees—including ones of similar size and position as the dead ones—all appeared healthy and vigorous. Along the lower end of the San Benito River and along the Pajaro River, there were very few standing dead trees. At the impacted Tres Pinos Creek site, 30 to 40 percent of the standing trees had suffered significant die-back or mortality. This impact had been noted in the inspection of aerial photographs. Most of the affected trees were re-sprouting from the base in spring 2019, and new seedlings had sprouted on the gravel bars in 2018, as shown in **Figure 6-7**.

The health and vigor of riparian vegetation cannot be reliably detected in aerial photographs. However, spectral analysis of light reflected from the vegetation does provide that information. Two commonly used metrics of vegetation health and vigor are the normalized difference vegetation index (NDVI) and normalized difference moisture index (NDMI), both of which involve ratios of selected visible and infrared wavelengths. NDVI relates to the greenness of vegetation and NDMI relates to transpiration. The Nature Conservancy compiled these two metrics from historical satellite imagery for riparian vegetation throughout California and incorporated it into the GDE Pulse on-line mapping tool (The Nature Conservancy, 2019b). The vegetation polygons were of "NCCAG compiled from various vegetation mapping databases mostly reflecting vegetation conditions in the early 2000s. For each polygon, the tool displays time series plots of annual summertime NDVI and NDMI during 1985-2019. In northern San Benito County, vegetation mapping is complete along the San Benito River, patchy along the Pajaro River, and mostly missing along Pacheco Creek and other small streams entering the basin.

To test the correlation between groundwater levels, NDVI and NDMI, values of each of those variables in 1992 and 1998 were compiled at the centroid of each of the 729 mapped vegetation polygons within the basin. The NDVI and NDMI values were taken directly from the GDE Pulse tool. Depth to water in model layer 1 at each polygon was obtained from grids of layer 1 groundwater levels from the 1975-2017 model calibration simulation. The three variables are shown in separate maps in **Figure 6-8a and 6-8b** for the lower and upper halves of the San Benito River reach within the basin. The relationship between the change in groundwater level and the NDVI and NDMI scores is inconsistent. For example, near the lower end of the San Benito River, groundwater levels rose a moderate amount and NDVI and NDMI scores also rose. However, some of the improvement in vegetative conditions in that area was related to a decrease in gravel mining activity. Farther upstream along the reach between about Bixby Road and Nash Road, groundwater levels greatly increased, but NDVI and NDMI scores decreased. However, the water levels in this area remained far below the plausible rooting depth of riparian vegetation, so the lack of correlation with groundwater levels is not surprising (see **Figures 6-5 and 6-6**). Results are also counterintuitive along Tres Pinos Creek between Tres Pinos and Paicines. Groundwater levels rose substantially near the downstream end of that reach, but NDVI sharply declined and NDMI also declined. A little farther upstream, groundwater levels were steady from 1992 to 1998, whereas NDVI declined and NDMI increased. This area includes the location where drought-related tree mortality was observed in April 2019.

A systematic, global test of the correlation between groundwater levels and the two vegetation metrics was implemented by preparing scatterplots of change in NDVI versus change in groundwater level from 1992 to 1998 and change in NDMI versus change in groundwater level. These plots are shown in **Figure 6-9.** For both NDVI and NDMI, scores increased from 1992 to 1998 in the large majority of polygons. However, the data cloud is essentially horizontal, meaning there was no correlation between those increases and the change in groundwater level.

Along the San Benito River, operation of Hernandez Reservoir can also affect riparian vegetation. The reservoir regulates runoff from about 39 percent of the San Benito River watershed area upstream of the basin. Its general mode of operation has been to store water in winter and make releases during several summer months to achieve live flow and groundwater recharge down to target locations within the basin. Depending on the current state of groundwater levels, the target locations have ranged from near Hospital Road down to Lucy Brown Road. The additional summer flows along the San Benito River through the Paicines Valley might explain the smaller change in depth to water during 1992 to 1998 compared to changes along nearby reaches of Tres Pinos Creek, which is unregulated.

This analysis of aerial photographs and NDVI and NDMI scores during 1992 to 1998 supports a conclusion that riparian vegetation extent and vigor was not correlated with groundwater levels. Although drought-related die-back and mortality was documented at one location, that appeared to be the exception rather than the rule, and it is unclear whether the impact was caused by a local decline in groundwater levels versus a cessation of surface flow in that reach of Tres Pinos Creek. This conclusion is consistent with the conclusion based on the evaluation of shallow groundwater levels and ET flux.

6.7.2.5. Stream Flow

Changes in stream flow can affect riparian and aquatic organisms and water supply for downstream users. Current conditions and the effect of pumping on stream flow were evaluated using records from stream gauges and the results of groundwater modeling.

Stream gauges have been operated at five locations within the basin: on Pacheco Creek near San Felipe Road and Walnut Avenue, on Tres Pinos Creek upstream of Tres Pinos, and on the San Benito River below the Tres Pinos Creek confluence and at old Highway 156. The locations of the gauges are shown in

Figure 6-10. Daily flows at the gauge locations can be used to estimate the timing and duration of passage opportunities for adult and juvenile steelhead trout. The groundwater model can be used to simulate the effects of pumping on flow at those locations and other locations along waterways in the basin, but only in terms of monthly average flows. Hydrographs of simulated monthly stream flow at six locations in the basin are shown in **Figures 6-11a and 6-11b**. Simulated flows for the future baseline and reduced-pumping scenarios are shown. For locations at or near one of the stream gauges, monthly averages of the gauged flows are also shown. The difference in pumping between the two simulations is 12.6 cfs basin-wide.

Ultimately, the reduced pumping scenario resulted in changes in Pajaro River outflow at the downstream end of the model (bottom graph in **Figure 6-11b**). Farther upstream, the effect is spread out among numerous streams. Also, the effect accumulates from upgradient parts of the basin toward downgradient areas. Along Pacheco Creek, for example, the change in pumping had no discernible effect at Walnut Avenue but increased downstream to occasionally as much as 3 cfs at San Felipe Lake (**Figure 7a**). Most of the time, the effect at San Felipe Lake was 0-2 cfs. At the gauge on Tres Pinos Creek, the effect of the pumping reduction is imperceptible. However, the fact that the model under-simulates stream flow at that location could conceal some pumping effects. The model also under-simulates stream flow at the San Benito River gauge at Old Highway 156, but the effect of the pumping reduction appears to be similarly negligible.

Geographic patterns in the effect of pumping on stream flow can also be seen in profiles of flow along streams as they approach the downstream end of the model. **Figure 6-12a** shows flow profiles along Pacheco Creek, Miller Canal, and the Pajaro River in June 1992 (dry year), June 1994 (normal year) and June 1998 (wet year). June was selected because it is a time when irrigation pumping is significant and when steelhead smolts might still be passing through. On all three dates, pumping effects were negligible from the upstream edge of the model down to around San Felipe Road. From there to the confluence with Tequisquita Slough at San Felipe Lake, the effect increased to about 1 cfs. That effect remained essentially constant down to the confluence with the San Benito River. Under the wet conditions of 1998, flow increased rather than decreased all the way to the confluence of the San Benito River in all simulations. The effect of reduced pumping was still apparent, however.

Along the San Benito River (**Figure 6-12b**), pumping effects in 1992 and 1994 were negligible upstream of Paicines Valley, increased to about 6 cfs through Paicines Valley and down to Old Highway 156, then decreased farther downstream. In 1998 flow generally increased along the entire length of the river. Pumping effects were not apparent until the San Juan Valley reach, where a difference of about 8 cfs accumulated.

Overall, the 10 percent change in pumping had relatively small effects on stream flow. In no case did it alter the presence or absence of flow.

Note that the appearance of very low flow along the Pajaro River resulted from the omission of surface inflow from the Llagas Subbasin (Uvas Creek and other local streams) in the model. In reality, those inflows contribute substantial flow to the Pajaro River along the reach skirting the edge of the basin. Therefore, the changes in stream flow associated with this magnitude of change in pumping would not likely impact riparian vegetation.

Decreased outflow in the Pajaro River could potentially affect water available for diversion and groundwater recharge in the Pajaro Valley Basin. Over the long term, changes in consumptive use in the North San Benito Basin manifest as an equivalent change in surface outflow in the Pajaro River. The effects on downstream water users would depend on the timing and magnitude of changes in river flow relative to the recharge capacity along the Pajaro River in that basin. However, this theoretical effect does not appear to be of great concern to downstream users. Neither a recent modeling study (Hanson et al., 2014) nor the current basin management plan (Carollo Engineers, 2014) mention upstream depletion of Pajaro River flow as an issue in basin management.

6.7.2.6. Fish Passage

Depletion of stream flow by groundwater pumping could theoretically affect the timing and duration of flows that are large enough to allow migration of steelhead trout between the ocean and spawning areas in the headwaters of Pacheco Creek and the San Benito River. This possibility was investigated by estimating the number of passage days from historically gauged daily flows, then calculating the change in passage days if flows were changed by the amounts shown in the scenario with a 10 percent reduction in pumping. Note that in the simulation, pumping was decreased and the number of passage days increased. It is assumed that an increase in pumping of the same magnitude would result in a proportional decrease in passage days (that is, the relationship between pumping and passage opportunity is roughly linear for small changes in pumping from existing conditions).

South central California coast steelhead adults typically migrate upstream during December-March, and smolts typically migrate downstream during April-June. No studies were found documenting the locations of critical riffles and the minimum flows required for upstream and downstream passage along Pacheco Creek and the San Benito River. Based on the rating curve for Pacheco Creek at the Walnut Avenue gauge and assuming a water depth of 0.7 foot at that location as the minimum depth required for upstream adult migration (Holmes et al., 2014), a minimum passage flow of 31 cfs was estimated. Smolts are smaller and swim with rather than against the current. They can migrate at lower water depths (0.3 foot) and flows, and a minimum passage flow of 6 cfs was assumed for this analysis. The San Benito River channel is broad and sandy, particularly between Highway 156 and Lucy Brown Road. Higher minimum flows were assumed for migration along this reach of the river: 50 cfs for adults and 10 cfs for smolts. The number of days with flow exceeding these minimum values during the corresponding date windows were tabulated for each year for the period of record at each gauge. For the pumping-affected condition, daily flows in Pacheco Creek were increased by 1 cfs, which was the amount associated with a simulated 10 percent reduction in pumping (see flow profiles in **Figure 6-12a**). For the San Benito River, daily flows were uniformly increased by 6 cfs in response to a 10 percent reduction in pumping, consistent with the flow profile along that waterway (**Figure 6-12b**).

The effect of the simulated pumping change of 10 percent on the steelhead adult passage opportunity along Pacheco Creek is shown in **Figure 6-13**. In contrast to the previous figures, this figure is plotted using an increase in pumping rather than a decrease. In 6 out of the 34 years with data, passage opportunity was decreased by 1-3 days. All of those years were ones with an above-average number of passage days to begin with, so the impact on reproductive success would likely be negligible. For smolts (**Figure 6-14**), the number of passage days was decreased by 1-6 days in 16 out of 34 years. Almost all of the reductions were in years when total passage opportunity was greater than the median duration of 17 days. Although the reductions were frequent, they were generally small relative to the overall passage opportunity within the 6-year steelhead lifespan. Thus, this hypothetical scenario might reduce long-term reproductive success for the local population, but the reduction would probably be small.

On the San Benito River at old Highway 156, the simulated 10 percent increase in pumping would decrease adult passage in 24 out of 49 years, by a maximum of 44 days (**Figure 6-15**). Unlike Pacheco Creek, the reductions were not limited to years with above-average numbers of passage days. However, for years with fewer than the median number of passage days (about 7), reductions never exceeded two days. For smolts (**Figure 6-16**) pumping depletion reduced passage in 31 out of 49 years, by a maximum of 44 days. In five years, passage opportunity was decreased to 0 days. The frequency and magnitude of the reductions are substantial and would probably adversely impact the long-term reproductive success of the steelhead population using the San Benito River. However, the results are quite sensitive to the estimate of minimum passage flow for smolts. That flow has not been determined through field studies and is considered a data gap.

The effects of a moderate increase in groundwater pumping on steelhead migration would probably not be significant along Pacheco Creek but could be along the San Benito River if the minimum passage flow is near the estimate of 10 cfs used in the above analysis. The future growth scenario described in Section 8 Projects and Management Actions contemplates possible increases in Hollister municipal use on the order of 10,000 AFY and increased irrigation demand for new vineyards on the order of 4,000 AFY over the next 50 years. All of the irrigation and some of the municipal use would be supplied by groundwater, much of it in areas where increased pumping could affect flow in the San Benito River. Thus, groundwater conditions might not be sustainable with respect to steelhead passage.

6.7.3. Definition of Undesirable Results

The Sustainability Goal includes an objective to support beneficial uses of interconnected surface waters. Consistent with that objective, undesirable results of excessive depletion of surface water are:

- riparian vegetation die-back or mortality during droughts of a magnitude that disrupts ecological functions or causes substantial reductions in populations of riparian-associated species, and
- decreased reproductive success of steelhead trout during droughts beyond an amount that can easily be recovered during subsequent wet periods.

6.7.4. Potential Effects on Beneficial Uses and Users

The analysis presented in this section demonstrates that groundwater conditions are currently sustainable with respect to inter-connected surface water and GDEs, with the possible exception of steelhead smolt migration along the San Benito River. The distribution and health of riparian vegetation shows little correlation with groundwater levels. Basin outflows appear sufficient to meet the needs of downstream water users. Adult steelhead migration is not strongly impacted by changes in pumping, but smolt migration along the San Benito River might be significantly impacted by pumping. These conclusions are based on evaluations of groundwater levels in the range bracketed by 1992 (end of drought) and 1998 (end of wet period) conditions and simulated model results from pumping within 10 percent of current pumping.

6.7.5. Sustainable Management Criteria for Interconnected Surface Water

SGMA requires that "the minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" (§354.28(c)(6)). However, GSP Regulations allow GSAs to use groundwater elevation as a proxy metric for any of the sustainability indicators when setting minimum thresholds and measurable objectives (23 CCR § 354.28(d) and 23 CCR § 354.30(d)).

It would be difficult to define a minimum threshold in terms of flow depletion in this basin for two reasons. First, phreatophytic riparian vegetation appears to be more correlated with areas where depth to water is consistently shallow than with the magnitude or duration of surface flow. Second, the two streams that potentially support steelhead migration have reaches that go seasonally dry in almost all years interspersed with reaches that are nearly perennial. Pumping impacts on flowing reaches would not alter passage opportunity if upstream or downstream reaches are already naturally dry.

6.7.6. Minimum Threshold

Given the above, the minimum threshold is defined here by groundwater levels. As noted previously, wells in the groundwater levels monitoring program are production wells with relatively deep screens that have not been sited and designed for tracking surface water-groundwater interactions. The lack of such shallow monitoring wells is a data gap and a source of uncertainty. Hence, the minimum threshold described here is initial. Nonetheless, it is intended to be protective of GDEs until the monitoring program can be refined to better represent near-stream shallow conditions. Wells to be included in the initial surface water-groundwater tracking program have been identified as currently monitored wells within 1 mile of a shallow water table reach along specific reaches of the Pajaro River, Pacheco Creek, San Benito River, or Tres Pinos Creek. These reaches and monitoring are shown on **Figure 6-17**. The distribution of monitoring sites is uneven; refinement of the surface water-groundwater tracking program will include not only addition of some dedicated near-stream monitoring wells, but also systematic evaluation of the monitoring points to be representative.

Because stream flow depletion is conceptually dependent on groundwater levels, and fish and vegetation appeared to have weathered the 1987-1992 drought, it is reasonable to set 1992 groundwater levels as the basic metric for sustainability of interconnected surface water. Spring rather than fall water levels were selected for the criterion because they are less affected by short-term pumping cycles, coincide with the season of fish migration, and provide an indication of groundwater availability for phreatophytes during the subsequent dry season.

Therefore, in the North San Benito Basin:

> The **Minimum Threshold** for depletion of interconnected surface water is the amount of depletion associated with the lowest water levels during the 1987-1992 drought, with some adjustments made for wells with groundwater levels lower in 2016 than in 1992.

Specifically, undesirable results would occur if more than 25 percent of monitored wells within 1 mile of a shallow water table reach along the Pajaro River, Pacheco Creek, San Benito River, or Tres Pinos Creek had static spring water levels lower than the lowest static spring water level during 1987-1992. This percentage is considered small enough to detect a problem before it becomes too widespread or extreme, but large enough to allow for typical variability among wells and among measurement dates (that is, to minimize "false positives"). The minimum threshold is expected to protect beneficial uses of surface water for aquatic and riparian habitat maintenance until additional data are collected to support a more accurate minimum threshold definition.

6.7.6.1. Relationship of Minimum Threshold to Other Sustainability Indicators

- **Groundwater Levels.** Nine of the 20 wells used to evaluate the minimum threshold are also representative wells used for compliance with the minimum threshold for groundwater levels. The groundwater level minimum threshold involves two consecutive quarterly water-level measurements rather than a single spring measurement. However, both thresholds are based on historical water levels. For the wells included in both sets of criteria, the interconnected surface water threshold water levels are generally the same or higher than the water-level thresholds. That is, along the GDE stream reaches, the interconnected surface water criteria restrict water-level declines more than the water-level criteria do. This is the logical result of the different objectives of the two sets of criteria.

- **Groundwater Storage.** The minimum threshold interconnected surface water would similarly be more restrictive than the minimum threshold for groundwater storage near GDE reaches, because the latter is functionally the same as the minimum threshold for water levels.

- **Seawater Intrusion.** Seawater intrusion would not occur in the North San Benito Basin due to its inland location. No minimum threshold was defined and there is no consistency issue.

- **Land Subsidence.** Significant land subsidence is only likely to occur with groundwater levels below historical minimum levels. The levels specified as minimum thresholds for interconnected surface water are within the historical range and thus unlikely to cause subsidence.

- **Water Quality.** Water quality issues in the North San Benito Basin are primarily associated with dispersed loading of nitrate and salinity and long-term increases in ambient concentrations of those constituents. Those processes are generally independent of groundwater levels. Groundwater outflow is an important mechanism for salt removal that requires relatively high groundwater levels on a long-term average basis. High levels and groundwater discharge into streams also benefit riparian vegetation and aquatic habitat. Therefore, the minimum threshold for interconnected surface water is consistent with the minimum threshold for water quality.

6.7.6.2. Effect of Minimum Threshold on Sustainability of Adjacent Areas

The only adjoining groundwater basin is the Llagas Subbasin located across the Pajaro River from the Bolsa Management Area. Groundwater consistently flows from the Llagas Subbasin toward the Bolsa MA. If Bolsa water levels were lowered, outflow from the Llagas Subbasin would increase. The water levels used to define the minimum threshold for depletion of interconnected surface water are within the historical range of water levels and thus would not cause unreasonable impacts on groundwater availability in Llagas. By protecting vegetation and fish migration along the Pajaro River—which is a shared boundary between the subbasins—the minimum threshold will protect those resources for the benefit of both subbasins.

The Pajaro Valley groundwater basin is not immediately adjacent to the North San Benito Basin, but it is located downstream along the Pajaro River, which supplies a significant amount of recharge. Recent hydrogeologic and groundwater planning studies for the Pajaro Valley basin have not identified upstream depletion of river flow as a water supply concern. Therefore, maintaining flow depletion within the historical range is presumed to be sustainable with respect to the Pajaro Valley basin.

6.7.6.3. Effect of Minimum Threshold on Beneficial Uses

Surface diversions are not a source of supply in the north San Benito Basin; all water uses are supported by imported water or groundwater. Depletion of surface flow could impact downstream groundwater users if it reduced recharge from stream percolation in those areas. However, the minimum threshold at least limits the depletions to rates within the historical range of experience. With respect to groundwater, this GSP does not propose increases in groundwater pumping above existing amounts, so groundwater levels are expected to remain within the historical range. In areas where the minimum-threshold water level for interconnected surface water is higher than the minimum-threshold for chronic lowering of groundwater levels, the interconnected surface water threshold improves groundwater availability.

The minimum threshold is expected to protect beneficial uses of surface water for aquatic and riparian habitat maintenance. The few springs in the interior of the basin that could plausibly be affected by pumping (along Tequisquita Slough and San Juan Creek) are on the upgradient side of the Calaveras and San Andreas faults, where shallow water levels are relatively stable. Along stream reaches in red-legged frog habitat (San Benito River upstream of Bird Creek and Tres Pinos Creek between Tres Pinos Creek Valley and Southside Road), the lowest simulated water levels in the future baseline scenario were under 1992 conditions and were equal to or higher than historical water levels at that time.

The Pajaro River Wetlands Mitigation Bank is adjacent to a stream reach identified as a riparian vegetation GDE and hence is covered by the minimum threshold for depletion of interconnected surface water. It includes approximately 100 acres of wetland, much of which is seasonal (Wildlands, Inc. 2021). Groundwater conditions are highly confined in the Bolsa area where the wetland is located. Historical groundwater levels in the nearest monitored well (11S/4E-26B1) are close to the ground surface, exhibit no long-term declines and have modest declines during droughts. The lowest spring water level during 1987-1992 (which is the MT definition) was only 20 ft below the ground surface. The water table elevation near the ground surface is certainly higher and more stable. The wetland was established after 1992, but there is no reason to expect any adverse effect associated with groundwater levels if they decline to the MT in the future.

6.7.6.4. Relationship of Minimum Threshold to Regulatory Standards

Other than SGMA, there are no local, state, or federal regulations that specifically address stream flow depletion by groundwater pumping. The California and Federal Endangered Species Acts protect species listed as threatened or endangered, including steelhead trout and red-legged frogs. The minimum threshold for depletion of surface water is designed to prevent stream flow conditions from impacting those species beyond the level of impact that has historically occurred.

6.7.6.5. How the Minimum Threshold Will Be Monitored

Nineteen wells that are currently monitored for water levels by SBCWD are within 1 mile of stream reaches where spring depth to water is typically 20 feet or less and are not separated from the reach by a fault. The locations of the wells are shown in **Figure 6-17**, and the spring 1992 water levels for those wells are listed in **Table 6-6**. Where measured water levels were not made, water levels were estimated from nearby wells. In the Southern MA—where monitoring did not begin until after 1992—water levels in that year were estimated based on simulated differences between 1992 and 2015 water levels.

The wells in **Table 6-6** are all water supply wells with relatively deep screens. They are useful for relating future conditions to historical ones, but they do not provide a reliable indication of the true water table elevation near the ground surface. Shallow monitoring wells are needed in riparian areas to provide accurate water table information and elucidate the relationship between deep water levels and vegetation conditions. A monitoring improvement for this GSP would be to install shallow monitoring wells at several riparian locations in the basin. Over time, minimum threshold groundwater elevations for the new shallow wells can be defined based on the monitored data and the relationship to deep water levels.

Table 6-6. Minimum Threshold Spring Groundwater Elevations for Interconnected Surface Water

Surface Water / GDE	Spring MT		Source of Elevation
Key Well	Groundwater Elevation (ft NAVD88)	Depth to Water (ft)	
11-4-26B1	127	18	Measured[1]
11-4-34A1	128	14	Measured[1]
11-5-13D1	214	44	Measured[1]
11-5-20N1	90	61	Measured[1]
11-5-27P2	122	64	Measured
11-5-28B1	128	39	Measured
12-4-17L20	113	27	Measured
12-4-21M1	120	51	Measured
12-4-26G1	114	96	Measured
12-4-34H1	117	82	Measured
13-5-11E1	220	87	Measured
13-5-13F1	316	31	Measured
13-6-19J1	412	38	Measured
13-6-19K1	341	81	Measured
DONATI 2	633	63	Estimated[2]
RFP VINEYARD 3	637	69	Estimated[2]
RIDGEMARK 5	618	50	Estimated[2]
RIDGEMARK 7	624	68	Estimated[2]
SCHIELDS 4	620	62	Estimated[2]

1. Water levels in this area were lower in 2016 than in 1992. The measured spring 2015 or 2016 water level is shown, whichever was lower, or the estimated water level based on nearby wells.

2. 1992 water level estimated from measured 2015 water level based on differences in simulated water levels for those two years.

6.7.7. Measurable Objective

The measurable objective for interconnected surface water is an amount of depletion that is less than the amount specified as the minimum threshold. Given the weak correlation between groundwater levels and vegetation health, no specific rise in shallow groundwater levels or increase in stream flow is identified as providing a preferred set of GDE conditions.

Groundwater conditions with respect to interconnected surface water and most GDE parameters are already sustainable. The minimum threshold water levels for interconnected surface water will prevent any decrease in passage opportunity for steelhead smolts along the San Benito River until studies identify the flow requirements for passage more accurately. Therefore, no interim milestones are needed to achieve sustainability at this time.

6.7.7.1. Discussion of Monitoring and Management Measures to be Implemented

Two actions are needed to better quantify the relationship between groundwater levels and habitat conditions. The first is to install shallow piezometers that measure water table depth at approximately four locations where riparian vegetation might potentially be impacted by pumping. Locations would be selected and piezometers installed during the first 5-year implementation period. Example locations might include the Pajaro River, Pacheco Creek near San Felipe Road, the San Benito River near Lucy Brown Road, the San Benito River in the Paicines Valley, and Tres Pinos Creek near Highway 25. The wells would be added to the overall water-level monitoring program.

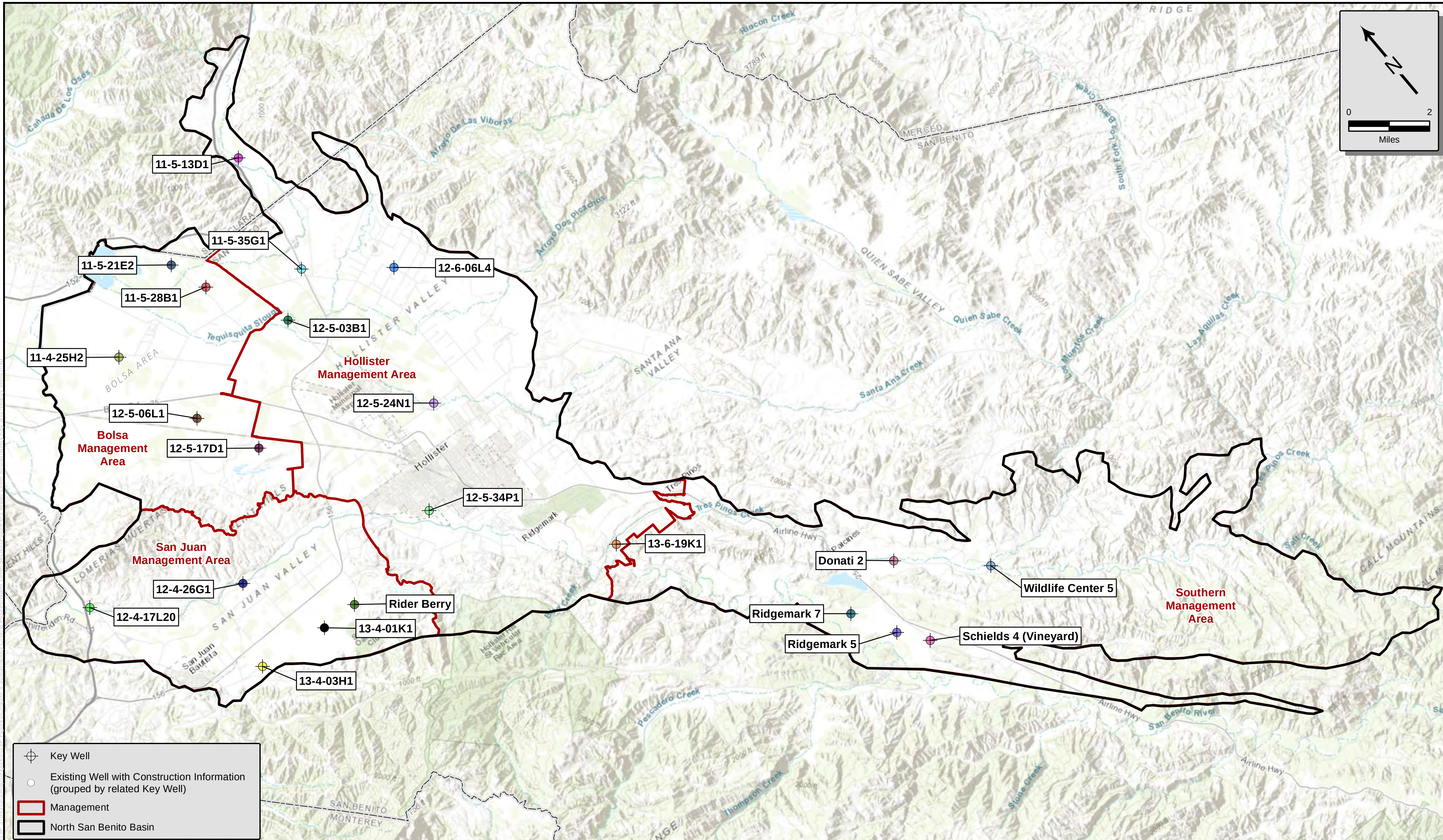
The second action is to conduct a field study to identify the critical riffle that limits fish passage opportunity along the San Benito River and estimate the minimum flow required to allow passage over the riffle. This study can be completed during the first 5-year implementation period and support a refinement of the interconnected surface water minimum threshold during the 5-year GSP update process.

Potential management actions to reduce impacts to steelhead smolt passage along the San Benito River—which appears to be the most sensitive aspect of interconnected surface water—include:

- Change land use designations, obtain conservation easements or implement other land-use management measures designed to minimize future increases in groundwater pumping along the San Benito River upstream of the critical riffle that might reduce passage opportunity.
- Cooperate with other agencies to control invasive vegetation in riparian areas. Although this would benefit overall habitat conditions, it would not be a substitute for adequate flows.
- Restrict groundwater pumping near the critical riffle when San Benito River flow is receding through the minimum passage flow. This would be contingent on the results of the fish passage study and an evaluation of the expected benefits of short-term pumping reductions on base flow.
- In extreme drought conditions with evident and widespread mortality of riparian vegetation (which would only occur if the minimum threshold water levels for interconnected surface water are grossly exceeded), irrigate selected areas of riparian vegetation to provide ecological refugia and nuclei for riparian recovery following the drought.
- Site, design and operate groundwater recharge projects to have multiple benefits including aquatic/riparian habitat protection.

Two additional potential management measures were considered at a conceptual level and dismissed as impractical or ineffective. One would be to preferentially deliver CVP water to irrigated lands near GDE reaches, to reduce local groundwater pumping and stream flow depletion. In addition to the negligible to weak relationship between groundwater levels and riparian vegetation vigor revealed by the GDE Pulse data analysis, agricultural CVP water is largely unavailable during prolonged drought periods when this intervention would be most needed. This measure would not likely be effective.

A second potential measure would be to reoperate Hernandez Reservoir to retain more water in storage in normal and wet years in order to increase releases in dry years when vegetation and passage impacts would be greatest. A reservoir operations study found that this type of operation would increase the frequency and magnitude of spills from the reservoir and decrease long-term total groundwater recharge along the San Benito River below the reservoir. A decrease in recharge would tend to lower groundwater levels and decrease groundwater discharge into gaining reaches (which are GDE reaches). As a result, this concept does not appear to offer a net benefit to habitat conditions for fish and riparian vegetation.

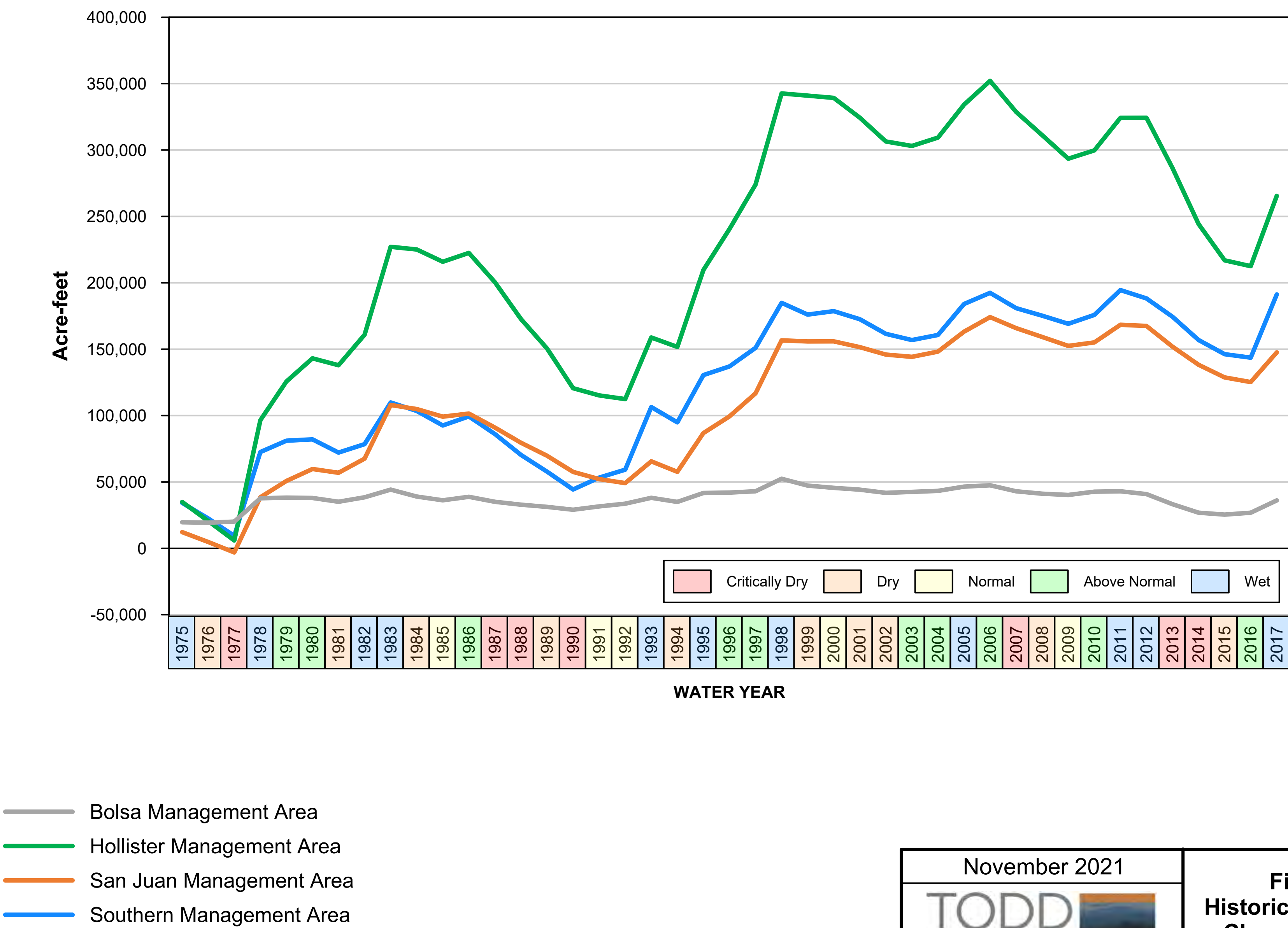


- Closest to Key Well 11-4-25H2
- Closest to Key Well 11-5-13D1
- Closest to Key Well 11-5-21E2
- Closest to Key Well 11-5-28B1
- Closest to Key Well 11-5-35G1
- Closest to Key Well 12-4-17L20
- Closest to Key Well 12-4-26G1
- Closest to Key Well 12-5-03B1
- Closest to Key Well 12-5-06L1
- Closest to Key Well 12-5-17D1
- Closest to Key Well 12-5-24N1
- Closest to Key Well 12-5-34P1
- Closest to Key Well 12-6-06L4
- Closest to Key Well 13-4-03H1
- Closest to Key Well 13-6-19K1
- Closest to Key Well Donati 2
- Closest to Key Well Rider Berry
- Closest to Key Well Ridgemark 5
- Closest to Key Well Ridgemark 7
- Closest to Key Well Schields 4 (vineyard)
- Closest to Key Well Wildlife Center 5

November 2021

TODD GROUNDWATER

Figure 6-1
Water Level Sustainability Criteria Key Wells and Nearby Wells

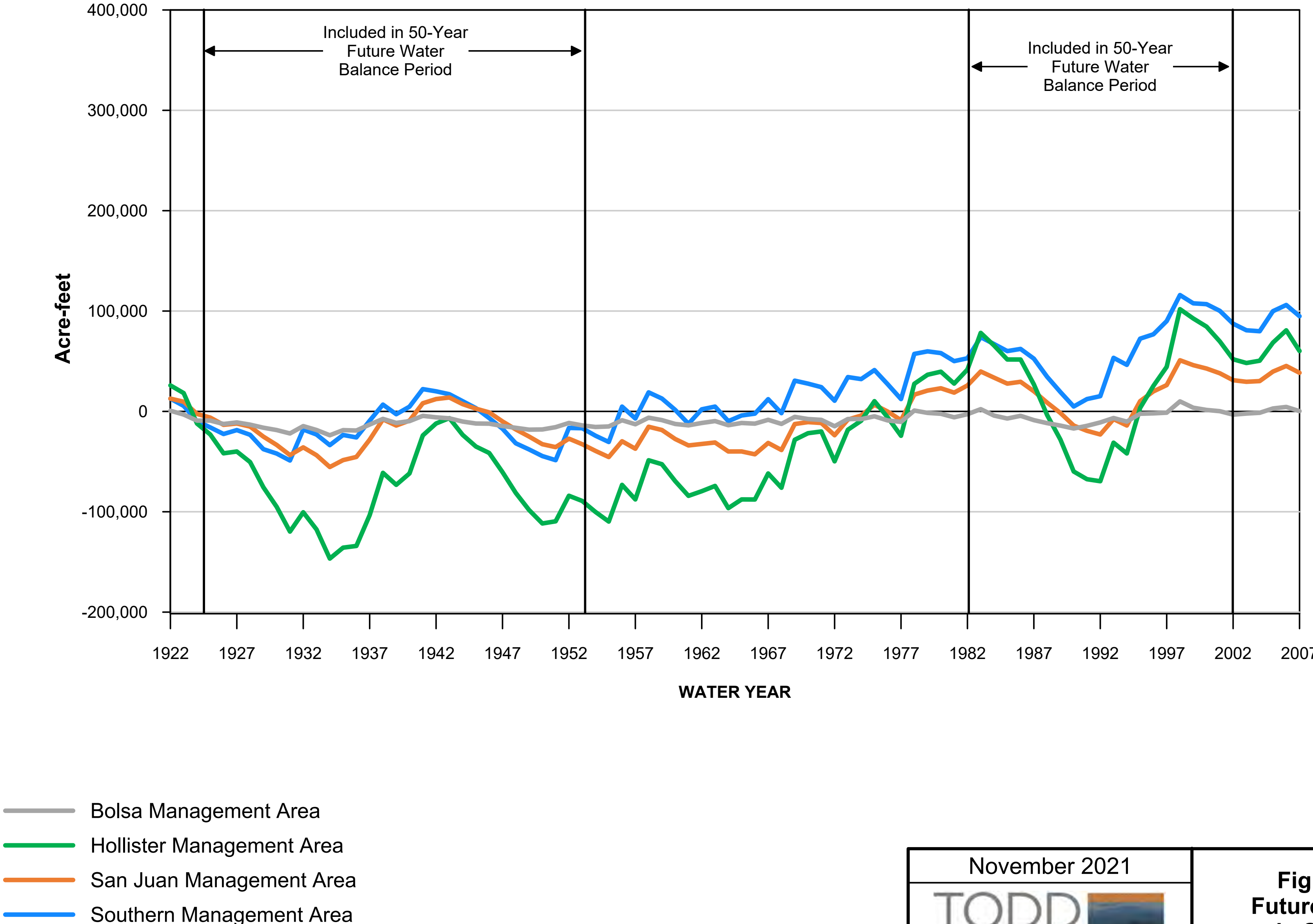


Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-2 Change in Storage.gpj

November 2021

TODD GROUNDWATER

Figure 6-2
Historical and Current Change in Storage

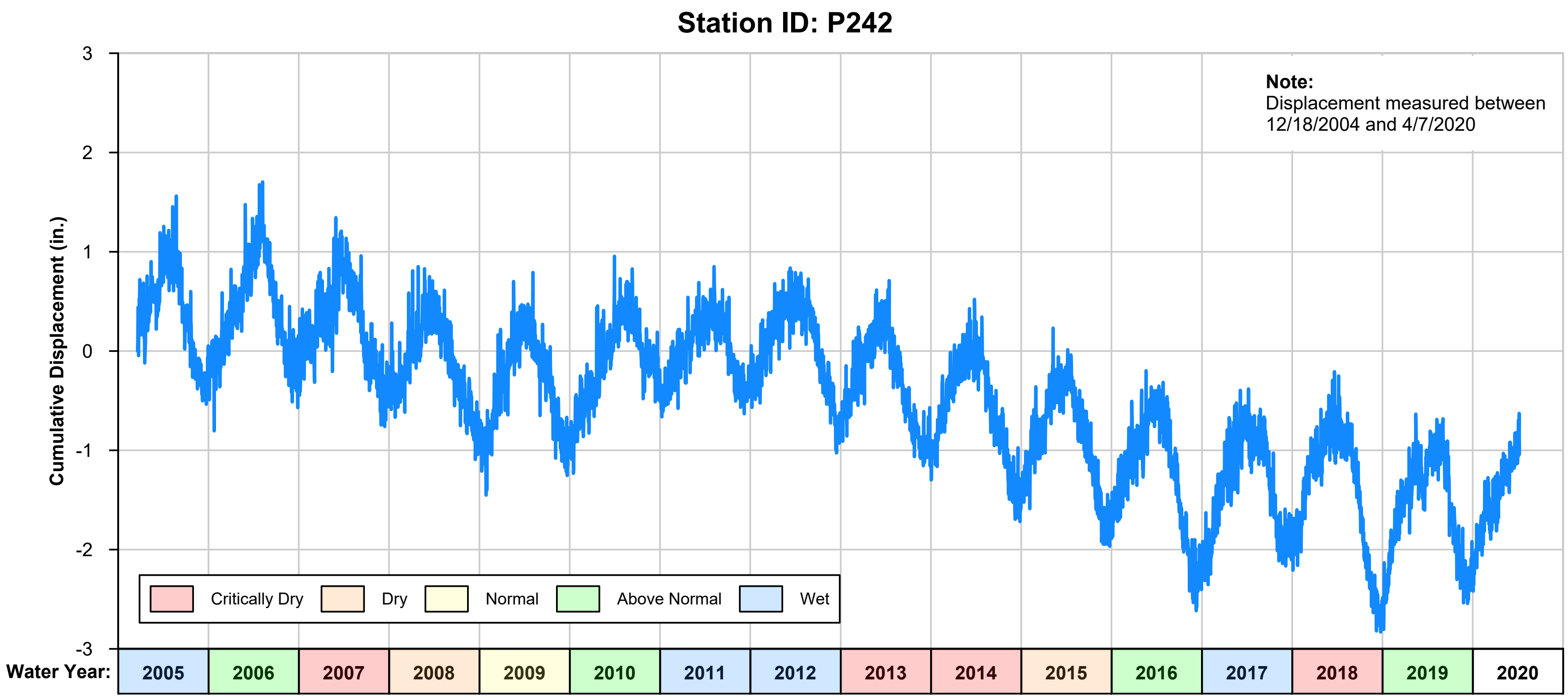


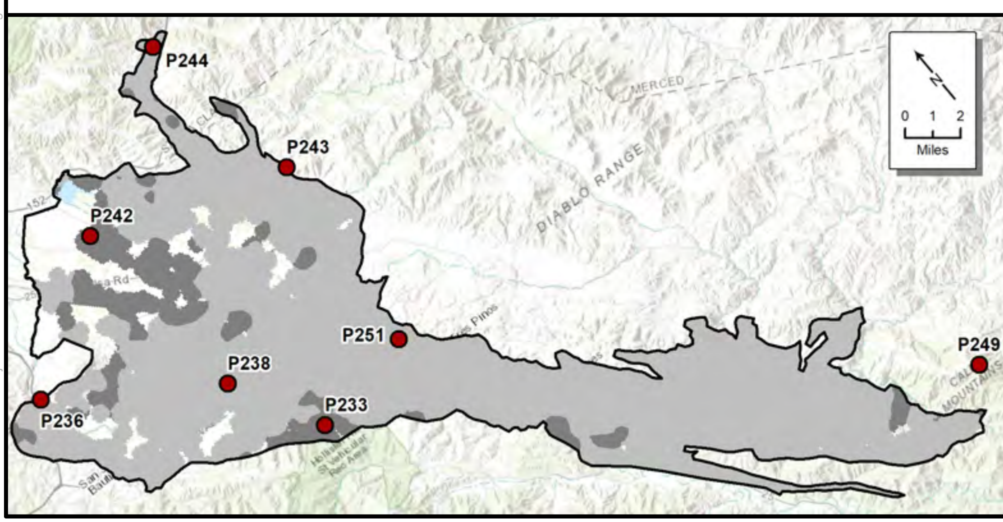
November 2021

TODD GROUNDWATER

Figure 6-3
Future Change in Storage

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-3 Future Change in Storage.gpj





Vertical Displacement (inches)

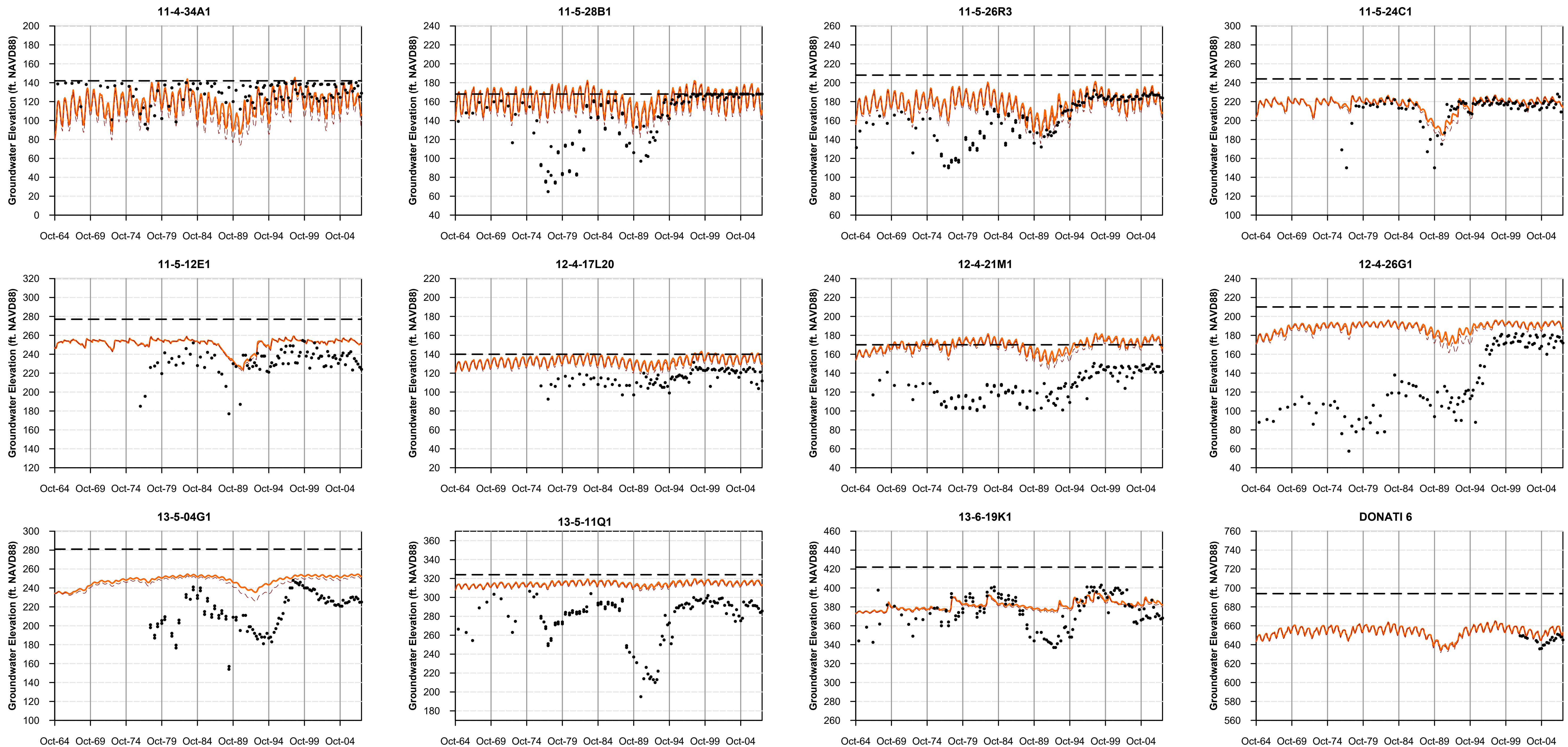
- -2 - 0 inches
- 0 - 2 inches

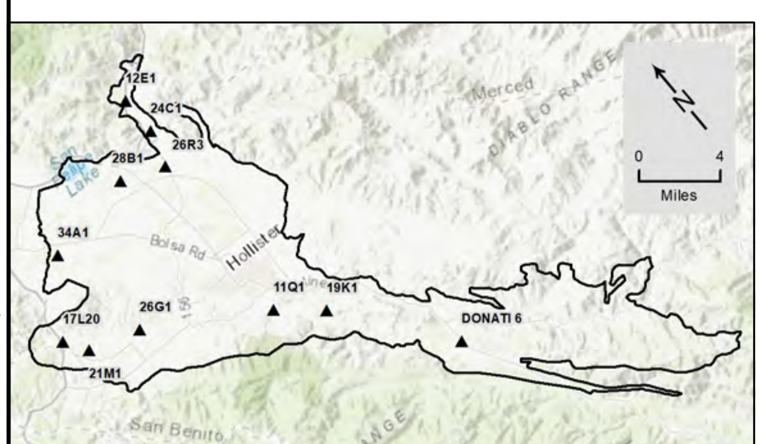
Note:
Vertical displacement data from California Department of Water Resources measured between 6/13/2015 and 9/19/2019 (Tre/Altamira).

Figure 6-4
Historical Ground Surface Elevation from GPS Monitoring

November 2021

TODD GROUNDWATER





Historical

10% Pumping Reduction

Future Baseline

Ground Surface

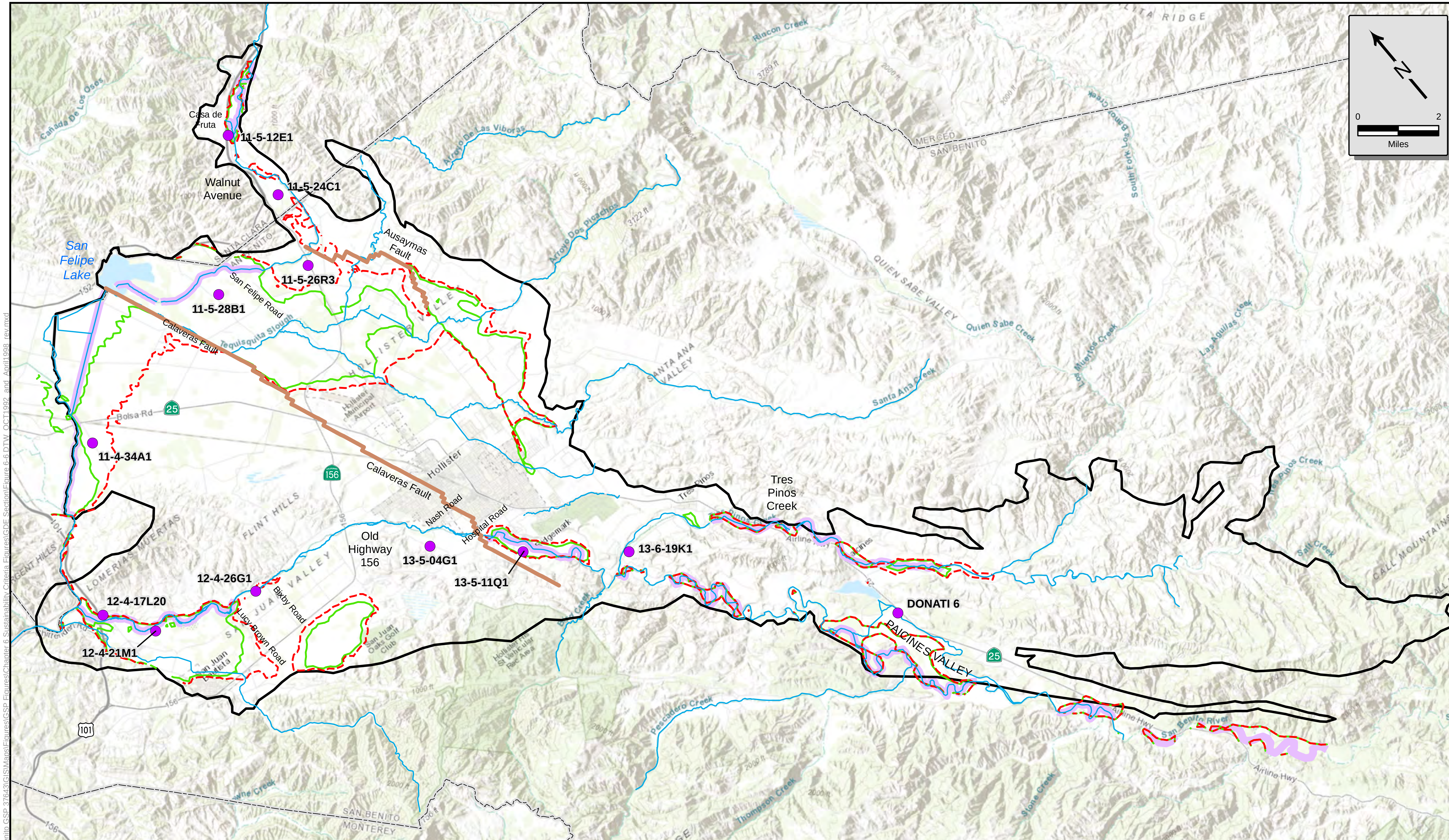
Data:
T:\Projects\San Benito GSP 37643\Model\Water_Levels\Hydrographs_1922-2007.xlsm

November 2021

TODD GROUNDWATER

Figure 6-5
Hydrographs of Future Baseline and Reduced Pumping Scenarios

Path: \\todd-file\data\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-5 Hydrographs of Future Baseline and Reduced Pumping Scenarios.gpj



Hydrograph Well

April 1998 Depth to Water = 20 ft

October 1992 Depth to Water =20 ft

Gaining reach (potential riparian GDE)

Major Fault

North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 6-6
Depth to Water
October 1992 and
April 1998

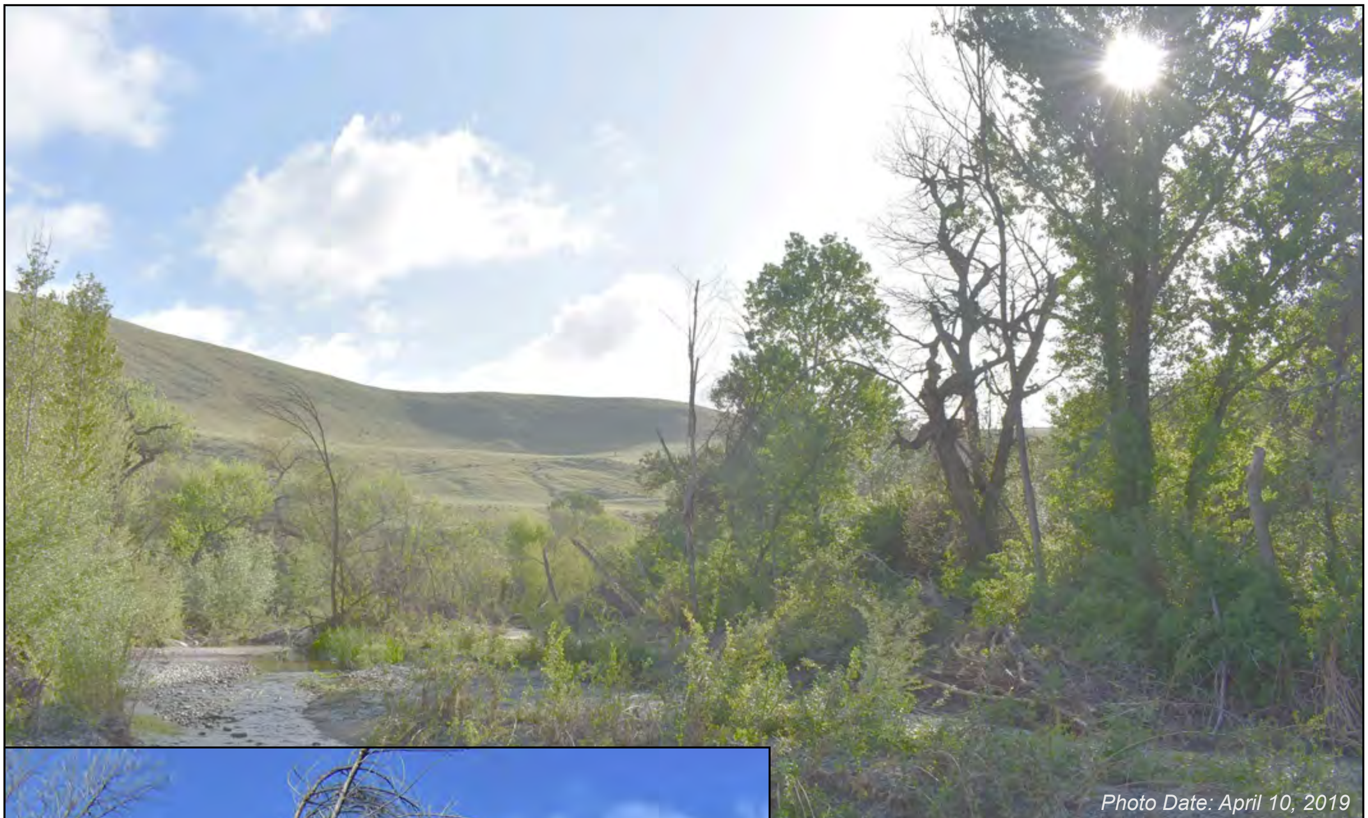


Figure 6-7
Drought-Related Tree Mortality along Tres Pinos Creek

November 2021

TODD GROUNDWATER

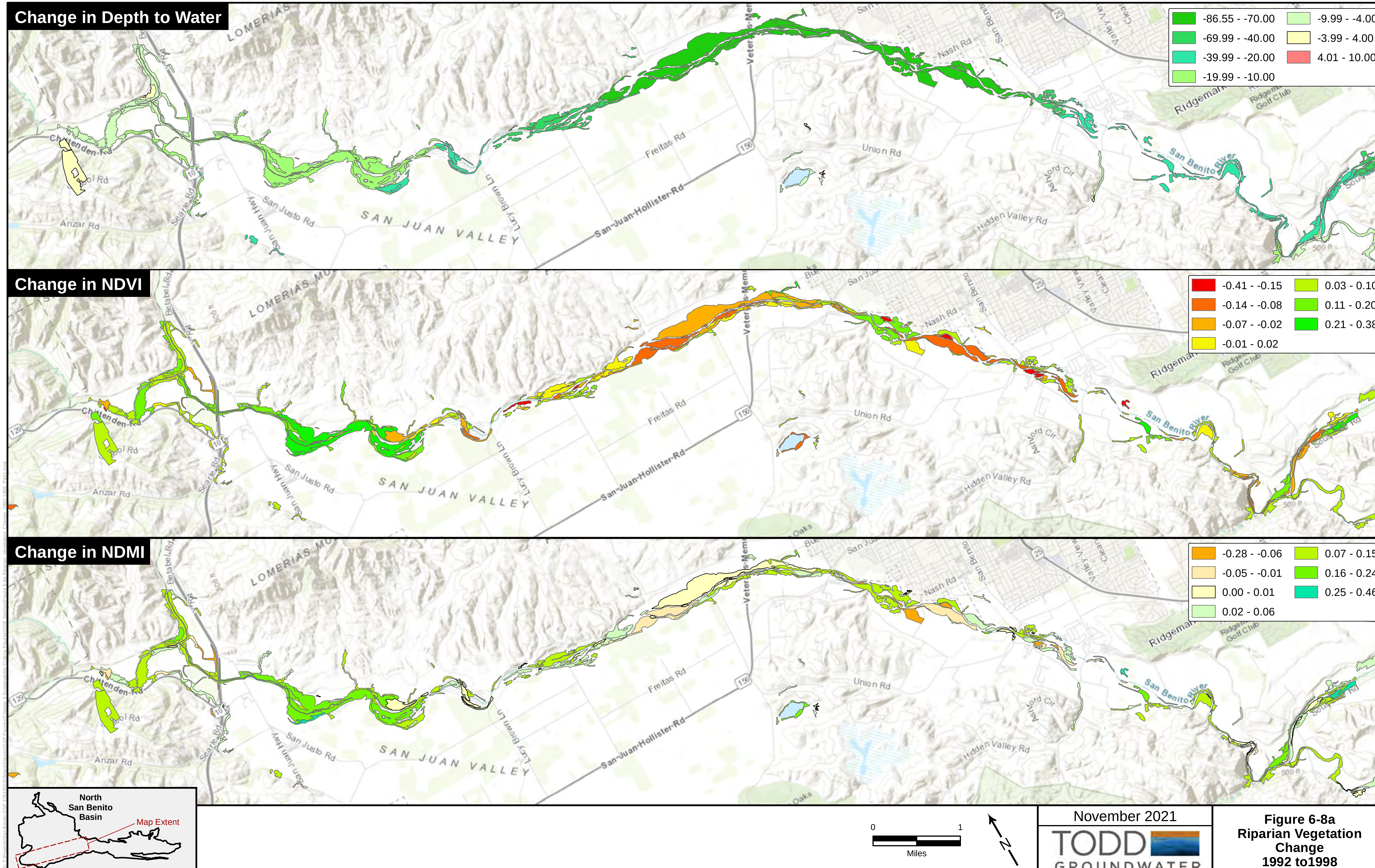
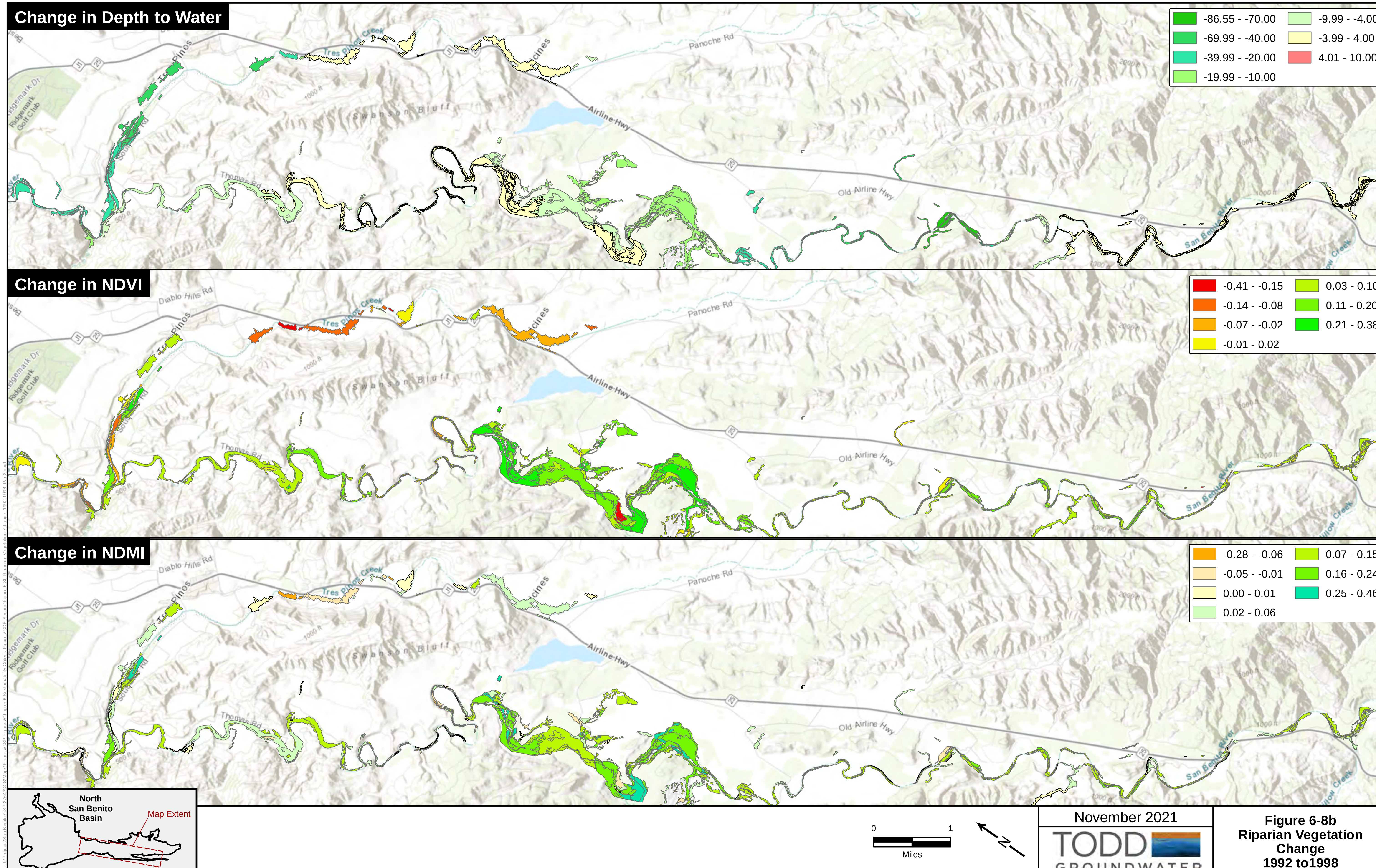
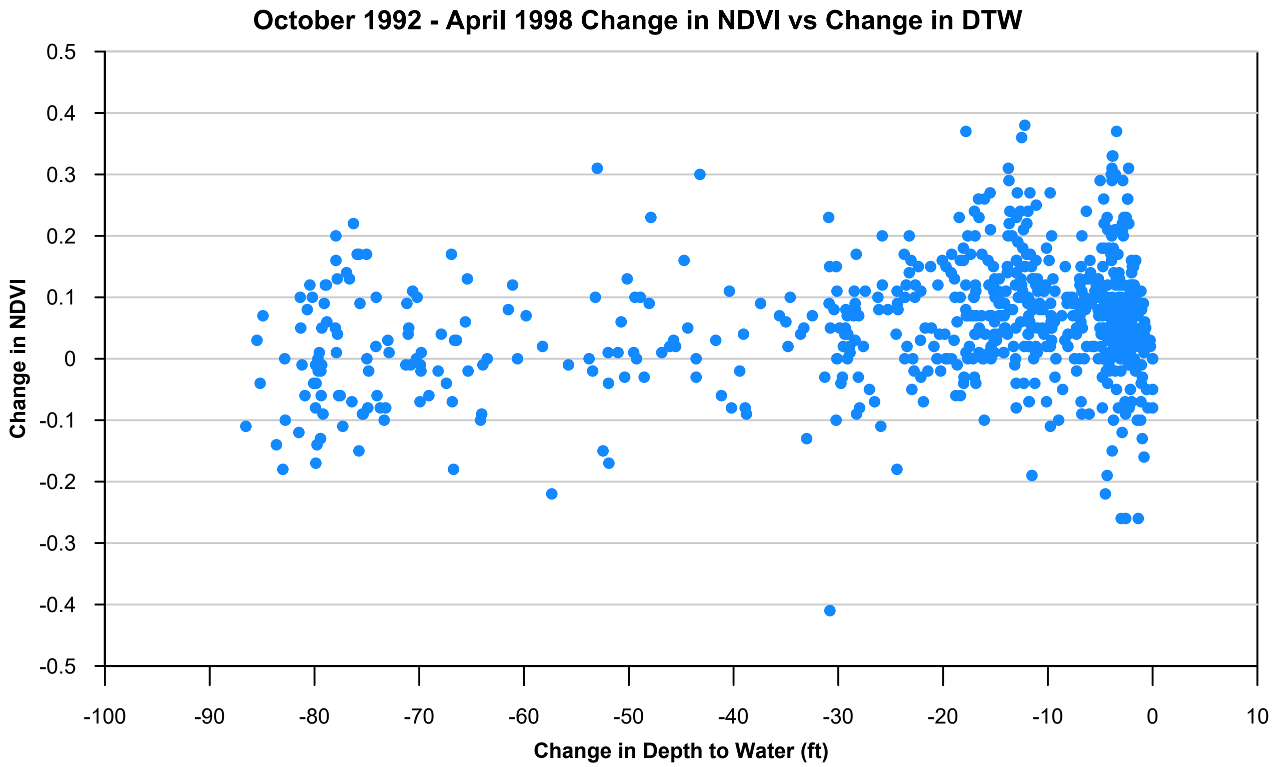


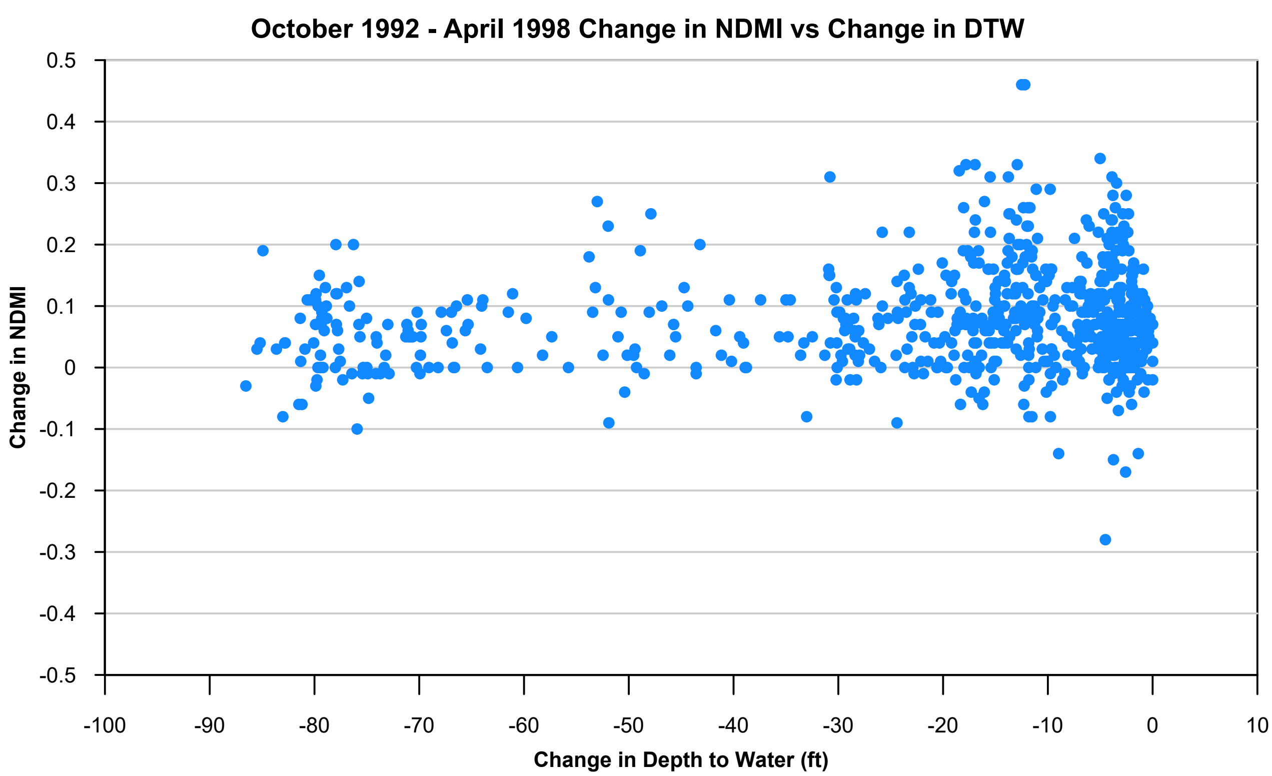
Figure 6-8a
Riparian Vegetation Change
1992 to1998



November 2021

Figure 6-8b
Riparian Vegetation Change
1992 to1998





Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-9 Relationships of NDVI and NDMI to Groundwater Level.gpj

Data:
T:\Projects\San Benito GSP 37643\Data\GDE\NDVI-NDMI-DTW_correlation.xlsx

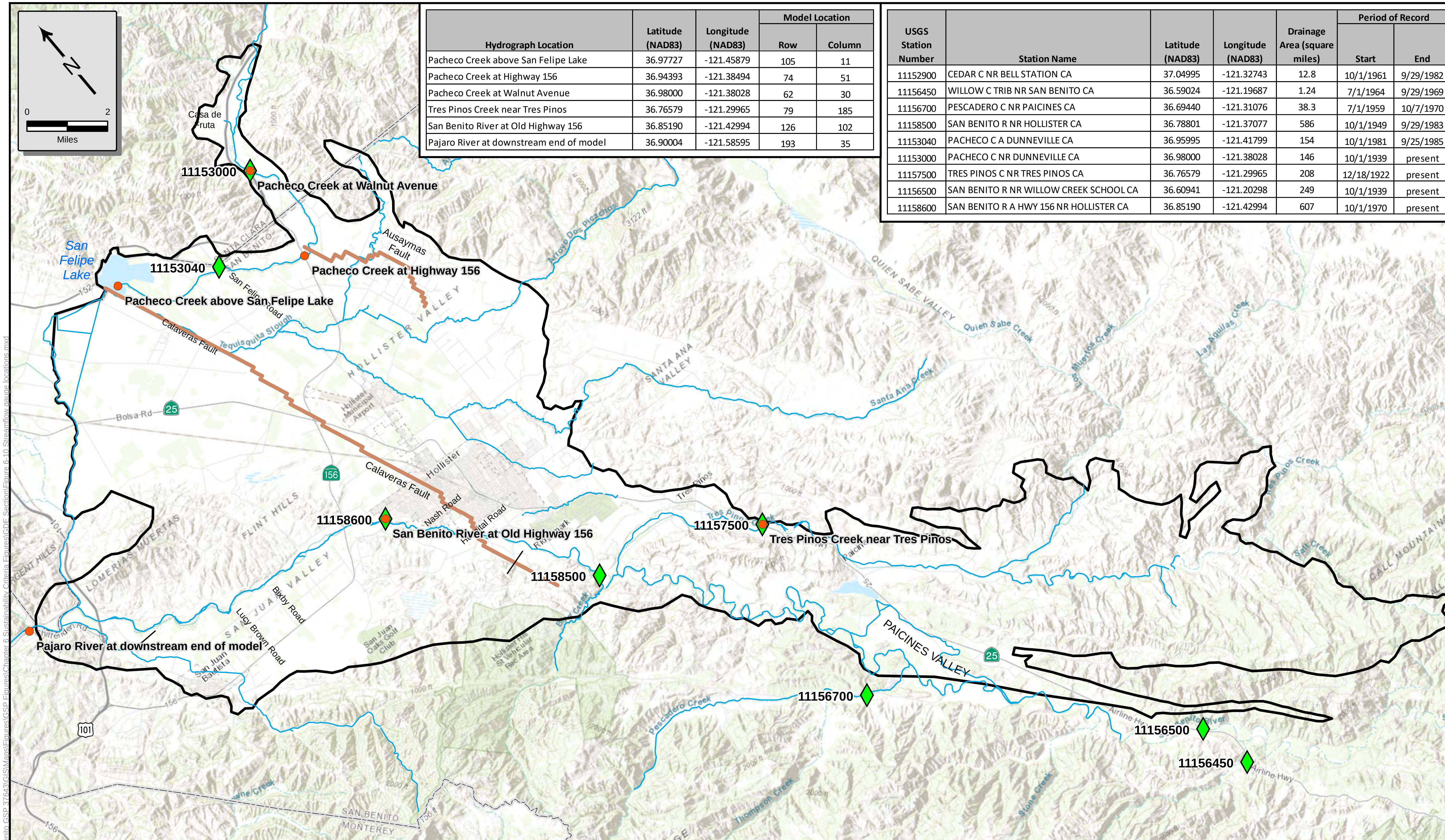
November 2021

TODD GROUNDWATER

Figure 6-9
Relationships of NDVI and NDMI to Groundwater Level

Hydrograph Location	Latitude (NAD83)	Longitude (NAD83)	Model Location Row	Model Location Column
Pacheco Creek above San Felipe Lake	36.97727	-121.45879	105	11
Pacheco Creek at Highway 156	36.94393	-121.38494	74	51
Pacheco Creek at Walnut Avenue	36.98000	-121.38028	62	30
Tres Pinos Creek near Tres Pinos	36.76579	-121.29965	79	185
San Benito River at Old Highway 156	36.85190	-121.42994	126	102
Pajaro River at downstream end of model	36.90004	-121.58595	193	35

USGS Station Number	Station Name	Latitude (NAD83)	Longitude (NAD83)	Drainage Area (square miles)	Period of Record Start	Period of Record End
11152900	CEDAR C NR BELL STATION CA	37.04995	-121.32743	12.8	10/1/1961	9/29/1982
11156450	WILLOW C TRIB NR SAN BENITO CA	36.59024	-121.19687	1.24	7/1/1964	9/29/1969
11156700	PESCADERO C NR PAICINES CA	36.69440	-121.31076	38.3	7/1/1959	10/7/1970
11158500	SAN BENITO R NR HOLLISTER CA	36.78801	-121.37077	586	10/1/1949	9/29/1983
11153040	PACHECO C A DUNNEVILLE CA	36.95995	-121.41799	154	10/1/1981	9/25/1985
11153000	PACHECO C NR DUNNEVILLE CA	36.98000	-121.38028	146	10/1/1939	present
11157500	TRES PINOS C NR TRES PINOS CA	36.76579	-121.29965	208	12/18/1922	present
11156500	SAN BENITO R NR WILLOW CREEK SCHOOL CA	36.60941	-121.20298	249	10/1/1939	present
11158600	SAN BENITO R A HWY 156 NR HOLLISTER CA	36.85190	-121.42994	607	10/1/1970	present



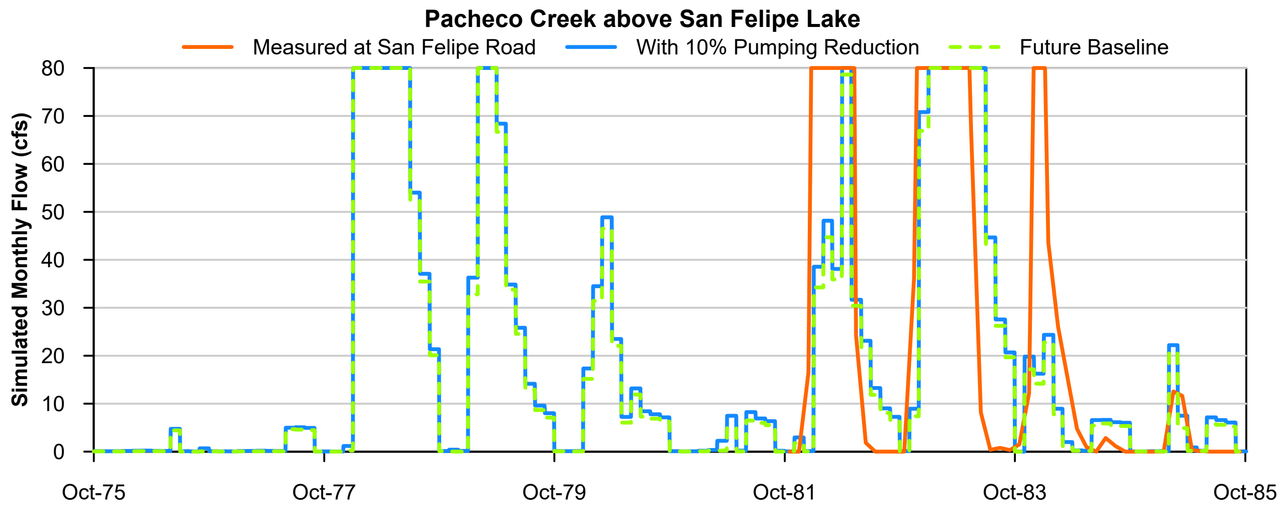
Stream Gauges in Basin
Stream Hydrograph Location
Major Fault
North San Benito Basin

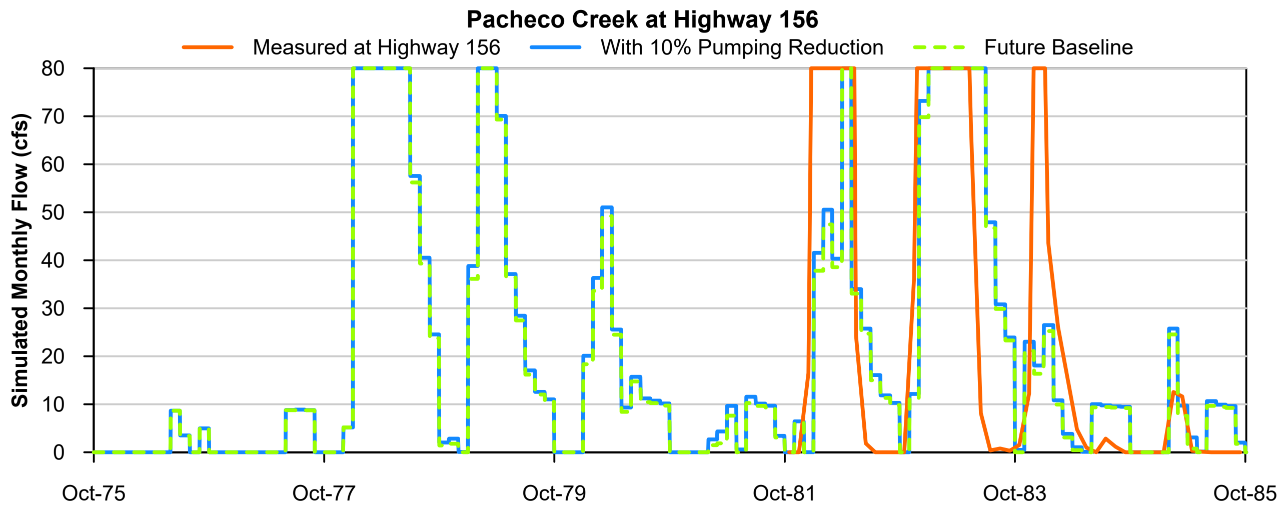
November 2021

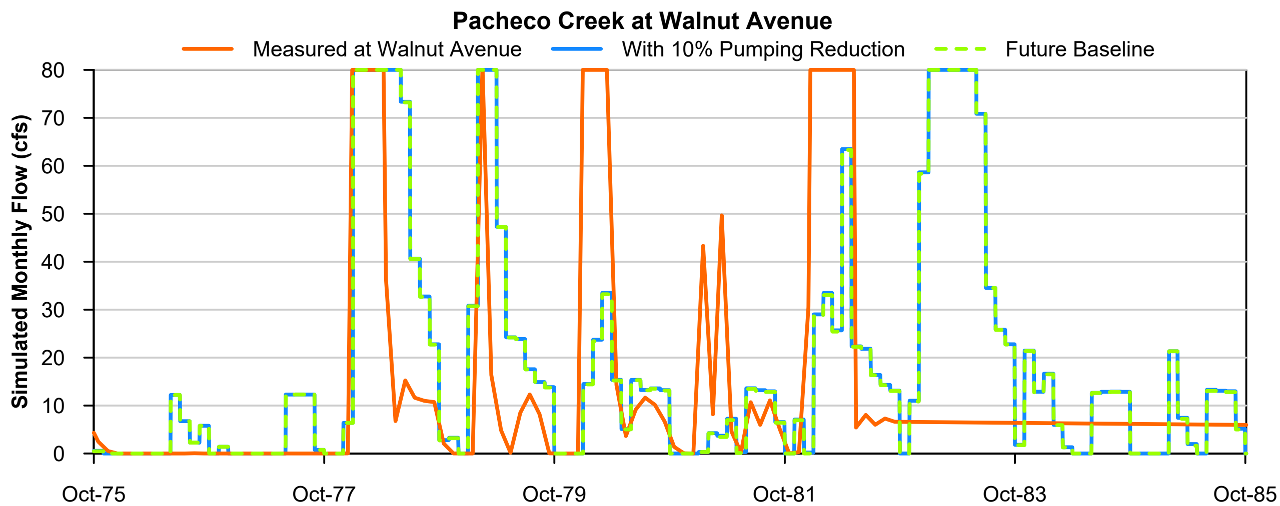
TODD GROUNDWATER

Figure 6-10
Stream Flow Gauge and Hydrograph Locations

Path: T:\Projects\San Benito GSP 37643\GIS\Maps\Figures\GSP Figures\Chapter 6 Sustainability Criteria Figures\GDE Section\Figure 6-10 Streamflow gauge locations.mxd







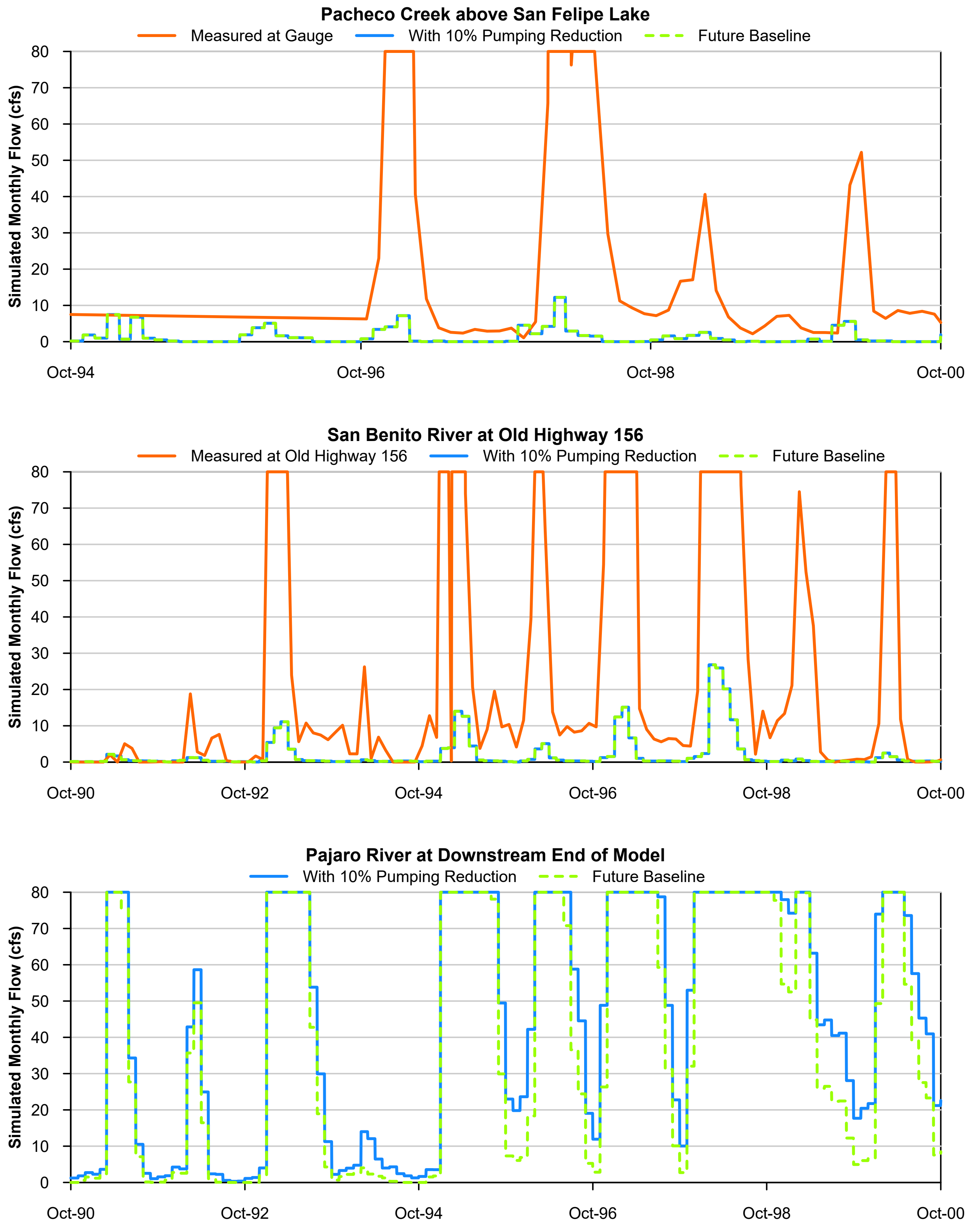
Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\GWV\
SB7517_gage_str_35locations2.xlsx

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-11a Simulated Monthly Stream Flow at In-Basin Locations.gpj

November 2021

TODD GROUNDWATER

Figure 6-11a
Simulated Monthly Stream Flow at In-Basin Locations



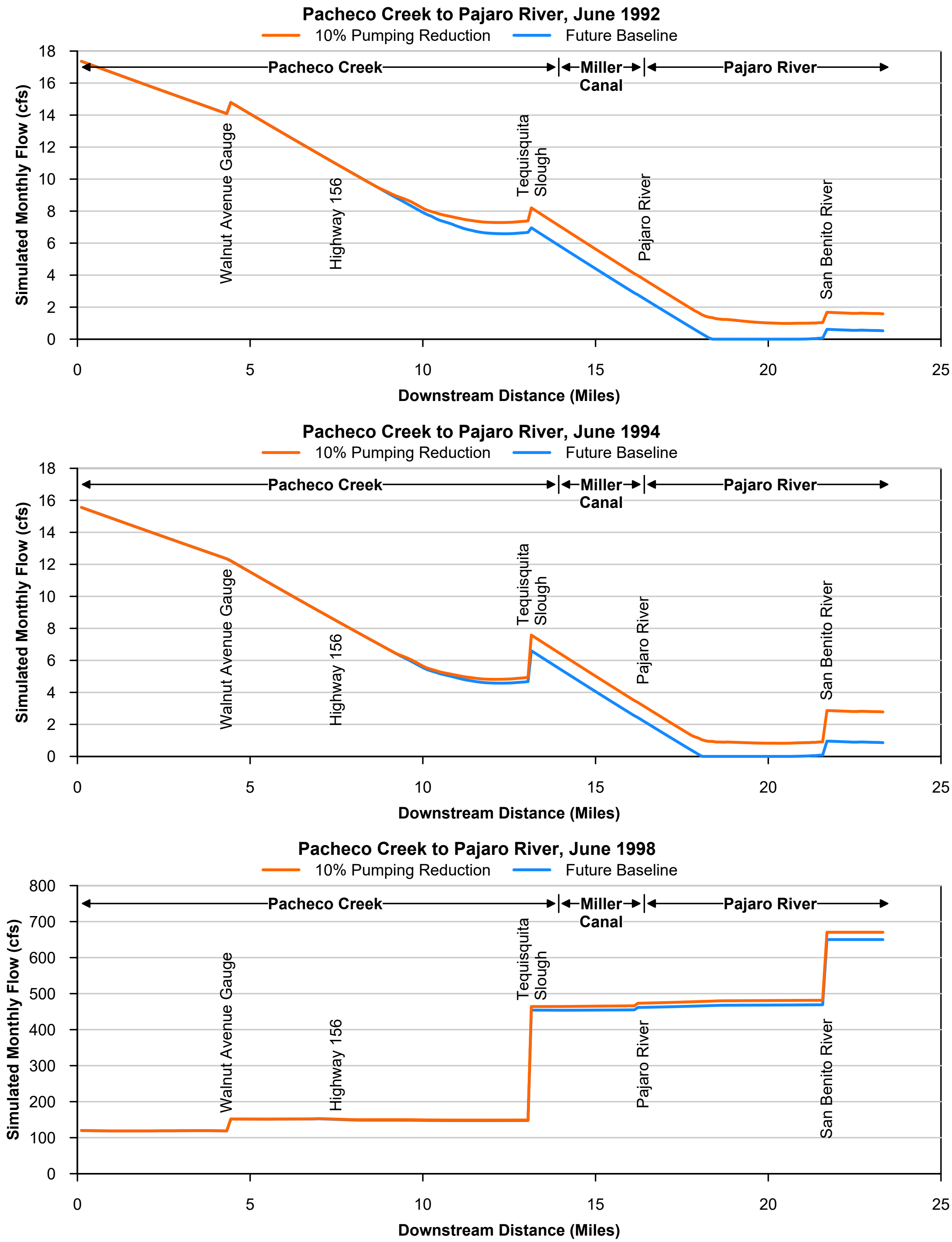
Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\GWV\
SB7517_gage_str_35locations2.xlsx

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-11b Simulated Monthly Stream Flow at In-Basin Locations.gpj

November 2021

TODD GROUNDWATER

Figure 6-11b
Simulated Monthly Stream Flow at In-Basin Locations



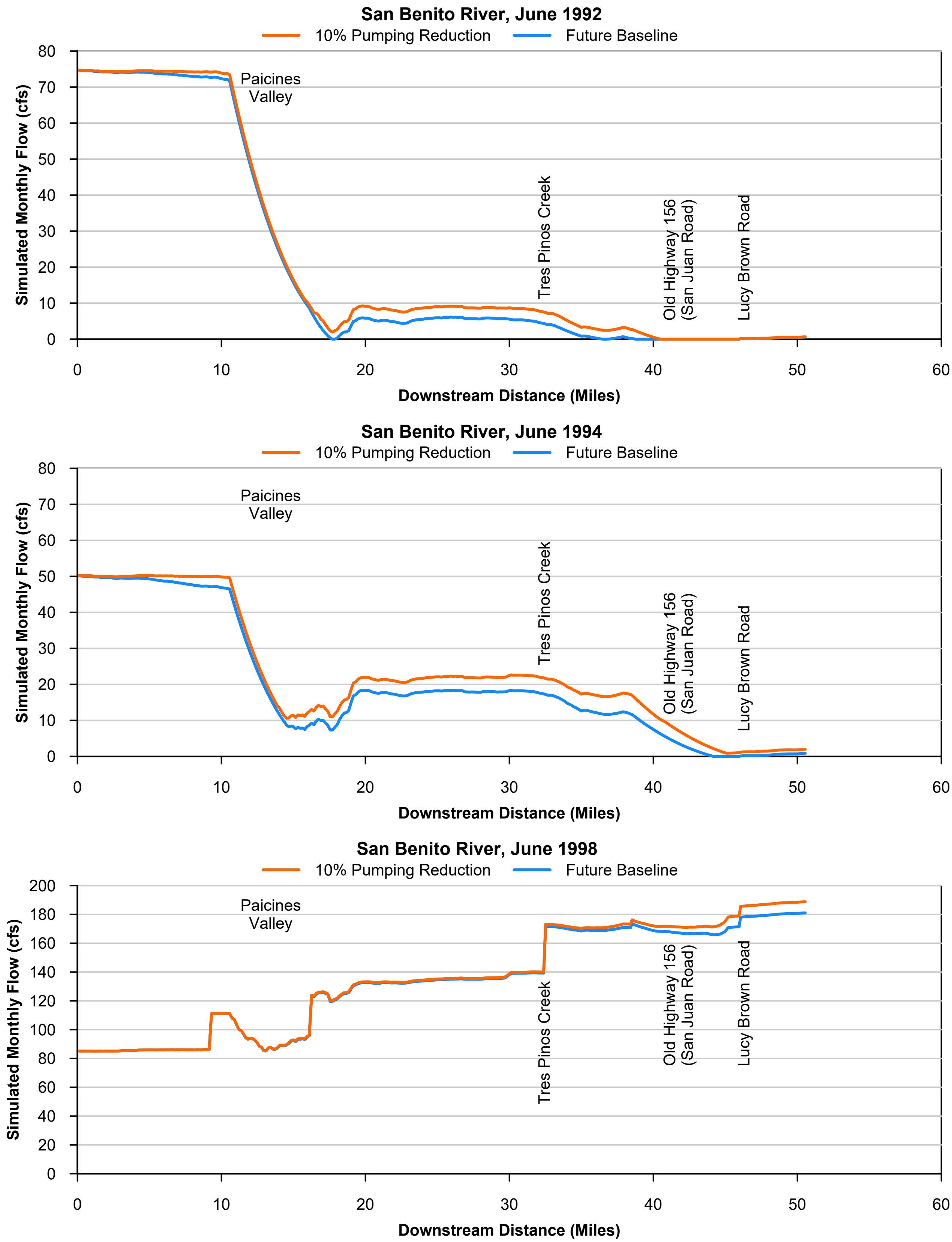
November 2021

TODD GROUNDWATER

Figure 6-12a
Flow Profile along the San Benito River

Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\GWV
SB7517_streamflow_Run057_6507_SP1-516.xlsx

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-12a Flow Profile along the San Benito River.gpj



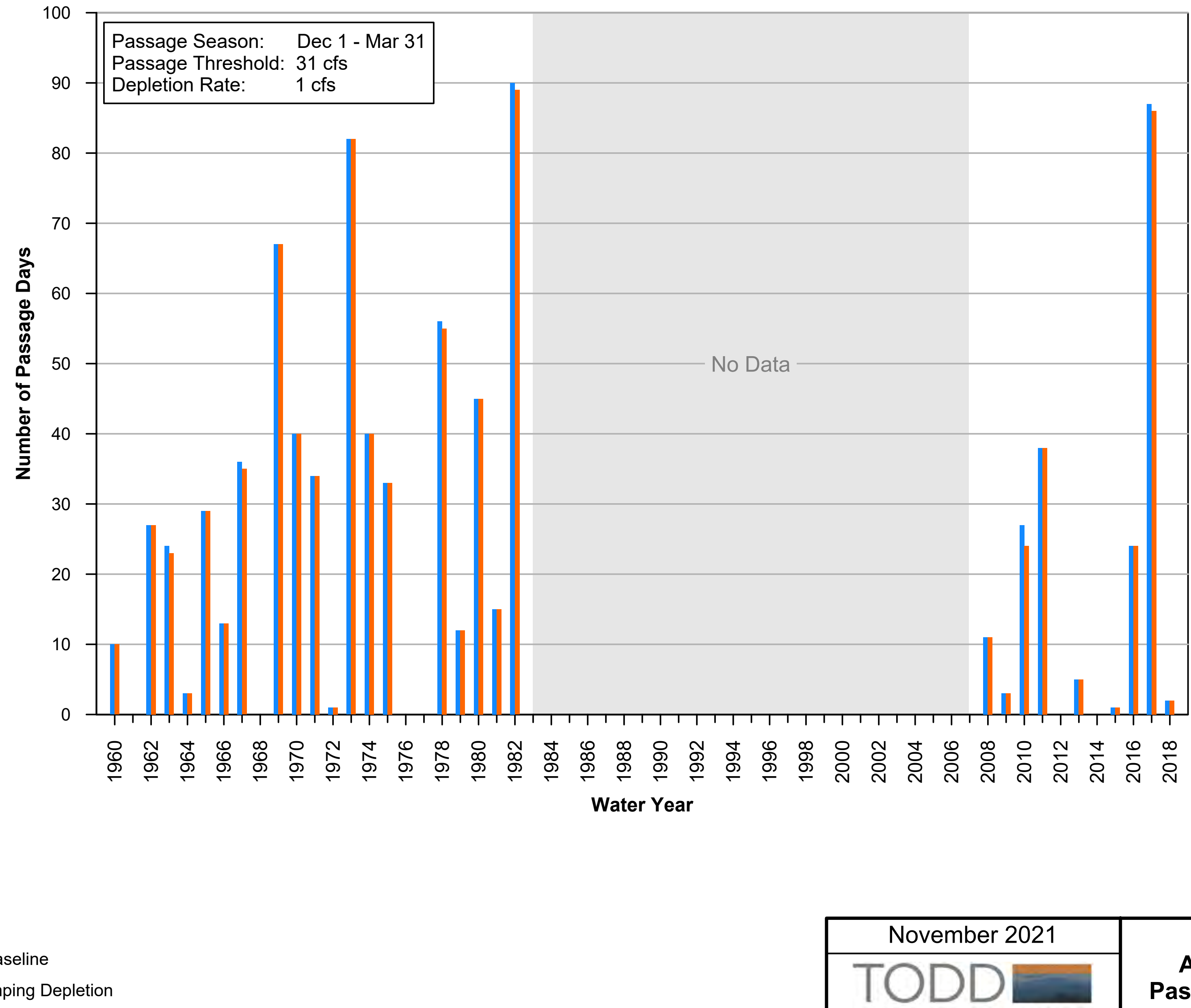
November 2021

TODD GROUNDWATER

Figure 6-12b
Flow Profile along the San Benito River

Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\GWV
SB7517_streamflow_Run057_6507_SP1-516.xlsx

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-12b Flow Profile along the San Benito River.gpj

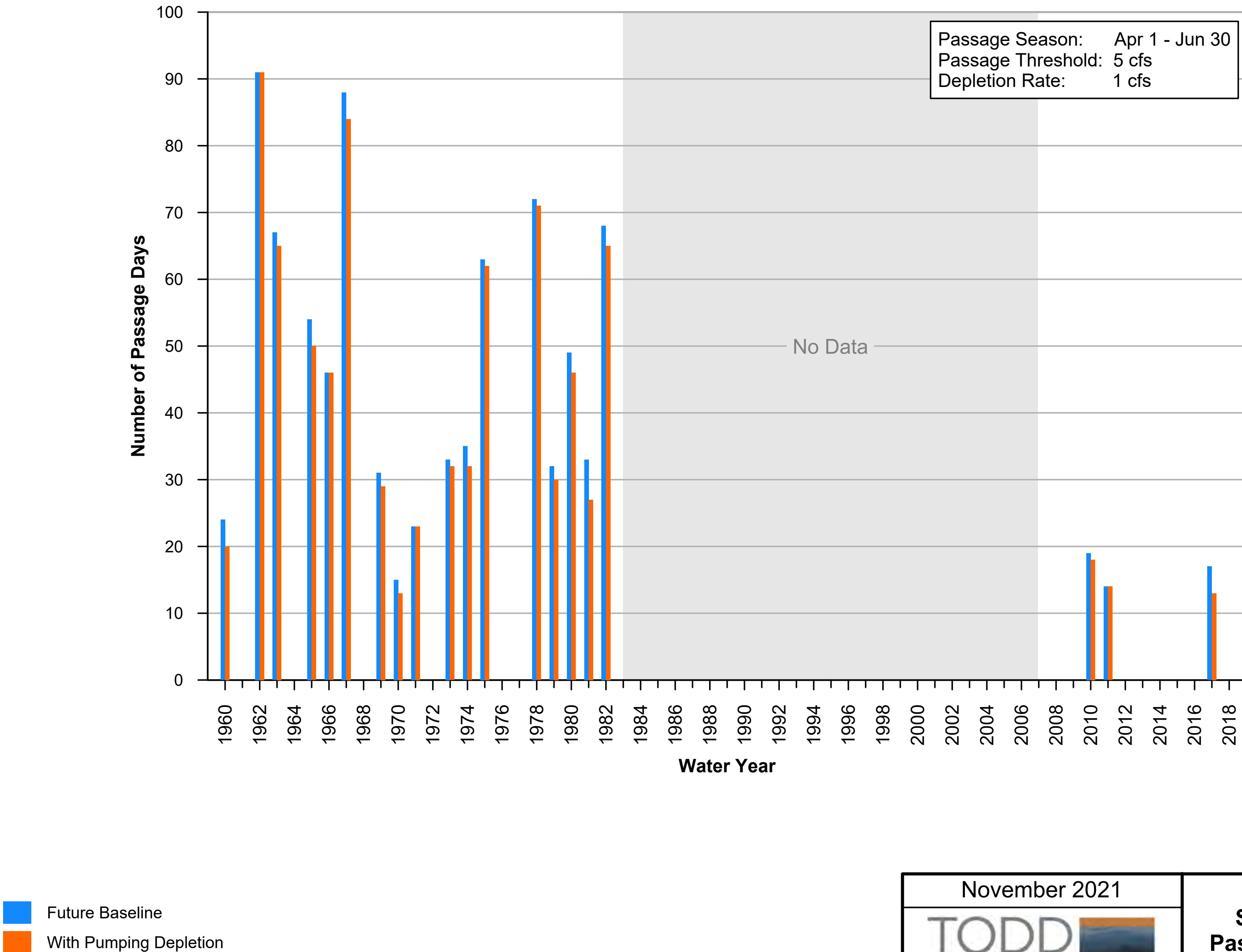


November 2021

TODD GROUNDWATER

Figure 6-13
Adult Steelhead Passage Opportunity on Pacheco Creek

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-13 Adult Steelhead Passage Opportunity on Pacheco Creek.gpj

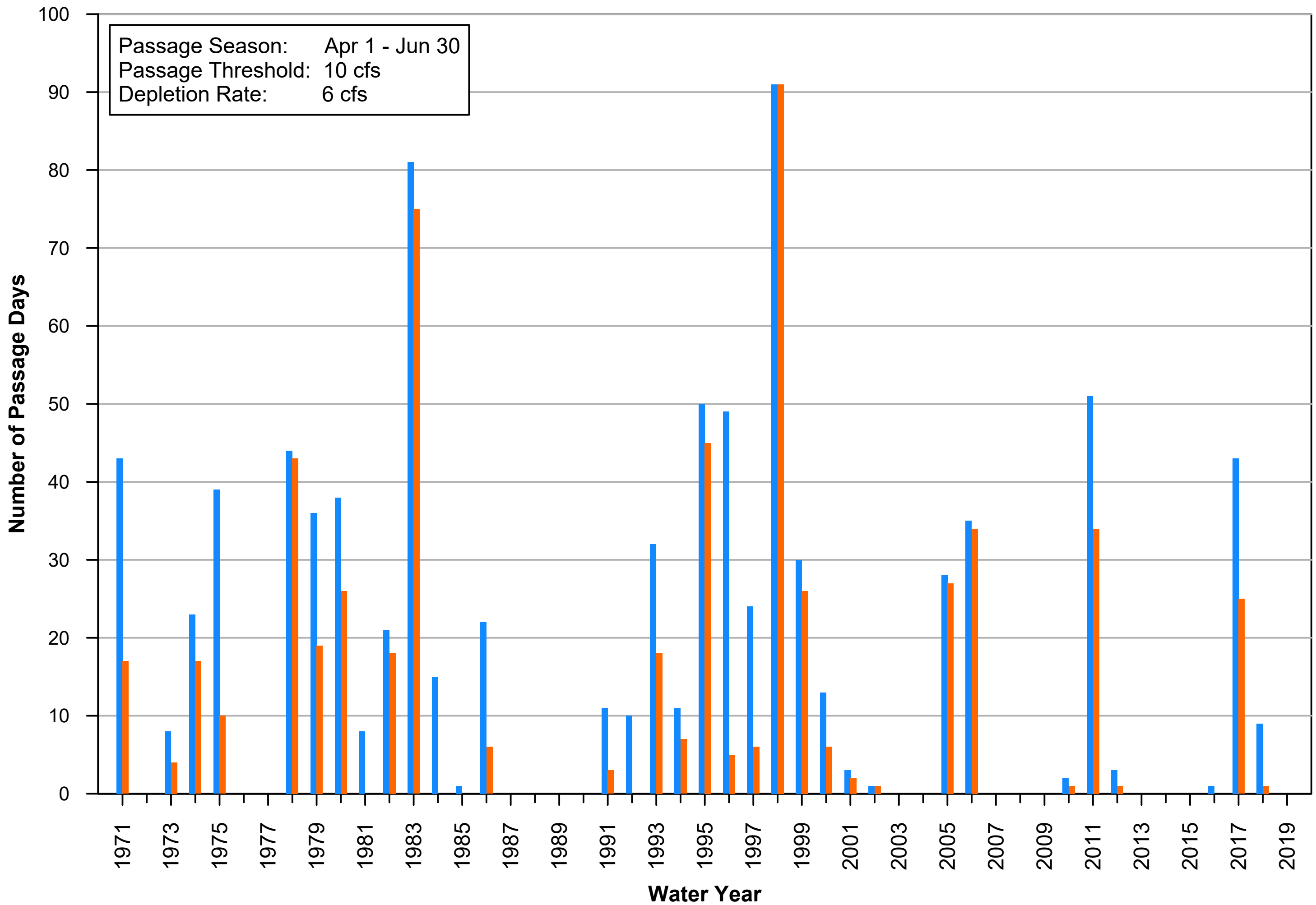


November 2021

TODD GROUNDWATER

Figure 6-14
Steelhead Smolt Passage Opportunity on Pacheco Creek

Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-14 Steelhead Smolt Passage Opportunity on Pacheco Creek.gpj

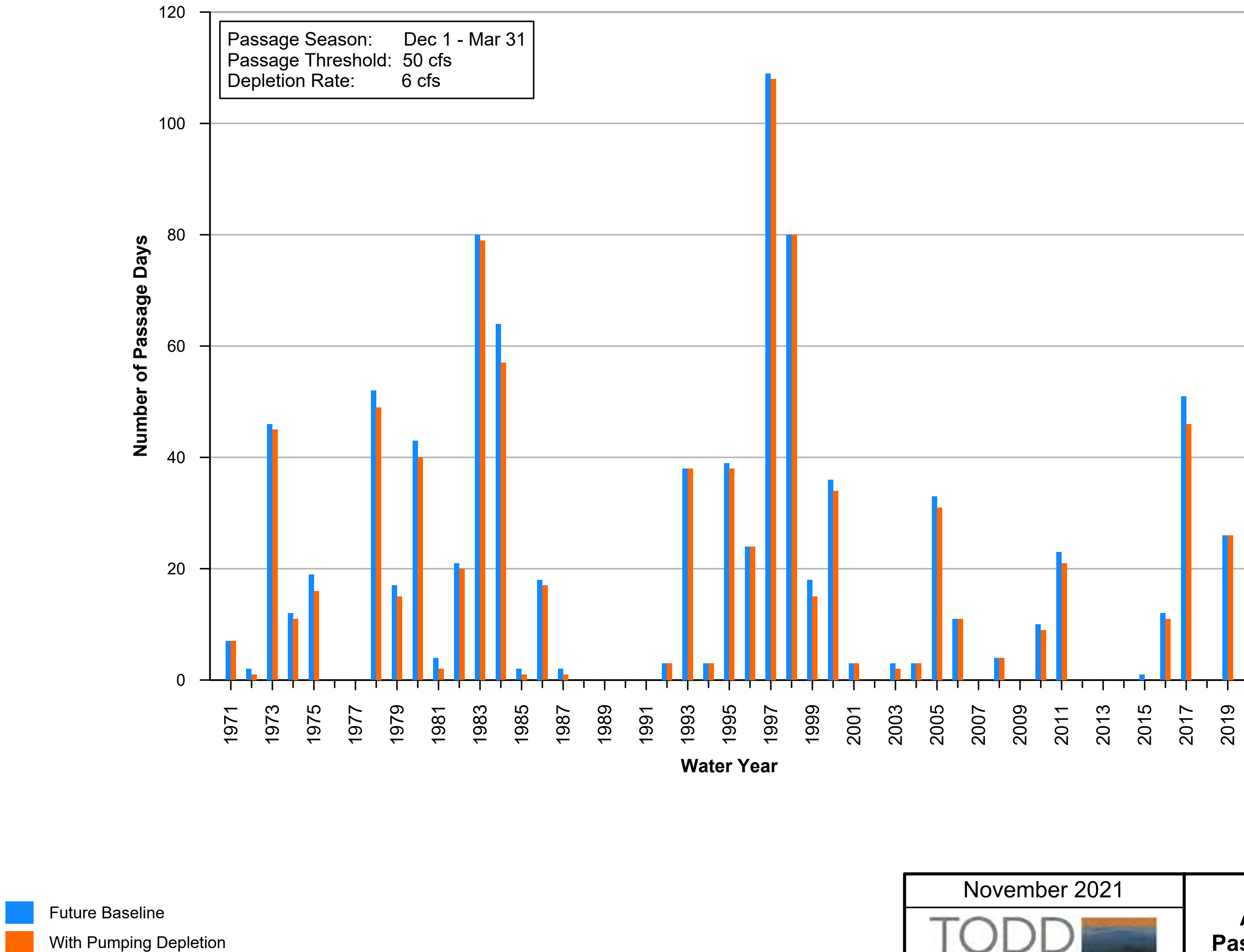


Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 6-15 Steelhead Smolt Passage Opportunity on San Benito River.gpj

November 2021

TODD GROUNDWATER

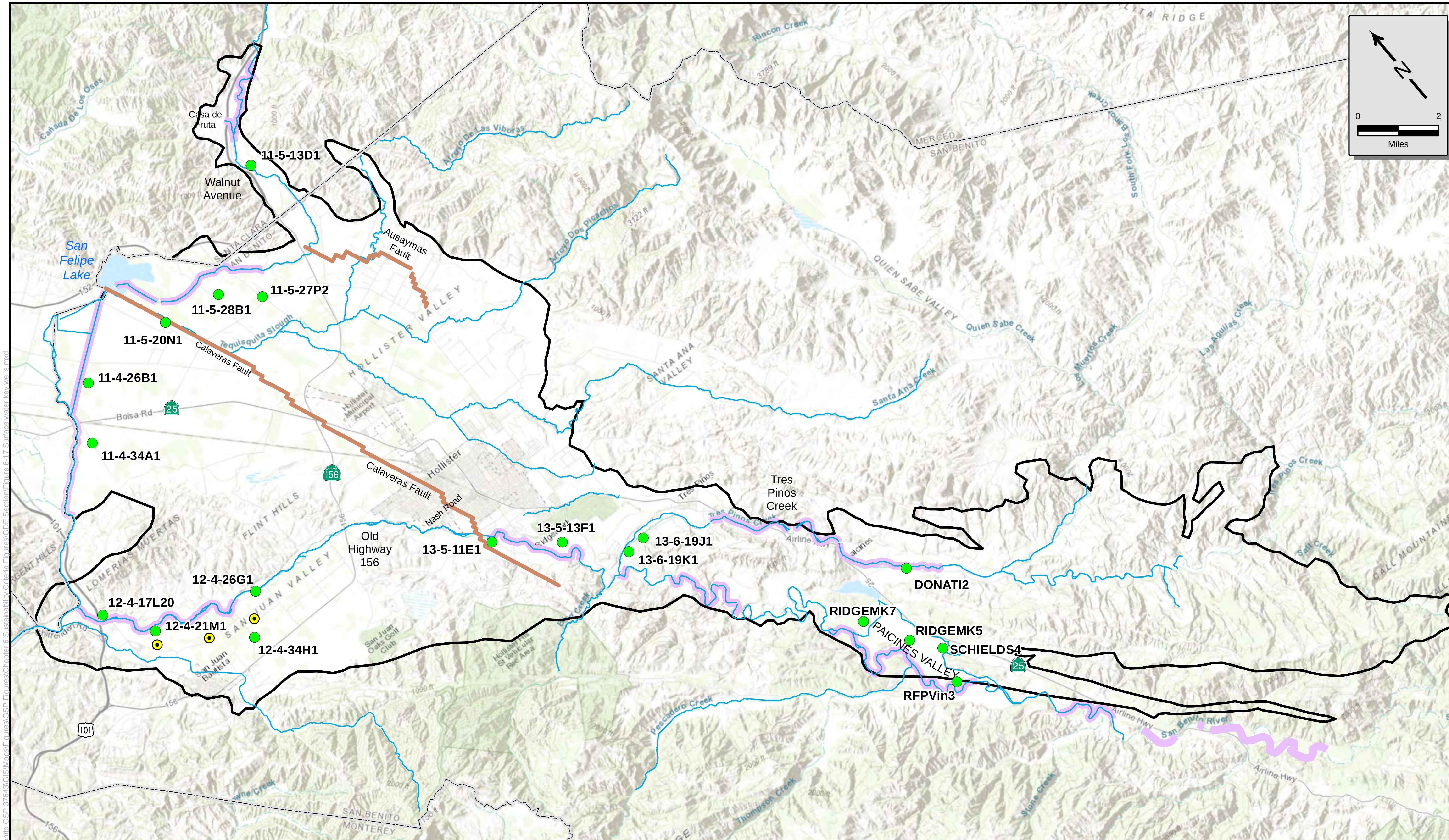
Figure 6-15
Steelhead Smolt Passage Opportunity on San Benito River



November 2021

TODD GROUNDWATER

Figure 6-16
Adult Steelhead Passage Opportunity on San Benito River



Interconnected Surface Water Key Well

Existing Shallow Monitoring Well

Stream Reach Potentially Connected to Groundwater

Major Fault

North San Benito Basin

November 2021

TODD GROUNDWATER

Figure 6-17
Surface Water Key Wells

7. MONITORING NETWORK

The overall objective of the monitoring network for this Groundwater Sustainability Plan (GSP) is to yield representative information about water conditions as necessary to guide and evaluate GSP implementation. Specifically, monitoring network objectives are to:

- Build on the existing monitoring network and available data.
- Expand the network to better represent all Management Areas.
- Reduce uncertainty and provide better data to guide management actions, document the water budget, and better understand how the surface water/groundwater system interacts.
- Monitor groundwater conditions relative to sustainability criteria.
- Identify and track potential impacts on groundwater users/uses and better communicate the state of the basin.

With the intent to provide sufficient data for demonstrating short-term, seasonal, and long-term trends in groundwater and related surface conditions, this GSP builds on existing monitoring programs (summarized in Section 2.1.4) that provide historical information and a context for monitoring. These topics also have been addressed in terms of data gaps in the December 2018 Technical Memorandum (TM), "Data to Support GSP Preparation" (in **Appendix E**). Data gaps are addressed in terms of information needed for understanding the basin setting, evaluation of the efficacy of Plan implementation, and the ability to assess whether the Basin is being sustainably managed.

This GSP Section describes the monitoring network as enhanced to fulfill the Sustainable Groundwater Management Act (SGMA) requirements and explains how it will be implemented. This includes description of the monitoring protocols for data collection, the development and maintenance of the data management system (DMS), and the regular assessment and improvement of the monitoring program. This section also summarizes the siting of new dedicated monitoring wells, installed with funding assistance from the Sustainable Groundwater Management Round 3 Grant program (Round 3).

7.1. DESCRIPTION OF MONITORING NETWORK

Table 7-1 provides a summary of the monitoring network, which documents groundwater and related surface conditions as relevant to the sustainability indicators: groundwater levels, storage, land subsidence, water quality, and interconnected surface water[11]. The discussion of change in groundwater storage addresses monitoring for evaluation of the water budget inflows and outflows including climate, land use and cropping, surface water flows, imported water deliveries, reservoir releases for groundwater recharge, wastewater percolation and water recycling, and groundwater pumping.

[11] Seawater intrusion is noted, but no risk of seawater intrusion exists in this inland basin.

Table 7.1-1. North San Benito Monitoring Program Summary

Monitored Variable	Type of Measurement	Locations	Data Interval	Data Collection Agency	Database Storage Agency	Notes
Groundwater levels						
North San Benito Basin	Depth to water, feet	> 100 wells in North San Benito Basin	Quarterly to Semiannual	SBCWD GSA	SBCWD GSA	Measured consistent with data standards and converted to elevations relative to NAVD88
Llagas Subbasin	Depth to water, feet	About 10 wells in Llagas Subbasin	Quarterly to Semiannual	Valley Water GSA	Valley Water GSA	Valley Water GSA data sharing
Groundwater storage						
Rainfall	Rain gauge, daily total, inches	CIMIS Stations # 126, 143	Daily	NCDC with local partners	NCDC	Download from web annually for annual water budget and model update
Reference ET (ET_0)	Daily ETo, inches	CIMIS Stations # 126, 143	Daily	CA DWR, CIMIS program	DWR	Download from web
Stream flow	Daily average flow, cfs	Five active and eight inactive USGS gages	Daily	USGS	USGS	Download from web
Stream flow	Instantaneous flow, cfs	Misc. flow measurements	misc / historical	SBCWD GSA	SBCWD GSA	Map of current and historical locations provided in Annual Reports (e.g., 2018)
CVP deliveries- Agricultural	Metered water deliveries, AF	Zone 6	Monthly	SBCWD GSA	SBCWD GSA	Reported by distribution subsystem; in Annual Reports as acre-feet per year (AFY), compiled by then-defined subbasin areas and Zone 6, to be updated to Management Areas
CVP deliveries- Municipal	Metered water deliveries at WTPs	Lessalt and West Hills WTP,	Monthly	SBCWD GSA	SBCWD GSA	In Annual Reports as AFY; City of Hollister, Sunnyslope County Water District, Stonegate
Reservoir water budgets	Inflows, outflows, observed and computed change in storage	Hernandez, Paicines, San Justo Reservoirs	Monthly	SBCWD GSA	SBCWD GSA	Water year budgets reported in Annual Report, AFY
Reservoir releases-percolation	Reported as acre-feet per month	Hernandez, Paicines Reservoirs	Monthly	SBCWD GSA	SBCWD GSA	Historical annual releases reported in Annual Report, AFY
CVP diversions to percolation	Reported as acre-feet per month	Pacheco, Arroyo de las Viboras, Arroyo Dos Picachos, Santa Ana Ck, Tres Pinos Creek, San, Benito River	Monthly	SBCWD GSA	SBCWD GSA	Annual percolation (AFY) since 1994 reported by stream reach in Annual Reports; percolation since 2017 only to recharge basins adjacent to listed streams
Wastewater pond water budgets	WWTP effluent discharge, evaporation, percolation, AF	Hollister domestic and industrial pond, Ridgemark I and II, Tres Pinos	Monthly	City of Hollister, Sunnyslope County Water District, Tres Pinos County Water District	SBCWD GSA	AFY reported in Annual Report; San Juan Bautista discharges not reported because wastewater exits San Juan MA without recharging
Wastewater percolation	WWTP percolation volume, AF	Hollister domestic and industrial pond, Ridgemark I and II, Tres Pinos	Monthly	City of Hollister, Sunnyslope County Water District, Tres Pinos County Water District	SBCWD GSA	Annual data reported in Annual Report; San Juan Bautista discharges not reported because wastewater exits San Juan MA without recharging; Hollister industrial ponds also percolate stormwater
Recycled water use	Recycled water delivery, AF	Hollister	Monthly	City of Hollister	SBCWD GSA	Annual data, AFY, reported in Annual Report
Crop patterns	Map of crops by field, mid-summer	San Benito Groundwater Basin	Annual	DWR (LandIQ)	DWR	Download shapefile from DWR SGMA Data Portal
Municipal Water Use	Metered water use by sector	City of Hollister, Sunnyslope County Water District, Tres Pinos County Water District, San Juan Bautista	Monthly	City of Hollister, Sunnyslope County Water District, Tres Pinos County Water District, San Juan Bautista	SBCWD GSA	Annual data reported in Annual Report: CVP, groundwater, recycled water use (AFY)
Groundwater pumping						
Agricultural, Zone 6 in Hollister and San Juan MAs	Metered hours of pump operation x average pump discharge	Irrigation wells, Zone 6	Semi-annual	SBCWD GSA	SBCWD GSA	Annual data reported in Annual Report:
Agricultural, Bolsa and Southern MAs	Estimated		Annual	SBCWD GSA	SBCWD GSA	Annual estimates provided in water budget updates of Annual Report
Municipal	Metered monthly total pumping by well	Municipal well locations	Monthly	SBCWD GSA	SBCWD GSA	Request data from cities of Hollister and San Juan Bautista, Sunnyslope County Water District
Community Water Systems	Estimated		Annual	SBCWD GSA	SBCWD GSA	Annual estimates provided in water budget updates of Annual Report
Rural domestic, commercial, industrial	Estimated		Annual	SBCWD GSA	SBCWD GSA	Annual estimates provided in water budget updates of Annual Report
Subsidence						
Subsidence	UNAVCO GPS measurements of ground surface displacement	Eight stations in and around North San Benito Basin	Real time, processed daily	UNAVCO (link on DWR SGMA Data Portal)	UNAVCO	Download annually, update graphs, evaluate for inelastic subsidence, and compare results with Minimum Threshold rate
Subsidence	InSAR satellite mapping of ground displacement	North San Benito Basin	Annual change	DWR (InSAR)	DWR SGMA Data Portal	Download annually, smooth InSAR raster data sets (see Section 6.4.4.6), compare cumulative elevation change since 2015 against Minimum Threshold criterion.
Groundwater quality						
SBCWD Groundwater Quality Monitoring Program	Specific conductance, TDS, N	About 20 wells in North San Benito Basin	Quarterly/ Semi-annual	SBCWD GSA	SBCWD GSA	Additional constituents; Title 22 and boron
Rural ag/domestic wells; community water systems	Specific conductance, N	About 20 wells in North San Benito Basin	Various	ILRP, DDW, RWQCB, USGS, DWR, DPR	SWRCB Geotracker database	Download data every three years from Geotracker as part of Triennial Upate
Interconnected Surface Water and GDEs						
Groundwater levels	Depth to water, feet	Six shallow Round 3 wells	Quarterly	SBCWD GSA	SBCWD GSA	Measured consistent with data standards and converted to elevations relative to NAVD88

The monitoring is described in the following sections relative to the sustainability criteria, including description of the monitoring network with respect to the four Management Areas (MA) and the level of monitoring and analysis appropriate for each MA.

7.1.1. Chronic Lowering of Groundwater Levels

As described in Plan Area Section 2.1.4.1, the San Benito County Water District (SBCWD) has had a groundwater level monitoring program since water year (WY) 1977; the Annual Groundwater Reports provide quarterly groundwater level data for each year in **Appendix F**. The data are the basis for groundwater level contour maps, change maps, hydrographs, groundwater level profiles, and storage change computations, which have been presented to support ongoing groundwater basin management and to fulfill requirements of portions of the San Benito County Water District Act (California Water Code Appendix 70-7.6). Historically, groundwater level monitoring efforts were focused on Zone 6, where SBCWD delivers CVP water and has maintained a relatively intensive monitoring program with additional monitoring in the adjacent Bolsa. The SBCWD monitoring program includes wells in the Pacheco Valley in Santa Clara County and Valley Water (SCVWD) provides data for selected wells in southern Llagas Subbasin which have been used in the SBCWD annual groundwater level maps. SBCWD has provided data to the California Statewide Groundwater Elevation Monitoring (CASGEM) program since 2011.

The groundwater level monitoring network currently is being improved through the following actions:

- In 2018, SBCWD initiated a program (funded by Round 2 and SBCWD cost sharing) to increase the number of existing production wells in the monitoring program. That effort involved mapping and prioritization of unmonitored areas in the Basin, identification of wells with recent access problems, identification of potential wells to add to the program, and digitization of well information. This has resulted in the resurrection or addition of about 20 production wells for monitoring as part of this GSP.
- In 2019, SBCWD developed a systematic approach to add dedicated monitoring wells to the monitoring program. This was submitted to California Department of Water Resources (DWR) as part of the Application for Round 3 Sustainable Groundwater Management Planning grant funds. This application was approved by DWR and the Round 3 work plan was initiated in June 2020.

Potential data gaps in the groundwater level monitoring program are described in the December 2018 TM, “Data to Support GSP Preparation” and listed in Sustainability Criteria Section 6.2.6 along with responsive actions that include continuation of the implementation efforts above. Benefits of these efforts will accrue over the next few years and will support review and update of the monitoring program in the 2027 Five-Year GSP Update.

7.1.1.1. Spatial and Vertical Coverage

Figure 7-1 shows locations of groundwater level Key Wells, new dedicated monitoring wells, and other wells monitored as part of the SBCWD groundwater level monitoring program. Also shown are wells in the adjacent Llagas Subbasin that are monitored by Valley Water (SCVWD) and data shared with SBCWD for North San Benito. **Table 7-1** provides a summary of relevant monitoring programs.

The 22 Key wells for groundwater levels also are listed in **Table 6-1** (Sustainability Criteria Section 6.2.6) with the respective Minimum Thresholds.

The scientific rationale for inclusion of wells in the SBCWD groundwater level monitoring program has involved the following:

- Spatial distribution and density of wells, accounting for variable geographic conditions including topography, hydrology, geologic structures, aquifer characteristics, confined and unconfined conditions, pumping patterns, management activities (including managed aquifer recharge), and potential impacts to beneficial uses/users.
- Length, completeness, and reliability of historical groundwater level record.
- Well depth, with specific information on well construction preferred.
- Regular access to the well for measurements.

Well density has been a consideration in identifying new dedicated monitoring well sites and adding existing wells to the monitoring program. DWR guidance (DWR, 2016a, see BMP, Table 1) generally recommends between one to ten monitoring wells per 100 square miles. The North San Benito program is consistent with this guidance (with an area of about 200 square miles and 2019 monitoring of more than 100 wells). More importantly, the SBCWD monitoring program has been developed to account for the variable spatial factors listed above. Monitoring program improvements as part of the GSP include identification of additional existing wells for monitoring across the entire basin with a focus on adding wells in the Bolsa and Southern MAs.

Data on vertical gradients generally are lacking (except the Nested Well in Hollister MA). As discussed in Hydrogeologic Conceptual Model Section 3.6.1, a single principal aquifer has been identified, comprising the Holocene alluvial sediments. While groundwater in the principal aquifer occurs under both unconfined and confined conditions, no distinct continuous confining layer has been identified. Vertical gradients also have not been distinguished because of the reliance of the monitoring program on production wells, which tend to have long screens. This is a data gap recognized in the Groundwater Model Update and Enhancement Report (**Appendix G**) relative to calibration for vertical hydraulic conductivity in most areas. This data gap (among others) is addressed in the Round 3 work plan with installation of new dedicated monitoring wells (with discrete perforated intervals), including shallow wells.

With regard to the data and reporting standards described in GSP Regulations Section 352.4., wells in the SBCWD groundwater level monitoring program have been selected on the basis of local objectives and the above rationale, with the intent to address GSP requirements for well information (e.g., unique site ID, identified reference point, well completion report if available, etc.) as part of GSP implementation. New dedicated monitoring wells (intended to provide a framework for the monitoring program) will be compliant with GSP Regulations.

It should be noted that identification of sites for new dedicated monitoring wells involves not only consideration of monitoring needs for groundwater levels, but also groundwater quality, potential subsidence, and surface water-groundwater interactions.

7.1.1.2. Monitoring Frequency

SGMA and the CASGEM program require collection of static groundwater elevation measurements at least two times per year to represent seasonal low and seasonal high groundwater conditions. The Annual Groundwater Reports provide quarterly groundwater level data, which is more frequent than required and allows tracking of seasonal and long-term trends.

7.1.2. Reduction of Groundwater in Storage

As described in GSP Section 6.3, groundwater level Minimum Thresholds are used as a proxy metric for groundwater in storage. Accordingly, the monitoring of groundwater levels described above in Section 7.1.1 also pertains to tracking sustainability for groundwater in storage.

In addition, GSP Regulations require annual evaluation and reporting of change in groundwater in storage. As documented in past Annual Groundwater Reports (**Appendix F**), change in groundwater in storage has been calculated annually as the product of groundwater level change (feet), basin area (acres), and storativity. In addition, change in storage has been computed triennially using the water budget equation (inflows-outflows=change in storage).

For the GSP, the updated and expanded numerical model has been used to quantify the water budget and change in storage (see Water Balance Section 5) using available information from the SBCWD Monitoring Program. The numerical model (described in **Appendix G**) fulfills data and reporting standards described in Section §352.4.

As described in Plan Area Section 2.1.4.1 and summarized in **Table 7-1**, the SBCWD Monitoring Program provides information needed to update the water budget and assess annual change in groundwater storage. This program compiles and reviews information on climate (rainfall and evapotranspiration), stream flow, imported CVP water deliveries, reservoir releases and CVP percolation, wastewater percolation and water recycling, and groundwater pumping (municipal and agricultural in Zone 6). Previously, change in the volume of groundwater in storage has also been assessed through water budget evaluations that utilize land use information and water demand rates. Change in groundwater in storage is quantified for each of the four Management Areas (as described in Water Balance Section 5).

The lack of reliable measurements of agricultural pumping is a primary source of uncertainty in estimating change in groundwater in storage. Groundwater pumping in Zone 6 has been evaluated since about 1990 as the product of metered hours of pump operation and average pump discharge, but the accuracy of this method has been questioned because of discrepancies with water budget evaluations (based on land use and water factors) and with numerical modeling. Beyond Zone 6, annual groundwater pumping has been assessed on a triennial basis through land use estimates and water budget evaluations.

7.1.2.1. Spatial Coverage

As indicated in **Table 7-1**, evaluation of change in groundwater in storage involves multiple monitored variables; locations of monitoring are described in the table. **Figure 7-2** shows specific locations of climate stations and stream gage locations; also shown are wastewater percolation sites and CVP percolation ponds.

As noted in the December 2018 Technical Memorandum on Data to Support GSP Preparation in **Appendix E**, only four stream gages are currently operated in the Basin and regular monitoring of surface water flows (including natural percolation along stream channels) has been identified as a data gap. The lack of a stream gage on upper Tres Pinos Creek has been identified as a priority item to extend spatial coverage.

With regard to spatial coverage, groundwater pumping for agriculture in Zone 6 (see Plan Area **Figure 1-2** for extent) historically has been evaluated as the product of metered hours of pump operation and average pump discharge, while agricultural pumping beyond Zone 6 has been assessed through water budget evaluations using available land use information.

This GSP includes evaluation of options for evaluating groundwater pumping systematically throughout the basin. These options include continuation of historical methodologies, implementation of a well metering program to measure groundwater pumping, or application of remote sensing methodologies to evaluate groundwater consumption of various land use types (different crops, land covers) to evaluate groundwater use.

7.1.2.2. Monitoring Frequency

Table 7-1 describes the data interval for the monitored variables the contribute to evaluation of groundwater in storage. Groundwater in storage will be assessed annually using the numerical model, which will be recalibrated during each Five-Year Update.

7.1.3. Subsidence

The Monitoring Program will include review of available data including interferometric synthetic aperture radar (InSAR) and University Navigation Satellite Timing and Ranging System Consortium (UNAVCO), to identify any land subsidence in North San Benito (see **Table 7-1**). As applicable, these data will be used to monitor rate and extent with reference to the Minimum Threshold and Measurable Objective, which are described in Sustainability Criteria Sections 6.4.4 and 6.4.5, respectively. These data represent measurements of ground surface displacement and thus are directly applicable to scientific assessment of potential subsidence. Assuming continued data availability, the Monitoring Program will involve annual download of UNAVCO and InSAR data with annual review for any indications of significant, cumulative inelastic subsidence. The reporting will be consistent with GSP Regulations.

7.1.3.1. Spatial Coverage

Figure 7-3 shows the North San Benito Basin with recent InSAR information from DWR and the location of UNAVCO stations. The UNAVCO and InSAR data provide adequate coverage of the North San Benito Basin including all Management Areas. As described in Groundwater Conditions Section 4.3 and Sustainability Criteria Section 6.4, InSAR data are available for the entire Basin (and beyond). UNAVCO data are available from eight ground stations in and around the Basin. While seven of the eight stations are located around the basin and likely show tectonic movement, one station is in the Bolsa MA and shows small changes that indicate local inelastic subsidence. This UNAVCO data and InSAR data will be cross-checked, and in conjunction with local groundwater level and pumping data, will be used to assess relationships between levels, pumping, and subsidence data.

7.1.3.2. Monitoring Frequency

Assuming continued data availability, the Monitoring Program will involve annual download of UNAVCO and InSAR data with analysis for any signs (rate and extent) of cumulative inelastic subsidence. Generally, subsidence has not been noticed in North San Benito and any rates indicated by UNAVCO monitoring have been small. While data will be reviewed annually, at this time detailed analysis relative to the Minimum Threshold and Measurable Objective is planned as part of the Five-Year Update.

7.1.4. Seawater Intrusion

There is no monitoring for seawater intrusion and no gaging of tidal influence. The NSBGB is located inland from Monterey Bay approximately 20 miles upstream from the mouth of the Pajaro River; lowest elevations (at the confluence of the San Benito River and Pajaro River) are above about 110 feet. No risk of seawater intrusion exists in the Basin given its location and therefore no monitoring is needed.

7.1.5. Degraded Water Quality

In addition to the general monitoring objectives listed above, specific objectives for the GSP water quality monitoring program include the following:

- Collect groundwater quality data from the principal aquifer to identify and track trends of any water quality degradation.
- Map the movement of degraded water quality.
- Define the three-dimensional extent of any existing degraded water quality impact.
- Assess groundwater quality impacts to beneficial uses and users.
- Evaluate whether management activities are contributing to water quality degradation.

The existing water quality monitoring programs for North San Benito Basin are described in Plan Area Section 2.1.4.1, Groundwater Conditions Section 4.4.1, and Sustainability Criteria Section 6.6.4.1. To summarize, the SBCWD Monitoring Program involves at least annual sampling of about 20 wells with lab analysis for general minerals, physical parameters, and selected constituents of concern. As described in Groundwater Conditions Section 4.7 and discussed in depth in Section 6.6 on the water quality sustainability criteria, a broad suite of inorganic constituents is sampled and analyzed and known regulated contamination sites are tracked. Based on understanding of the basin and tracking since 1997, TDS and nitrate have been identified as the key constituents of concern for which sustainability criteria have been defined. As described in Groundwater Conditions Section 4.5, the monitoring and reporting for the Salt and Nutrient Management Plan are conducted as part of SBCWD's water quality monitoring program and triennial update.

In addition to its regular, direct monitoring program, once every three years, SBCWD compiles and reviews all available information on water quality and summarizes it in the Annual Groundwater Report (Todd, 2019). As indicated in the 2019 Annual Groundwater Report, the Triennial Update incorporates all available data from SBCWD, the Regional Water Quality Control Board (regulated facilities and the Irrigated Lands Regulatory Program), California State Water Resources Control Board Division of Drinking Water (DDW), United States Geological Survey (USGS), City of San Juan Bautista, Tres Pinos County Water District, City of Hollister, and Sunnyslope County Water District. This is consistent with DWR guidance to use existing water quality monitoring data to the greatest degree possible.

The GSP monitoring program will continue both the SBCWD Monitoring Program and the Triennial Update. Accordingly, this data set can be used to detect a range of problems quickly, to track trends, allow geochemical investigation, and support focused management actions.

Data from the Triennial Update form the basis for the water quality Minimum Thresholds and Measurable Objectives.

7.1.5.1. Spatial and Vertical Coverage

As described in the Groundwater Conditions Section (see **Figure 4-15)** and summarized in **Table 7-1,** the SBCWD Monitoring Program has historically been focused on the Hollister and San Juan MAs with about 20 wells. Only two wells were monitored as part of the program in Bolsa MA and none in the Southern MA. However, the Triennial Update has involved compilation and review of all water quality data from local and state agencies, and thereby, water quality has been monitored throughout the North San Benito Basin. As documented for the key constituents of TDS and nitrate (see **Table 6-3**), TDS was measured in 213 wells in 2015-2017 and 256 wells were sampled for nitrate in the same years.

For the purposes of this discussion, monitoring of regulated contamination sites is distinguished from monitoring of basin-wide groundwater quality conditions. Monitoring of regulated contamination sites involves dedicated monitoring wells that often are shallow and have documented well construction and sampling depths. These regulated sites are discussed in Groundwater Conditions Section 4.6.1 and locations are shown on Figure **4-17**. While some of these shallow wells could be potentially used for regional monitoring, there are important considerations. For some sites, monitoring wells would have been sited and designed for site-specific problems (e.g., gas stations) that do not necessarily have regional implications. For other sites (e.g., food processing, wastewater disposal, fertilizer handling/storage), the monitoring is potentially pertinent to regional conditions (e.g., if uncontained) and is important to track, but may not be representative of regional conditions or trends.

Figure 7-4 shows the spatial distribution of wells currently in the SBCWD Water Quality Monitoring Program, including the wells historically monitored and new dedicated monitoring wells that will be sampled regularly.

The scientific rationale for selection of wells currently in the SBCWD Water Quality has included:

- Areal distribution of wells across Zone 6, the area for distribution of CVP imported water.
- Location relative to areas with water quality issues; these include natural issues (e.g., siting of the Nested Well addresses native elevated boron) and human-induced activities such as wastewater disposal and general salt loading.
- Length, completeness, and reliability of historical record.
- Regular access to the well for measurements.
- Well depth, with specific information on well construction preferred.

As with the groundwater level monitoring program, existing wells in the SBCWD groundwater quality monitoring program will be evaluated relative to GSP Regulations Section 352.4. requirements for well information. Most do not have sufficient well construction information to identify the zones being monitored and this information will need to be acquired. The new dedicated monitoring wells (part of the Round 3 effort) are designed to meet requirements; these new wells address gaps not only in the water level monitoring program, but also the water quality monitoring program.

Vertical coverage is discussed in Groundwater Conditions Section 4.9, which indicates that the water quality monitoring programs in the Basin do not reveal vertical differences in water quality. The exception is the Nested Well in Hollister MA, a dedicated monitoring well that is part of the SBCWD Program and samples from five depth zones. Otherwise, vertical coverage is a recognized data gap; this reflects the facts that 1) most monitored wells (excluding the contamination site wells mentioned above) are private pumping wells with long screens and 2) well construction information is lacking for most wells.

As stated in Section 6.6, the SBCWD Monitoring Program will be improved and expanded to address spatial and vertical coverage. This will include evaluation of existing wells to add to the SBCWD monitoring program; continued review of data from local agencies and the Irrigated Lands Regulatory Program is likely to reveal candidate wells for inclusion in the SBCWD Program. Additional investigations of nitrate and salt loading may include installation of additional dedicated monitoring wells designed to evaluate loading and vertical migration of salt and nitrate, and these could be added to the Monitoring Program. Lastly, the SBCWD Monitoring Network is enhanced by addition of dedicated monitoring wells as part of the work plan for the Round 3 Sustainable Groundwater Management Planning Grant.

7.1.5.2. Temporal Coverage and Monitoring Frequency

As described in Sections 2.1.4.1 and 6.6.4.1, SBCWD has been monitoring groundwater quality since 1997; the SBCWD Monitoring Program wells generally are sampled semi-annually. This is consistent with objectives to detect problems relatively quickly and to track trends in areas of variability. Semi-annual sampling is consistent with the general guidance provided in the DWR Best Management Practices for Monitoring Networks and Identification of Data Gaps (DWR, December 2016), which suggests sampling at the seasonal high and low (or more frequent as appropriate).

An evaluation of quality data indicates that seasonal fluctuations in concentrations are tracked on a biannual basis with little risk to missed changes in groundwater concentrations. As particular water quality issues are identified in local areas, more frequent monitoring could be instituted for selected wells with the regional sampling program conducted on a biannual basis.

As described in Groundwater Conditions Section 4.6.1, North San Benito Basin does include regulated contamination sites; information is compiled from these sites as part of the Triennial Update. This frequency of SBCWD review has been sufficient to evaluate potential impacts to beneficial uses and users, given that these sites are regulated by State agencies.

7.1.5.3. Monitored Constituents

As described in Section 6.6.4.1, wells in the SBCWD Program generally are sampled semiannually with lab analysis for general minerals, physical parameters, and selected constituents of concern. Sections 4.7 and 4.8 discuss specific analytes including TDS, nitrate, hardness, boron, perchlorate and metals (arsenic, chromium, manganese, and selenium). The selection of key constituents (TDS and nitrate) are based on relevance to important water quality issues (Belitz, 2003).

Noting that TDS represents the sum of various constituents, some of which are a concern, the monitoring program should analyze for all major anions and cations (bicarbonate, chloride, and sulfate; and calcium, magnesium, sodium, and potassium). This is necessary for basic geochemical plotting of water types and verification of analytical accuracy. Analyses should also include boron, given its elevated concentrations in the basin and crop sensitivity issues. Boron may also assist in determining wastewater impacts as would total phosphate (DWR, 1966) and surfactants (measured as methylene blue active substances (MBAS)). Turbidity should be measured by the laboratory on each groundwater sample to assist evaluation of any detections of metals.

7.1.6. Depletion of Interconnected Surface Water

The minimum threshold defined for depletion of interconnected surface water is defined by groundwater levels monitored within one mile of specific stream reaches with shallow groundwater conditions. At this time, wells in the groundwater levels monitoring program are production wells with relatively deep screens that have not been sited and designed for tracking surface water-groundwater interactions. The lack of shallow monitoring wells has been a data gap.

Improvement of the surface water-groundwater monitoring program includes addition of dedicated near-stream shallow monitoring wells, implemented as part of the Round 3 Sustainable Groundwater Management Planning grant funds from DWR. At time of writing, sites for dedicated shallow groundwater monitoring wells have been identified with planned installation before 2022. Monitoring of these new dedicated wells will begin as soon as possible.

Benefits of the new wells will accrue over the next few years and support characterization of the spatial and temporal exchanges between surface water and groundwater, plus subsequent development of methods to calculate depletions of surface water caused by groundwater extractions, as required by the GSP Regulations §354.34(c)(6), and as planned as part of the 2027 Five-Year GSP Update.

Improvements of the monitoring network will be responsive to GSP Regulations that require characterization of the following:

- Flow conditions including surface water discharge, surface water head, and baseflow contribution.
- Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.
- Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.
- Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.

7.1.6.1. Spatial and Vertical Coverage

Figure 7-5 is a map showing locations of key wells currently selected for monitoring shallow groundwater levels along selected stream reaches. The identification of key stream reaches is described in Sustainability Criteria Section 6.7 and has addressed all management areas. **Table 7-1** provides a summary of the monitoring.

The scientific rationale for inclusion of wells in the shallow groundwater level monitoring program has involved the following:

- Location within one mile of stream reaches where springtime depth to water is typically 20 feet or less and with no separation from the reach by a fault.
- Length, completeness, and reliability of historical groundwater level record with measurements beginning before 1992 (the end-of-drought year specified in definition of the MT).
- Well depth, with specific information on well construction preferred.
- Regular access to the well for measurements.

The currently selected wells are all water supply wells with relatively deep screens and therefore do not provide the needed vertical (shallow) coverage. Accordingly, sites have been selected for installation of new dedicated shallow wells as part of the Round 3 effort. The rationale for selecting these sites includes location close to the selected stream reaches, land availability and accessibility.

As with the regional groundwater level monitoring program (see Section 7.1.1), existing wells in the groundwater monitoring program for shallow groundwater have been evaluated with regard to GSP Regulations Section 352.4. requirements for well information, and data deficiencies (for example, lack of a unique ID) have been noted for improvement during GSP implementation. The new dedicated shallow monitoring wells are designed to fulfill GSP Regulations Section 352.4 standards.

7.1.6.2. Temporal Coverage and Monitoring Frequency

The monitoring for groundwater levels along selected stream reaches will be implemented as part of the overall groundwater level monitoring program as described in Section 7.1.1.2. Monitoring of existing wells in the program will be continued, serving as the Key Wells for monitoring relative to the Minimum Thresholds defined in GSP Sustainability Criteria Section 6.7.6. In the meantime, the periods of record for new dedicated shallow wells will be established. Groundwater level data will be reviewed annually (for each annual report) with reference to the Minimum Threshold. Detailed analyses of the relationships among deep and shallow groundwater level data, stream flow, and riparian conditions will be provided in the Five-Year Update (or sooner if extreme drought conditions and riparian mortality occur; see GSP Section 6.7.7.1).

7.2. Protocols for Data Collection and Monitoring

This section focuses on groundwater level monitoring (including regional and surface water-oriented) and groundwater quality sampling by SBCWD. Other data (e.g., climate, streamflow, municipal pumping, subsidence) are compiled by other agencies.

This section describes general procedures for documenting wells in the monitoring program and for collecting consistent high quality groundwater elevation and groundwater quality data. In general, the methods for establishing location coordinates (and reference point elevations for elevation monitoring) follow the data and reporting standards described in the GSP Regulations (Section 352.4) and the guidelines presented by USGS Groundwater Technical Procedures. These procedures are summarized below.

7.2.1. Field Methods for Monitoring Well Data

Background data for each monitoring well is required for its inclusion in the monitoring program. These data are generally available for wells in the network described on **Table 7-1** and shown on **Figures 7-1, 7-4, and 7-5**. As part of GSP implementation, location and elevation data will be acquired where missing, revised if conditions at a monitored well change, and added when new wells are brought into the program. The methods for acquiring these data follow:

- Location coordinates will be surveyed with a survey grade Global Positioning System (GPS). The coordinates will be in Latitude/Longitude decimal degrees and reference the NAD83 datum.
- Reference point elevations will also be surveyed with a survey grade GPS with elevation accuracy of approximately 0.5 feet. During surveying, the elevations of the reference point and ground surface near the well will be measured to the nearest 0.5 foot. All elevation measurements will reference NAVD88 vertical datum.

7.2.2. Field Methods for Groundwater Elevation Monitoring

Reference points and ground surface elevations will be documented as described above prior to groundwater elevation monitoring in the field. Field methods for collection of depth-to-water measurements are described below:

1. Measurements in all wells will be collected within a three-day window whenever possible.
2. Active production wells should be turned off prior to collecting a depth to water measurement.
3. The standard period of time that a well needs to be off before a static measurement is taken is 48 hours.
4. To verify that the wells are ready for measurement, SBCWD staff will coordinate with well operators and/or owners as necessary.
5. Coordination with well operators/owners should occur approximately four days prior to the expected measurement date.
6. Depth to groundwater measurements are collected by either electric sounding tape (Solinst or Powers type sounders) or by steel tape methods. These depth-to-water measurement, methods are described in DWR's Groundwater Elevation Monitoring Guidelines (DWR, 2010). Depth to groundwater will be measured and reported in feet to at least 0.1 foot.

7.2.3. Field Methods for Groundwater Quality Monitoring

SBCWD's current Quality Assurance Project Plan was reviewed for adequacy of data collection and analysis procedures. As described in the Salt and Nutrient Management Plan for Northern San Benito County (Todd, 2014), wells in the SBCWD water quality monitoring program are sampled for Title 22 general physical properties and inorganics.

Groundwater sampling is conducted by trained professionals from SBCWD. Sampling follows standard monitoring well sampling guidelines such as those presented in the National Field Manual for the Collection of Water-Quality Data (USGS, 2021).

Generally, the wells have been pumped prior to sample collection, or are purged. Purging is conducted until field instruments indicate that water quality parameters (pH, ORP, specific conductance, and temperature) have stabilized and turbidity measurements are below five Nephelometric Turbidity Unit (NTUs). The pumping or purging demonstrate that the sample collected is representative of formation water and not stagnant water in the well casing or well filter pack. For groundwater, field temperature and conductivity are recorded while the well is being purged to ensure that physical parameters have stabilized before collecting a sample. All groundwater samples are collected in laboratory-supplied, pre-labeled containers and include prescribed preservatives.

All field measurements are recorded in a field logbook or worksheets and the sample containers are labeled correctly and recorded on the chain-of-custody form. The applicable chain-of-custody sections are completed and forwarded with the samples to the laboratory. Upon receipt of the samples at the laboratory, laboratory personnel complete the chain-of-custody. QA/QC assessment of field sampling includes use of field blanks. Field blanks identify sample contamination that is associated with the field environment and sample handling. These samples are prepared in the field by filling the appropriate sample containers with the distilled water used for cleaning and decontamination of all field equipment. One field blank per sampling event is collected.

Samples are sent to a State-certified laboratory that has a documented analytical QA/QC program including procedures to reduce variability and errors, identify and correct measurement problems, and provide a statistical measure of data quality. The laboratory conducts all QA/QC procedures in accordance with its QA/QC program. All QA/QC data are reported in the laboratory analytical report, including: the method, equipment, and analytical detection limits, the recovery rates, an explanation for any recovery rate that is less than 80 percent, the results of equipment and method blanks, the results of spiked and surrogate samples, the frequency of quality control analysis, and the name of the person(s) performing the analyses. Sample results are reported unadjusted for blank results or spike recovery.

7.3. Representative Monitoring

SBCWD has had a groundwater level monitoring program since 1977 and a comprehensive water quality monitoring program since 2004. To allow quantification and tracking of sustainability criteria, representative monitoring sites, or key wells, have been identified for 1) regional groundwater level monitoring and 2) for monitoring shallow groundwater conditions where surface water-groundwater connection is likely and tied to Groundwater dependent ecosystems (GDEs). These key wells are shown on **Figures 7-1** and **7-5**, respectively. These have been designated by SBCWD as the point at which sustainability indicators are monitored. Information on the quantitative values for minimum thresholds, measurable objectives, and interim milestones is included in Sustainability Criteria Sections 6.2 and 6.7, respectively.

As discussed in Sustainability Criteria Section 6.3, change in groundwater in storage is closely related to groundwater levels, which can serve as a proxy for monitoring change in storage. Moreover, groundwater level MTs and MOs are sufficiently protective to ensure prevention of significant and unreasonable results relating to storage. Accordingly, monitoring of the key wells for groundwater levels also serve to track sustainability for storage.

As discussed in Section 6.4, the definition of undesirable results and the quantification of the MT and MO are based on InSAR and UNAVCO information on vertical displacement of the ground surface; these spatial and temporal data are provided by DWR on its website.

Section 6.5 discusses seawater intrusion, which is not possible in this inland basin.

Section 6.6 describes undesirable results, outlines the SBCWD Water Quality Monitoring Program and the Triennial Update, and defines sustainability criteria for water quality. As described in Section 6.6.5, water quality MTs and MOs are defined relative to the numerous data points compiled for the Triennial Update, which includes multiple data sources including but not limited to the SBCWD Water Quality Monitoring Program. MTs and MOs are quantified in terms of the percentage of wells with concentrations exceeding the selected water quality goal for nitrate and Total Dissolved Solids (TDS) based on current conditions (2015-2017).

While not serving as stand-alone representative sites for definition of water quality MTs and MOs, the SBCWD Water Quality Monitoring Program wells shown in **Figure 7-4** are sampled regularly to identify water quality problems and to track water quality trends.

7.4. DATA MANAGEMENT SYSTEM (DMS)

SBCWD has been collecting and compiling groundwater data annually including water levels, water quality, and water use for the Annual Groundwater Report. These data and data from Valley Water (SCVWD) and other sources are being compiled in relational databases, which consists of an Access database, GIS geodatabase, and Excel workbooks and has capabilities for queries to quickly check and summarize data. As part of the GSP, the data management system has been redesigned to be practicable, usable, intuitive, and cost effective. **Appendix E** includes a technical memorandum that describes the final DMS. The relational database includes easy to update tables and reports that assist in comparison of real time conditions and sustainability goals. As described in Section 7.1.6 of the December 2018 TM, "Data to Support GSP Preparation," the District will develop an ID system for wells and will cross reference wells with water level data, water quality data, and wells logs (**Appendix E**).

7.5. ASSESSMENT AND IMPROVEMENT OF MONITORING NETWORK

SBCWD has actively engaged in assessment and improvement of its monitoring network. This process has been intensified as part of the GSP, given the need to identify data gaps and to assess uncertainty in setting and tracking sustainability criteria. Monitoring improvements are a major part of GSP implementation and will be reviewed and updated for each five-year assessment.

7.5.1. Identification and Description of Data Gaps

Data gaps are identified in **Table 7-2** according to major monitored variable and described in terms of insufficient number of monitoring sites and utilization of monitoring sites that are unreliable (including those that do not satisfy minimum standards). Access issues also are indicated as the cause of insufficient frequency of monitoring, in other words when issues with access to private wells prevent scheduled level monitoring or sampling and cause an interruption in the historical record. Data gaps also are described in terms of the location and reason for data gaps in the monitoring network, and local issues and circumstances that limit or prevent monitoring. Data gaps listed in **Table 7-2** do not include gaps in understanding, which build on the monitoring network but also require investigation and analysis, for example, a focused investigation of salt and nitrate loading to shallow groundwater. These planned studies are described as Management Actions in GSP Section 9.

Table 7-2. Identification and Description of Data Gaps

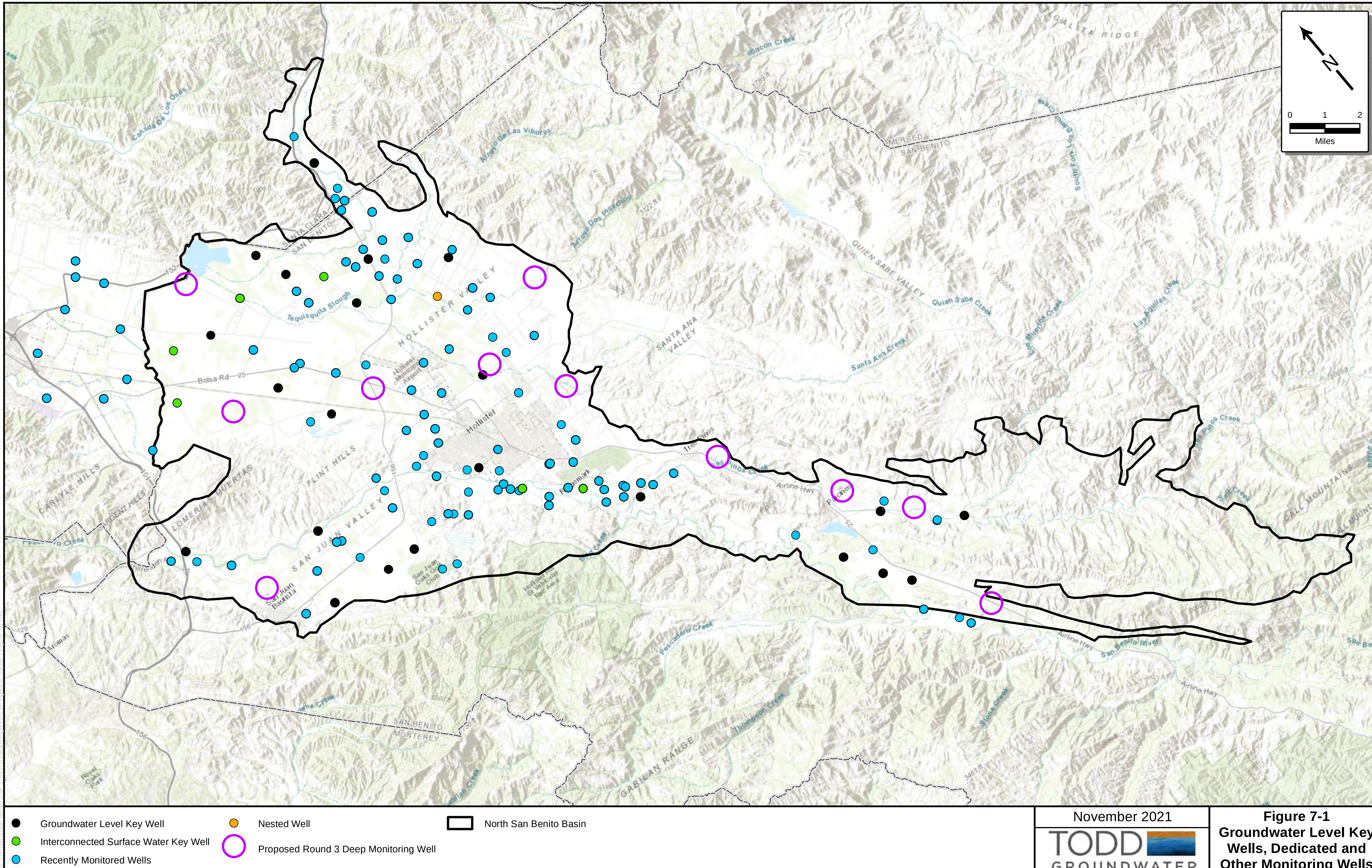
Monitored Variable	Insufficient Sites	Unreliable Sites	Access Issues	Location	Local Issues
Regional Groundwater levels	√	√	√	The network has focused on Zone 6 and relied on private production wells. Insufficient dedicated monitoring wells exist, especially in Bolsa and Southern MAs. Insufficient data exist on vertical gradients.	The network has relied on private production wells, many lacking well construction information. Other wells lack a unique ID, do not have an accurate reference point, and/or have access issues. Need for basin-wide funding.
Stream flow	√			Only five active gages; gage lacking on Upper Tres Pinos Creek	Cost of installing, maintaining gages
Groundwater extraction	√	√	√	Current power metering method is limited to Zone 6; need for consistent method for entire basin	Need for basin-wide funding and implementation of single, consistent method
Groundwater quality	√	√	√	Insufficient dedicated monitoring wells exist, especially in Bolsa and Southern MAs; insufficient data on vertical variations.	Network has relied on private production wells, many lacking well construction information, a unique ID, and have access issues. Additional analytes needed.
Shallow groundwater levels	√			Shallow groundwater monitoring wells lacking along stream reaches with potential surface water-groundwater connection.	

7.5.2. Description of Steps to Fill Data Gaps

As a matter of context, improvement of the groundwater monitoring network has included the SBCWD program initiated in 2018 to map and prioritize unmonitored areas in the Basin, identify wells with recent access problems, identify potential wells to add to the program and digitize well information. It also has included the siting, design, and installation of dedicated monitoring wells as part of the Round 3 work plan initiated in June 2020.

Steps to improve the monitoring program and fill data gaps include:

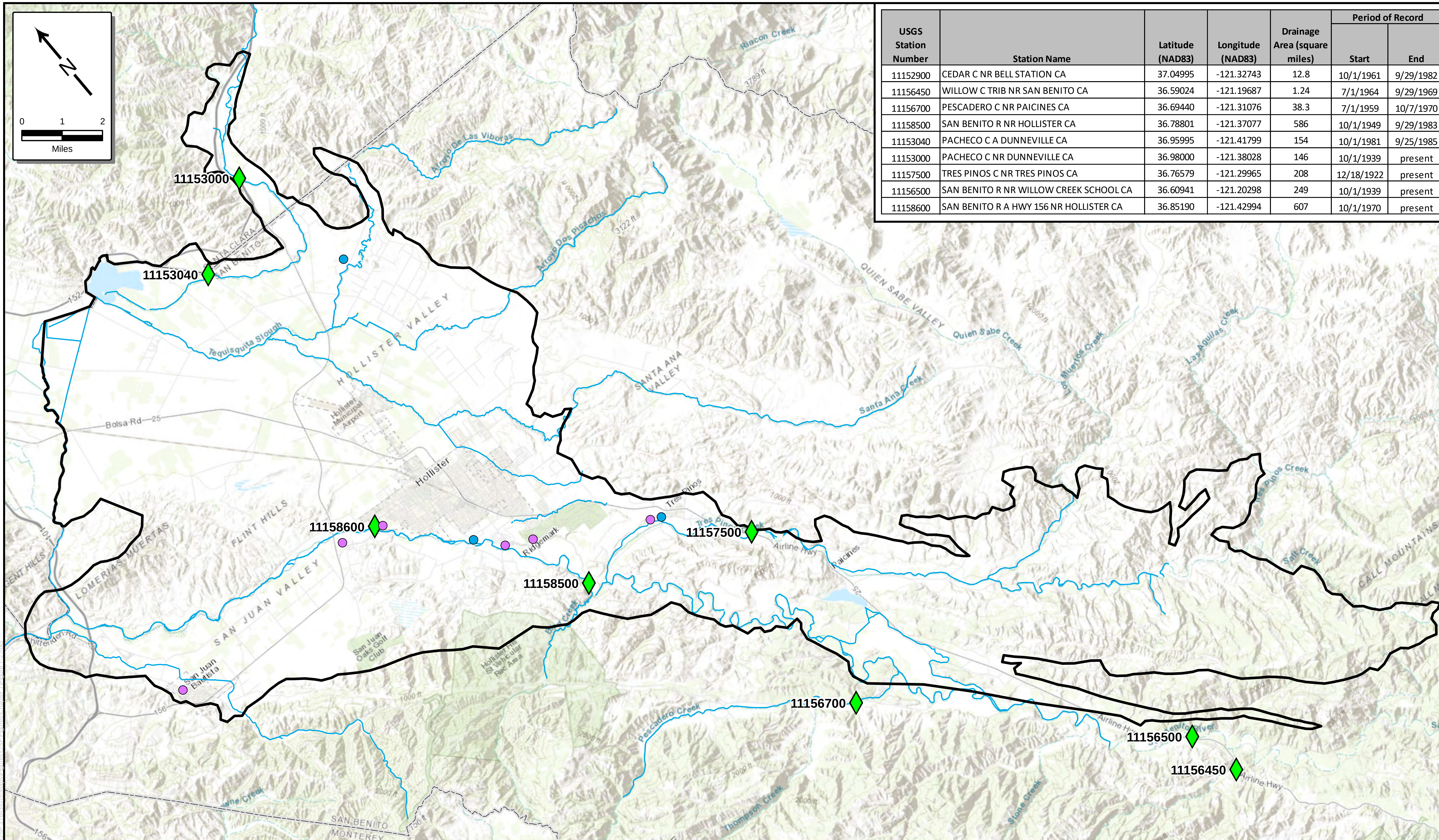
1. Develop and implement basin-wide funding mechanism to support monitoring throughout the MAs.
   - Support ongoing monitoring of regional groundwater levels and quality including shallow groundwater along selected stream reaches, monitoring associated with managed aquifer recharge, and surface water monitoring (SBCWD miscellaneous measurements and installation of additional stream gages).
   - Support evaluation of groundwater extractions consistently throughout the basin.
2. Improve the well inventory as part of the DMS.
   - Develop and implement a program to provide unique well identification beginning with monitored wells. This would allow discontinued use of well names as identifiers and would comply with data and reporting standards described in GSP Regulations Section 352.4. For all monitored wells, document well information (e.g., unique site identifier, identified reference point, well completion report if available, etc.) in a GIS-linked database; this is a priority task for GSP implementation.
   - Document private well locations and construction information and compile into a well inventory database; this will increase knowledge of private wells that potentially could be affected by regional groundwater level or water quality changes. This documentation can be developed incrementally beginning with more recently drilled private wells and/or a focus on data gap areas.
   - Enhance the DMS with cross-referencing of monitoring sites (groundwater and surface water) relative to location and monitoring for regional groundwater level, groundwater quality, shallow groundwater, subsidence, or managed aquifer recharge.
3. Revise the SBCWD water quality sampling program to provide regular analysis of all major anions and cations to allow basic geochemical evaluation and verification of analytical accuracy. Also consider including boron, total phosphate, surfactants (MBAS), and turbidity.
4. Continue to evaluate wells included in the SBCWD monitoring network and programs (levels and quality). This would include potential discontinuation of wells with inadequate documentation or problematic access, and wells that are deemed unnecessary, and it would include addition/installation of monitoring sites as needs are identified. This is an ongoing, adaptive effort.



November 2021

TODD GROUNDWATER

Figure 7-1
Groundwater Level Key Wells, Dedicated and Other Monitoring Wells



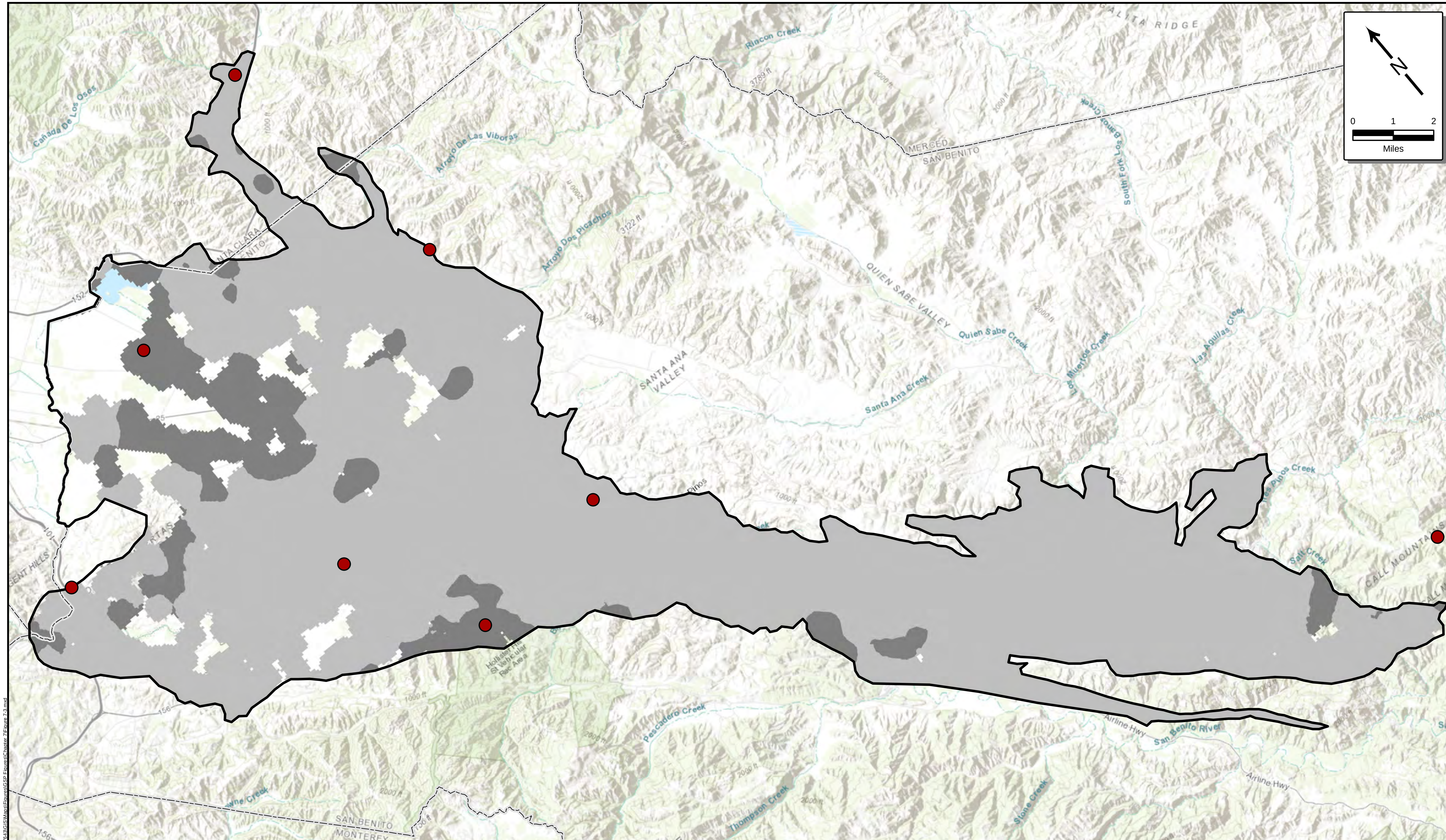
USGS Station Number	Station Name	Latitude (NAD83)	Longitude (NAD83)	Drainage Area (square miles)	Period of Record	
					Start	End
11152900	CEDAR C NR BELL STATION CA	37.04995	-121.32743	12.8	10/1/1961	9/29/1982
11156450	WILLOW C TRIB NR SAN BENITO CA	36.59024	-121.19687	1.24	7/1/1964	9/29/1969
11156700	PESCADERO C NR PAICINES CA	36.69440	-121.31076	38.3	7/1/1959	10/7/1970
11158500	SAN BENITO R NR HOLLISTER CA	36.78801	-121.37077	586	10/1/1949	9/29/1983
11153040	PACHECO C A DUNNEVILLE CA	36.95995	-121.41799	154	10/1/1981	9/25/1985
11153000	PACHECO C NR DUNNEVILLE CA	36.98000	-121.38028	146	10/1/1939	present
11157500	TRES PINOS C NR TRES PINOS CA	36.76579	-121.29965	208	12/18/1922	present
11156500	SAN BENITO R NR WILLOW CREEK SCHOOL CA	36.60941	-121.20298	249	10/1/1939	present
11158600	SAN BENITO R A HWY 156 NR HOLLISTER CA	36.85190	-121.42994	607	10/1/1970	present

Stream Gauges in Basin
Recharge Ponds
Wastewater Treatment Plant Recharge
Stream
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 7-2
Hydrology Monitoring Locations



UNAVCO Stations

North San Benito Basin

San Benito County

Vertical Displacement (inches)

-2 - 0 inches

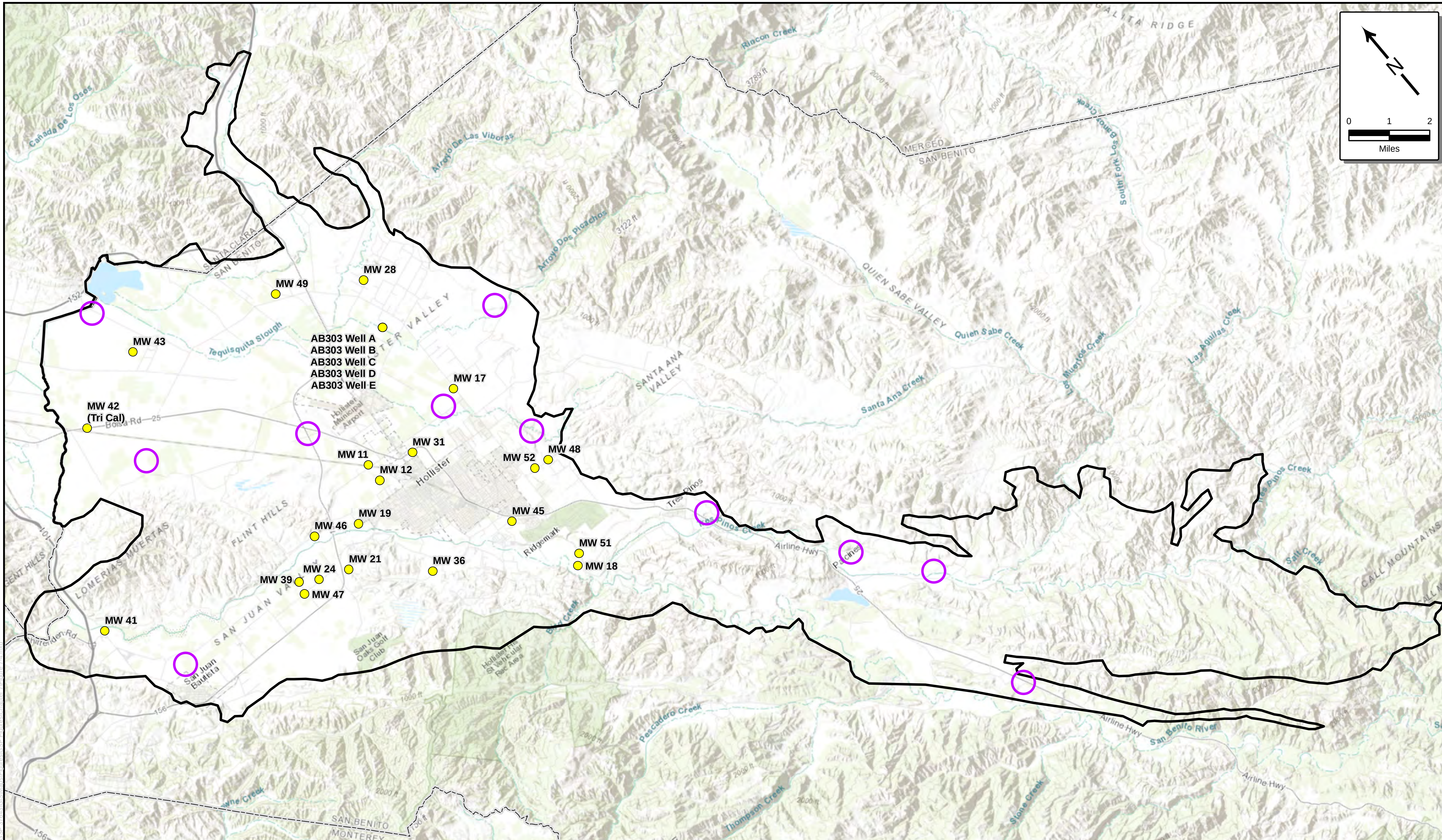
0 - 2 inches

Note:
Vertical displacement data from California Department of Water Resources measured between 6/13/2015 and 9/19/2019 (Tre/Altamira).

November 2021

TODD GROUNDWATER

Figure 7-3
InSAR Ground Surface Elevation Monitoring and Unavco Station Locations



Water Quality Monitoring Well

Proposed Round 3 Deep Monitoring Well

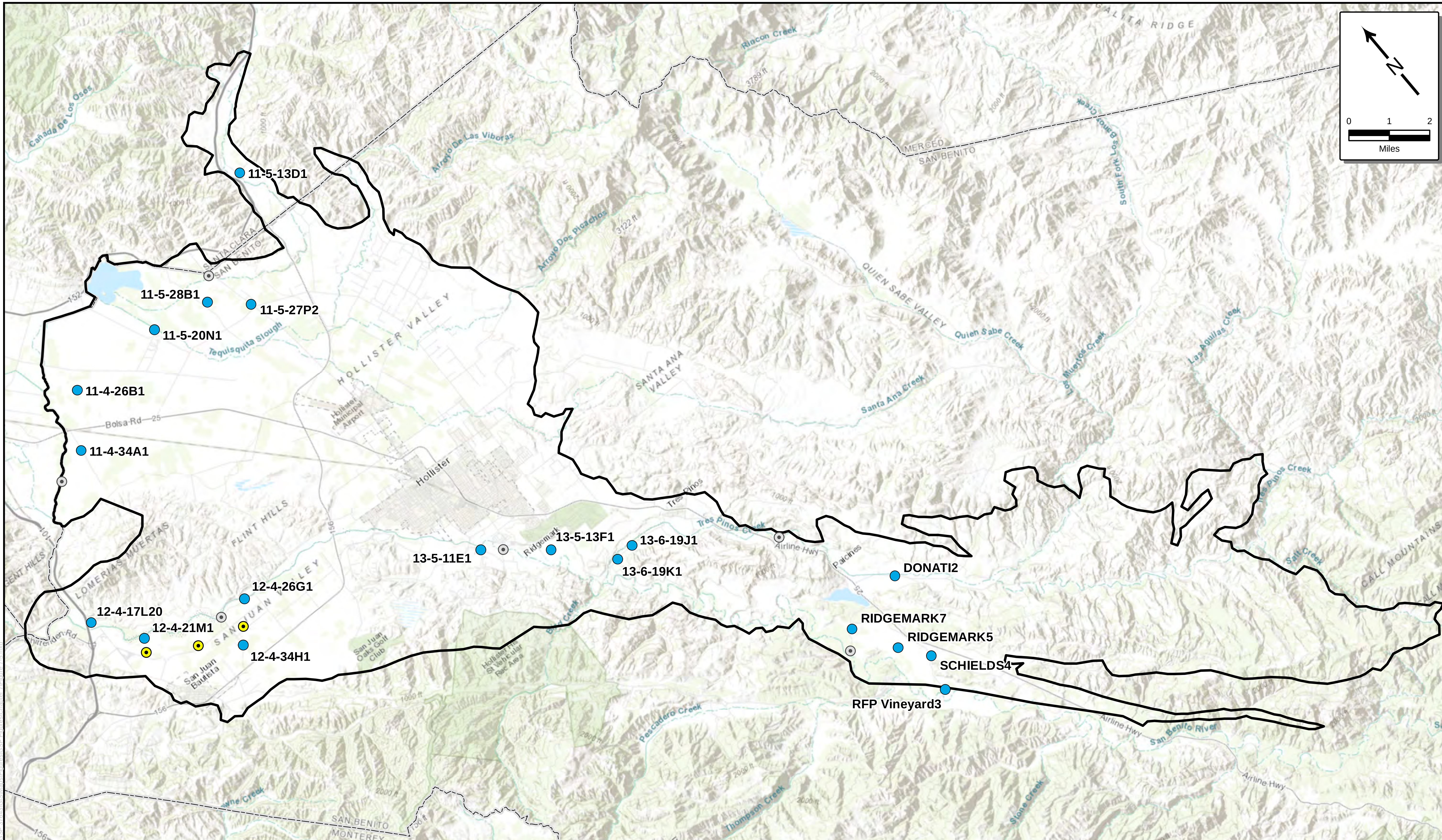
North San Benito Basin

San Benito County

November 2021

TODD GROUNDWATER

Figure 7-4
Wells in the SBCWD Water Quality Monitoring Program



Interconnected Surface Water Key Well
Existing Shallow Monitoring Well
New Shallow Interconnected Surface Water Monitoring Wells
North San Benito Basin
San Benito County

November 2021

TODD GROUNDWATER

Figure 7-5
Surface Water Key Well Locations

8. PROJECTS AND MANAGEMENT ACTIONS

Groundwater conditions in North San Benito Basin are sustainable. However, long-term sustainability requires continuation of monitoring, reporting, and management actions that are adaptive to changing climatic, water supply, and water demand conditions. This section describes numerical modeling forecasting scenarios, building on the future baseline scenario with climate change and with growth, and then presents ongoing, new, and recommended projects and management actions needed to maintain sustainability.

8.1. SIMULATION OF FUTURE CONDITIONS WITH CLIMATE CHANGE AND GROWTH

Future baseline conditions have been simulated using the numerical model as described in Section 5, Water Balance. That baseline simulation reflects a continuation of current conditions into the future and indicates that sustainability will be maintained as represented in a water budget (recognizing that undesirable results also must be addressed). Simulation of the effects of projected climate change and future growth are described here as context for the projects and management actions described below. Future growth includes urban growth and some expansion of vineyard acreage, as described in Section 8.1.2.

8.1.1. Climate Change

Climate change will affect local hydrology and Central Valley Project (CVP) water availability. The climate change scenario assumed land use and water use patterns were the same as in the future baseline scenario. Adjustments to the rainfall and reference evapotranspiration (ETo) time series for the rainfall-runoff-recharge model were made using data sets provided by the California Department of Water Resources (DWR). Those consist of statewide grids of four-by-four-kilometer cells, each with monthly time series of multipliers for precipitation and ETo that can be applied to historical data to estimate future conditions. DWR produced multipliers representing climatic conditions for 2030 and 2070. For this Groundwater Sustainability Plan (GSP), the 2070 data set was selected to fully reveal anticipated climate-change effects. Sixty-two of the grid cells overlapped the watershed area tributary to the groundwater basin. Analysis polygons from the rainfall-runoff-recharge model were assigned to the nearest grid cell, and the corresponding monthly multipliers for precipitation and ETo were applied.

DWR also produced monthly stream flow multipliers at a basin scale, with a single time series of values for the entire watershed area tributary to the model. Those multipliers were applied only to the Pacheco Creek and San Benito River inflows because the simulated inflows for other streams entering the basin already reflected climate change effects through the precipitation and ETo adjustments in the rainfall-runoff-recharge model.

The general result of climate change indicated by the precipitation and ETo multipliers is that the climate in 2070 will be warmer and wetter than the current climate. Precipitation and rainfall recharge are expected to increase in winter, and crop water demand—and hence groundwater pumping for irrigation—are expected to increase in summer. **Figure 8-1** shows the changes in annual rainfall recharge and groundwater pumping for irrigation for each management area under baseline and climate change conditions. In all management areas, rainfall recharge was considerably higher in wet years under climate change, but about the same as under historical conditions in dry and normal years. In contrast, pumping was greater by a fairly uniform amount in all years. In management areas without CVP water (Southern and Bolsa), irrigation pumping was only slightly higher under climate change conditions. The increase was larger in Hollister and San Juan because CVP imports were reduced by climate change, which necessitated even greater reliance on groundwater.

Table 8-1 shows average annual water balances for the 50-year future analysis period for each management area. In addition to the changes in rainfall recharge and irrigation pumping noted above, subsurface bedrock inflow from tributary watersheds was consistently slightly higher in the climate change scenario than the baseline scenario due to increased rainfall recharge combined with negligible irrigation pumping in the watersheds. In most management areas, percolation from streams increased and groundwater discharge to streams decreased under climate-change conditions, partly due to increased surface water inflow but primarily due to increased groundwater pumping for irrigation. Municipal groundwater pumping was the same under 2070 climatic conditions except in the Hollister Management Area (MA), where it increased due to climate-related reductions in CVP availability.

Hydrographs of simulated groundwater levels for the future baseline and future climate change scenarios are compared in **Figure 8-2**. The hydrographs cover the entire 1922-2007 simulation period. Historical water levels for the corresponding dates are shown simply to compare future water levels with the range of historical conditions (these are not calibration simulations intended to simulate historical water levels). Minimum thresholds are shown for reference. Several geographic patterns can be seen in the results.

In the Southern MA, climate-change water levels in winter were sometimes 2-5 feet higher than future baseline water levels due to increased flow and stream recharge along the San Benito River and Tres Pinos Creek (see hydrographs Donati 2 and Ridgemark 7). Summer water levels were usually 2-5 feet lower than future baseline water levels due to increased irrigation pumping. There was little change in cumulative water-level decline during droughts.

Several patterns are evident in different parts of the Hollister MA. At the southern end, water levels near Tres Pinos Creek and the San Benito River were higher under climate change conditions than under future baseline conditions at times when increased stream recharge more than offset increased irrigation pumping (see hydrograph 13-6-19K1). Throughout the central part of the Hollister MA, the climate-change water levels dropped below the future baseline levels by up to 20 feet during the simulated 1922-1935 drought, remained about that much lower until the mid-1990s, then recovered most or all of the way to baseline levels by 2007 (see hydrographs 12-5-24N1 and 12-6-6L4). This probably reflects the combined effects of local recharge, CVP availability and irrigation pumping simulated for 1922-1935 drought conditions and the wet period in the late 1990s. In Pacheco Creek Valley at the northern end of the Hollister MA, simulated water levels for both scenarios were nearly identical (see hydrograph 11-5-13D1).

Water level patterns in the San Juan MA were similar to those in the central part of the Hollister MA. That is, climate-change water levels dropped to 10-20 feet below the future baseline water levels during 1922-1935 drought conditions and remained that low until the sequence of wet years in the 1990s (see hydrographs 12-4-26G1, 12-5-30H1 and 13-5-11E1).

In the Bolsa MA east of the Calaveras Fault, water levels were usually 5-10 feet lower in summer under climate change conditions but similar to future baseline water levels in winter (see hydrograph 11-5-28B1). In the Bolsa area west of the Calaveras Fault, simulated water levels for the baseline and climate change scenarios fell below the bottom of model layer 1 early in the simulation, causing the layer 1 cells to go dry. This was accompanied by a shift from unconfined to confined conditions, which resulted in a much larger amplitude of seasonal water-level fluctuations. In reality, the system would likely continue to show some water-table response to pumping, with more moderate seasonal fluctuations. The general result of climate change was lower water levels in summer and water levels about the same as (sometimes higher than) future baseline water levels in winter. No long-term trend was apparent (see hydrograph 12-5-17D1).

Cumulative storage change over the 86-year simulation is shown for each management area under baseline, future growth, and future climate change conditions in **Figure 8-3**. The warmer and wetter climate led to a long-term increase in storage in the Southern MA because there is relatively little cropland assumed and additional rainfall recharge was not fully offset by increased irrigation pumping. Additional San Benito River inflow and percolation also helped boost the long-term storage trend. It is likely that increased rainfall would shift some grasslands toward deeper-rooted shrubby vegetation, which would intercept and consume some of the additional recharge calculated for this scenario. In the Hollister MA, climate change resulted in lower groundwater storage throughout the simulation, but not an obvious declining trend. Increased irrigation demand offset the increase in rainfall recharge, and decreased CVP availability shifted some irrigation supply to groundwater. A similar pattern occurred in the San Juan MA. Although there was an increase in net percolation from the San Benito River, it offset only about half of the increase in irrigation pumping. In the Bolsa MA, groundwater storage was lower throughout the simulation but without a long-term declining trend.

In summary, there were no long-term water-level or storage trends associated with the climate change scenario. The projected shift in local hydrology toward wetter and warmer conditions increased simulated pumping and water-level declines in summer and during most droughts, but increased stream inflow and net percolation generally offset those declines. In the most impacted area—the central part of Hollister MA—simulated water levels remained lower by up to 20 feet for decades before an exceptionally wet period provided enough recharge to recover back to baseline water levels. CVP supplies under 2070 climate conditions are expected to be consistently less than under future baseline conditions because of a loss of snowpack in the CVP source areas. In the simulation, this caused further increases in agricultural pumping in the Hollister and San Juan MAs relative to the Southern and Bolsa MAs and accentuated drawdown in summer and during most droughts.

8.1.2. Future Growth

Anticipated future changes in land use include urban growth and some expansion of vineyard acreage. The projected 2068 land use, developed with input from the Technical Advisory Committee (TAC), assumed for the simulation is shown in **Figure 8-4**. The future growth scenario simulated 2068 land use throughout the 86-year hydrologic period used for future simulations. It did not phase in land use changes over the course of the simulation. This is the best way to demonstrate whether 2068 assumed land use is sustainable because 1) it avoids subjective decisions about the concurrent timing of droughts and development, and 2) provides time for the full effect of 2068 land use on groundwater conditions to become apparent.

Urbanization was implemented in the model by converting selected recharge analysis polygons from natural vegetation or agricultural use to urban use. The selection of recharge zones to convert was based on the following practical considerations:

- Development has reached “buildout” conditions by 2068. Buildout water use in the Hollister Urban Area (HUA) has been estimated at 20,148 AFY, or roughly double the current use (HDR, 2008).
- The newly urbanized polygons in and near Hollister increased the total urban area from 5,114 acres in 2014 to 8,962 acres in 2068. This increase of 75 percent is slightly less than the increase in population and water use based on an assumption that future development will be somewhat denser on average than the existing urban area.
- Infill development was prioritized.
- Where reasonable, urbanization was on recharge zones that were non-irrigated in 2014 (natural grassland, idle, and grain). This creates a worst-case scenario in terms of the overall increase in consumptive use of groundwater. Only 238 of the 3,848 acres converted to urban categories were irrigated in 2014.
- San Juan Oaks and the Vintage project were specifically included. Other areas of urban expansion were east of Fairview (south of Santa Ana Road), along McCloskey Road and in the Union Road area west of the San Benito River. This last area is somewhat developed already but is shown as “agricultural” in the 2035 County General Plan. A few small non-irrigated recharge zones were converted to urban use around the periphery of San Juan Bautista.
- No future development in the Bolsa area was assumed, as none of the current proposals appear certain.

Total vineyard acreage in San Benito County is expected to increase, but probably not as fast as it has historically. Based on San Benito County Agricultural Commissioner annual crop reports, vineyard acreage remained fairly stable at 3,700-3,800 acres during 2005-2012, then increased to 4,400 acres in 2017, as shown in **Figure 8-5**. If the growth rate of 2013-2017 continued, total acreage would roughly double by 2050 (increase by 4,500 acres). However, recent industry trends indicate a slowing of grape production in California and nationally. Silicon Valley Bank’s “State of the Wine Industry Report 2019” (2020) identified a slowing in the rate of increase in U.S. wine consumption since 2013. This was attributed largely to generational changes in terms of disposable income and beverage preferences. The report also noted “the slight oversupply of grapes in California and the inability of wineries to take price increases against higher input costs” in the face of weakening demand and past “premiumization” of wines.

The recharge zones shown on the 2068 land use map as future new vineyards total 3,531 acres, which is a 78 percent increase over the 2017 acreage. They are all within the extensive “Wine/Hospitality Priority Area” delineated in the 2013 San Benito County General Plan. They are also on moderate slopes near existing cultivated areas within the active model domain. To evaluate the worst-case impact of these new vineyards on consumptive use of groundwater, they are all on recharge polygons that were not irrigated prior to conversion. Finally, they are all assumed to be irrigated by groundwater rather than imported water.

The largest changes in average annual water budgets were in municipal and industrial (M&I) and agricultural pumping. Relative to baseline, M&I pumping increased in the Hollister and San Juan MAs by a total of 12,900 AFY (**Table 8-1**). Two additional City of Hollister wells are assumed to be installed in Hollister MA. Most of the vineyard expansion was assumed to occur in the Southern MA, where agricultural pumping increased by about 2,700 AFY. The increase in pumping was largely offset by changes in other head-dependent flows in the water balance. In the Southern MA, for example, percolation from the San Benito River and Tres Pinos Creek increased and groundwater discharge to those waterways decreased, with a combined shift equal to 87 percent of the increase in pumping. Similar interactions with surface water occurred in the Hollister MA. Overall, however, average annual water balances in three of the MAs became less positive or more negative.

Hydrographs of simulated groundwater levels at selected wells under the future growth scenario are shown in **Figure 8-6** and match the changes in the water balances. Comparison of growth scenarios to the future baseline indicated the following. Growth-scenario water levels were almost identical to future baseline water levels in the Southern MA (see hydrographs Donati and Ridgemark7). Water levels were generally slightly lower in the southern part of the Hollister MA, where most of the increase in pumping occurred (hydrographs 12-4-24N1 and 12-5-37B20). Increased wastewater percolation reduced drought water-level declines in the San Juan MA (hydrographs 12-4-26G1 and 12-5-30H1). Water levels were slightly lower in the Bolsa MA east of the Calaveras Fault (hydrograph 11-5-26B1) but mostly unchanged west of the fault (hydrograph 12-5-17D1).

Cumulative storage changes in the four MAs for growth scenarios differed somewhat from the baseline and climate change scenarios (see **Figure 8-3**) as follows.

- In the Southern MA, storage in the growth scenario tracked the baseline simulation almost exactly because increased pumping for vineyard expansion was offset by increased net percolation from the San Benito River and Tres Pinos Creek.
- In the Hollister MA, storage was consistently lower than under baseline conditions but without a long-term declining trend (similar to the climate change results). Groundwater pumping increased to supply some of the increased urban water use, but over the long run this was offset by increased net stream percolation and decreased outflow to other MAs.

- In the San Juan MA, storage was occasionally higher under the growth scenario than under the baseline scenario because increased future wastewater percolation occurred in the San Juan MA whereas increased future groundwater pumping was mostly in the Hollister MA.
- In the Bolsa MA, cumulative storage was similarly lower than under the baseline scenario and without a long-term declining trend. The growth scenario did not include any land use changes in the Bolsa MA, but two hypothetical future City of Hollister wells were located along San Felipe Road north of Fairview Road, where they would intercept some groundwater flow into the Bolsa MA.

The effects of climate change and future growth would be additive. The combination might be enough to initiate long-term storage declines, but it would certainly lower the minimum groundwater levels during droughts, potentially exceeding minimum thresholds in some locations. A combined growth plus climate change scenario was subsequently simulated (many months later, after various improvements and corrections to the underlying model), and that simulation did not show net storage declines from 1922 to 2007 except in the Bolsa MA, where there was an average annual storage decrease of 43 AFY, which is smaller than the uncertainty in modeling results.

Table 8-1. Average Annual Water Budgets under Future Baseline, Growth and Climate Change Scenarios

A. Southern Management Area

Water Balance Items	Future Baseline	2070 Climate	Growth
Groundwater Inflow	**(AFY)**	**(AFY)**	**(AFY)**
Subsurface inflow from external basins	0	0	0
Percolation from streams	24,916	26,825	25,933
Bedrock inflow	1,110	1,363	1,110
Dispersed recharge from rainfall[1]	4,424	5,820	4,641
Irrigation deep percolation	753	966	889
Reclaimed water percolation	0	0	0
Inflow from Hollister MA	838	879	833
Total inflow	32,041	35,853	33,406
Groundwater Outflow			
Subsurface outflow to external basins	0	0	0
Wells - M&I and domestic	(67)	(67)	(100)
Wells - agricultural	(6,895)	(10,511)	(9,638)
Groundwater discharge to streams	(19,371)	(18,994)	(18,039)
Riparian evapotranspiration	(1,611)	(1,611)	(1,590)
Outflow to Hollister MA	(2,987)	(3,025)	(2,879)
Total outflow	(30,930)	(34,207)	(32,247)
Net Change in Storage	**1,110**	**1,646**	**1,159**
Change from Baseline	**n.a.**	**536**	**49**

B. Hollister Management Area

Water Balance Items	Future Baseline	2070 Climate	Growth
Groundwater inflow	**(AFY)**	**(AFY)**	**(AFY)**
Subsurface inflow from external basins	0	0	0
Percolation from streams	21,715	24,661	22,482
Bedrock inflow	3,257	4,902	3,292
Dispersed recharge from rainfall[1]	18,008	21,030	18,926
Irrigation deep percolation	4,746	5,222	4,814
Reclaimed water percolation	2,304	2,304	4,585
Inflow from Southern MA	6,040	6,549	6,079
Total inflow	56,069	64,668	60,178
Groundwater Outflow			
Subsurface outflow to external basins	0	0	0
Wells - M&I and domestic	(3,777)	(4,099)	(15,018)
Wells - agricultural	(38,239)	(47,466)	(33,918)
Groundwater discharge to streams	(2,701)	(2,309)	(1,836)
Riparian evapotranspiration	(179)	(172)	(162)
Outflow to Bolsa and San Juan MAs	(10,219)	(10,045)	(8,761)
Total outflow	(55,114)	(64,091)	(59,695)
Net Change in Storage	**956**	**578**	**483**
Change from Baseline	**n.a.**	**(378)**	**(472)**

Tables show average annual values for water years 1922-2007. AFY = acre-feet per year.

[1] Dispersed recharge volumes adjusted from pre-processor to match model inflows

C. San Juan Management Area

Water Balance Items	Future Baseline	2070 Climate	Growth
Groundwater Inflow	**(AFY)**	**(AFY)**	**(AFY)**
Subsurface inflow from external basins	0	0	0
Percolation from streams	5,552	7,040	3,774
Bedrock inflow	538	846	-29
Dispersed recharge from rainfall[1]	7,254	8,635	7,628
Irrigation deep percolation	2,158	2,360	2,173
Reclaimed water percolation	2,314	2,314	6,583
Inflow from Hollister and Bolsa MAs	4,802	4,919	3,905
Total inflow	22,618	26,113	24,035
Groundwater Outflow			
Subsurface outflow to external basins	0	0	0
Wells - M&I and domestic	(473)	(473)	(2,104)
Wells - agricultural	(17,466)	(21,629)	(17,040)
Groundwater discharge to streams	(1,378)	(785)	(1,721)
Riparian evapotranspiration	(1,064)	(1,028)	(1,079)
Outflow to Bolsa MA	(1,675)	(1,835)	(1,687)
Total outflow	(22,055)	(25,751)	(23,631)
Net Change in Storage	**562**	**363**	**404**
Change from Baseline	**n.a.**	**(200)**	**(158)**

D. Bolsa Management Area

Water Balance Items	Future Baseline	2070 Climate	Growth
Groundwater Inflow	**(AFY)**	**(AFY)**	**(AFY)**
Subsurface inflow from external basins	4,744	5,054	4,852
Percolation from streams	3,588	3,762	3,597
Bedrock inflow	7	8	9
Dispersed recharge from rainfall[1]	9,699	11,307	9,638
Irrigation deep percolation	1,875	2,027	1,875
Reclaimed water percolation	0	0	0
Inflow from Hollister and San Juan MAs	5,081	4,805	4,541
Total inflow	24,994	26,963	24,512
Groundwater Outflow			
Subsurface outflow to external basins	(22)	(27)	(21)
Wells - M&I and domestic	(11)	(11)	(17)
Wells - agricultural	(19,877)	(21,494)	(19,880)
Groundwater discharge to streams	(2,955)	(2,964)	(2,360)
Riparian evapotranspiration	(231)	(221)	(223)
Outflow to San Juan MA	(1,883)	(2,250)	(2,034)
Total outflow	(24,979)	(26,967)	(24,534)
Net Change in Storage	**16**	**(4)**	**(22)**
Change from Baseline	**n.a.**	**(20)**	**(38)**

Tables show average annual values for water years 1922-2007. AFY = acre-feet per year.

[1] Dispersed recharge volumes adjusted from pre-processor to match model inflows

8.2. Summary of Projects and Management Actions

This section describes the projects and management actions that the Groundwater Sustainability Agency's (GSAs) have identified to maintain groundwater sustainability in North San Benito Basin.

Projects are substantial efforts that involve an increase in water supply or a reduction in demand for the GSP Area. *Actions* provide a framework for groundwater management including establishing GSP procedures or policies, filling data gaps with scientific studies or improved monitoring, and providing for funding.

The GSAs have been actively managing their local groundwater resources for decades and hence have been developing various projects and management actions, which are relevant to sustainability and in different stages of planning or development. Additional projects and actions have been identified, some as part of this GSP process, for assessment relative to identified data gaps and sustainability criteria. This section identifies projects and actions relevant to sustainability and provides description and assessment appropriate to the stage of planning or implementation. Selected projects/actions are described (consistent with the GSP Regulations) in terms of objectives, circumstances of implementation, public notice, permitting and regulatory process, timetable, benefits, costs, and how the action will be accomplished. The legal authority of the San Benito County Water District GSA (SBCWD GSA) and Santa Clara Valley Water District GSA are described in the Introduction Section 1.4. Both GSAs have the legal authority for planning, construction, and operation of surface water storage and groundwater basin management projects.

The projects and management actions have been organized into four project categories and six management actions as listed below.

Projects

- Develop Surface Water Storage (Pacheco Reservoir Expansion Project)
- Expand Managed Aquifer Recharge (MAR)
- Enhance Conjunctive Use
- Enhance Water Conservation.

Management Actions

- Improve Monitoring Program and Data Management System (DMS)
- Develop Response Plans
- Enhance Water Quality Improvement Programs
- Reduce Potential Impacts to groundwater dependent ecosystems (GDEs) (Steelhead and Riparian Vegetation)
- Provide Long-term Basin-wide Funding Mechanism
- Provide Administration, Monitoring, and Reporting.

The four projects involve conjunctive use of available supplies plus water conservation. These produce benefits by maintaining groundwater levels above minimum thresholds and thereby avoiding chronic groundwater level declines, storage depletion, subsidence, and reduction of potential impacts to GDEs.

The projects also promote water quality improvement by maximizing high quality imports and supporting basin outflows.

The first management action supports the cost-effective implementation of all projects and management actions. The next three management actions address response plans, water quality improvement, and protection of GDEs. These were identified during the GSP process to provide specific GSA responses to potential undesirable results. The last two actions provide the needed funding, administration, monitoring, and reporting on an annual basis.

8.2.1. Expected Benefits Relative to Sustainability Criteria and Objectives

As documented in Section 5 Water Balance and Section 6 Sustainability Criteria, the North San Benito Groundwater Basin is not in a state of overdraft. This is the result of long-term management, including importation of CVP water, which is used in conjunction with local surface water and recycled water supplies and local groundwater resources. The projects and management actions described here work together toward the sustainability objectives, namely: to provide a reliable and efficient groundwater supply, to provide reliable storage, to protect groundwater quality, to prevent subsidence, to support beneficial uses of interconnected surface waters, and to support integrated and cooperative water resource management.

Table 8-2 lists the projects and management actions and indicates the applicability of each project and action in providing expected benefits relative to five sustainability criteria topics relevant to North San Benito Groundwater Basin.

Each of the Projects and Management Actions is described in the following subsections.

Table 8-2 Expected Sustainability Benefits of Projects and Management Actions

Sustainability Criteria / Projects and Management Actions	Groundwater Levels	Groundwater Storage	Subsidence	Groundwater Quality	Connected Surface Water
Develop Surface Water Storage (Pacheco Expansion)	✓	✓			✓
Expand Managed Aquifer Recharge	✓	✓	✓	✓	✓
Enhance Conjunctive Use	✓	✓	✓	✓	✓
Enhance Water Conservation	✓	✓	✓		✓
Improve Monitoring Program and DMS	✓	✓	✓	✓	✓
Develop Response Plans	✓			✓	
Enhance Water Quality Improvement Programs				✓	
Reduce Potential Impacts to GDEs					✓
Provide Long-term Basin-wide Funding Mechanism	✓	✓	✓	✓	✓
Provide Administration, Monitoring and Reporting	✓	✓	✓	✓	✓

8.3. Develop Surface Water Storage (Pacheco Reservoir Expansion Project)

As discussed throughout the GSP, groundwater levels and storage in North San Benito Basin have been maintained at relatively high levels because of the availability of CVP supply. Maintenance of groundwater levels within recent historical ranges also brings benefits in reducing the risk of subsidence, maintaining groundwater quality, and supporting GDEs. However, reliability of CVP supply has been reduced by multiple factors including environmental considerations in the Sacramento-San Joaquin Delta and climate change. Given this situation, which is likely to increase with climate change, development of additional surface water storage is being planned. This allows direct use of CVP water when available and replenishment of groundwater storage for use during drought or shortage.

Potential options for additional surface water storage include Pacheco Reservoir expansion, Paicines Reservoir expansion, San Justo Reservoir expansion, new Hawkins Reservoir, and an additional offstream reservoir. At this time, the surface water storage project with the most advanced planning is the Pacheco Reservoir Expansion Project (PREP), described here. Planning for PREP is advanced, but the project remains uncertain in part because of cost. While other surface water projects have been identified by SBCWD, Managed Aquifer Recharge and associated use of groundwater storage within North San Benito Basin is the alternative to PREP currently being developed (see Section 8.4).

As described in Section 8.1.1, the climate change modeling scenario indicates that the local climate in 2070 will be not only warmer but also wetter than the current climate. Given the challenges presented by cumulative effects of growth and climate change, consideration should be given to projects that can increase storage and use of local surface water supplies.

8.3.1. Description

The Pacheco Reservoir Expansion Project (PREP) is a collaborative effort of Valley Water, San Benito County Water District, and Pacheco Pass Water District (PPWD). The project would establish a new dam and expanded reservoir on the North Fork of Pacheco Creek. The existing dam and reservoir were constructed in 1939 and have been used for supplemental groundwater recharge along Pacheco Creek. The reservoir is located in Santa Clara County northeast of North San Benito Basin. PREP would increase Pacheco Reservoir's operational capacity from 5,500 acre-feet up to 140,000 acre-feet (SBCWD, 2021). Sources of water supply to the expanded project would be a combination of local watershed inflows and CVP supplies. A pipeline is planned to the Pacheco Pass Conduit, the CVP pipeline that delivers water from San Luis Reservoir located about 13 miles to the northeast. Deliveries from San Luis Reservoir also flow west through the Conduit to the San Felipe Division of the CVP, which includes Valley Water and SBCWD.

In 2018, Valley Water, the Pacheco Pass Water District and the San Benito County Water District collaborated to secure $484.5 million in funding from California's Water Storage Investment Program (WSIP), funded by the Proposition 1 Water Quality, Supply, and Infrastructure Improvement Act of 2014. The WSIP and funding for Pacheco Reservoir Expansion Project is administered by the California Water Commission (CWC), which provides current information on its website (CWC, 2021).

Although not a project sponsored by the GSAs, the B.F. Sisk Dam Safety of Dams Modification Project involves raising the dam that creates San Luis Reservoir (USBR, 2020). This project, being developed by the USBR and DWR, is intended to reduce seismic risk, but also will increase water storage behind the dam. As of 2020 environmental review and permitting have been completed and final designs are underway. Construction is scheduled for completion in 2028.

While the local inflows are within the jurisdiction of the Valley Water GSA, the CVP supplies would be provided by U.S. Bureau of Reclamation (USBR) as part of the Valley Water and SBCWD share of contracted CVP pumped water from San Luis Reservoir. Availability of CVP water will decrease in the future due to climate change. Simulations of the CVP system completed by DWR using its CalSim2 operations model indicate that the average annual availability of agricultural CVP water would decrease from 48 percent of contract amounts to 32 percent due to climate change between 2030 and 2070, and average annual M&I availability would decrease from 75 percent to 69 percent of contract amounts.

8.3.2. Feasibility and Level of Uncertainty

The CWC provided a technical review of the Pacheco Reservoir Expansion Project as part of its 2018 Technical Review (CWC, 2018). While focused on Valley Water, this review indicated that the project would be integrated with existing surface water and groundwater supplies and provide local operational flexibility and contribute to SGMA, conjunctive use, and supply management. Uncertainty analyses provided to CWC by Valley Water addressed two extreme climate scenarios (2070 Wetter-Moderate Warming and 2070 Drier-Extreme-Warming) provided by WSIP. The analysis indicated that the project would provide additional public benefits under the extreme climate conditions (CWC, 2018). Additional feasibility studies (engineering, environmental, permitting) are underway; for example, the Draft Environmental Impact Report (EIR) is expected in 2022.

8.3.3. Project Implementation

As of early 2021, the project is in planning stages including environmental documentation, feasibility studies, and permitting (CWC, 2021). With implementation after 2029, project implementation would be integrated into Valley Water and SBCWD operations of the San Felipe Division of the CVP.

8.3.4. Public and Agency Noticing and Outreach

Information describing the project is provided on the websites of Valley Water, SBCWD and the CWC. The Valley Water website provides news, updates, and access to documents. Translation to multiple languages is provided by the website. In addition, Valley Water has invited the public to meetings and webinars and has encouraged commentary, for example on the EIR process. Valley Water also has provided presentations and tours to stakeholder groups. The CWC website provides quarterly reports on the project's status and expected completion dates.

8.3.5. Permitting and Regulatory Process

As of early 2021, Valley Water has initiated communication with many of the regulatory agencies that will require permits, approvals, certifications, and agreements (CWC, 2021). The estimated completion date for all required federal, state, and local approvals, certifications, and agreements is December 2024. The project description and framework for the draft EIR is being developed with an estimated public release in December 2021 for the Draft EIR and July 2023 for the Final EIR.

8.3.6. Legal Authority

PPWD, Valley Water, and SBCWD have collaborated to secure funding for this project from CWC, and Valley Water has entered into an agreement with CWC for project planning and environmental costs. PPWD owns and operates the existing Pacheco Reservoir, North Fork Dam, and related storage and conveyance infrastructure. PPWD is a California Water District formed in 1931 through Water Code §34000 to §38501 and has the authority to acquire, plan, construct, maintain, improve, operate, and keep in repair the necessary works for the production, storage, transmission, and distribution of water for irrigation, domestic, industrial, and municipal purposes, and any drainage or reclamation works.

The legal authority of Valley Water (Santa Clara Valley Water District) and SBCWD are described in the Introduction Section 1.4.

8.3.7. Project Benefits

Among the expected benefits of PREP are the following relevant to sustainability in North San Benito:

1. Increase reliability of imported water supplies to San Benito and Santa Clara counties.

2. Provide an emergency water supply to San Benito and Santa Clara counties.
3. Improve opportunities for water transfers through San Luis Reservoir.
4. Increase operational flexibility of water supplies at San Luis Reservoir.
5. Improve ability of PPWD to store water under its diversion and water use permit.
6. Provide additional water for groundwater recharge.
7. Improve delivered water quality, reducing taste and odor problems that result from seasonal algae blooms in San Luis Reservoir.
8. Increase suitable habitat in Pacheco Creek for the federally threatened South Central California Coast steelhead by providing suitable water flow and temperature to support the migration and survival of these fish.

The first four of these benefits involve increased reliability and flexibility of surface water import operations among the cooperating agencies and with USBR. These benefits are directly relevant to the measurable objectives for groundwater levels and storage and indirectly support avoidance of subsidence. Benefits will be evaluated by the GSAs in terms of increased imported water supply especially during drought and shortages. The benefits of additional water for recharge and water quality improvement have been evaluated by Valley Water in the context of overall conjunctive use of the subbasins in Santa Clara County including subbasins of the Santa Clara Valley Groundwater Basin and the Llagas Subbasin of the Gilroy-Hollister Basin. Such benefits accrue similarly to North San Benito Basin.

Effects of PREP on the North San Benito Basin groundwater were simulated on a preliminary basis using the numerical model. Specific benefits considered in this study included groundwater recharge and improvement of Pacheco Creek flows for steelhead.

Model inputs accounted for existing (non-project) and with-project conditions and included annual CVP use (agricultural, municipal, and percolation), municipal groundwater use basinwide, agricultural pumping in the Hollister and San Juan Management Areas, and Pacheco Creek inflow to the groundwater model. The general effect of the project was to maintain a nearly constant Pacheco Creek baseflow of about 15 to 20 cfs into the model. Groundwater model outputs included Pacheco Creek flow and percolation, groundwater elevation hydrographs for selected wells, and groundwater elevation contours. The preliminary findings included the following:

- PREP keeps groundwater in a "full" condition along Pacheco Creek down to about Highway 156.
- Farther downstream along Pacheco Creek PREP raises water levels a moderate amount, only during droughts. However, the reach below San Felipe Road has an existing problem with high groundwater levels.
- Throughout the rest of the basin, groundwater levels are occasionally different, but there is no significant long-term or drought-period benefit.
- PREP increases average annual use of CVP water by only about 1,100 AFY. It reduces average annual percolation of CVP water in local percolation basins by about 360 AFY due to new competing allocations of that water.
- Pacheco Creek stream flow is higher and more persistent during the dry season under PREP.
- During the steelhead migration season (Jan-Jun), flows are often smaller with PREP than under existing conditions because PREP would increase capture of runoff in the Pacheco Creek watershed.

- Overall, the water supply and habitat benefits of PREP to North San Benito basin are small. The net change in direct use and percolation of CVP water (740 AFY) equals only 2 percent of current total water use.

Benefits of the project in the future would be evaluated using the GSP monitoring program for groundwater levels, surface water, and GDEs.

8.3.8. Status and Timeline

The CWC website (CWC, 2021) provide up-to-date information on the project including quarterly reports. Construction to expand Pacheco Reservoir is anticipated to begin in 2024. As of 2021, construction is estimated to take at least eight years. Consequently, benefits would begin to accrue after 2032.

8.3.9. Estimated Costs and Financing

In 2018, Valley Water, Pacheco Pass Water District and San Benito County Water District collaborated to secure $484.5 million in WSIP funding, at the time accounting for more than one-third of the estimated $1.3 billion project cost. In 2020, Valley Water performed a more detailed design study which included an updated cost estimate. This design study indicated that construction costs for the proposed project had increased to about $2.5 billion, prompted largely by major changes to the dam and spillway design. In January 2021, the Valley Water Board of Directors instructed staff to continue with planning and design of the proposed project (SCVWD, 2021b). Valley Water is seeking federal funding and exploring other avenues to reduce the cost of the project to ratepayers.

Cost sharing for the Project and its potential operation and maintenance will be established in the Operating Agreement between Santa Clara Valley Water District, San Benito County Water District, and Pacheco Pass Water District.

8.4. Expand Managed Aquifer Recharge

Climate change and growth in urban and agricultural water demand will both tend to undermine the sustainability of groundwater conditions in the North San Benito Basin by increasing groundwater declines during dry periods. Those declines can be offset by increasing the amount of recharge during wet periods, provided the recharged water remains in storage until the next drought. Funded by a Sustainable Groundwater Planning (SGWP) Grant as part of this GSP, the MAR project has been initiated with a feasibility study. Documentation of this study will be provided on the SBCWD website in the Technical Memorandum (TM), *North San Benito Managed Aquifer Recharge Feasibility and Location Assessment Study*.

8.4.1. Description

The MAR study addresses the entire basin to evaluate potential locations, several methods of recharge, and several sources of water. To evaluate locations, the MAR study uses best available information on recharge parameters and applies a detailed geographic information system (GIS) index-overlay method to evaluate potential locations. Numerical modeling also was applied to assess issues such as mounding, migration, and recovery of recharge water. The combination of water source, method, and location that currently appears to have the greatest advantages and the fewest disadvantages involves recharge of CVP water using injection or Aquifer Storage Recovery (ASR) wells in the Hollister MA.

Other water sources and recharge mechanisms were evaluated but deemed less promising at this time.

- Diversion of water from local streams to offsite percolation basins was evaluated, with the conclusion that insufficient water would be available for a cost-effective project. Future climate change effects on local hydrology (potentially including increased rainfall and runoff) could warrant reassessment of local streamflow as a water source.
- Percolation of urban stormwater already occurs in detention basins in Hollister, but for a regional project, land costs and local percolation rates are not sufficiently favorable.

Methods considered for recharge of CVP water included percolation basins, temporary flooding of agricultural fields (AgMAR), and injection or ASR wells. Percolation basins are a proven means of recharge in North San Benito, but disadvantages include the relatively low percolation rates of most local soils and the high cost of land for a facility that is used only sporadically. Former gravel pits may provide unique opportunities, which will be evaluated as opportunities arise. AgMAR, or flooding of agricultural fields when surplus CVP water is available, was not selected for further evaluation at this time. AgMAR is difficult to implement on a periodic basis because of the many and complex arrangements with numerous landowners that would be required. In addition, field flooding would accelerate downward migration of accumulated salts and nitrates (and other agricultural chemicals) in the soil.

Injection wells have been selected as the best method for implementing MAR in the Basin. Disadvantages including relatively high installation and operation and maintenance costs are outweighed by advantages, including low land costs, avoidance of percolation rate limitations, and a long potential recharge season. Injection wells also have two important water quality benefits. First, injection avoids moving poor-quality shallow groundwater down to deep water-supply aquifers, and second, it dilutes the mineral content of native groundwater and thereby improves the quality of water pumped from nearby downgradient water supply wells. ASR wells are advantageous in providing recovery/production capabilities in addition to recharge.

8.4.2. Water Source and Reliability

The primary source is CVP water that is available in wet years when the agricultural allocation is in excess of 50 percent of SBCWD's contract amount. An estimated eleven injection wells could accommodate 6,000 AFY of desired recharge capacity. This amount was targeted by SBCWD analysis of CVP availability given historical use rates of SBCWD agricultural customers and using output from DWR's CalSim2 model of statewide CVP and State Water Project operations. The CalSim2 model produces monthly estimates of CVP water availability over the 1922-2003 hydrologic period. The analysis thereby incorporates best available information on CVP availability; the intent of the project is to increase imported water reliability through storage in the groundwater basin.

8.4.3. Feasibility and Level of Uncertainty

To evaluate the feasibility of the MAR project, the numerical model has been applied to injection well scenarios for injection-only (MAR) wells and for ASR wells. Design of the scenarios reflect additional siting considerations, including where recharge is most needed and how long the recharged water can be retained in storage before being lost to groundwater outflow. These considerations led to a focus on Hollister MA, which contains the area slowest to recover following historical overdraft during the 1940s to 1970s. This is the area that has the greatest need of supplemental recharge and retains it the longest. Scenarios were designed with hypothetical wells as follows:

- The first is an injection-only scenario in which eleven MAR injection wells are located along CVP distribution pipelines close to and roughly upgradient of City of Hollister and SSCWD municipal supply wells. This arrangement maximizes the water-quality benefit of injection by allowing the recharged water to be recovered at nearby existing potable supply wells.
- The second scenario involves eleven ASR wells near the north end of Hollister. For the ASR scenario, the amounts and timing of injection are the same as for the MAR injection-only scenario. Extraction is assumed to occur in all non-injection years at a rate that balances the injected and extracted volumes over the simulation period.

8.4.3.1. Results of Scenario Simulations

The effects of the injection well and ASR well scenarios were each simulated and compared to a reference simulation that consisted of the future baseline simulation plus future growth and climate change. For the injection wells, two scenarios were run, one with injection concentrated into a four-month season (November-February) and another with injection over nine months of each year (June-February).

Hydrographs were prepared to allow comparison of results for the reference simulation and the injection well scenario at selected wells. Simulations in some wells showed high water levels in the injection wells that indicated the need to spread injection out over nine months. While the presence of faults sharply truncates the mounding in some directions, the effect spread substantially during the six years following injection.

For the ASR well scenario, hydrographs in selected wells show prominent spikes in water levels during injection years, with water levels declining back to near baseline levels within about four years. During longer periods between injection years, water levels drop below the baseline levels because of extraction at the ASR wells. Overall, the ASR scenario is water-budget neutral: increased recharge from injection is balanced in subsequent years by increased extractions, with the latter spread out over all of the municipal wells.

Analysis also included contour mapping of differences in water levels between the ASR well scenario and the reference simulation. This allowed documentation of long-term storage of water and consideration of mounding effects, which also indicated that a longer operating season is preferable not only to minimize well interference but also to decrease the number of wells needed and their required injection rates.

The feasibility analysis also includes comparison of average annual water budgets for the injection well and ASR well scenarios with the future growth reference simulation. Water budget changes were reviewed in terms of increase in total recharge contributed by the injection wells, increased groundwater storage, decreased percolation from streams, increased groundwater outflow to streams, and decreased outflow to the Bolsa and San Juan MAs. All of the above changes in water budgets are relatively small, because on an average annual basis the injected CVP water represents only about one percent of total inflows to the Hollister MA. The spillover effects on water budgets in the San Juan and Bolsa MAs represent even smaller percentages of those budgets.

8.4.3.2. Level of Uncertainty

The preceding analyses demonstrate the conceptual feasibility of injecting and storing surplus CVP water at the management-area scale. Land requirements are low for wells, and construction costs are significant but predictable. One uncertainty with injection or ASR wells is the overall transmissivity of the aquifer system at each well location, which is locally variable. In general, low injection capacities can be overcome with additional wells, but at increased cost. Another uncertainty is the amount and method of treatment that would be required for water prior to injection. At a minimum, water must be highly filtered to prevent clogging of the aquifer formation near the well. Adjustments of pH or TDS might be needed to prevent desorption of clays or metals in the aquifer. The Regional Water Quality Control Board (RWQCB) and/or California Division of Drinking Water (DDW) might impose additional requirements to protect ambient groundwater quality and public health.

8.4.4. Project Implementation

The MAR study has demonstrated the conceptual feasibility of injection and/or ASR recharge projects using CVP. Next steps are likely to include additional investigation of water quality issues, focusing on potential geochemical interactions between recharge water sources (CVP and potentially a CVP/groundwater blend) and native groundwater. Subsequent field work may include pilot injection testing at existing wells; installation and testing of test injection wells; and a pilot injection program. Both the MAR Project and North County Project (see Section 8.5.3) are focused on the Hollister MA, and coordination or merging of the two is being considered. Project development also includes planning, predesign, and design for needed treatment, injection, and conveyance facilities; continued evaluation and modeling (system modeling, groundwater, and geochemical modeling); environmental compliance and permitting; institutional agreements; land acquisition; cost estimating and financing; and stakeholder outreach.

8.4.5. Public and Agency Noticing and Outreach

Documentation of the MAR study and findings will be provided on the SBCWD website in a TM, *North San Benito Managed Aquifer Recharge Feasibility and Location Assessment Study*. During the study, updates were provided to the TAC and the presentations uploaded to the SBCWD website, where they are available to the public. Future progress on the MAR efforts will be summarized in the Annual Groundwater Reports and associated public meetings.

8.4.6. Permitting and Regulatory Process

The Central Coast RWQCB and the Drinking Water Division of the SWRCB are the primary agencies responsible for permitting injection and ASR wells. The permitting process will likely entail technical studies of the quality and treatment of the source water and potential reactions of injected water with aquifer materials and ambient groundwater. San Benito County Water District issues permits to construct any type of well in San Benito County, and these wells would need this type of permit. Implementation of the MAR project would require compliance with the California Environmental Quality Act (CEQA), in the form of an environmental impact report.

8.4.7. Legal Authority

SBCWD's powers originate from the San Benito County Flood Control and Water Conservation District Act passed by the California Legislature in 1953. That statute gives SBCWD broad powers "to construct, maintain, alter and operate any and all works or improvements, within or without SBCWD, necessary or proper to carry out any of the objects or purposes of this act", which include the power "to store water in surface or underground reservoirs". Injection and ASR wells would clearly fall within the scope of these powers.

8.4.8. Project Benefits

Managed aquifer recharge in general, and injection or ASR wells specifically would provide three benefits to water users in northern San Benito County:

- Increase long-term recharge and supply of groundwater in the Basin by importing and storing additional CVP water when it is available. This would decrease storage depletion and water-level declines during droughts, helping to avoid exceeding the minimum thresholds for those sustainability indicators. The additional recharge also protects against reduced recharge or increased demand associated with future growth and climate change.
- Improve the long-term salt balance of the basin by increasing natural outflow from the Basin.
- Locally improve groundwater quality near the injection wells by diluting it with CVP water. ASR wells or injection of CVP water close to and upgradient of water supply wells would improve the quality of the extracted water compared to extracting native groundwater.

8.4.9. Status and Timeline

For the recharge study, initial investigations, preliminary feasibility studies, conceptual designs and initial cost analysis are part of this GSP as summarized in the TM, *North San Benito MAR Feasibility and Location Assessment Study* (to be provided on the SBCWD website). Overall, engineering studies, permitting and CEQA compliance can be expected to take 1-2 years.

8.4.10. Estimated Costs and Financing

Initial costs will be presented in the *North San Benito MAR Feasibility and Location Assessment Study* being prepared in 2021. At time of writing, four options are being explored with different conceptual designs and capacities and with various levels of water treatment. Estimated capital costs range between $69 million and $81 million. Estimated annual yields range from 2,085 to 3,085 AFY, with estimated yield costs ranging from $1,990 to $2,900 per AFY.

Financing may be through local funding and/or state and federal grants and loans. Past projects, such as the Hollister Urban Area Water Project, have been implemented through a combination of local financing and state grants. Opportunities for outside financing (grants or loans) will be fully explored from state water programs and federal infrastructure funding. For local financing, the agencies will need to update their financial plans and rate studies. Rate study updates should include a review of both rates and connection fees.

8.5. ENHANCE CONJUNCTIVE USE

Projects that enhance conjunctive use include the following:

- Hollister Urban Area Water and Wastewater Project
- City of San Juan Bautista Regional Water and Wastewater Solution

- North County Project
- Zone 3 Operations Planning Tool.

8.5.1. Hollister Urban Area Water and Wastewater Master Planning Project

The Hollister Urban Area Water and Wastewater Master Planning Project has been the major means for regional cooperation and coordination of water, wastewater, and recycled water facilities for the urban areas in the North San Benito Basin. It was first initiated in 2004, followed by a master plan produced in 2008 (HDR, 2008) and a Master Plan Update in 2017 (HDR, 2017).

As of 2021, regional water and wastewater planning is being expanded to include the City of San Juan Bautista. This includes development by SBCWD and City of San Juan Bautista of a San Juan Bautista Water Supply Plan (WSP) for provision of high quality treated CVP water to San Juan Bautista. Planning also is being conducted by SBCWD, City of Hollister, and City of San Juan Bautista to convey wastewater to the City of Hollister Wastewater Treatment Plant. The planning addresses issues the City of San Juan Bautista currently has related to meeting drinking water standards for its potable water system and meeting waste discharge requirements for its wastewater discharges to a tributary of San Juan Creek.

8.5.1.1. Description and Implementation

The Hollister Urban Area Water and Wastewater Master Planning Project (Master Plan) has been implemented through the steps summarized in the next paragraphs. It continues as an active planning process for the foreseeable future. Relative to groundwater sustainability, the Master Plan provides for conjunctive use of CVP supply, groundwater, wastewater, and recycled water. While CVP supply is sourced from beyond GSA jurisdictions and is not always reliable (see Plan Area Section 2.1.2), the groundwater, wastewater, and recycled water are local sources and the conjunctive use planning increases supply reliability.

2008 Master Plan. The Master Plan was initiated through the 2004 Memorandum of Understanding (MOU) developed among the City of Hollister (City), San Benito County (County), and SBCWD. The 2004 MOU was subsequently amended in 2008 to include Sunnyslope County Water District (SSCWD). The 2008 Master Plan identified projects or program elements for water, wastewater, and recycled water with implementation through 2023. The Hollister Urban Area (HUA) was defined to include the City of Hollister and adjacent unincorporated areas of San Benito County designated for urban development.

The 2008 Master Plan was a major milestone for regional cooperation and coordination of water, wastewater, and recycled water facilities to serve the HUA. The 2004 MOU described the principles, objectives, and assumptions that formed the basis of the 2008 Master Plan, focusing on the following goals:

- Improve municipal, industrial, and recycled water quality.
- Increase the reliability of the water supply.
- Coordinate infrastructure improvements for water and wastewater systems.
- Implement goals of the Groundwater Management Plan.
- Integrate recommendations of the Long-term Wastewater Management Plans (LTWMP) with the Master Plan.
- Support economic growth and development consistent with the City of Hollister and San Benito County General Plans and Policies.
- Consider regional issues and solutions.

The HUA water projects defined in 2008 include: (1) purchases or transfers of imported water supplies, (2) North County Groundwater Bank, (3) new urban wells, (4) upgrade of the Lessalt Water Treatment Plant, (5) new surface water treatment plant [West Hills], (6) demineralization of urban wells, (7) a new pipeline to Ridgemark, and (8) new treated water storage.

Wastewater elements include (1) Ridgemark Wastewater Treatment Plant upgrades, (2) expansion of the City of Hollister Water Reclamation Facility, and (3) the Cielo Vista Estates connection to the City of Hollister Water Reclamation Facility. Recycled water elements include (1) Phase 1 recycled water facilities (2) Phase 2a and Phase 2b recycled water facilities, and (3) Ridgemark recycled water facilities. Non-structural solutions include water conservation, salinity education, water softener ordinance, new development connections to the city sewer, and other measures.

2017 Master Plan Update. Implementation of the 2008 Master Plan process involved major capital improvement projects including:

- Lessalt Water Treatment Plant Upgrade and Fairview Road Transmission Pipeline
- West Hills Water Treatment Plant and Transmission Pipeline to City Well Nos. 4 and 5
- SSCWD New Well No. 11
- City of Hollister Water Reclamation Facility Upgrade
- SSCWD Ridgemark Wastewater Treatment Plant
- Expansion of the recycled water system for agricultural reuse

In addition, SBCWD improved water supply reliability during droughts by purchasing additional out-of-basin water supplies, entering into an agreement with Valley Water to participate in the Semitropic Water Bank, and working with the USBR to renegotiate its historical use baseline for the municipal and industrial portion of its CVP contract. The Master Plan process has also included water conservation programs (see Section 8.6 Enhance Water Conservation) that have successfully reduced water demand in the HUA. In addition, both SSCWD and the City have adopted water softener programs to remove self-regenerating water softeners in the HUA (see Section 8.11 on Water Quality Improvement Programs).

With achievement of 2008 Master Plan goals, the agencies proceeded with a new memorandum of understanding and update of the 2008 Master Plan. The 2014 Memorandum of Understanding (2014 MOU) was developed between the City, SBCWD, and SSCWD to facilitate and guide this update. The 2014 MOU incorporated the principles, objectives, and assumptions from the 2004 MOU. It also reaffirmed the institutional framework and responsibilities of the Governance and Management Committees. The overall objectives of the Master Plan were updated to include:

- Provide continuous improvement towards achieving drinking water and recycled water quality goals.
- Increase dry year water supply reliability.
- Provide adequate water supply to respond to long-term growth needs.
- Continue to address water, wastewater, and recycled water needs through coordinated regional solutions.

The 2017 Update also was coordinated with related planning efforts including the 2015 Hollister Urban Area Urban Water Management Plan (UWMP), the City's distribution system master plan, and this GSP. The following issues were identified for evaluation in the Master Plan Update.

- Update water demand and wastewater flow projections.
- Review and evaluate previously identified long-term water supply options.
- Review drinking water goals for Total Dissolved Solids (TDS) and hardness.
- Review goals for recycled water TDS.
- Evaluate the need, timing, and estimated cost of the following facilities:
  - Expansion of the West Hills WTP,
  - Crosstown Pipeline,
  - Groundwater Demineralization or Softening,
  - Modifications and/or expansion of the City's Water Reclamation Facility and the SSCWD Ridgemark Wastewater Treatment Plant,
  - Expanding the recycled water system, and
  - Major infrastructure improvements to the water distribution system and the wastewater collection system.

In 2014, the California Division of Drinking Water (DDW) adopted water quality regulations to limit the levels of hexavalent chromium, Cr(VI), to a maximum of 10 parts per billion (ppb) in drinking water. This regulation was subsequently rescinded in 2017 and currently Cr(VI) levels are controlled in California drinking water by existing regulations that include an maximum contaminant level (MCL) of 50 ppb. However, consideration of the lower regulatory levels indicated significant issues with City of Hollister and SSCWD groundwater compliance. In response, in 2015 the City prepared a Hexavalent Chromium Compliance Plan for Groundwater Supply to provide a reliable and cost-effective plan for the City to manage in municipal water supply wells in accordance with DDW regulations. The 2017 Master Plan Update also provided recommendations for compliance with the Cr(VI) regulations at the time. While subsequently rescinded, the Master Plan Update has increased its focus on providing high quality water to the HUA.

8.5.1.2. Water Source and Reliability

The Master Plan process involves use CVP supplies, which are available to SBCWD through its existing contracts for municipal and agricultural supplies. As discussed in the 2020 UWMP (Todd, 2021), the reliability of CVP is expressed by variable annual allocations; while agricultural allocations may be zero in some years, municipal allocations have been 25 to 100 percent. DWR has provided simulation of future CVP allocations, which support planning to address this uncertainty.

Local groundwater is reliable, as managed by SBCWD in partnership with local agencies. Recycled water also is locally controlled and reliable.

8.5.1.3. Feasibility and Level of Uncertainty

The Master Plan process is based on a succession of engineering studies and design, hydrogeologic investigations (including field study and numerical modeling), and planning. Uncertainties with regard to the groundwater basin setting (local groundwater quantity and quality) are addressed by focused investigations (e.g., test drilling) and by ongoing monitoring.

8.5.1.4. Public and Agency Noticing and Outreach

The 2008 Master Plan included development of a Communications Plan, which identified key stakeholders including environmental organizations, developers, special interest groups, local business owners, agricultural operators, drinking water and sewer customers, and political organizations. Five public workshops were held. The Communications Plan has been updated in the 2017 Update to keep the public and other agencies engaged in and informed about the projects or management actions.

8.5.1.5. Permitting and Regulatory Process

The 2017 Master Plan Update indicates that agreements between agencies will be required to implement projects providing joint benefits. These agreements will be similar to the memoranda of understanding developed for previously completed projects, such as the Lessalt and West Hills WTPs and agricultural use of recycled water.

The 2017 Update also indicates that numerous federal, state, and local permits will also be required for implementation. The required permits will be identified during the preparation of the engineering predesign studies and environmental compliance documents. Recommended facilities will require environmental compliance with CEQA to evaluate the environmental impacts of the projects. Project-specific compliance would be determined on a case-by-case basis for individual projects. If federal grants or loans are used to pay for specific facilities, additional environmental review may be required to comply with the National Environmental Policy Act (NEPA). In addition, if federal facilities are impacted, such as the Hollister Conduit, NEPA compliance also may be triggered.

8.5.1.6. Legal Authority

The legal authority of SBCWD is described in the Introduction, Section 1.4.

8.5.1.7. Project Benefits

The Master Plan process has specified objectives (listed in Section 8.5.1.3) that allow qualitative evaluation of project benefits and in the case of water quality, quantitative goals that can be measured by compliance with drinking water and recycled water regulations. As described in the 2017 Update, the Master Plan process has been coordinated with this GSP. Accordingly, recent Master Plan objectives and projects have been considered in light of benefits to meeting sustainability management criteria, including changes in basin conditions (e.g., climate change) over time. The Master Plan supports maintenance of measurable objectives, particularly pertaining to levels, storage, and water quality.

8.5.1.8. Estimated Costs and Financing

The 2017 Update provides estimated costs for recommended facilities with costs presented in five-year intervals to 2025. Total costs were estimated at $31 million for the recommended facilities (HDR, 2017). Completed projects include the crosstown pipeline with an extension to City of Hollister wells 4 and 5, at a cost of $7.2 million (SSCWD, 2021). Other projects are underway including North County groundwater project and new well for the City of Hollister; other projects are in early planning stages.

As with completed projects, financing of recommended projects is through local funding and/or state and federal grants and loans. The agencies track opportunities for outside financing (grants or loans) from state water programs and federal infrastructure funding. For local financing, the agencies update their financial plans and rates.

8.5.1.9. Status and Timeline

As described in the 2017 Update, the planning period for the Master Plan Update extends from 2015 to 2035. The initial year of the planning period was selected to provide a common baseline for data related to land use, water supply and demand, and wastewater flows. The final year of the planning period coincides with the planning horizon of the 2015 UWMP. In terms of implementation, major infrastructure improvements would be completed through 2025 and the Master Plan would be updated no later than 2025.

8.5.2. City of San Juan Bautista Regional Water and Wastewater Solution

Regional water and wastewater planning is being expanded to help resolve City of San Juan Bautista issues with groundwater supply and wastewater quality.

The groundwater in and around the City of San Juan Bautista is poor quality with elevated nitrates, TDS, and hardness. The City of San Juan Bautista manages a water system with three groundwater production wells (wells 1, 5, and 6). In March 2020, well 6, the City's newest well, was taken offline because routine testing indicated nitrate concentrations increasing toward the MCL, which was subsequently exceeded. Well 6 was the third well in recent history to be affected by excessive nitrates. Such loss of well capacity is critical to the City because its best source, well 1, does not have the capacity to reliably meet City water demands and interruption of production from Well 5 potentially could result in water shortage.

The City's wastewater system collects wastewater from approximately 800 residential, commercial, industrial, and institutional accounts, and provides treatment at its wastewater treatment plant (WWTP) with subsequent discharge of the effluent into a creek ("No-Name Creek"). Because of local geologic conditions, the creek (or effluent discharge) is not considered to recharge the groundwater basin and instead flows out of the North San Benito Basin to the Pajaro River. This creek is subject to federal EPA permit requirements that are enforced through a shared permit with the SWRCB.

The WWTP operates under discharge permits with limits for salinity (chloride, sodium, and TDS), but has been and remains in violation of these three limits for several years (Stantec, 2020). The elevated chloride, sodium, and TDS concentrations have been driven by agricultural processing (which is being mitigated by new limits on and pre-treatment of industrial discharges) and by the groundwater hardness that results in use of self-regenerating water softeners throughout the community. Such water softeners result in elevated chloride, sodium, and TDS concentrations that are discharged into the City's wastewater collection system and then pass through the WWTP, contributing to the discharge permit violations.

This discharge of excessive TDS prompted the EPA and the City to work together on a schedule for the City to come into compliance with its permit by December 21, 2023. Alternatives for wastewater treatment improvements have been identified (Stantec, 2020), an alternative has been selected involving regionalization with Hollister WWTP and use of water from West Hills WTP. Currently the City of San Juan Bautista is working toward the regional water and wastewater solution, working closely with SBCWD and City of Hollister.

8.5.2.1. Description

The Regional Solution involves importing high quality water from the West Hills WTP to replace groundwater, removing residential self-generating water softeners, reducing industrial salt loading to the City wastewater, and then conveying San Juan Bautista wastewater to the City of Hollister WWTP.

For the water supply element, the San Juan Bautista Water Supply Plan (WSP) is being planned as a cooperative effort of SBCWD and the City of San Juan Bautista in which SBCWD provides imported CVP water to San Juan Bautista by means of a pipeline from the West Hills Water Treatment Plant. Water from West Hills WTP is only moderately hard (97 mg/L) and has less total dissolved solids (260 mg/L) than the water provided by the City of San Juan Bautista wells (comparable TDS from Well 1 is 628 mg/L) (Akel, 2020). As proposed, West Hills WTP surface water would be conveyed to the City of San Juan Bautista through a six-mile-long gravity-fed pipeline and blended with the City's groundwater. As of March 2021, SBCWD and San Juan Bautista are developing a mutual agreement for the WSP, which will provide for planning and implementation of the project, CEQA compliance, financing, and institutional arrangements.

With delivery of improved water quality, domestic water softeners will not be needed in the City of San Juan Bautista. A water softener ordinance is being developed that establishes a program for the timely removal of existing residential brine discharging water softening appliances and prohibition of the installation of new ones. The discharges from agricultural processing facilities are in the process of being addressed by establishing a new industrial pre-treatment program and by limiting industrial users to discharge only domestic wastewater into the City's sewer collection system (Stantec, 2020).

For wastewater treatment, the City of San Juan Bautista, in cooperation with City of Hollister, is developing a wastewater plan that involves conveyance of San Juan Bautista wastewater to the City of Hollister WWTP. This project assumes use of the higher quality West Hills water and implementation of the domestic and industrial salinity control measures noted above in order to meet City of Hollister effluent limits.

8.5.2.2. Water Source and Reliability

This project is in planning stages and technical, environmental, and regulatory feasibility are being established. Reliability of supply for the City of San Juan Bautista will be increased because the City will have two distinct sources: imported CVP water from the West Hills WTP and local groundwater supply from its own wells. The reliability of CVP is discussed in the 2020 UWMP (Todd, 2021); municipal allocations in recent years have ranged from 25 to 100 percent but are used conjunctively with local groundwater. CVP water has been used directly by the City of Hollister and SSCWD since the 2002 construction of the Lessalt Treatment Plan, and while representing an imported source, is reliable.

8.5.2.3. Feasibility and Level of Uncertainty

This project is in planning stages and technical, environmental, and regulatory feasibility are being established through engineering studies and preliminary design.

8.5.2.4. Project Implementation

Project implementation, driving toward required permit compliance by December 2023, is now in planning stages. The City of San Juan Bautista Water Compliance Plan is underway with timelines into 2022 to develop the fiscal strategy, water import, and wastewater export (Reynolds, 2021).

8.5.2.5. Public and Agency Noticing and Outreach

Community engagement for the project has included workshops, a community survey, utility bill inserts, and public presentations to the City Council. The water and wastewater issues also have been presented in the online news source, BenitoLink, with updates on project status.

8.5.2.6. Permitting and Regulatory Process

An initial review of potential environmental impacts is provided in the City's 2020 Wastewater Master Plan Appendix A (Stantec, 2020), noting that a CEQA Initial Study will be provided. Permit requirements also are listed.

8.5.2.7. Legal Authority

The legal authority of SBCWD is described in the Introduction Section 1.4 while the water supply roles and responsibilities of the cities of San Juan Bautista and Hollister are indicated in Section 2.1.

8.5.2.8. Project Benefits

Project benefits include provision of a reliable and high-quality water supply to the San Juan Bautista community, measurable in terms of delivered water quality. Because of the improved delivered water quality, use of water softeners can be reduced with resulting improvement of wastewater quality. Wastewater conveyed to the City of Hollister can be recycled, representing a new source of supply. Discharge of high-TDS water to the Pajaro River Tributary will cease; this is considered to have minimal effect on the groundwater basin because of limited recharge along the creek channel. However, cessation of the wastewater discharge will be measurably beneficial to surface water quality and reflected in compliance with discharge permit requirements. Project benefits also include enhancement of the working relationships with federal and state agencies with regulatory responsibility for water quality.

8.5.2.9. Estimated Costs and Financing

Total project costs for the Regional Solution are $13 million (see Table 24 in Stantec, 2020). The San Juan Bautista Water Compliance Plan includes development of a fiscal strategy, including a rate study and approval of new rates and applications for grant funding.

For the Water Supply Plan, the City of San Juan Bautista and SBCWD would complete an MOU that includes mutual financial commitments whereby SBCWD will finance and build the water supply pipeline to San Juan Bautista. The agreement will establish a base rate for water and cost recovery for the capital investment and operations and maintenance. This may be similar to the financing agreement between SBCWD and the City of Hollister and SSCWD for the Hollister Urban Area Water and Wastewater Master Planning Project. The City of San Juan Bautista is seeking a similar agreement with the City of Hollister wherein San Juan Bautista will finance, design, and build a force main to convey its wastewater to the Hollister WWTP.

8.5.2.10. Status and Timeline

A proposed project schedule is presented in the 2020 Wastewater Master Plan Appendix A (Stantec, 2020) with planning to be completed in November 2023.

8.5.3. North County Project

The North County Project, described in the 2017 Master Plan Update (HDR, 2017), will develop production well capacity in the northeastern portion of the North San Benito Basin to actively manage groundwater storage, to increase municipal water supply and drought year reliability, and to improve municipal water quality for the City of Hollister. The "North County" area has not been formally delineated but is generally located in the northern Hollister and northeastern Bolsa Management Areas east of the Calaveras Fault, north of the City of Hollister and extending up Pacheco Creek Valley. The area has been defined mostly on the basis of relatively low concentrations of total dissolved solids (TDS) in groundwater.

8.5.3.1. Description and Implementation

The North County Project involves siting, design, and installation of new production wells, with the possibility of including ASR operations (see also Section 8.4). The long-term goal is to develop up to 5,000 acre-feet per year (AFY) of local groundwater supply that is reliable during drought. The Project uses local groundwater from the North San Benito Basin that has a high level of certainty, given the long-term monitoring and management by SBCWD, availability of hydrogeologic information in the area, and results of numerical groundwater modeling.

Phase I would provide an estimated 1,000 acre-feet/year (AFY) of new high quality water supply to the northerly part of the combined City and SSCWD water distribution system. Facilities would include new wells, pipelines, treatment (if required), storage tank and booster pump station. Phases 2 and 3 would provide up to 5,000 AFY of reliable water supply to agricultural and M&I users. This supply would be provided by a wellfield and blended with CVP supply through a connection to the Hollister Conduit. The effort is being led by SBCWD in cooperation with the City of Hollister and SSCWD.

Numerical groundwater flow modeling has been used to assess the general technical feasibility, potential effects on groundwater levels and Pacheco Creek streamflow, and effects of the Pacheco Reservoir Expansion Project (Todd, 2018). Scenarios included various combinations of a new well for the City of Hollister, a wellfield to supply groundwater into the Hollister Conduit, the Pacheco Reservoir Expansion Project, and expansion of existing conjunctive use of groundwater and imported water. The simulation results indicate that new pumping at the proposed City well and Phase II and III well fields would not cause groundwater levels to fall below historical minimum water levels. Thus, all scenarios appear feasible from a hydrogeologic standpoint.

To further evaluate optimal sites for the Phase I City of Hollister well, SBCWD staff collected groundwater level data for wells in the North County (SBCWD, 2020). Review of these data have been used to focus on an area north of the Hollister Airport; to collect, analyze, and review water quality (including TDS, nitrate, sodium, iron, manganese, arsenic, and total hardness); and to identify the best site. An available parcel was selected with physical and legal access for test drilling. As of March 2021, a test well has been installed and sampled.

Next steps involve a feasibility study with evaluation of well yield and water quality, definition of any need for treatment and process, refinement of conceptual facilities plans, updating operational scenarios and distribution system modeling, updating estimated costs and economic analysis, and preparation of a feasibility study report.

8.5.3.2. Water Source and Reliability

The source of water for the project is local groundwater, which is sustainably managed by SBCWD GSA in partnership with local agencies including City of Hollister and SSCWD.

8.5.3.3. Level of Uncertainty

The project is based on best available information about the North San Benito Basin and a series of investigations that have involved numerical groundwater flow modeling, water quality sampling and analysis, installation and sampling of a test well, and engineering feasibility studies.

8.5.3.4. Public and Agency Noticing and Outreach

Public noticing has occurred through the public meetings of the boards of directors for SBCWD and SSCWD, and City of Hollister City Council. Initial outreach for the North County Project has been included in the 2017 Update and continued as part of this GSP.

8.5.3.5. Permitting and Regulatory Process

As summarized in the 2017 Master Plan Update, multiple institutional agreements may be needed to implement the North County Project depending on its scope:

- Agreements between SBCWD and Valley Water and/or Pacheco Pass Water District (PPWD) for operation of the existing Pacheco Dam and Reservoir or an expanded facility.
- Agreement between the USBR and the SBCWD to use the Hollister Conduit for transmission of North County groundwater (Warren Act).
- Agreements between North County landowners and SBCWD for banking/exchange of groundwater and CVP supplies.

A MOU has been developed in 2019 among SBCWD, City of Hollister, and SSCWD for Phase I of the North County Groundwater Project. The MOU summarizes the project, its objectives and scope of a feasibility study, program management, budget, and cost sharing.

The 2017 Update also indicates that numerous federal, state, and local permits will also be required for implementation. The required permits will be identified during the preparation of the engineering predesign studies and environmental compliance documents. For this project, a complete EIR will be required. If federal grants or loans are used to pay for specific facilities, additional environmental review may be required to comply with NEPA. In addition, if federal facilities are impacted, such as the Hollister Conduit, NEPA compliance also may be triggered.

8.5.3.6. Legal Authority

The legal authority of SBCWD is described in the Introduction Section 1.4 while the water supply roles and responsibilities of the City of Hollister are indicated in Section 2.1.

8.5.3.7. Project Benefits

Project benefits of the North County Project relate to financing, fire suppression flows, and water deliveries through the City of Hollister and SSCWD water distribution system. Relevant to SGMA objectives for groundwater levels and storage, the Project enhances conjunctive use by providing an additional 1,000 AFY of reliable high quality water supply to the HUA, especially during dry years. Relative to water quality, quantitative goals can be measured by improved quality of groundwater delivered for City of Hollister drinking water purposes.

8.5.3.8. Estimated Costs and Financing

The 2017 Update provides estimated costs for the North County Groundwater Project at $6.7 million. As with other Master Plan projects (see Section 8.5.1.5), financing would occur through local funding and/or state and federal grants and loans.

8.5.3.9. Status and Timeline

Planning and investigations are underway. The estimated timetable for the North County Project, as described in the 2017 Update, indicated that most work and costs would occur in 2021-2025.

8.5.4. Zone 3 Operations Planning Tool

SBCWD owns and operates two reservoirs along the San Benito River. Hernandez Reservoir (capacity 17,200 AF) is located on the upper San Benito River in southern San Benito County. Paicines Reservoir (capacity 2,870 AF) is an offstream reservoir between the San Benito River and Tres Pinos Creek. It is filled by water diverted from the San Benito River, with some of the diversions consisting of natural runoff and some consisting of water released from Hernandez Reservoir. Water stored in the two reservoirs is released for percolation in Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season. Zone 3 is the zone of benefit for the operation of these facilities (see **Figure 1-2)**.

The project includes development, application, and periodic review and refinement of the Zone 3 Operations Planning Tool (Micko, 2017). This Tool creates annual operations plans for Hernandez and Paicines Reservoirs and for re-diverting Hernandez Reservoir releases to Paicines Reservoir at the San Benito River Diversion (Hill) Diversion. Source water for this project is local San Benito River streamflow as regulated by Hernandez and Paicines reservoirs, which are owned and operated by SBCWD.

8.5.4.1. Description

In 2017, SBCWD sponsored development of the Zone 3 Operations Planning Tool to create annual operations plans for Hernandez and Paicines Reservoirs and for re-diverting Hernandez Reservoir releases to Paicines Reservoir at the San Benito River Diversion (Hill) Diversion. The objective for developing the tool was to standardize and facilitate the annual effort to plan Hernandez operations under differing hydrologic and water supply conditions consistent with an adopted water supply management strategy. The Zone 3 Operations Planning Tool generates annual operation plans for coordinated management of surface water and groundwater supplies in the San Benito River watershed.

The Planning Tool is based on available hydrologic data, including precipitation at the Hollister and Hernandez rain gauges, current flow at the Tres Pinos Creek and San Benito River streamflow gauges (through online links), depth to groundwater data for selected wells for April, Hernandez and Paicines reservoir storage and releases, and imported water information including the CVP Agricultural Allocation, other imported supplies for the current year, if any, and current San Justo Reservoir storage.

The annual plans then are developed based on current hydrologic conditions, current surface water supplies, and spring groundwater levels. The plans are developed consistent with an overall basin management strategy to effectively utilize local supplies and imported water supplies.

8.5.4.2. Project Implementation

The Project is implemented annually. The Tool provides for input of hydrologic data, and the program should be run in April, May, and June. The program creates a Zone 3 Operations Plan. The plan includes target monthly Hernandez Reservoir release rates, total release volume and October 1 carryover storage. The Plan also includes target diversion to and releases from Paicines Reservoir. Current and projected end-of-season operational storage levels are provided for Zone 3 groundwater subbasins. The initial plan includes program-selected release and transfer values.

8.5.4.3. Water Source and Reliability

The source of water includes San Benito River flows, as regulated by SBCWD through operations of its Hernandez and Paicines reservoirs. These flows are reliable in terms of local control and continuing operations but are subject to drought and climate change. Effects of climate change are addressed in Section 8.1.1 Climate Change.

8.5.4.4. Level of Uncertainty

The Planning Tool is based on available hydrologic data and application of hydrologic accepted analyses and reasonable assumptions. Uncertainties with regard to the basin setting (local hydrology and groundwater levels) are addressed by ongoing monitoring.

8.5.4.5. Public and Agency Noticing and Outreach

The outcome of reservoir operations is summarized in the Annual Groundwater Report, including reservoir water budget information for Hernandez, Paicines, and San Justo reservoirs and annual total releases from Hernandez and Paicines reservoirs.

8.5.4.6. Permitting and Regulatory Process

The Planning Tool development required no permitting, regulatory, or environmental review process.

8.5.4.7. Legal Authority

The legal authority of SBCWD is described in the Introduction Section 1.4.

8.5.4.8. Project Benefits

Releases from Hernandez and Paicines reservoirs are managed to maximize percolation along the stream channels of the San Benito River and Tres Pinos Creek and to avoid losses out of the basin. The Planning Tool helps optimize these benefits, with benefits to Southern MA and also to the Hollister and San Juan MAs downstream. This tool helps maintain measurable objectives pertaining particularly to groundwater levels and storage, and groundwater quality by optimizing recharge of relatively good quality surface water.

8.5.4.9. Estimated Costs and Financing

Original 2017 costs to develop the Planning Tool involved consultant costs (Micko Consultants) and amounted to $29,260.

8.5.4.10. Status and Timeline

This project is ongoing, with continuing accrual of benefits.

8.6. ENHANCE WATER CONSERVATION

Water conservation is an ongoing program for sustainable water supply, with additional measures for drought and water shortage. In San Benito County, local water agencies—including SBCWD, City of Hollister, City of San Juan Bautista, and SSCWD—formed the Water Resources Association of San Benito County (WRA) to implement water conservation and water resource protection, including Best Management Practices (BMPs) for water demand management. For its service area in Santa Clara County (including areas in North San Benito Basin), Valley Water has extensive water conservation efforts conducted through its Water Conservation Program (SCVWD, 2021c).

8.6.1. Description

The San Benito WRA retains a Water Conservation Coordinator, who is a SBCWD employee, to serve the water conservation needs for the WRA residential, commercial, and agricultural water users.

Responsibilities of the Coordinator are to administer, implement, analyze, and evaluate water management and conservation programs, including program cost, water consumption patterns, and estimates of water savings and demand reduction. The Coordinator is responsible for specific BMPs listed in the UWMP, including utility operations (e.g., ordinances, metering programs, tiered pricing), public education and outreach, residential programs, business programs, and landscape programs (Todd, 2021).

Implementation of the water conservation program for the HUA is achieved through the UWMP, (Todd 2021), prepared by a partnership of SBCWD, the City of Hollister, and SSCWD. UWMP preparation is closely coordinated with the Water and Wastewater Master Plan (described in Section 8.5) and this GSP. The UWMP is prepared consistent with DWR guidelines.

Water conservation in SBCWD's CVP service area (Zone 6) is covered by the Agricultural Water Management Plan (AWMP) which implements water conservation efforts within the agricultural sector. SBCWD implements an Enhanced Watershed Management Program through the AWMP and includes volumetric and incentive pricing, farm irrigation and infrastructure capital improvements, and other waste reduction measures (SBCWD, 2015).

8.6.2. Project Implementation

While the conservation efforts listed in Section 8.6.1 are ongoing, implementation of additional conservation measures is triggered by drought or other shortage conditions.

SBCWD, City of Hollister, SSCWD, and Valley Water have all passed ordinances/resolutions to address shortages in water supply. In addition, the HUA agencies have created a Water Shortage Contingency Plan (WSCP), which serves as a guide for adjusting supply and demand in response to a water shortage. (Todd, 2021). The WSCP (presented in the HUA UWMP) includes a six-stage plan addressing water shortage stages of up to 10 percent, 20 to 30 percent, 40 to 50 percent, and greater than 50 percent of water supply. Valley Water similarly has a WSCP implemented through the Valley Water UWMP (SCVWD, 2021a).

Implementation of restrictions and prohibitions is based on a fundamental prioritization of domestic supply for human health and safety over non-essential uses, including landscape irrigation. In the event of a water shortage, water service may be restricted or prohibited for non-essential uses, recognizing that certain end users may be required to save more water than others because of their specific use. Prohibitions on end uses will affect user types differently:

- For urban residential users (who typically rely on HUA agencies for domestic supply), water service will continue during a shortage with restrictions on outdoor water use in Stages 1 through 5 and prohibitions in Stage 6.
- Rural residential users of CVP M&I water (i.e., five-acre parcels) would also be subject to restrictions and prohibitions on outside water features and landscape irrigation.
- Landscape irrigators (e.g., golf courses, dedicated irrigation meters) are subject to increasing restrictions for Stages 1 through 5 and the prohibition in Stage 6.
- Commercial businesses are subject to all restrictions in Stages 1 through 5 and prohibitions in Stage 6.

The specific water demand reduction actions are specified in the WSCP along with the respective trigger stages. The communication protocols also are described through which the water agencies alert the public when a water shortage stage has occurred and is lifted. Legal authorities of the agencies also are documented.

In 2014, SBCWD passed a Water Shortage Emergency resolution asking for voluntary conservation by Municipal and Industrial users as well as small parcel customers. Another resolution was passed establishing an over-use charge for agricultural users (SBCWD, 2021).

8.6.3. Water Source and Reliability

Water conservation actions address all sources of water supply with the exception of recycled water, which is considered a reliable resource. These actions increase reliability of water sources by reducing demand.

8.6.3.1. Level of Uncertainty

Water conservation efforts have a measurable effect on water demand, as documented in the HUA and Valley Water UWMPs. For example, in 2015, in response to drought, the HUA community decreased water demand by 23% in response to increased public outreach and education and restrictions similar to Stage 2 of the WCSP. Similarly, water use in Santa Clara County over the past seven years has decreased by about 21% compared to 2013, the wet year prior to the 2014-2016 drought (Valley Water News, 2021). It is noteworthy that water demand has not rebounded to pre-drought water use. This is due in large part to the public outreach and permanent changes enacted during the drought. Turf that was removed has not been replaced, high efficiency appliances remain in homes, and landscape plans continue to keep irrigation efficient.

While these improvements have resulted in decreased water demand, the future potential gains from the rebate and retrofit programs are less certain and may be limited by demand hardening. The WRA will continue to provide public outreach and education about irrigation efficiency. While these programs are difficult to account per unit water savings, the overall effect of reducing demand during the drought demonstrates the overall water savings.

8.6.4. Public and Agency Noticing and Outreach

Public outreach is ongoing within the HUA and Valley Water as part of demand management measures. The nature and extent of outreach that has been implemented is quantified in the respective UWMPs (Todd, 2021; SCVWD, 2021a) that are updated every five years. Additional noticing and outreach are implemented when shortages occur. Implementing any stage of the WCSP involves clear and timely communication with the public, stakeholders, key decisionmakers, and local, regional, and state governments. The WSCP Communication protocols allow agencies to efficiently communicate any current or predicted water shortages and response actions that are triggered. Communication protocols are outlined for each stage in the UWMPs.

8.6.5. Project Benefits

Benefits are enhanced water conservation, which is fundamental to cost-effective management of water supplies for all beneficial uses in North San Benito. Water conservation directly helps to maintain measurable objectives relative to groundwater levels and storage, with indirect benefits to preventing subsidence and maintaining connected surface water, especially in drought. As part of the UWMP five-year updates, demand management measures and WSCPs are evaluated and updated as appropriate. The evaluation process includes quantifying water conservation efforts of each demand management measure. For the HUA, the effectiveness of the WSCP was quantified during the 2011-2016 drought, when HUA agencies were able to reduce water demand in 2015 by more than 25 percent.

8.6.6. Estimated Costs and Financing

The HUA agencies provide funding for the WRA. The annual budget has increased from $324,000 in fiscal year 2015-2016 to $372,000 in fiscal year 2020-2021 (not including additional consultant funding for development of the UWMP). The water waste ordinances are enforceable for retailer customers in the City of Hollister and SSCWD. Enforcement costs are a part of each agency's overhead. The Valley Water conservation budget for FY 2017 was $5.7 million (for the entire county), funded by water charges, cost-share agreements, and grants (SCVWD, 2016).

The HUA Agencies proactively prepare for periodic revenue shortages and periods of increased spending that occur during droughts. All surplus revenues that SBCWD, City of Hollister, and SSCWD collect are currently reinvested into the water supply system in preparation for potential revenue reduction during water shortages. Based on projected and observed declines in revenue during shortages, the entities determined rate increases may be needed in the WSCP Stage 2 through 6 to maintain the same revenue.

8.6.7. Status and Timeline

The water conservations efforts are ongoing with demand management measures always in place. When drought or other shortages occur, the WSCP is enacted based on each shortage stage. Urban water management plans (including WSCPs) are updated every five years, consistent with the water code and guided by DWR.

8.7. IMPROVE MONITORING PROGRAM AND DMS

As presented in Section 7.5, Assessment and Improvement of Monitoring Network, this GSP has identified data gaps and has made recommendations to fill those gaps. Some of these are addressed elsewhere in this GSP. Most notably, **Appendix H** summarizes siting of the new dedicated monitoring wells installed in 2021 with DWR SGWP Round 3 grant funding. Monitoring program and Data Management System (DMS) improvements described in this section are organized as follows:

- Measure agricultural groundwater extraction
- Improve monitoring well network and DMS
- Improve water quality monitoring program
- Enhance surface water gaging.

8.7.1. Description

These managements actions are applicable mostly to the San Benito County portion of the Basin, within the jurisdiction of the SBCWD GSA. For the small area in Santa Clara County (3,354 acres), Valley Water GSA can utilize or develop its own or similar programs applicable to its jurisdiction. Data sharing is ongoing between the GSAs.

8.7.1.1. Measure Agricultural Groundwater Extraction

GSP Regulations require annual reporting of groundwater extractions except for those of de minimis users. Municipal pumping is regularly metered and reported, and SBCWD has measured agricultural pumping in Zone 6 using pump power meter records. However, a single, reliable, and consistent method of measuring agricultural pumping is needed for the entire basin. This management action pertains to the San Benito County portion of the basin.

Alternative methods of measuring agricultural groundwater extraction have been evaluated as part of this GSP, with input from the TAC and stakeholders, see Section 1. Alternative methods considered for North San Benito have included 1) use of pump power meters, 2) use of in-line discharge meters on wells, and 3) remote sensing techniques. Criteria to evaluate the three alternatives have included:

- Accuracy and reliability relative to purpose
- Costs and allocation of costs between the GSA and well owner
- Feasibility and timing of implementation
- Ease of ongoing data collection and maintenance
- Well owner acceptability and cooperation.

To summarize, use of power meters has been removed from further consideration because it is not sufficiently accurate and reliable. Use of in-line meters may be a viable option because it is relatively accurate (with regular checking/maintenance), understood by well owners, and gives growers direct access to their pumping data. Drawbacks of meters include a possible lack of acceptance by owners, slow implementation as hundreds of meters are installed by well owners, the probable need for SBCWD to establish access to each well for verification, the cost of the meter to the well owner, and the need for SBCWD staff time and ongoing access to the meter.

8.7.1.2. Remote sensing can overcome many of the drawbacks of the other methods, but it is a relatively new and evolving technology. To further explore this option, SBCWD conducted a brief pilot study in 2021 to test the remote sensing services offered by a private vendor. Improve Monitoring Well Network and DMS

SBCWD has had a quarterly groundwater level monitoring program since 1977 that has provided the basis for groundwater level contour maps, change maps, hydrographs, groundwater level profiles, and storage change computations. Assessment of the monitoring network (Section 7) has identified data gaps including uneven distribution across the basin, reliance on private production wells, and insufficient data on vertical gradients. Many private wells used in the network lack well construction information, and others lack a unique ID, do not have an accurate reference point, and/or have access issues. The 2021 installation of grant-funded, dedicated monitoring wells provides significant improvement to the network, as does the ongoing effort to assess the network coverage, to identify more existing wells for the program, and to digitize well information.

This management action involves regular review and evaluation of wells included in the SBCWD monitoring network and programs (levels and quality) as an ongoing, adaptive effort. This would include potential discontinuation of wells with inadequate documentation or problematic access and wells that are deemed unnecessary, and it would include addition/installation of monitoring sites as needed. It also includes review of monitoring schedules and frequency to match the monitoring objective, e.g., quarterly monitoring of groundwater levels for Key Wells and a minimum for other wells.

Other recommendations include improvement of the well inventory part of the DMS:

- Develop and implement a program to provide unique well identification beginning with monitored wells. This would allow discontinued use of well names as identifiers and would comply with data and reporting standards described in GSP Regulations §352.4. For all monitored wells, document well information (e.g., unique site ID, identified reference point, well completion report if available, etc.) in a GIS-linked database; this is a priority task for GSP implementation.
- Develop a procedure to regularly document private well locations and construction information and compile into a well inventory database; this will increase knowledge of private wells that potentially could be affected by regional groundwater level or water quality changes. This documentation would occur annually and involve data compilation for all newly permitted wells and incremental documentation of previously permitted wells or wells in an identified gap area.
- Enhance the DMS with cross-referencing of monitoring sites (groundwater and surface water) relative to location and monitoring for regional groundwater level, groundwater quality, shallow groundwater, subsidence, or managed aquifer recharge.

8.7.1.3. Enhance Outreach on Well Permitting

As indicated in Section 2.1.5.5, SBCWD has authority for well permitting in San Benito County. to minimize construction of new wells with insufficient well depth, SBCWD will provide outreach to local well drillers and prospective well owners, for example, through its website and well permitting process. Such outreach will inform well drillers about the MTs for groundwater levels. This will likely involve description of the MTs and Key Wells, provision of information (for example, a general map of MT depths to water) to guide well drillers, and explanation of the potential risks of shallow wells.

8.7.1.4. Improve Water Quality Monitoring Program

SBCWD has established a water quality monitoring program with quarterly to semiannual sampling of groundwater at about 20 wells (see Section 6.6.4.1). This program is intended to protect beneficial uses and support groundwater management decisions, with some wells included to represent regional conditions and others to track local problems. The distribution of monitored sites is uneven, with most sites in Hollister and San Juan MAs (see **Figure 4-15**). Additional potential improvements to the SBCWD monitoring network have been identified, including the 2021 program to install shallow and deep dedicated monitoring wells for improved distribution of sites and better representation of basin conditions geographically and vertically (see **Appendix H**).

Another recommendation is to review wells that are monitored as part of the RWQCB Irrigated Lands Regulatory Program (ILRP), evaluate them for inclusion in the SBCWD program, and add them, with mutual agreement with the well owner. This action would involve an initial systematic review of the ILRP wells, subsequent acquisition of access agreements, and then periodic review and update.

The evaluation of sustainability criteria for water quality constituents of concern—TDS and nitrate—also highlighted the problem of legacy loading. This involves historical salt and nitrate loading at the ground surface (for example, due to irrigation, use of fertilizers, or wastewater disposal) and the unknown lag time until the loading affects deeper groundwater zones used by wells. Uncertainties include the amount of historical loading relative to current loading at any given site and the rates at which constituents are moving down to affect deep pumping zones. Because of legacy loading, current water quality results and trends may be indicative of past, not current, land uses and practices.

Given this problem, additional investigations and monitoring are recommended (but not yet scoped) to better understand vertical distribution and migration of TDS and nitrate in the subsurface. A focus would be on shallow groundwater conditions that reflect recent and current loading, but studies also should include sampling in areas where the water table is relatively deep, in order to assess nitrogen removal in the vadose zone. The pilot program noted in section 8.7.1.2 also explored ways to provide information to growers to help manage nitrogen and phosphorus loading.

8.7.1.5. Enhance Surface Water Gaging

As noted in the December 2018 Technical Memorandum on Data to Support GSP Preparation, only four stream gages are currently operated in the Basin (see Figure 3-3) and a stream gage on upper Tres Pinos Creek has been identified as a priority item. As shown on Figure 3-3, two gages are at or near the outlet of the North San Benito Basin and two gages are near surface water inflow sites, one on upper Pacheco Creek and another on the San Benito River above Paicines.

A new stream gage on lower Tres Pinos Creek above Paicines could allow measurement of inflow (depending on specific location) from the middle and upper reaches of Tres Pinos Creek, Las Aguilas Creek, and Los Muertos and Quien Sabe creeks. A gage just below the confluence of middle Tres Pinos Creek and Los Muertos Creek would provide data for a previously ungaged watershed. The streamflow data will inform the understanding of groundwater conditions in Southern Management Area, refinement of the groundwater flow model and the Zone 3 Operations Planning Tool, and improvement of surface water recharge operations along Tres Pinos Creek and the San Benito River.

The four existing gages represent collaboration of SBCWD and the U.S. Geological Survey (USGS), in which USGS installs, operates, and maintains the gage. A similar approach is assumed for a potential Tres Pinos gage.

8.7.2. Project Implementation

These monitoring and data management actions can be implemented as follows:

- **Investigate Alternatives for Measurement of Agricultural Groundwater Extraction**. This is a high-priority action that is required specifically in GSP Regulations with annual reporting. At this time, SBCWD is exploring multiple remote sensing-based options for estimating ET as a means of estimating and tracking total and groundwater use.
- **Improve Monitoring Well Network and DMS.** Development of unique well identification program and improvements to the DMS, such as cross referencing and organization of a well inventory, should be started without delay and completed within two years. Documentation of private well locations and construction can be phased, with priority given to areas with numerous domestic wells that might be adversely impacted by drought. The initial effort should be completed in the first 5-year period. Thereafter the inventory should be updated annually.
- **Improve Water Quality Monitoring Program**. Installation of dedicated shallow and deep monitoring wells was initiated in 2021. Review of wells in the ILRP for addition to the SBCWD program can be initiated with the next triennial water quality update.

Enhance Surface Water Gaging. It is assumed that gage installation will involve agreement between SBCWD and USGS, in which USGS installs, operates, and maintains the gage. Communication with USGS can begin within the first-five year period. An implementation issue is the cost of installing and maintaining a surface water gage. It is assumed that SBCWD would explore a cost-sharing agreement with USGS. However, other options can be explored such as acoustic water level sensors that can be mounted on the undersides of bridges.

8.7.3. Public and Agency Noticing and Outreach

Progress on the recommended management actions will be summarized in the Annual Groundwater Reports and associated public meetings.

8.7.4. Permitting and Regulatory Process

The permitting, regulatory process, and environmental review for installation of shallow monitoring wells will be summarized in the Well Drilling and Construction Technical Memorandum for the North San Benito Basin Dedicated Groundwater Monitoring Wells, which is being prepared in 2021.

. The various studies and procedural improvements require no permitting, regulatory, or environmental review process. Installation of a surface water gage is categorically exempt from CEQA review as a data collection activity (2019 CEQA guidelines §15306)

8.7.5. Legal Authority

The legal authority of SBCWD GSA is described in the Introduction, Section 1.4, and includes monitoring, conduct of investigations, and agreements with other agencies. This broad authority includes measurement of groundwater extraction (as in Zone 6). SGMA not only empowers but requires GSAs to measure and report groundwater extraction on an annual basis.

8.7.6. Project Benefits

Benefits of these four management actions involve the following:

- **Investigate Alternatives for Measurement of Agricultural Groundwater Extraction**. Accurate measurement of agricultural pumping will benefit understanding of the water balance and will inform model updates and refinement. This in turn supports improved management of groundwater levels and storage (pertinent to measurable objectives for levels, storage, subsidence, and connected surface water). Measurement of groundwater extraction will provide a basis for a groundwater extraction fee planned for the future that will fund continued extraction measurements in the San Benito portion of the basin.
- **Improve Monitoring Well Network and DMS.** These management actions support accurate and cost-effective data management that support all measurable objectives across the entire basin. Particular benefits may accrue to areas with numerous domestic wells that might be adversely impacted by drought.
- **Improve Water Quality Monitoring Program**. These management actions promote water quality monitoring efforts across the basin and provide most benefit with regard to water quality objectives.
- **Enhance Surface Water Gaging.** Installation of a gage on Tres Pinos Creek will benefit understanding of the water balance, support update and refinement of the groundwater flow model, and allow refinement of the Zone 3 Operations Planning Tool that helps optimize recharge. This support maintenance of measurable objectives relative to groundwater levels,

storage, and connected surface water. Benefits will accrue particularly to the Southern MA and also to Hollister and San Juan MAs.

8.7.7. Estimated Costs and Financing

Estimated costs and financing involved with these four management actions are described below.

- **Investigate Alternatives for Measurement of Agricultural Groundwater Extraction**. At this time, SBCWD is exploring multiple remote sensing-based options for estimating ET as a means of estimating and tracking groundwater use and is planning to initiate a full-scale remote sensing program in 2022; an estimated annual cost is $125,000 per year and would be funded by the groundwater extraction fee for the San Benito portion of the basin.
- **Improve Monitoring Well Network and DMS.** Development of a procedure for annual compilation of well information and maintenance of a well inventory database should occur in the first two years as part of the annual monitoring and reporting effort, which will be funded by the Groundwater Management Fee. Ongoing data compilation and well inventory update will be conducted by SBCWD staff.
- **Improve Water Quality Monitoring Program**. Additional review of the SBCWD groundwater quality monitoring program and potential addition of ILRP wells would likely by accomplished as part of the annual monitoring and reporting effort, which will be funded by the Groundwater Management Fee.
- **Enhance Surface Water Gaging.** Installation of a USGS stream gage is estimated to cost about $32,500 (as of 2017) with a cost of about $19,000 per year for annual operation and maintenance. Other options (see Section 8.7.2) may be less costly. Financing will be funded by the Groundwater Management Fee.

8.7.8. Status and Timeline

As described in Section 8.7.2, implementation is planned to start in the first five-year period and to continue as needed with immediate and continuing accrual of benefits.

8.8. Develop Response Plans

The discussion in Section 6.2.6 for setting Minimum Thresholds for chronic lowering of groundwater levels concludes that such undesirable results are not occurring in North San Benito and that the basin is managed sustainably relative to groundwater levels. Nonetheless, declining groundwater levels are likely to occur at times due to drought and climate change and may approach Minimum Thresholds. Regular groundwater level monitoring and annual reporting will provide an early warning system; however, a response plan is warranted.

Similarly, review of water quality data indicates potential for rapid increases in some constituents (see for example, **Figure 4-19**). While likely indicating a local problem and not a basin-wide sustainability issue, the usefulness of a systematic response program was recognized.

This management action is to develop such response plans.

8.8.1. Description

This management action is applicable throughout the North San Benito Groundwater Basin. However, the focus here is the San Benito County portion of the Basin, within the jurisdiction of the SBCWD GSA. For the small Basin area in Santa Clara County (3,354 acres), Valley Water GSA can utilize or develop its own or similar programs applicable to its jurisdiction. Data sharing—including discussion of any significant groundwater level declines—is ongoing between the GSAs.

A response program for declining groundwater levels would be based on the groundwater level monitoring program and linked to monitoring of the Key Wells. As groundwater level declines are tracked, initial response actions would include data verification; evaluation of the rate, extent, and pattern of declines; identification of factors causing the decline; assessment of potential undesirable results in nearby wells; and consideration of potential response actions. Initial responses would likely involve intensified outreach and educational efforts by the GSA (or WRA) and promotion of voluntary efforts. Responses may involve a series of stages similar to those in Water Shortage Contingency Plans. Response efforts would be developed specific to the management area and situation.

- For the Southern MA, SBCWD would likely begin more active recharge along the San Benito River and Tres Pinos Creek, with surface water management and percolation to increase groundwater in storage for the agricultural areas and Paicines community upstream of Swanson's Bluff. This action would be modified considering downstream conditions in the Hollister and San Juan MAs, which could be affected by similar conditions at the same time.
- For the Hollister and San Juan MAs, responses would likely involve more active/focused conjunctive use operations including additional purchases and percolation of imported water (in average and wet years when more water is available) and acceleration of projects such as the MAR project.
- For the Bolsa MA, supplemental water sources are not readily available. Following the initial response actions listed above, specific measures to manage water demand should be identified (for example, a tiered pricing structure) and classified to provide staged responses to problems of increasing severity.

Similarly, a response program for rapid, potentially adverse changes in groundwater quality would be developed based on the water quality monitoring program with links to the Water Quality Key Wells. The program would be focused on detecting local sources of degradation that impact groundwater quality relatively strongly and rapidly. This is distinct from the ongoing water quality improvement programs that address the slow, dispersed loading of salts and nitrates from agricultural, rural, and urban activities. The intent is early detection of local impacts that can enable appropriate actions to halt further local contamination before the impacts become severe or widespread. As with the groundwater levels program, the water quality program would include data verification, evaluation of potential sources of the water quality degradation, assessment of potential undesirable results in nearby wells, and consideration of potential response actions. Potential actions would include focused outreach and education, and cooperation with the appropriate regulatory agency.

8.8.2. Project Implementation

Given definition in this GSP of Minimum Thresholds at Key Wells and implementation of the GSP monitoring network, development of these response programs can proceed during the first five-year period. These actions are intended to be rapid responses on an as-needed basis, thus should be "on the shelf" and ready when needed, with periodic review and update.

8.8.3. Public and Agency Noticing and Outreach

Notice to the public and other agencies that the development of these management actions is being considered can occur through the Annual Report and associated public presentations. Each response action may involve specific and more intensive outreach and noticing efforts, as described above. Thereafter, the response programs will be ongoing, and implemented when needed.

8.8.4. Permitting and Regulatory Process

It is anticipated that the rapid response programs would be implemented within the existing authorities and water management and thus would not trigger any permitting requirements, environmental review, or regulatory process.

8.8.5. Legal Authority

The legal authorities of SBCWD and Valley Water are described in the Introduction Section 1.4.

8.8.6. Project Benefits

Benefits would involve the capability to respond systematically and rapidly to potential adverse water level decline and water quality deterioration issues. Benefits would accrue to the entire North San Benito community with rapid identification and resolution of potential problems, indicated by a slowing of groundwater level declines and cessation/cleanup of potential contaminant sources. These actions help maintain the measurable objectives relative to groundwater levels and groundwater quality.

8.8.7. Estimated Costs and Financing

Costs to develop such programs are estimated at $15,000 each. Implementation will be dependent on the actual scope of the programs and the severity and extent of groundwater level declines or quality problems, with most issues potentially handled within the general operations of SBCWD staff, but some issues warranting more intensive investigation.

8.8.8. Status and Timeline

Program development can start within the first five-year period with accrual of benefits as the programs are used.

8.9. Enhance Water Quality Improvement Programs

As discussed in Section 6, Sustainable Management Criteria, local groundwater water quality is naturally mineralized and affected by human activities, including salt and nitrate loading. While groundwater quality has not been shown to change significantly and groundwater continues to be used for beneficial uses, an objective of the GSAs is to improve groundwater quality and the strategy of this GSP is to identify and implement management measures to reduce nitrate and salt loading. Measures already undertaken and to be continued include operation of HUA water treatment plants that allow expanded use of CVP water and thereby improve wastewater quality, HUA wastewater treatment improvements (nitrate reduction) and water recycling, HUA and WRA programs to reduce salt loading from water softener use, and the RWQCB ILRP, which requires nitrate budgeting for most irrigated fields in San Benito County.

8.9.1. Description

Additional management actions identified to enhance water quality include collaboration with UC Extension and other organizations toward reduced nitrate and salt loading by agriculture, support to farmers for use of remote sensing to optimize fertilizer applications, and cooperation with the County and local agencies on regulation of water softeners and wastewater treatment/disposal including onsite wastewater treatment systems (see also Sections 8.5.1.1 and 8.5.2 on current efforts).

Additional analyses of the salt balance may be considered, potentially using the numerical model to assess salt outflows. A general indication of salt flushing from the basin is provided by the water balance information in Section 8.1 Simulation of Future Conditions with Climate Change and Growth. Groundwater discharge to streams in the San Juan and Bolsa MAs are flows that remove salts from the Basin. However, those outflows represent only 6.6 percent and 10.7 percent of total inflows to those MAs, respectively. Thus, it is likely that salts will continue to accumulate in the Basin. Increasing outflow as a percentage of inflow generally decreases the long-term equilibrium salt concentration in a basin, but the locations and salinities of individual sources of recharge make a significant difference. Modifying the regional groundwater flow model to simulate salt loading and transport would provide a clearer picture of long-term salinity trends and equilibrium concentrations.

A Salt and Nutrient Management Plan (SNMP) was developed for the San Benito County portion of the Basin in 2014.[12] As summarized in Section 4.5, this SNMP identified sources of salts and nutrients, assessed potential impacts of recycled water projects, confirmed ongoing measures to manage salt and nutrient sources, and laid out a monitoring program. Update of the Salt and Nutrient Management Plan (SNMP) would build on the new information provided by monitoring of the new dedicated shallow and deep monitoring wells, triennial updates (planned for 2022 and 2025), and addition of ILRP wells (see Section 8.7.1.2).

8.9.2. Project Implementation

Implementation of these management actions can begin as needed during the first five-year period with preparation of the SNMP in the second five-year period. Cooperation with other agencies is ongoing.

8.9.3. Public and Agency Noticing and Outreach

Notice and outreach to the public and other agencies about these management actions will occur through the Annual Report and WRA outreach. The SNMP process includes agency involvement and public outreach.

[12] Santa Clara County areas of the Basin were not included in the SNMP study area. Nonetheless, data were provided on maps, including available land use and water quality data. No recycled water projects have been planned for these areas. It is likely that this approach would be maintained. In 2014 Valley Water prepared SNMPs for the Llagas and Santa Clara basins.

8.9.4. Permitting and Regulatory Process

The management actions included in this section are studies, plans, or ongoing programs that would be implemented within the existing authorities and water management functions of the GSAs and may not trigger permitting requirements. CEQA review is not required for planning studies. Actions to improve water quality by reducing pollutant loading would fall under the “common sense exemption” for CEQA review (CEQA Guidelines Section 15051(b)(3)) unless there were an ancillary activity such as disposal of brine concentrate from a demineralization facility.

8.9.5. Legal Authority

These actions are within the legal authority of SBCWD as described in the Introduction Section 1.4.

8.9.6. Project Benefits

Benefits would involve improved understanding of groundwater quality conditions and occurrence of constituents of concern, notably TDS and nitrogen. This in turn supports improved management, and maintenance of measurable objectives relative to TDS and nitrate. Benefits would accrue to the entire North San Benito community.

8.9.7. Estimated Costs and Financing

Consultant costs to develop a SNMP for North San Benito Basin are approximately $250,000. The remaining management actions may be handled within the general operations of SBCWD staff, with some issues potentially warranting more intensive investigation with use of consultants.

8.9.8. Status and Timeline

SNMP development would benefit from the next two triennial water quality updates and thus is planned for the second five-year period. It would require about two years to complete. The other management actions can start within the first five-year period with accrual of benefits as the programs are used.

8.10. Reduce Potential Impacts to GDEs

Previous sections of the GSP (Section 4.11, Interconnection of Surface Water and Groundwater, and Section 6.7, Depletions of Interconnected Surface Water) provide information on surface water-groundwater connections, identify potential GDEs (riparian vegetation and steelhead), discuss potential undesirable results, define a minimum threshold using groundwater levels as proxy, describe monitoring for GDEs, and discuss implementation of recommended actions to better quantify the relationship between groundwater levels and habitat conditions and to explore means to reduce potential impacts to GDEs. This section describes these recommended actions.

8.10.1. Description

The first recommended action involves installation of dedicated shallow monitoring wells to measure water table depth at locations where riparian vegetation might potentially be impacted by pumping. This was initiated in 2021 as part of this GSP. As described in **Appendix H**, six shallow monitoring wells have been sited at locations near the Pajaro River, Pacheco Creek, San Benito River (two sites), Paicines

Creek, and Tres Pinos Creek. The wells will be added to the overall water-level monitoring program, adding needed data on shallow groundwater levels.

The second recommended action is focused on steelhead trout migration. The San Benito River is identified as critical habitat for steelhead (as are other local streams), but documentation is lacking about fish passage, particularly along the San Benito River, which is broad and sandy along a substantial length of its lower reach in San Juan Valley. The recommendation is to conduct a field study to identify the critical riffle that limits fish passage opportunity along the San Benito River and estimate the minimum flow required to allow passage over the riffle.

Potential management actions to reduce potential impacts to GDEs will be based on existing information, water level data from existing and new monitoring wells, and studies such as the fish passage study. With regard to riparian vegetation, best available information indicates that the distribution and health of riparian vegetation shows little correlation with groundwater levels.

Steelhead smolt passage along the San Benito River appears to be the most sensitive aspect of interconnected surface water. Findings of the steelhead passage study will be fundamental to identifying and developing management actions to reduce potential impacts with details on how, where, and when an action is implemented. Pending results of that study, conceptual management actions for steelhead and riparian vegetation if impacts appear during droughts may include:

- Change land use designations, obtain conservation easements, or implement other land-use management measures designed to minimize future increases in groundwater pumping along the San Benito River upstream of the critical riffle that might reduce passage opportunity.
- Cooperate with other agencies to control invasive vegetation in riparian areas. Although this would benefit overall habitat conditions, it would not be a substitute for adequate flows.
- Restrict groundwater pumping near the critical riffle when San Benito River flow is receding through the minimum passage flow. This would be contingent on the results of the fish passage study and an evaluation of the expected benefits of short-term pumping reductions on base flow.
- In extreme drought conditions with evident and widespread mortality of riparian vegetation (which would only occur if the minimum threshold water levels for interconnected surface water are grossly exceeded), irrigate selected areas of riparian vegetation to provide ecological refugia and nuclei for riparian recovery following the drought.
- Site, design and operate groundwater recharge projects to have multiple benefits including aquatic/riparian habitat protection.

8.10.2. Project Implementation

The first and second management actions (installation of shallow monitoring wells and fish passage study) are intended to increase understanding of shallow groundwater conditions and potential undesirable results on GDEs. The usefulness of shallow monitoring wells is predicated on monitoring and data collection over many years, and thus the wells have already been installed and monitoring has been initiated. The monitoring will be ongoing as part of the Monitoring Network (Section 7). Assuming suitable hydrologic conditions, the San Benito River fish passage study can be completed during the first

5-year implementation period and thus support refinement of the interconnected surface water minimum threshold during the 5-year GSP update process.

8.10.3. Public and Agency Noticing and Outreach

Progress on the recommended management actions will be summarized in the Annual Reports.

8.10.4. Permitting and Regulatory Process

The permitting, regulatory process, and environmental review for installation of shallow monitoring wells will be summarized in the Well Drilling and Construction Technical Memorandum for the North San Benito Basin Dedicated Groundwater Monitoring Wells, which is being prepared in 2021.. The fish passage study requires no permitting, regulatory, or environmental review process. Evaluation of potential management actions similarly is a study; specific projects generated from it may require permitting and CEQA review.

8.10.5. Legal Authority

The legal authority of SBCWD is described in the Introduction Section 1.4.

8.10.6. Project Benefits

Improved monitoring of water table conditions in riparian areas will allow early detection of potential vegetation die-back or mortality during droughts. Although riparian vegetation suffered negligible impacts during the 2013-2015 drought, this information will improve preparedness for future droughts and help identify the most effective interventions if need for a response is indicated (nearby pumping reductions versus direct irrigation, for example). The fish passage study will contribute greatly to an understanding of whether groundwater pumping and levels have a significant impact on fish passage based on the location of the riffle with respect to reaches of the San Benito River that are interconnected with groundwater.

8.10.7. Estimated Costs and Financing

The cost of installing shallow riparian monitoring wells has already been covered by the SGMP Round 3 grant, although additional wells may be indicated in the future. A field study to identify the critical riffle along the San Benito River, estimate minimum passage flows for adult and juvenile steelhead, and apply the groundwater model to estimate groundwater pumping effects on passage flow duration would be approximately $20,000. Additional interventions during droughts might not be necessary, based on experience during previous droughts. If monitoring shows that action is needed, the GSAs will select the most appropriate action based on the location, type and severity of vegetation impacts.

8.10.8. Status and Timeline

Shallow riparian monitoring wells are being installed in 2021. The critical riffle study will be completed during the first five-year GSP implementation period.

8.11. Provide Long-term Basin-wide Funding Mechanisms

Groundwater sustainability necessitates the continuation of activities including monitoring, data compilation, data analysis, numerical model update, public outreach and annual reporting, five-year GSP updates, investigations, coordination with other agencies, and program administration. While the GSAs have conducted such activities, SGMA requirements are more comprehensive and rigorous. In addition, the extent of activities encompasses the entire North San Benito Groundwater Basin. Accordingly, this management action provides mechanisms for long-term, basin wide funding within the respective jurisdictions of the SBCWD and Valley Water GSAs.

Based on the legal authority provided by the 1953 San Benito County Water District Act (California Water Code Appendix 70) and by SGMA, SBCWD plans to implement two types of fees for the SBCWD portion of the Basin. The first is based on the acreage of parcels within the SBCWD portion of the Basin benefitting from SGMA management. This Groundwater Management Fee is the focus of this section. The second type of fee being planned is based on the volume of groundwater pumped by groundwater users. Currently no means exists for measuring property-specific groundwater pumping volumes across the entire Basin, so this method is planned for later implementation.

8.11.1. Description

The Groundwater Management Fee provides a mechanism for funding of sustainability planning and management across the entire North San Benito Basin; most of this discussion pertains to the San Benito County portion of the basin. The Santa Clara County portion includes 3,354 acres; the share of funding from this area will be addressed through agreement between SBCWD GSA and Valley Water GSA.

Implemented through Resolution No. 2021-13 of the SBCWD GSA Board of Directors, the Groundwater Management Fee has been based on best available information on 1) costs of preparing and implementing the GSP and 2) benefits to water agencies, cities, and landowners with parcels overlying the North San Benito Basin.

Analysis of costs for preparing and implementing the GSP has been based in part on review of existing costs for groundwater management (for example in SBCWD Zones 3 and 6) and evaluation of additional costs that account for the entirety of the basin and for SGMA requirements. Accordingly, cost analysis has addressed costs for GSP preparation, monitoring, data compilation, data analysis, numerical model update, public outreach, and annual reporting, five-year GSP updates, investigations, coordination with other agencies, and program administration.

Groundwater management, including GSP development and implementation, provides benefits for all landowners within the Basin that use groundwater for agriculture, landscaping, municipal, industrial, domestic, or environmental uses. However, parcels overlying the unconsolidated alluvial materials in valley areas have greater access to groundwater, while groundwater occurrence and beneficial uses are limited in the upland areas within the Basin. As described in Section 3, the valley areas represent productive portions of the Basin, consistent with the location of the Principal Aquifer and areas of the Secondary Aquifer in proximity to the Principal Aquifer. Upland areas within the Basin underlain by the Secondary Aquifer have less access to groundwater due to geologic and topographic factors.

An assessment of potential benefit from groundwater management and the development and implementation of a GSP has been completed on a parcel basis for the entire Basin. Parcels were categorized relative to location in upland areas of the Basin that have less access to groundwater and receive insignificant benefit from groundwater management and parcels within valley areas that represent the productive portions of the Basin that benefit from groundwater management and the development and implementation of a GSP. Parcels within the service areas of major municipal and industrial (M&I) water purveyors were identified. These parcels within the service areas of major M&I water purveyors have indirect access to benefits of groundwater management and are billed accordingly. A fee representing the benefits of groundwater management is appropriately directed to the water purveyor. The categorization of parcels within the Basin in San Benito County are categorized as follows:

- Areas Benefiting from GSP
- Upland Areas with Insignificant GSP Benefit
- Major Municipal and Industrial Areas, specifically:
    - City of Hollister Service Area
    - Sunnyslope County Water District Service Area
    - City of San Juan Bautista Service Area.

The area in Santa Clara County similarly can be addressed between the SBCWD GSA and Valley Water GSA in terms of:

- Areas Benefiting from GSP
- Upland Areas with Insignificant GSP Benefit.

8.11.2. Project Implementation

As established in Resolution No. 2021-13, the Groundwater Management Fee will be charged on the basis of land acreage. All property within the San Benito portion of the Basin will be charged the Fee, except lands classified as Upland Areas with Limited GSP Benefit. The fees are implemented for fiscal year 2021-22 through fiscal year 2025-26. The SBCWD GSA Board of Directors will annually review the fee and perform a comprehensive review every five years, with at least one public meeting.

8.11.3. Public and Agency Noticing and Outreach

Outreach to the public and agencies has included website announcements, mailers, and public presentations, including TAC meetings (November 4, 2020, and January 27, 2021), a well-attended public workshop (March 10, 2021), and public Board meetings. Meeting agenda and presentations are posted on the SBCWD website.

The SBCWD GSA Board of Directors convened a July 14, 2021 hearing to discuss the resolution to adopt the Groundwater Management Fee. This hearing was duly noticed pursuant to the requirements of Water Code section 10730(b). The GSA provided notice of the time and place of the public meeting at which the Groundwater Management Fee was considered; the notice was published in compliance with Government Code section 6066, was posted on the GSA's website, and mailed to interested parties. The date was made available to the public at least 20 days before the meeting, the GSA held the public meeting, and permitted written and oral presentations from the public.

The General Manager of the San Benito County Water District is authorized and directed to notify the California Public Utilities Commission (CPUC) of the Groundwater Management Fee by way of letter to the Director of the Water Division. SBCWD GSA also will furnish to the County Auditor-Controller and Board of Supervisors, on or before August 1 of each year for which collection of the Fee is requested, a copy of the resolution requesting collection together with the list of parcels and the amount to be collected for each parcel.

As indicated in the Resolution, a person may file a protest with the GSA and have an opportunity to discuss the basis of the appeal. SBCWD GSA will make a determination in writing and the person also may appeal to the SBCWD GSA Board of Directors.

8.11.4. Legal Authority

Both SBCWD and Valley Water have existing authorities to provide for funding of management activities, as provided in their respective legislation as special districts (see Introduction Section 1.4). In addition, the Sustainable Groundwater Management Act, specifically Water Code section 10730(a), authorizes a GSA to impose fees to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, program administration, and a prudent reserve.

8.11.5. Project Benefits

The benefits of the fee are to provide funding support for sustainable groundwater management across the entire North San Benito Basin. As documented throughout the GSP, sustainable groundwater management provides benefits for all landowners within the Basin, based on compliance with SGMA, monitoring of groundwater conditions, projects, and management actions to sustain groundwater, and regular reporting to stakeholders and the community about the sustainability of North San Benito water supplies. The Groundwater Management Fee assessment recognizes a basic differentiation at this time of benefits to parcels overlying productive valley areas with greater access to groundwater and upland areas where groundwater occurrence and beneficial uses are limited. Benefits will be considered as the SBCWD GSA Board of Directors annually reviews the fee, with a comprehensive review every five years.

8.11.6. Estimated Costs and Financing

The cost of developing funding measures has been included in costs of GSP preparation, and implementation will be funded by the Groundwater Management Fee. In its Resolution No. 2021-13, the SBCWD GSA Board of Directors has determined that the amount of the Groundwater Management Fee is no more than necessary to cover the reasonable costs of the governmental activity financed thereby and that the manner in which those costs are allocated to landowners charged with the Groundwater Management Fee bears a fair and reasonable relationship to the owners' benefits received from management of the Basin.

As stated in Resolution No. 2021-13 and Attachment A of the resolution, the SBCWD GSA has identified the total costs of GSP preparation and the expected annual management and administration costs over the next five years, that the GSA adopts and levies and provides for the collection of the Groundwater Management Fee:

Table 8-3. Total GSP Plan Development and Annual Expense

Fiscal year	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026
Total Expense	$525,935	$539,401	$553,271	$567,557	$582,272

8.11.7. Status and Timeline

In 2021, the SBCWD GSA has identified the total costs of GSP preparation and the expected annual management and administration costs over the next five years and has developed the Groundwater Management Fee to fund the costs of a groundwater sustainability program, including preparation and amendment of a GSP and the ongoing activities to sustain the GSP effort. Implementation of the Groundwater Management Fee is slated for implementation in 2021 and planned with annual review by the SBCWD GSA Board of Directors and five-year comprehensive review.

8.12. Provide GSP Administration, Monitoring and Annual Reporting

For decades, SBCWD has provided groundwater basin management focused mostly on Zone 6 and Zone 3. Since 2014, the two GSAs have participated actively in SGMA including development of their MOU for preparation of the GSP. SBCWD, with the cooperation of SCVWD (Valley Water), also has secured DWR SGM funding to develop the GSP, and successfully applied for a basin boundary modification to consolidate previously defined basins and to create the North San Benito Groundwater Basin. Current efforts include expansion of monitoring and reporting to encompass the entirety of the new basin.

Administrative actions described in this section include (but are not limited to) GSA update of their MOU to address GSP implementation and likely cooperation to secure additional funding. This management action also should include additional review of basin boundaries. This recognizes that the basis of existing boundaries remains uncertain and that modified boundaries could increase the effectiveness of projects and management actions.

The Annual Groundwater Report has been prepared at the direction of the Board of Directors to fulfill the requirements set forth in SBCWD's formation act (California Water Code Appendix 70). This Annual Groundwater Report has addressed most but not all the area now encompassed in the North San Benito Groundwater Basin. Appendix 70 requires preparation of the report (summarizing the water year October 1 through September 30) in December and presentation to the Board of Directors in January. Appendix 70 states that the annual report will provide documentation of groundwater levels and pumping, groundwater storage change, and overdraft (if any); an estimate of next-year conditions, agricultural pumping and water purchases; and the required recommendations for surface water deliveries, groundwater replenishment, and groundwater charges. In recent years, Annual Reports have been prepared with triennial updates on water budgets and on water quality conditions, and planning for the transition to SGMA compliance.

8.12.1. Description

Overall, this management action provides the ongoing GSP Administration by the GSAs, the monitoring and annual reporting to maintain sustainable management planning and compliance with SGMA. The monitoring network is described in Section 7, while improvements to the monitoring programs and DMS are described in Section 8.7.

The GSP Regulations (§ 356.2) regarding annual report preparation are extensive and relatively detailed and include annual reporting on sustainability conditions, including water quality, subsidence, and GDEs which are not currently reported on an annual basis. GSP requirements for annual report contents are summarized below:

- **General information**, including executive summary and location map.
- **Groundwater elevation** data including contour maps for seasonal high and low, hydrographs of groundwater elevations and water year type.
- **Groundwater extraction** for the preceding water year in a table by water use sector, identifying method and accuracy of measurements, and a map that illustrates general location and volume of groundwater extractions.
- **Surface water supply** used or available for groundwater recharge or in-lieu use, with annual volume and sources for the preceding water year.
- **Total water use** reported in a table by water use sector and water source type, identifying the method and accuracy of measurements. Existing water use data from the most recent UWMP/AWMP may be used, reported by water year.
- **Change in groundwater in storage** shall including change in storage maps, graph with water year type, groundwater use, annual change in groundwater in storage, and the cumulative change in groundwater in storage.
- A description of **progress implementing the GSP** since the previous annual report.

While historical Annual Groundwater Reports have had a focus on SBCWD Zone 6, SGMA requires that the Annual Report address the entire North San Benito Basin, including the small areas in Valley Water.

8.12.2. Project Implementation and Timeline

Annual monitoring and reporting are ongoing. While previously prepared solely at the direction of the SBCWD Board Project, future annual reporting will include technical information as previously provided with some adjustment to provide Appendix 70 financial information and recommended groundwater charges on an earlier schedule. Annual Reports will be prepared to summarize water resource conditions and management actions as of the preceding water year. Relative to historical practice, the schedule will be shifted to the schedule for GSP Annual Reports, which have an April 1 deadline.

Preparation of Annual Groundwater Reports typically have been a joint effort of SBCWD staff and a consultant team. Other cooperating agencies (including City of Hollister, SSCWD, City of San Juan Bautista, Tres Pinos Water District, Valley Water, and San Benito County) provide data.

8.12.3. Public and Agency Noticing and Outreach

The Annual Groundwater Report will be presented as a draft to the TAC and their comments and questions will be addressed. Similar to past practice, the Annual Report will be presented to the SBCWD Board of Directors at a duly noticed public meeting. The Annual Reports have been and will continue to be uploaded to the SBCWD website. The procedures for Annual Report delivery to the Valley Water GSA Board of Directors will be included in a MOU developed by the two GSAs for implementation of the GSP. The Annual Report will be submitted by April 1 of each year via the DWR online portal and thereby posted on the DWR website.

8.12.4. Permitting and Regulatory Process

This management action is a SGMA requirement. As an Annual Report, no permitting or regulatory processes are involved.

8.12.5. Legal Authority

The legal authorities of SBCWD GSA and Valley Water GSA are described in the Introduction Section 1.4.

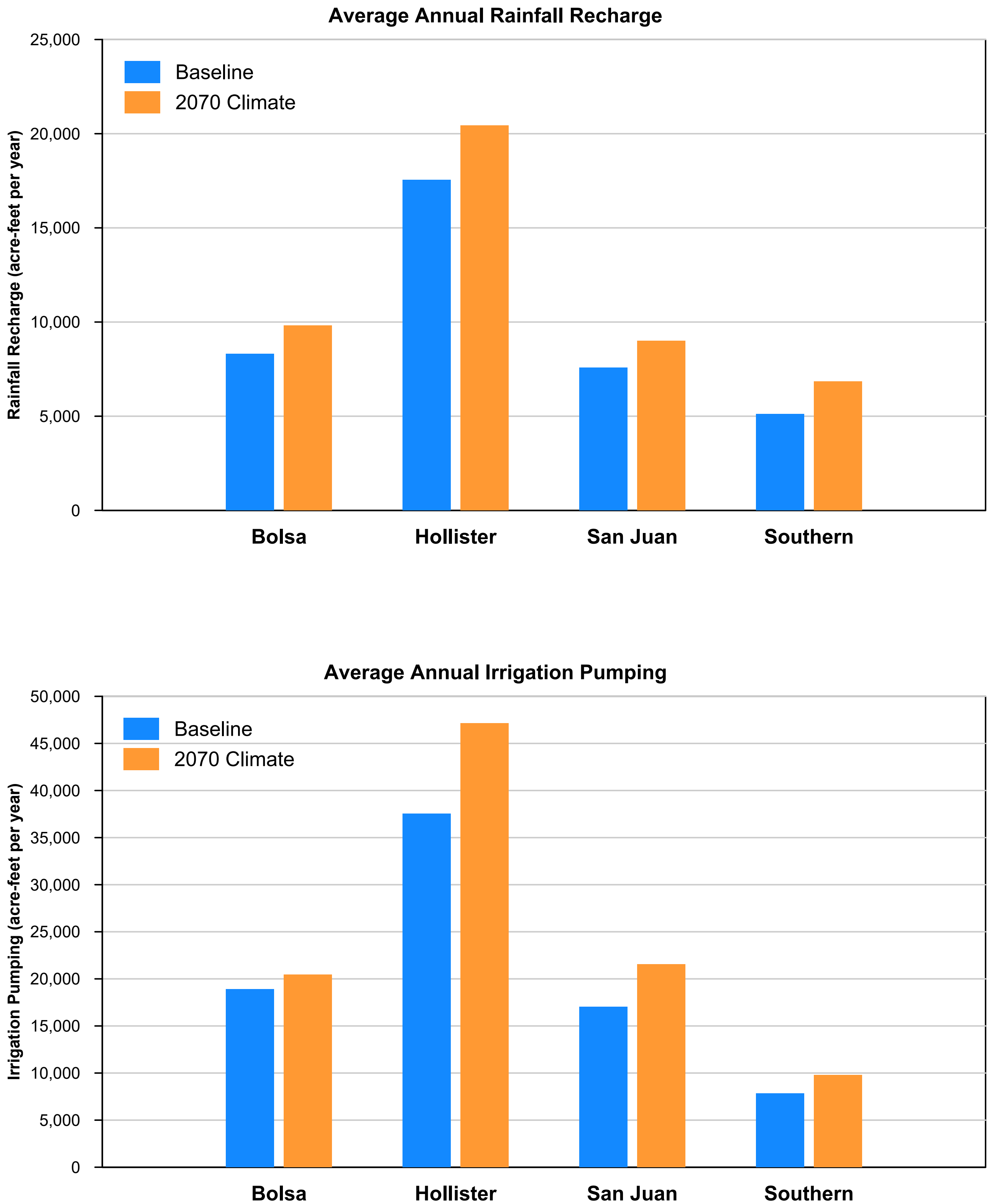
8.12.6. Project Benefits

Benefits of the Annual Reports involve communication of the “state of the basin” to decision makers, other agencies, stakeholders, and the public. Annual reporting helps guide management of groundwater resources in conjunction with surface water supplies. Benefits accrue to the community of the entire North San Benito Basin and are pertinent to all measurable objectives.

8.12.7. Estimated Costs and Financing

Annual report preparation has been and is a required and integral part of GSP preparation and implementation. Preparation of three Annual Reports (2017, 2018, and 2019) was included as part of the Sustainable Groundwater Planning (SGWP) Grant Agreement between DWR and SBCWD (Agreement Number 4600012676) and preparation of the 2020 and 2021 Annual Reports was part of the Amendment #1 to that Agreement. In all cases, preparation of the Annual Reports represented SBCWD cost share.

The estimated annual cost for consultant assistance to SBCWD for annual report preparation is approximately $100,000 per year for the next five years. Future costs can be covered through the Groundwater Management Fee (see Section 8.11).

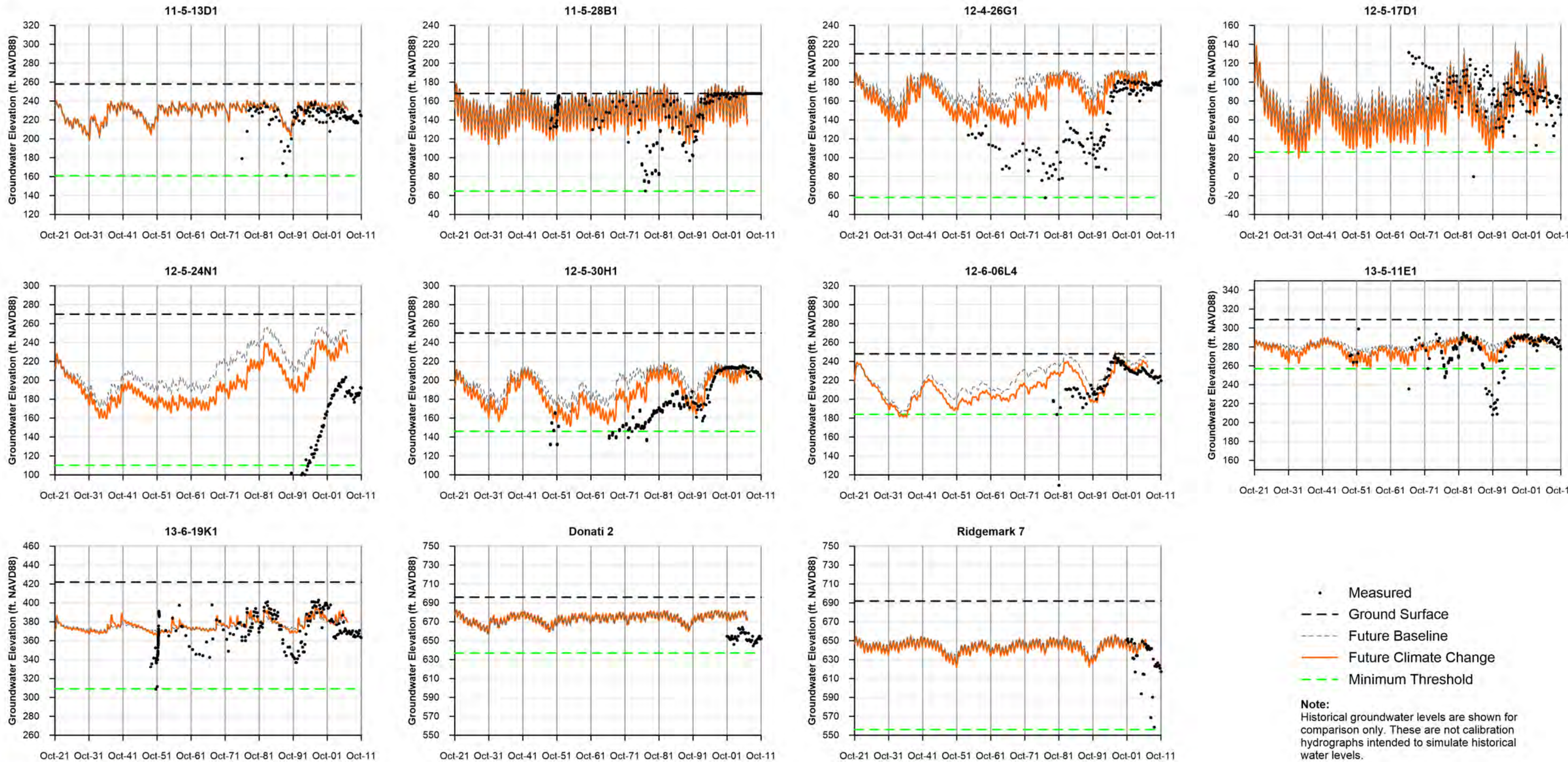


Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\
RCH\RechargeSummary_1922-2007_climate_change.xlsx Run63-2264

November 2021

TODD GROUNDWATER

Figure 8-1
Effect of
Climate Change on
Recharge and Pumping

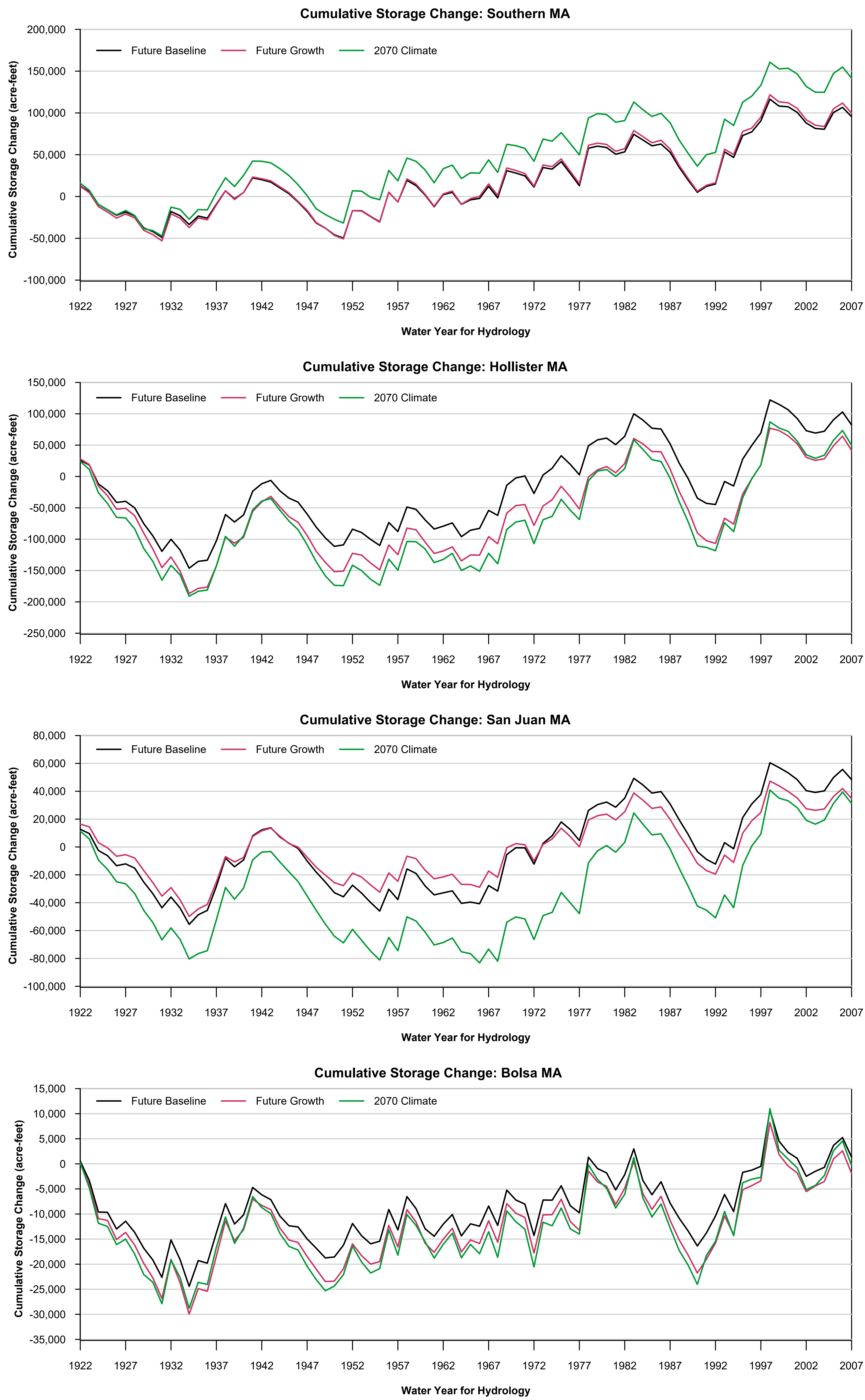


Data:
\\todd-dc2\data\Projects\San Benito GSP 37643\Model_1922-2007\Water_Levels\Hydrographs_1922-2007_climate_change.xlsm

November 2021

TODD GROUNDWATER

Figure 8-2
Climate Change Hydrographs



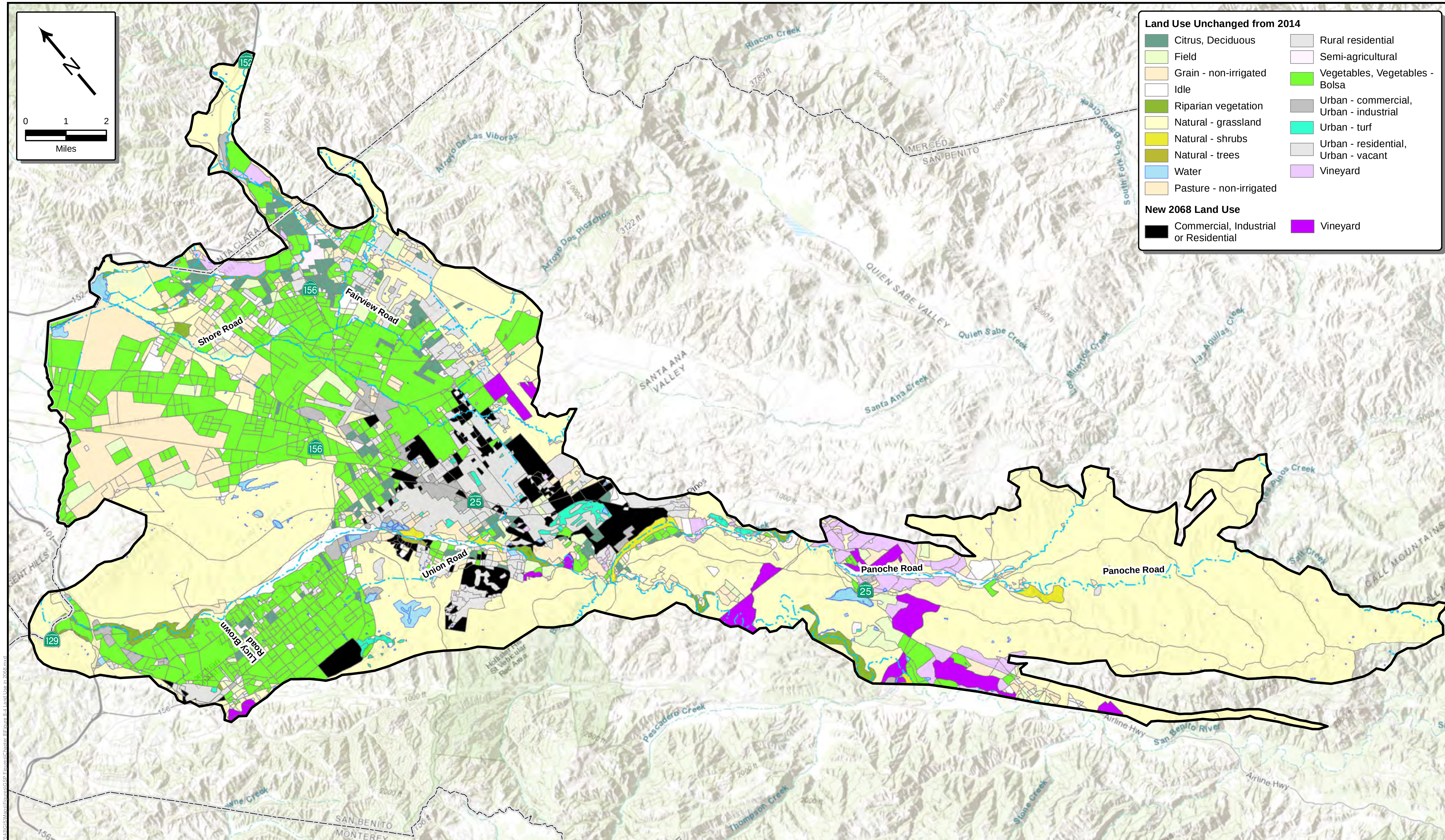
November 2021

TODD GROUNDWATER

Figure 8-3
Cumulative Storage Changes Under Baseline, Growth and Climate Change Scenarios

Data:
T:\Projects\San Benito GSP 37643\Model_1922-2007\GWV\ZBout_1922-2007_growth_&_climate.xlsx Cumulative Storage Fig

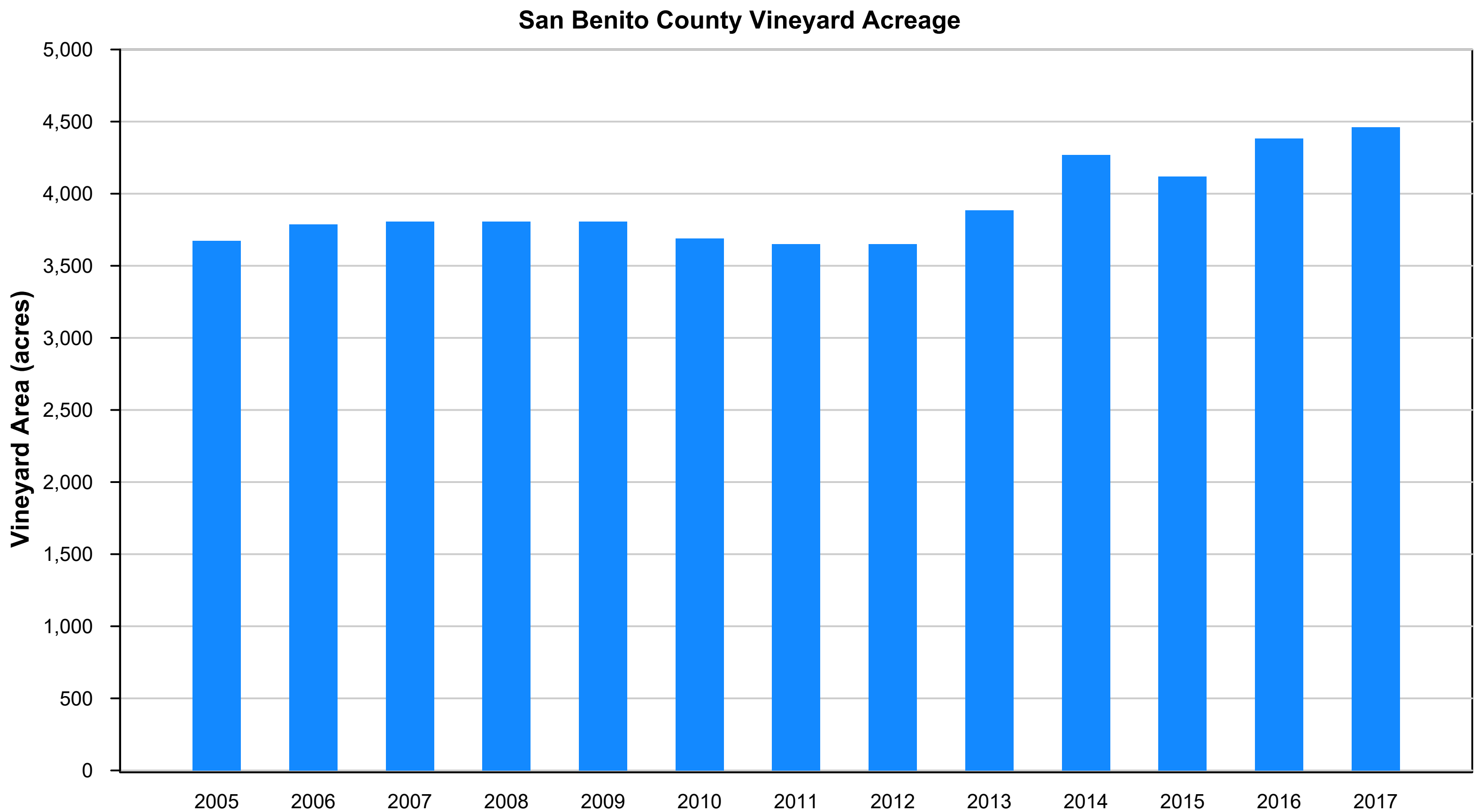
Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 8-3 Cumulative Storage Change.gpj



November 2021

TODD GROUNDWATER

Figure 8-4
Land Use in 2068



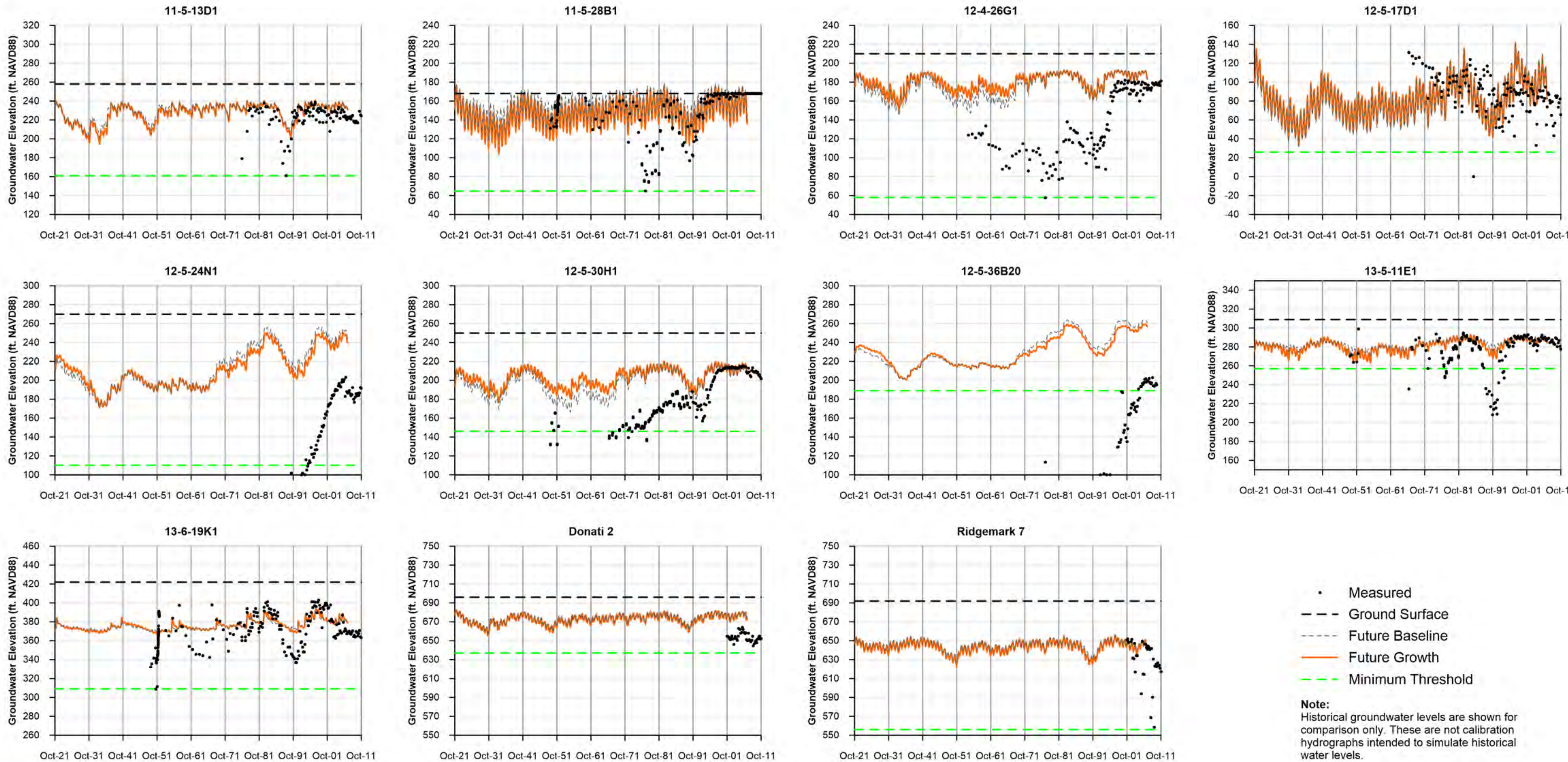
Path: T:\Projects\San Benito GSP 37643\GRAPHICS\SanBenitoGSP\Figure 8-5 Vineyard Acreage 2005-2017.grf

Data:
T:\Projects\San Benito GSP 37643\Data\Land Use\Vineyared_acreage_trend.xlsx Sheet1

November 2021

TODD GROUNDWATER

Figure 8-5
Vineyard Acreage
2005-2017



Note:
Historical groundwater levels are shown for comparison only. These are not calibration hydrographs intended to simulate historical water levels.

Data:
\\todd-dc2\data\Projects\San Benito GSP 37643\Model_1922-2007\Water_Levels\Hydrographs_1922-2007_future_growth.xlsm

November 2021

TODD GROUNDWATER

Figure 8-6
Future Growth Hydrographs

9. IMPLEMENTATION PLAN

While the North San Benito Groundwater Basin is considered to be sustainably managed, this status is by no means taken for granted. Potential effects of growth, land use change, and climate change have been evaluated by means of modeling simulations, but effects are likely to be cumulative, and thereby present challenges to sustainability. Accordingly, additional projects and actions must be continued or implemented to satisfy the Sustainability Goal to the foreseeable planning horizon. This Groundwater Sustainability Plan (GSP) implementation period begins in 2022 and continues until 2042.

9.1. Projects and Management Actions

Projects and Management Actions are described in Section 8, each in terms of technical description, feasibility and implementation, benefits, costs and financing, and timeline. The Projects and Management Actions are listed below in the same order as presented in Section 8.

Projects

- Develop Surface Water Storage (Pacheco Reservoir Expansion Project)
- Expand Managed Aquifer Recharge (MAR)
- Enhance Conjunctive Use
    - Hollister Urban Area Water and Wastewater Project
    - City of San Juan Bautista Regional Water and Wastewater Solution
    - North County Project
    - Zone 3 Operations Planning Tool
- Enhance Water Conservation.

Management Actions

- Improve Monitoring Program and Data Management System (DMS)
    - Measure agricultural groundwater extraction
    - Improve monitoring well network and DMS
    - Improve water quality monitoring program
    - Enhance surface water gaging
- Develop Response Plans
- Enhance Water Quality Improvement Programs
- Reduce Potential Impacts to Groundwater Dependent Ecosystems (GDEs) (Steelhead and Riparian Vegetation)
- Provide Long-term Basin-wide Funding Mechanism
- Provide GSP Administration, Monitoring, and Reporting.

The projects and management actions described here work together toward the sustainability goal and objectives, namely: to provide a reliable and efficient groundwater supply, to provide reliable storage, to protect groundwater quality, to prevent subsidence, to support beneficial uses of interconnected surface waters, and to support integrated and cooperative water resource management. The foremost element is to secure Central Valley Project (CVP) supplies, despite variations in its annual availability, and to store CVP water in the groundwater basin for use in drought and shortage. This is fundamental to avoiding undesirable results and overdraft.

9.1.1. Timeline

Table 9-1 is an estimated timeline for implementation. The timeline columns include the individual years 2021 through 2025, which are followed by five-year intervals to 2040-2045. With implementation officially starting in 2022, the last interval includes the 2042 deadline for the 20-year implementation to achieve the sustainability goal.

Table 9 1. Estimated Timeline for Projects and Management Actions

Description	GSP Implementation Period								
	2021	2022	2023	2024	2025	2026-2030	2031-2035	2036-2040	2041-2045
Projects									
Pacheco Reservoir Expansion Project									
Planning									
Construction									
Benefits									
Managed Aquifer Recharge (MAR) Project									
Planning									
Construction									
Benefits									
Hollister Urban Area Water/Wastewater Master Plan									
San Juan Bautista Regional Water/Wastewater Solution									
Planning									
Construction				(to be determined)					
Benefits					(to be determined)				
North County Project (phased)									
Planning									
Construction									
Benefits									
Zone 3 Operations Planning Tool (ongoing benefits)									
Water Conservation (ongoing with accrual of benefits)									
UWMPs and AWMPs									
Management Actions									
Improve Monitoring Program and DMS									
Establish Measurement of Agricultural Extraction									
Planning									
Implementation									
Benefits									
Improve Network and DMS									
Install dedicated monitoring wells									
Document wells, develop inventory, enhance DMS									
Improve Water Quality Monitoring									
Install Surface Water Gage									
Develop Response Plans									
Water Quality Improvement Programs									
Ongoing agency cooperation and outreach									
Additional analyses of salt balance									
Update SNMP									
Reduce Potential Impacts to GDEs									
Install Shallow Monitoring Wells									
Steelhead Passage Study			(to be determined)						
Provide Long-term Basin-wide Funding Mechanism									
Establish Groundwater Management Fee									
Establish Groundwater Extraction Fee									
Annual Administration, Monitoring, Reporting									
Five-Year Update									

The Projects, Management Actions, and GSP Administration, Monitoring, and Reporting are listed in rows and as warranted, major phases are indicated in terms of planning, construction, and accrual of benefits. As shown, most projects and management actions have been ongoing. Some have been initiated as part of this GSP preparation.

In general, the Projects are shown as independent efforts without dependency or other relationships. However, the Hollister Urban Area Water/Wastewater Master Plan has been ongoing since 2004 and has been a major coordination effort guiding water, wastewater, and recycled water projects and programs in the Hollister area. This effort has supported other listed projects such as the North County Project and water conservation. It has provided facilities (most notably water treatment plant construction and improvements) that are necessary for listed projects currently being planned such as Managed Aquifer Recharge and the San Juan Bautista regional solution. As another interconnection, the North County Project (which involves planning for new production wells in Hollister MA) is being considered in coordination with Managed Aquifer Recharge, which presents opportunities for ASR operations for new wells.

The Management Actions involve important interdependencies as summarized below:

- **Measure Agricultural Groundwater Extraction.** This action is needed not only for GSP Administration, Monitoring and Reporting, but also is planned as a basis to provide a long-term basin-wide funding mechanism, specifically to establish a groundwater extraction fee.
- **Improve Monitoring Program and DMS.** These actions (installation of dedicated monitoring wells, documentation of wells, DMS enhancement) provide a basin-wide framework for monitoring and reliable data that support the evaluation of all projects and actions affecting groundwater levels and quality.
- **Install Dedicated Monitoring Wells.** Specifically, installation of shallow monitoring wells is critical to tracking interconnected surface water and reducing potential impacts to GDEs.
- **Install Surface Water Gage.** Improved surface water gaging supports tracking interconnected surface water and could support refinement of the Zone 3 Operations Planning Tool.
- **Improve Water Quality Monitoring.** This is needed to support water quality improvement programs, including preparation of an updated SNMP.
- **Provide Long-Term Basin-Wide Funding Mechanism.** This is needed to support monitoring, improvements to the monitoring programs and DMS, annual reporting, and overall administration.

9.1.2. Roles and Responsibilities

All projects and management actions are implemented by San Benito County Water District Groundwater Sustainability Agency (SBCWD GSA) within its San Benito County jurisdiction, with the collaboration of Valley Water GSA in Santa Clara County, and with the cooperation of other local agencies and organizations. As described in Section 8, implementation of this GSP is coordinated with other projects and programs.

9.1.3. Summary of Funding Sources

Sources of funding have and will continue to vary according to the project or management action (see Section 8).

Funding for planning and implementation of projects and some management actions (e.g., installation of monitoring stations) will be achieved with local, state, and federal sources. The local agencies track opportunities for outside financing (grants or loans) from state water programs and federal infrastructure funding. For local financing, the agencies update their financial plans and rates as needed.

For ongoing administration, monitoring, reporting and some management actions, SBCWD is implementing a Groundwater Management Fee. To track groundwater extraction, SBCWD is planning a Groundwater Extraction fee based on the volume of groundwater pumped by groundwater users. The Santa Clara County basin portion of funding will be addressed through agreement between SBCWD GSA and Valley Water GSA.

10. REFERENCES

Acton Mickelson Environmental, Inc. (Acton Mickelson), 2000, Site Investigation Report, Former Whittaker Ordnance Facility, Hollister, California, AME Project No. 21002.03, Volume I and Volume II, January 13, 2000.

Agency for Toxic Substances and Disease Registry (ATSDR), 2003, Toxicological Profile for Selenium, U.S. Department of Health and Human Services, Public Health Service, ATSDR, 2003. https://www.atsdr.cdc.gov/ToxProfiles/tp92.pdf

Akel Engineering Group, 2020, 2020 Wastewater Master Plan for City of San Juan Bautista, November, accessed May 2021. https://cms6.revize.com/revize/sanjuanbautistaca/document_center/water/2020%20Improvements/SJB_2020WWMP_FINAL_111020.pdf

Aspen Environmental Group (Aspen), 2015, Final Environmental Impact Report Analysis of Oil and Gas Well Stimulation Treatments in California, June 2015. https://www.californiaenvironmentallawblog.com/energy/doggr-releases-final-well-stimulation-eir/

Belitz, Kenneth, Dubrovsky; Neil M., Burow, Karen; Jurgens, Bryant; and Johnson, Tyler, (Belitz), 2003, Framework for a Ground-Water Quality Monitoring and Assessment Program for California, U.S. Geological Survey, Water Resources Investigation Report 03-4166, Sacramento, California, 2003. https://pubs.usgs.gov/wri/wri034166/pdf/wri034166.pdf

Borchers, J.W., M. Gerber, J. Wiley and H.T. Mitten, 1998, Using down-well television surveys to evaluate land subsidence damage to water wells in the Sacramento Valley, California. In J.W. Borchers, ed. Land subsidence: case studies and current research. Star Publishing Co., Belmont, CA. https://www.academia.edu/4612113/Land_Subsidence_Case_Studies_and_Current_Research_Proceedings_of_the_Dr._Joseph_F._Poland_Symposium_on_Land_Subsidence

Brezing, Benjamin, Senior Water Resources Engineer, DWR. 2020, personal communication regarding download of InSAR data, August 24, 2020.

California Department of Parks and Recreation, 1978, Hollister Hills State Vehicular Recreation Area (SVRA) Resource Management Plan and General Development Plan, December, accessed August 2018 http://www.parks.ca.gov/pages/21299/files/244.pdf

California Geological Survey (CGS), 2002, Wagner, D.L., H.G. Greene, G.J. Saucedo, and C.I. Primdore, Geologic Map of Monterey 30’ x 60’ Quadrangle and Adjacent Areas, California: A Digital Database, Publication No. CD 2002-04, 2002. https://www.conservation.ca.gov/cgs/Documents/Publications/Regional-Geologic-Maps/RGM_001/RGM_001_Monterey_2002_Plate3of3.pdf

California Irrigation Management Information System (CIMIS), 2021, http://www.cimis.water.ca.gov/, station 126, Last accessed: June 2021.

California Polytechnic State University, City and Regional Planning Department (Cal Poly CRP), 2015, San Juan Bautista 2035 General Plan, November. https://www.san-juan-bautista.ca.us/document_center/San%20Juan%20Bautista%202035%20General%20Plan/San-Juan-Bautista-2035-General-Plan-FINAL-2-3-16.pdf

California Water Commission (CWC), 2018, Pacheco Reservoir Expansion Project - Technical Review, May, https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2018/WSIP/TechReview/Pacheco_TechReview.pdf

California Water Commission (CWC), 2021, Website, https://cwc.ca.gov/Water-Storage, Last accessed: June 2021.

Carollo Engineers, 2014. Pajaro Valley Water Management Agency – Basin Management Plan Update February. https://www.pvwater.org/images/about-pvwma/assets/bmp_update_eir_final_2014/BMP_Update_Final_February_2014_(screen).pdf

Clark, W. 0., 1924, Ground water in Santa Clara Valley, California: USGS Water-Supply Paper 519, 209 p. https://pubs.er.usgs.gov/publication/wsp519

County of Santa Clara, 2007, Drainage Manual, https://www.yumpu.com/en/document/view/7769804/drainage-manual-county-of-santa-clara

Department of Water Resources (DWR), 2021, State of California Household Water Supply Shortage Reporting System, available at https://mydrywatersupply.water.ca.gov/report/publicpage, last accessed March 2021.

Department of Water Resources, California (DWR), 1966, Investigation of Effects of Hollister Industrial Waste Upon Underlying Ground Water, Code 4103-044, 1965-66, A Report to the Central Coastal Regional Water Pollution Control Board, July 1966. https://books.google.com/books?id=Raj89ikfu60C&printsec=frontcover

Department of Water Resources, California (DWR), 2004a, Gilroy-Hollister Valley Groundwater Basin, San Juan Bautista Subbasin, California's Groundwater, Bulletin 118, Last update February 27. https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118

Department of Water Resources, California (DWR), 2004b, Gilroy-Hollister Valley Groundwater Basin, Bolsa Subbasin, California's Groundwater, Bulletin 118, Last update February 27. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_003_02_BolsaAreaSubbasin.pdf

Department of Water Resources, California (DWR), 2004c, Gilroy-Hollister Valley Groundwater Basin, Hollister Subbasin, California's Groundwater, Bulletin 118, Last update February 27. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_003_03_HollisterAreaSubbasin.pdf

Department of Water Resources, California (DWR), 2004d, Tres Pinos Valley Groundwater Basin, California's Groundwater, Bulletin 118, Last update February 27. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_025_TresPinosValley.pdf

Department of Water Resources, California (DWR), 2010b, California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting, December 2010. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/CASGEM/Files/CASGEM-Procedures-for-Monitoring-Entity-Reporting-Final-121610_ay_19.pdf

Department of Water Resources, California (DWR), 2016a, Monitoring Networks and Identification of Data Gaps, Best Management Practices for Sustainable Management of Groundwater, December 2016. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf

Department of Water Resources, California (DWR), 2016b, Modeling, Best Management Practices for Sustainable Management of Groundwater, December 2016. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-5-Modeling_ay_19.pdf

Department of Water Resources, California (DWR), 2018a, DWR Land Use Viewer, accessed August https://gis.water.ca.gov/app/CADWRLandUseViewer/

Department of Water Resources, California (DWR), 2018b, DWR Well Completion Report Map Application Tool, accessed July (https://www.water.ca.gov/Programs/Groundwater-Management/Data-and-Tools

Department of Water Resources, California (DWR), 2018d, California Department of Fish and Wildlife, and The Nature Conservancy, 2018, Natural communities commonly associated with groundwater (NCCAG), Statewide digital vegetation maps of vegetation and wetlands overlying groundwater basins, Available on-line at https://gis.water.ca.gov/app/NCDatasetViewer/, last accessed December 2018.

Department of Water Resources, California (DWR), 2019a, Gilroy-Hollister Valley Groundwater Basin, North San Benito Subbasin, California's Groundwater, Bulletin 118, Draft February 2019. https://cadwr.app.box.com/s/rhqaflj4t5d063he9o314ojzz394idec/file/764121467868

Department of Water Resources, California (DWR), 2019b, DWR SGMA Data Viewer, Land Subsidence, NASA JPL InSAR Dataset, accessed February 2019, https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer.

Drever, J.I., 1988, The Geochemistry of Natural Waters, 2nd Edition, Prentice-Hall, 1988.

Eaton, Frank M., McCallum, Roy D., and Mayhugh, Miles S., 1941, Quality of Irrigation Waters of the Hollister Area of California with Special Reference to Boron Content and its Effect on Apricots and Prunes, USDA Technical Bulletin No. 746, March 1941. https://agris.fao.org/agris-search/search.do?recordID=US201300406894

EMC Planning Group, 2015, 2035 San Benito County General Plan Update, Revised draft environmental impact report, Prepared for San Benito County, 2015. https://www.cosb.us/government/environment/san-benito-county-general-plan

Faye, Robert E., 1974, Mathematical Model of the San Juan Valley Ground-Water Basin, San Benito, California, USGS Water Resources Investigation 58-73, August 1974. https://pubs.er.usgs.gov/publication/wri7358

Faye, Robert E., 1976, Mathematical Model of the West Bolsa Ground-Water Basin, San Benito County, California, USGS Water-Resources Investigations 76-71, December 1976. https://pubs.er.usgs.gov/publication/wri7671

Federal Emergency Management Agency (FEMA), 2003, Lowest floor elevation, Technical Fact Sheet No. 4. http://flash.org/resources/files/HGCC_Fact04.pdf

Feeney, M. B., 1994, Hydrogeologic investigation, Arroyo Seco Cone, Staal, Gardner & Dunne, Inc, Prepared for Monterey County Water Resources Agency, April 1994. https://cawaterlibrary.net/wp-content/uploads/2018/06/Pages-from-Hydrogeologic-Investigation-Arroyo-Seco-Cone-April-1994.pdf

Fogg, G.E., L.M. LaBolle and G.S. Weissmann. 1999, Groundwater vulnerability assessment: hydrogeologic perspective and example from the Salinas Valley, California, In Assessment of non-point source pollution in the vadose zone. Monograph 108. American Geophysical Union, Washington, D.C. https://www.escholarship.org/uc/item/6gp6c6k6

Griggs, F.T. , 2009. California riparian habitat restoration handbook. 2nd edition. California Riparian Habitat Joint Venture, July, Last accessed 4/17/20. Document available on-line at https://water.ca.gov/LegacyFiles/urbanstreams/docs/ca_riparian_handbook.pdf

Hanson, R. T., Wolfgang Schmid, Claudia C. Faunt, Jonathan Lear, and Brian Lockwood. 2014, USGS Scientific Investigations Report 2014-5111 https://pubs.usgs.gov/sir/2014/5111/

HDR, 2008, Hollister Urban Area Water and Wastewater Master Plan, November. http://www.sbcwd.com/reports/Hollister%20Urban%20Area%20Water%20&%20WasteWater%20Master%20Plan%20110308.pdf

HDR, 2017, Hollister Urban Area Water and Wastewater Master Plan Update, June. http://www.sbcwd.com/reports/Hollister%20Urban%20Area%20Master%20Plan%20Update%20%20July%202017.pdf

Hem, J.D., 1989, Study and Interpretation of the Chemical Characteristics of Natural Water (third edition), U. S. Geological Survey Water-Supply Paper 2254, 1989. https://pubs.usgs.gov/wsp/wsp2254/pdf/wsp2254a.pdf

Holmes, R.W., D.E. Rankin, M. Gardand E. Ballard. July 2014. Instream flow evaluation, steelhead passage and connectivity of riverine and lagoon habitats, Big Sur River, Monterey County. Stream Evaluation Report 14-3. California Department of Fish and Wildlife, Sacramento, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=99800&inline

Hounslow, A.W., 1995, Water Quality Data: Analysis and Interpretation, Lewis Publishers, 1995.

Jenkins, O.P., 1973, Pleistocene Lake San Benito, California Geology, v. 23, no. 7, July 1973. http://www.johnmartin.com/earthquakes/eqpapers/00000026.htm

Jones & Stokes Associates (JSA), 1998, Groundwater Management Plan for the San Benito County Part of Gilroy-Hollister Groundwater Basin, April 1998.

Jones & Stokes Associates (JSA), 1999a, Annual groundwater report for the 1997-1998 water year, revised final, prepared for San Benito County Water District, January 28, 1999.

Jones & Stokes Associates (JSA), 1999b, Annual groundwater report for the 1998-1999 water year, final, prepared for San Benito County Water District, December 20, 1999.

Jones & Stokes Associates (JSA), 2000, Annual groundwater report for the 1999-2000 water year, final, prepared for San Benito County Water District, December 2000.

Jones & Stokes Associates (JSA), 2001, Annual groundwater report for water year 2001, final, prepared for San Benito County Water District, December 14, 2001.

Kapple, G. W., Digital Model of the Hollister Valley Ground-Water Basin, San Benito County, California, U.S. Geological Survey, Water Resources Investigations 79-32, March 1979. https://pubs.er.usgs.gov/publication/wri7932

Kapple, G.W., H.T. Mitten, T.J. Durbin and M.J. Johnson, 1984, Analysis of the Carmel Valley alluvial ground-water basin, Water-Resources Investigations Report 83-4280, June 1984. https://pubs.usgs.gov/wri/1983/4280/report.pdf

Kennedy/Jenks Consultants, 2003, Groundwater Management Plan Update for the San Benito County Part of Gilroy-Hollister Groundwater Basin, July.

Kilburn, C., 1972, Ground-Water Hydrology of the Hollister and San Juan Valleys, San Benito County, California, 1913-1968, United States Geological Survey, Open File Report 73-144, August 31,1972. https://pubs.er.usgs.gov/publication/ofr73144

Kondolf, G.M. and R.R. Curry, 1986, Channel erosion along the Carmel River, Monterey County, California. Earth Surface Processes and Landforms 11(2), May/June 1986. https://onlinelibrary.wiley.com/doi/abs/10.1002/esp.3290110308

Luhdorff & Scalmanini Consulting Engineers (LSCE), 1991, San Benito County Ground-Water Investigation, prepared for San Benito County, October 1991.

Luhdorff & Scalmanini Consulting Engineers (LSCE), 2015, Northern Counties (Monterey, Santa Cruz, Santa Clara, San Benito Counties) Characterization Report, June 1, 2015.

Luhdorff and Scalmanini Consulting Engineers (LSCE), Borchers JW, Grabert VK, Carpenter M, Dalgish B, Cannon D, 2014, Land subsidence from groundwater use in California, report prepared by LSCE with support by the California Water Foundation, available at: http://californiawaterfoundation.org/wp-content/uploads/PDF/1397858208-SUBSIDENCEFULLREPORT_FINAL.pdf, accessed September 2019.

Mahoney, D.L. and D.C. Erman, 1984, The role of streamside bufferstrips in the ecology of aquatic biota, R.E. Warner and K.M. Hendrix, eds, California riparian systems, 1984. https://publishing.cdlib.org/ucpressebooks/view?docId=ft1c6003wp&chunk.id=d0e24298&toc.depth=1&toc.id=d0e24298&brand=ucpress

Manaham, S.E., 1991, Environmental Chemistry (5th Edition), Lewis Publishers, Inc., 1991. https://www.biblio.com/9780873714259

McBride, J.R. and J. Strahan, 1984, The American Midland Naturalist, The University of Notre Dame, Vol 112 No. 2, October. https://www.jstor.org/stable/i200609

Moore Iacofano Goltsman, Inc., 2005, City of Hollister General Plan, Adopted December 2005, amended June 2007. http://hollister.ca.gov/wp-content/uploads/2014/12/Complete_General_Plan.pdf

Motzer, W.E., 2001, Perchlorate: Problems, Detection, Solutions, Environmental Forensics, v.2, n.4, 2001. https://www.sciencedirect.com/science/article/abs/pii/S152759220190059X

Moyle, P.B, 2002, Inland fishes of California, University of California Press, 2002. https://www.ucpress.edu/book/9780520227545/inland-fishes-of-california

Natural Resources Conservation Service (NRCS), 2018, SSURGO soil survey on-line map database available at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, last accessed December 2018.

Parameter-Elevation Regressions on Independent Slopes Model (PRISM) Climate Group, 2021, Oregon State University, http://prism.oregonstate.edu last accessed June 2021.

Rantz, S.E., 1969, Mean Annual Precipitation in the California Region, Basic-Data Compilation, U.S. Geological Survey (USGS) Isohyetal Map, Scale 1:1,000,000. https://pubs.usgs.gov/of/1998/of98-777/of98-777.pdf

Reynolds, Don, San Juan Bautista City Manager, 2021. Request to Present/Discuss the Status of San Juan Bautista Regional Water Solution with the Hollister City Council, Letter to Brett Miller, City of Hollister City Manager, Including attached draft MOU with SBCWD, draft Tech Memo Template, and PowerPoint. February 1, in City of Hollister Staff Report, accessed May 2021. http://hollisterca.iqm2.com/Citizens/FileOpen.aspx?Type=1&ID=1129&Inline=True

Reynolds, R.C., Jr., 1972, Boron, Element and Geochemistry, in R.W. Fairbridge (editor) The Encyclopedia of Geochemistry and Environmental Sciences, Van Nostrand Reinhold Company, 1972.

San Benito County Water District (SBCWD) and others, 2007, Pajaro River Watershed, Integrated Regional Water Management Plan. https://www.pajaroirwmp.org/s/Pajaro-IRWM-Plan-Update-2014-Final.pdf

San Benito County Water District (SBCWD), 2015, Agricultural Water Management Plan, October. Accessed August 2018 https://www.sbcwd.com/reports/2015%20SBCWD%20AWMP-USBR%20FINAL%20PLAN.pdf

San Benito County Water District (SBCWD), 2021, Pacheco Reservoir Expansion Project, accessed February 13, 2021. https://www.sbcwd.com/pacheco-reservoir-expansion-project/

Santa Clara Valley Water District (SCVWD), 1989, Mean Annual Precipitation Map for San Francisco & Monterey Bay Region, Hydrology Open File Report, October. https://californiarevealed.org/islandora/object/cavpp%3A172543

Santa Clara Valley Water District (SCVWD), 2016, 2016 Groundwater Management Plan Santa Clara and Llagas Subbasins. https://s3.us-west-2.amazonaws.com/assets.valleywater.org/2016%20Groundwater%20Management%20Plan.pdf

Santa Clara Valley Water District (SCVWD), 2021a, Urban Water Management Plan. https://fta.valleywater.org/dl/wpAcKTFl12

Santa Clara Valley Water District (SCVWD), 2021b, Valley Water News, Update to proposed expansion of Pacheco Reservoir includes changes to dam, spillway and increased costs, January, accessed February 13, 2021. https://valleywaternews.org/2021/01/11/update-to-proposed-expansion-of-pacheco-reservoir-includes-changes-to-dam-spillway-and-increased-costs/

Santa Clara Valley Water District (SCVWD), 2021c, Valley Water News, Valley Water Continues to Call For Voluntary Conservation As Drought Conditions Worsen, April, accessed April 2, 2021. https://valleywaternews.org/2021/04/01/valley-water-continues-to-call-for-voluntary-conservation-as-drought-conditions-worsen/

Silicon Valley Bank, 2020, State of the Wine Industry Report 2019, accessed May 2021. https://www.svb.com/globalassets/library/images/content/trends_and_insights/reports/wine_report/svb-2019-wine-report

Stantec, 2020, Preliminary Engineering Report, San Juan Bautista, Wastewater Treatment Improvements Project, Appendix A in Akel Engineering Group 2020 Wastewater Master Plan for City of San Juan Bautista September 28, accessed May 2021. https://cms6.revize.com/revize/sanjuanbautistaca/document_center/water/2020%20Improvements/SJB_2020WWMP_FINAL_111020.pdf

Strahan, J. 1984. Regeneration of riparian forests of the Central Valley. Pages 58-67 in R.E. Warner and K.M. Hendrix, eds. California riparian systems. University of California Press, Berkeley, CA. Accessible on-line at https://publishing.cdlib.org/ucpressebooks/view?docId=ft1c6003wp&chunk.id=d0e62700&toc.depth=1&brand=ucpress

Strassberg, G., Jones, N. L., Maidment, D. R., 2011, Arc Hydro Groundwater: GIS for Hydrogeology, ESRI Press, February 15, 2011.

Sunnyslope County Water District (SSCWD), 2021, Crosstown Pipeline Project, accessed May 2021. https://www.sunnyslopewater.org/crosstown-pipeline-project

The Nature Conservancy (TNC), 2019a, Plant Rooting Depth Database, accessed June 2021. https://groundwaterresourcehub.org/sgma-tools/gde-rooting-depths-database-for-gdes/

The Nature Conservancy, 2019b, GDE Pulse on-line vegetation mapping tool, available at https://groundwaterresourcehub.org/sgma-tools/gde-pulse/, last accessed June 2021.

Thomasson, H.G., Jr., F.H. Olmsted and E.F. LeRoux, 1960, Geology, water resources and usable ground-water storage capacity of part of Solano County, California. Water-Supply Paper 1464. U.S. Geological Survey, 1960. https://pubs.usgs.gov/wsp/1464/report.pdf

Todd Engineers (Todd), 1994a, Sunnyslope Groundwater Resources Phase 2, Report to Sunnyslope County Water District, November 1994.

Todd Engineers (Todd), 1994b, Paicines Ranch Resort, Groundwater Resources, prepared for Ridgemark Corporation, May 1994.

Todd Engineers (Todd), 2004, Development of a Water Quality Monitoring Program - Hollister Groundwater Basin, June 2004.

Todd Engineers (Todd), 2013, Technical Memorandum 1, Hydrogeologic Conceptual Model for Northern San Benito County Salt and Nutrient Management Plan, May 2013.

Todd Groundwater (Todd), 2014, San Benito County Salt and Nutrient Management Plan, April 2014. https://www.sbcwd.com/reports/Final%20Salt%20and%20Nutrient%20Management%20Plan.pdf

Todd Groundwater (Todd), 2015, Northern San Benito County Groundwater Model Update and Enhancement, June 12, 2015.

Todd Groundwater (Todd), 2018, San Benito North County Water Supply Options: Simulated Yields, Draft Memorandum from Gus Yates to Ambarish Ravi and Bob Ellis, HDR Engineering, September 11.

Todd Groundwater (Todd), 2019, San Benito County Water District Annual Groundwater Report WY 2019, December. https://www.sbcwd.com/wp-content/uploads/2019/12/Annual_GW_Report_2019.pdf

Todd Groundwater (Todd), 2021, Hollister Urban Area, 2020 Urban Water Management Plan, July. https://www.sbcwd.com/wp-content/uploads/2021/05/HUA-UWMP-2020-PUBLIC-DRAFT-050521.pdf

United States Bureau of Reclamation (USBR), 2020, B.F. Sisk Dam Safety of Dams Modification Project, December, accessed May 2020. https://www.usbr.gov/mp/sod/projects/sisk/

United States Fish and Wildlife Service (USFWS), 2019a, Critical habitat map for California tiger salamander, digital map https://www.fws.gov/sacramento/es/Critical-Habitat/Data/, last accessed March 13, 2019.

United States Fish and Wildlife Service (USFWS), 2019b, Critical habitat map for California red-legged frog, digital map https://www.fws.gov/sacramento/es/Critical-Habitat/Data/, last accessed March 13, 2019.

United States Geologic Survey (USGS), 2018, National Elevation Dataset (NED) for San Benito and Santa Clara Counties, available at: https://nationalmap.gov/elevation.html, last accessed November 2018.

United States Geological Survey (USGS), 2021, National Field Manual for the Collection of Water-Quality Data (NFM), available at: https://www.usgs.gov/mission-areas/water-resources/science/national-field-manual-collection-water-quality-data-nfm?qt-science_center_objects=0#qt-science_center_objects, last accessed February 2021.

University Navigation Satellite Timing and Ranging System Consortium (UNAVCO), 2021, Website: https://www.unavco.org/, Last accessed: June 2021.

Wallace, Robert E., 1990, The San Andreas Fault System, California, An overview of the history, geology, geomorphology, geophysics, and seismology of the most well know plate-tectonic boundary in the world, United States Geologic Survey (USGS) Professional Paper 1515, 1990. https://pubs.er.usgs.gov/publication/pp1515

Wildlands, Inc. 2021. Pajaro River wetland mitigation bank. Website: https://www.wildlandsinc.com/banks/pajaro-river-mitigation-bank-wetl/ last accessed November 2021.

Woodroof, R.D. and R.C. Roberts, 1984, Management of Riparian Vegetation In The North coast Region Of California's Coastal Zone, R.E. Warner and K.M. Hendrix, eds, California riparian systems, University of California Press, 1984. https://www.degruyter.com/document/doi/10.1525/9780520322431-090/pdf

World Health Organization (WHO), 2017, Guidelines for Drinking Water Quality, WHO, April. https://www.who.int/publications/i/item/9789241549950

Yates, G., 2002, Annual Groundwater Report for Water Year 2002, final, prepared for San Benito County Water District, December 16, 2002.

Yates, G., 2003, Annual Groundwater Report for Water Year 2003, final, prepared for San Benito County Water District, December 15, 2003.

Yates, G., 2005a, Annual Groundwater Report for Water Year 2004, revised final, prepared for San Benito County Water District, January 10, 2005.

Yates, G., 2005b, Annual Groundwater Report for Water Year 2005, final, prepared for San Benito County Water District, December 19, 2005.

Yates, G., J. Cattaneo and K.D. Schmidt, 1999, Investigation of Shallow Groundwater Conditions in the San Juan Valley, San Benito County, California, draft, prepared for San Benito County Water District, August 1999.