PUBLIC REVIEW DRAFT

Eastern Management Area Groundwater Sustainability Agency

# Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Plan

## DRAFT Section 3 – Basin Setting: HCM & Groundwater Conditions

November 20, 2020

EMA
Santa Ynez River Valley Groundwater Basin
Eastern Management Area
Groundwater Sustainability Agency

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# Appendices

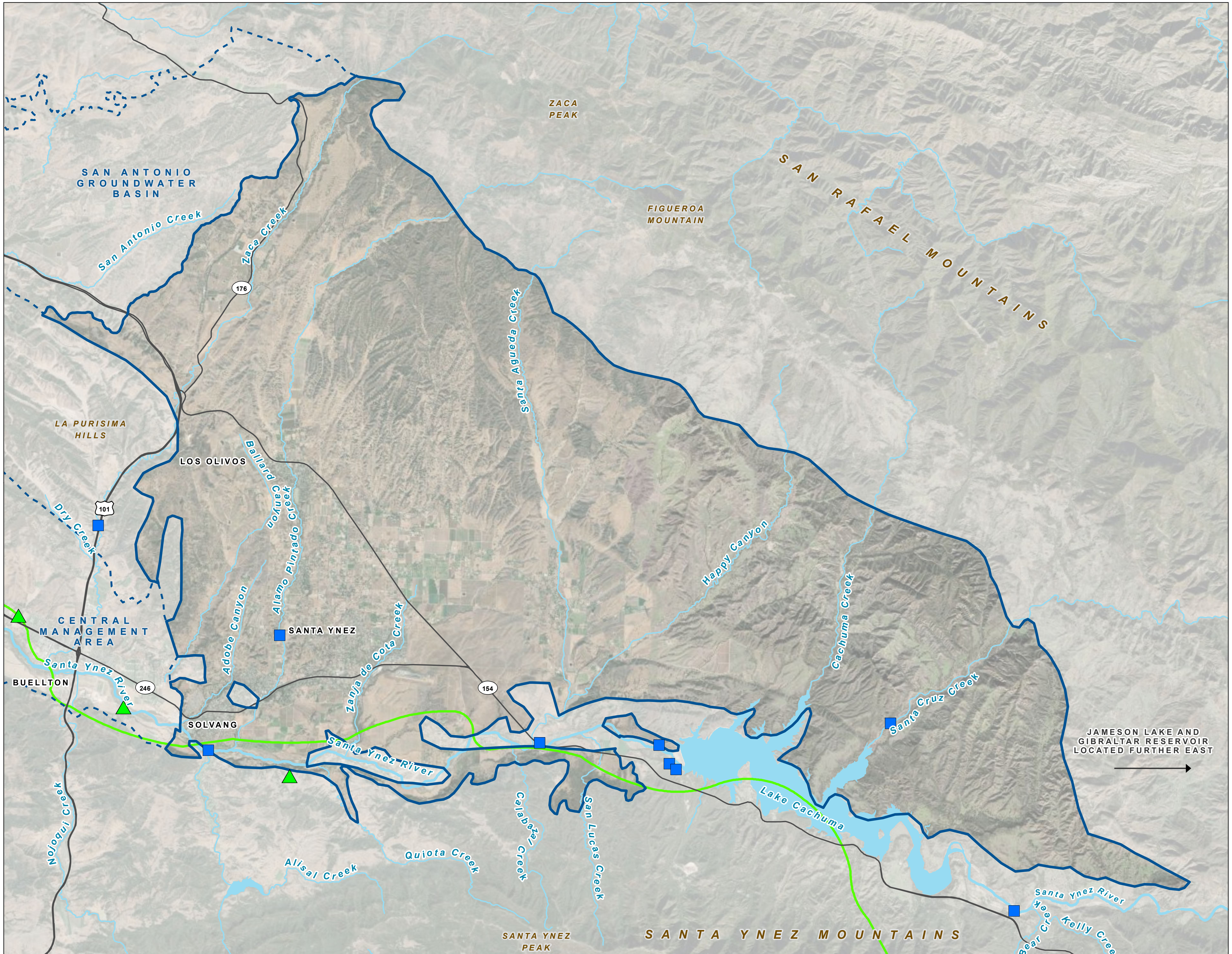
To come

# FIGURE 2-11

## Surface Water Features

Groundwater Sustainability Plan
Eastern Management Area

Provided for reference for Sections 3.1 and 3.2.




### LEGEND

- Surface Water Gage
- SWP Turnout
- SWP Pipeline
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

### NOTE

SWP: State Water Project

N

0 5,000 10,000 15,000
Feet

Date: November 18, 2020
Data Sources: ESRI, USGS, Maxar 2019

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

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

This section describes the physical setting and characteristics of the Eastern Management Area (EMA) of the Santa Ynez River Valley Groundwater Basin (Basin), including the basin boundaries, geologic formations and structures, and principal aquifer units. Accurate understanding of the Basin is central to sustainable management of the groundwater resource.

This section is principally based upon a body of published literature, primarily consisting of geologic and hydrogeologic investigations, annual groundwater planning reports (which have been prepared for a large portion of the EMA for over 40 years), and Basin-specific geologic and hydrogeologic data. The compiled literature, reports, and data relied upon for this report constitute the best available information relevant to EMA. This Basin Setting section of the GSP provides a foundation for sustainable groundwater management, and, to that end, will be updated as warranted to maintain this goal.

## 3.1 Hydrogeologic Conceptual Model [§354.14]

**§354.14 Hydrogeological Conceptual Model.**

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

Central to this section is the hydrogeologic conceptual model (HCM) for the EMA and, to some degree, the entire Basin. This section presents the regional hydrology, geology and descriptions of the principal aquifers and aquitards. The discussion of the principal aquifers includes generalized groundwater recharge and discharge areas, relevant groundwater water quality, and primary beneficial uses of the groundwater. The section concludes with discussion of identified data gaps and aspects of uncertainty associated with these elements.

This HCM provides the framework for subsequent sections of the basin setting, including groundwater conditions and water budgets. Together these sections aim to achieve the focused goal of understanding and managing the groundwater resource to achieve groundwater sustainability within the EMA and the Basin by 2042.

### 3.1.1 Regional Hydrology

#### 3.1.1.1 Topography and Watershed Boundary

**§354.14 Hydrogeological Conceptual Model.**

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

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

The groundwater Basin is located within the Santa Ynez River watershed in Santa Barbara County, which is in turn located on California's central coast. The watershed for the EMA extends north of the Santa Ynez Uplands and rises to 4,000 to 6,000 feet above sea level, which includes Figueroa Mountain (USGS, 1968).

The entire Basin is about 50 miles long and varies in width from about 4 to 7 miles, as presented on Figure 3-1. The overall Basin covers 319 square miles (204,000 acres), of which the easternmost 150 square miles make up the EMA. The EMA is one of the Basin's three management areas (MAs) along with the western management area (WMA) and central management area (CMA). These three areas are managed as individual MAs for SGMA due to the unique geology and hydrogeology in each.

The EMA is bounded on the north and east by impermeable rocks of the San Rafael Mountains and on the northwest by the adjacent San Antonio Creek Valley Groundwater Basin. The entire Basin is bounded on the south by the Santa Ynez Mountains (DWR, 2016; Figure 2-2 and Figure 3-1).

As will be discussed throughout this section, the EMA comprises two main areas the Santa Ynez Uplands and the Santa Ynez River Alluvium:[1]

The Santa Ynez Uplands covers a majority of the EMA, including the northern 130 square miles (87 percent) of the 150 square miles of the EMA. The Santa Ynez Uplands is characterized by the following:

- It is wholly within the EMA.
- It includes the towns of Santa Ynez, Ballard, and Los Olivos.
- It includes areas both within the Santa Ynez River Water Conservation District (SYRWCD) (referred to as Zone E) and areas to the north to the San Rafael Mountains and to the east to areas north of Lake Cachuma.
- It is separated from the topographically-lower Santa Ynez River Alluvium to the south by low permeability rocks, except in areas where tributaries to the Santa Ynez River (e.g., Alamo Pintado Creek) cut through.
- Its land-surface elevation ranges from a low of 480 feet above sea level in the southern portion along Alamo Pintado Creek near Solvang to a high of about 2,390 feet in the foothills in the north and northeast of the area.

The Santa Ynez River Alluvium underlies the Santa Ynez River and extends outside of the EMA, both upstream and downstream, for a total length of 36 miles between the upstream Bradbury Dam (to the east) through the CMA and WMA to the Lompoc Plain to the west, passing the cities of Solvang, Buellton, and Lompoc (SB County, 2011). The land-surface elevation within the Santa Ynez River Alluvium in the EMA

[1] The subareas referred to in this GSP follow the conventions used for management by SYRWCD. These areas are summarized in annual reports prepared by SYRWCD.

ranges from a low of 350 feet near Solvang, to a high of 600 feet near the base of Bradbury Dam (SB County, 2011).

Between the Santa Ynez Uplands and Santa Ynez River areas, lies an area of relatively limited groundwater production, referred to in SYRWCD annual reports as Zone C, which serves as a catch-all area for “all other portions of the District” This area is shown between the Santa Ynez Uplands and the Santa Ynez river on Figure 3-1 Groundwater production in this area is limited due to the relatively shallow and discontinuous aquifers and bedrock.

# FIGURE 3-1

## Topographic Map

Groundwater Sustainability Plan
Eastern Management Area


## LEGEND

Eastern Management Area Basin Boundary

**Elevation**

6,500'

150'

Elevation Contour, 500'

**All Other Features**

Major Road

Watercourse

Waterbody

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

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#### 3.1.1.2 Soil Types

**§354.14 Hydrogeological Conceptual Model.**

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

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

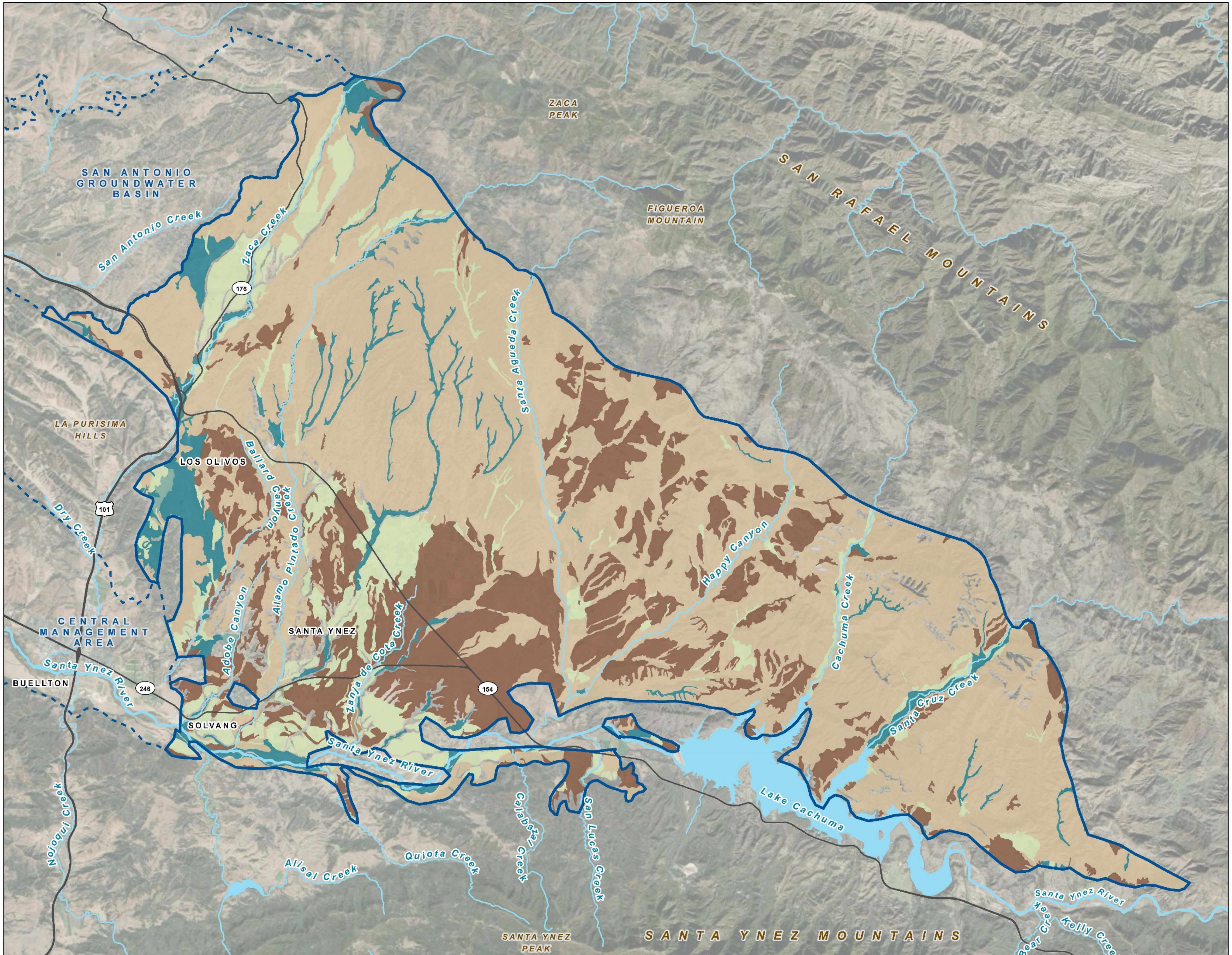
Soil types have been mapped and presented by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (USDA, 2020; Figure 3-2). The saturated hydraulic conductivity of the surficial soils is a good indicator of surficial soil infiltration potential. The soil hydrologic grouping is an assessment of soil infiltration rates that are determined by the water transmitting properties of the soil, which includes 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 have 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 percent and 20 percent clay and between 50 percent and 90 percent sand.
- **Group C – Slow Infiltration Rate:** Water transmission through the soil is somewhat restricted; soils typically have between 20 percent 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 groups generally correlate with the hydraulic conductivity of underlying geologic units, with lower soil hydraulic conductivity zones correlating to areas underlain by clayey portions of the Paso Robles Formation. The higher soil hydraulic conductivity zones generally correspond to areas underlain by Alluvium within the Santa Ynez River, unsaturated Older Alluvium, and areas of coarser sediments within the Paso Robles Formation.

Soils with the highest infiltration rate in Group A mainly consist of deep, well-drained to excessively drained sands or gravelly sands, characterized by low runoff potential even when thoroughly wet. These high infiltration soils are present in three general areas:

- **Vicinity of Los Olivos and Solvang**
- **Along Santa Agueda and Alamo Pintado Creeks**, as well as along the **Tributary Alluvium of Santa Cruz Creek** north of Lake Cachuma
- **Along the Santa Ynez River**




# FIGURE 3-2

## Hydrologic Soil Groups

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

Eastern Management Area Basin Boundary

**HYDROLGRP_DCD**

- A High Infiltration Rate
- A/D High Infiltration Rate when Drained
- B Moderate Infiltration Rate
- C Slow Infiltration Rate
- C/D Slow Infiltration Rate when Drained
- D Very Slow Infiltration Rate

**All Other Features**

- Major Road
- Watercourse
- Waterbody

**Hydrologic Soil Groups**

Group A: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

N

0 5,000 10,000 15,000
Feet

Date: October 29, 2020
Data Sources: ESRI, USGS, Maxar 2019

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The soils in Group B have a moderate infiltration rate when thoroughly wet and are moderately deep and well-drained. These have moderately fine to moderately coarse texture. These soils are located within the following:

- **Tributary Alluvium of Zaca Creek** north of Highway 101
- **Santa Ynez Uplands** north of Santa Ynez
- **Zanja de Cota Creek and a majority of the Zone C area**, between the Santa Ynez Uplands area and Santa Ynez River area

The slow and very slow infiltration rate soils in Groups C and D, respectively, make up the remainder of the EMA, occurring primarily in the Older Alluvium that blankets the area and found in areas of the Santa Ynez Uplands. These soils have slow to very slow infiltration rates when thoroughly saturated wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture.

### 3.1.1.3 Surface Water Bodies

**§354.14 Hydrogeological Conceptual Model.**

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

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

The Santa Ynez River flows west over approximately 90 miles, from its headwaters in the San Rafael and Santa Ynez Mountains, to the Pacific Ocean, draining approximately 900 square miles. The Santa Ynez River headwaters originate in the Santa Ynez and San Rafael Mountains at an elevation of about 4,000 feet near the eastern boundary of Santa Barbara County, with average annual precipitation of up to 49 inches per year.[2] The Santa Ynez River has three dammed reservoirs upstream of the WMA and the CMA: Jameson Reservoir is the farthest upstream, then Gibraltar Reservoir, and finally Lake Cachuma (Figure 2-11). Although reservoir releases do flow into the Santa Ynez River, the reservoirs are also managed to divert water out of the Santa Ynez River watershed via a system of tunnels through the Santa Ynez Mountains for use by the cities located on the Santa Barbara County south coast (i.e., Goleta and Santa Barbara).

Downstream of the dam that forms Lake Cachuma—Bradbury Dam, the Santa Ynez River continues flowing west and is primarily intermittent throughout the Basin, carrying mainly flood flows from tributary watershed land downstream of Bradbury Dam and occasional spills and releases of water from Lake Cachuma. During summer months, water is released from Lake Cachuma to meet downstream water rights.

#### 3.1.1.3.1. Downstream Water Rights Releases

The EMA is recharged in part by downstream water rights releases from Lake Cachuma, as ordered by SYRWCD. Water rights releases for users downstream of Lake Cachuma are set forth in the State Water Resources Control Board Order of 1973 (WR 73-37), as amended in 1989 (WR 89-18) and most recently in 2019 (2019-0148). These releases are based on the establishment of two accounts and accrual of credits (storing water) in Lake Cachuma for the above and below Narrows areas. Releases from the Above Narrows Account are made at Bradbury Dam for the benefit of downstream water users between the dam and the

2 PRISM Climate Group. 2014. *Average Annual Precipitation 1981–2010*.

Lompoc Narrows. Releases from the Below Narrows Account are conveyed to the Narrows for the benefit of water users in the Lompoc Plain subarea. The SYRWCD designates the riparian flow subarea as "Zone A," which is referred to as the Santa Ynez River Area on Figure 3-1.

The Santa Ynez River is the most significant natural surface water feature within the Basin (Figure 2-11). The Santa Ynez River drains the entire Basin as it flows through the Basin's southern end from east to west. From its origins in the Los Padres National Forest to the east near Divide Peak and the Ventura County Border, the river enters three reservoirs, including Jameson Reservoir, Gibraltar Reservoir, and Lake Cachuma, all of which were built for municipal water supply. Both Jameson and Gibraltar Reservoirs have storage capacities of approximately 5,000 acre-feet each. Lake Cachuma is much larger with a total storage capacity of as much as 195,578 acre-feet (at an elevation of 753 feet). Surface water flow is diverted from each of the three reservoirs for delivery through one of three tunnels, to supply water for users in the communities of Santa Barbara, Montecito, and Carpinteria. Historically, the primary uses of Cachuma water have been for people and agriculture. The recent water rights decision also includes provisions to protect endangered Southern California steelhead in the Santa Ynez River.

The largest of the three  reservoirs is Lake Cachuma, which is approximately 5 miles long, up to 1 mile wide, and is fed by the upper Santa Ynez River and two major tributaries from the Santa Ynez Uplands to the north, which are Santa Cruz Creek and Cachuma Creek. Below the Bradbury Dam, which impounds Lake Cachuma, the Santa Ynez River flows west into and through the EMA. In the EMA downstream of Bradbury Dam, the Santa Ynez River is joined by major several tributaries—including Santa Agueda Creek, Zanja de Cota Creek, and Alamo Pintado Creek—as the river flows past the communities of Solvang and Santa Ynez, as shown on Figure 3-1. Water rights releases from the Bradbury dam are made for the benefit of downstream users of water along the Santa Ynez River in a manner that balances the flood flow capture capacity within the reservoir and the reliable downstream supply of water for aquatic and riparian needs and human demands along the river. Within the EMA, the Santa Ynez River flows east of Highway 154, past the communities of Solvang and Santa Ynez, as presented on Figure 3-1.

Streamflow data from the historic and existing streamflow gauges, along with Lake Cachuma storage data, have been obtained from the USGS. Data documenting water releases from Bradbury Dam were compiled from the United States Bureau of Reclamation (USBR) sources.

Within the EMA, the Santa Ynez River is currently gauged and recorded just upstream of the EMA where it flows under Highway 154 at the San Lucas Bridge. Flow of the Santa Ynez River within the EMA was actively gauged near Solvang from 1970 until the gauge was terminated in 2013. Streamflow is also measured ongoing along Alamo Pintado Creek, at a location approximately 2.5 miles upstream of its confluence with the Santa Ynez River.

The periods with monthly streamflow data sets from stream gauging stations within and surrounding the EMA are presented on Table 3-1. The locations of these gauging stations, with the exception of the upstream stations along the Santa Ynez River, are presented on Figure 2-11.

**Table 3-1. Summary of Streamflow Gauging Stations**

| Station Name | Elevation (Feet) | Location | Beginning of Record | End of Record | Station No. |
|---|---|---|---|---|---|
| Jameson Reservoir | 2,240 | Upstream | 1970 | 2013 | 11121010 |
| Santa Ynez River Below Gibraltar Reservoir | 1,229 | Upstream | 1988 | Active | 11123000 |
| Gibraltar Dam Release Weir | 1,229 | Upstream | 2007 | Active | 11122010 |
| Santa Ynez River Above Gibraltar Dam Storage | 1,399 (varies) | Upstream | 1988 | Active | 11122000 |
| Santa Ynez River Below Los Laurels Canyon | 788 | Upstream | 1947 | Active | 11123500 |
| Santa Cruz Creek | 783 | Upstream | 1941 | Active | 11124500 |
| Hilton Canyon Below Bradbury Dam | 653 | Upstream | 2002 | 2016 | 11125605 |
| Hilton Canyon Creek | 740 | Upstream | 2016 | Active | 11125600 |
| Santa Ynez River near Santa Ynez (stage) | 558 | Upstream | 1928 | 2009 (Currently stage only) | 11126000 |
| Santa Ynez River at Highway 154 (Water Quality) | 520 | Upstream | 2007 | Active | 11126400 |
| Alamo Pintado Creek | 540 | Within EMA | 1970 | Active | 11128250 |
| Zaca Creek Near Buellton | 471 | Downstream | 1963 | Active | 11129800 |
| Santa Ynez River at Solvang | 350 | Within EMA | 1970 | Active | 11128500 |

#### 3.1.1.4 Sources and Point of Delivery of Imported Water

**§354.14 Hydrogeological Conceptual Model.**

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

**(6) The source and point of delivery for imported water supplies.**

In addition to local surface water and groundwater sources, supplemental water is imported into the EMA. While groundwater supplies a majority of the water demand within the EMA, surface water is available to the EMA via local sources (the Cachuma Project and Cachuma releases that convey water through the Santa Ynez River Alluvium), and from an imported source: SWP through the Coastal Branch of the SWP (Santa Barbara County, 2011). Pumping from the Santa Ynez River Alluvium is managed as surface water by the SWRCB, and is not subject to management by the Basin's GSAs under SGMA.

**State Water Project**

Water is primarily imported to the EMA through the Central Coast Water Authority (CCWA) pipeline. Since 1997, this pipeline has delivered water from the SWP. Water is delivered at turnouts to specific water distribution systems, as well as to Lake Cachuma. Within the Basin, the receiving entities are VAFB, the City of Buellton, the City of Solvang, and the SYRWCD Improvement District No. 1. CCWA water can also be mixed in with the water rights releases at Lake Cachuma.

In 1997 and 1998, CCWA was formed to finance, construct, manage, and operate Santa Barbara County's 42-mile extension of the SWP water pipeline, the State facilities in Santa Barbara and San Luis Obispo Counties, and a regional water treatment plant (Santa Barbara County, 2011). Beginning in 1998, ID No. 1 began receiving water from the SWP through the new pipeline. The location of the pipeline and turnouts in Solvang and ID No. 1 are presented on Figure 2-11.

ID No. 1 holds an SWP allocation of 2,000 AFY and a 200 AF drought buffer. A total of 1,500 AFY are contractually committed for use by the City of Solvang. The drought buffer effectively increases the amount of water that can be delivered in the event that the agency's full allocation is not delivered in a given year.

All of the imported water, both within ID No. 1 and the City of Solvang, is used by agricultural, municipal, domestic, and industrial customers. Ninety five percent of the water these uses occur on land overlying the Santa Ynez Upland area; however, it is not possible at this time to determine exactly where the imported water is used in the ID No. 1 system, because the imported water is a mixture of upland groundwater, river well water, and imported surface water.

## 3.1.2 Regional Geology

**§354.14 Hydrogeological Conceptual Model.**

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

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

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

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

This section describes the geologic formations and structure in the EMA portion of the Basin. These descriptions are summarized from published reports from the USGS (1951 and 1968), and reports by consultants and federal, state, and local agencies. The surficial geology and geologic structures are mapped and described by Dibblee (1987a, 1987b, 1988a, 1988b, 1993a, 1993b, 1993c, 1994, and 2005), as presented on Figure 3-4.

### 3.1.2.1 Regional Geologic and Structural Setting

The Basin is located at the extreme southern end of the Coast Ranges geomorphic province, as defined by the California Geological Survey (2002). The Santa Ynez Fault zone, which is located near the southern boundary of the Basin, is the southern boundary of the Coast Ranges, which extend more than 500 miles to the north up the California Coast to the Oregon border. The Coast Ranges are northwest-trending mountain ranges and valleys, which follow the trend of the San Andreas Fault. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary rocks. The northern and southern extent of the Coast Ranges of which are separated by a depression forming in which the San Francisco Bay lies.

The Transverse Ranges south of the Basin are an east-west trending series of steep mountain ranges and valleys. Contrary to the north-south trending ranges in the Basin's Coast Ranges, the structure of the Transverse Ranges is oblique to the normal northwest trend of coastal California, hence the name "Transverse." The province extends offshore to include the San Miguel, Santa Rosa, and Santa Cruz islands. Intense north-south compression is squeezing the Transverse Ranges, causing this to be one of the most rapidly rising regions on earth (CGS, 2002).

Within the Coast Ranges, the Basin consists of a westward-trending, linear, structural depression between rugged mountain ranges and hills that is open to the Pacific Ocean on its west end. The main structural features of the Basin are a pair of the synclines and anticlines (i.e., folding of the rocks), which represent folded formations in the lowland between the Santa Ynez Mountains on the south and the faulted San Rafael Mountains on the north.

Within the EMA, several faults bound the EMA and cross it, as shown on Figure 3-4. The San Rafael Mountains to the north of the EMA were uplifted along the Little Pine fault zone, which trends northwest and has a displacement of several thousand feet (USGS, 1951).

Several additional faults exist within the EMA. The Santa Ynez River fault zone crosses below the Santa Ynez River area. Likewise, the Baseline Fault and the associated Los Alamos Fault and Casmalia Fault Zone, presented on Figure 3-4, cross the Santa Ynez Uplands area of the Basin in a southeast to northwest trend. These faults do not exhibit vertical offset of adjacent materials and are not believed to be barriers to groundwater flow, but are likely semi-permeable because of the interbedded (and layered) nature of the underlying Paso Robles Formation (Hoffman et al., 1996).

The Tertiary-age older consolidated sedimentary formations surrounding and underlying the EMA include the Monterey Formation and the Vaqueros Formation. These units outcrop at the surface on the southern and northern edges of the EMA and underlie the water-bearing formations or aquifers. The water-bearing formations (aquifers) are discussed further in Section 3.1.3.

###### 3.1.2.1.1. Monterey Formation (bedrock below Principal Aquifers)

The Miocene-age Monterey Formation (Tm/Tml on Figure 3-4) consists of interbedded argillaceous and siliceous shale, sandstone, siltstone, and diatomite. The Monterey Formation outcrops in the highlands surrounding the EMA, defines the base of the Basin, and lies stratigraphically below the Paso Robles Formation at the western edge of the EMA. Regionally, the unit thickness of the Monterey Formation is up to as great as 3,500 feet and is often highly deformed. The Monterey Formation is a source for oil in the Zaca Oilfield northwest of Los Olivos. Groundwater produced from the Monterey Formation often has high concentrations of hydrogen sulfide, total organic carbon, and manganese. The locations of oil and gas exploration wells drilled in the EMA are presented on Figure 3-3. Oil and gas exploration has been important to the understanding of the geology of the region, including the EMA. The oil and gas wells identified on Figure 3-3help identify the depth and extent of the geologic formations that surround and underlie the EMA.

Water wells completed in the Monterey Formation are occasionally productive if a sufficient thickness of highly deformed and brittle siliceous shale is encountered. More often, however, the Monterey shale produces groundwater to wells in very low quantities.

###### 3.1.2.1.2. Other Bedrock Formations (bedrock below Principal Aquifers)

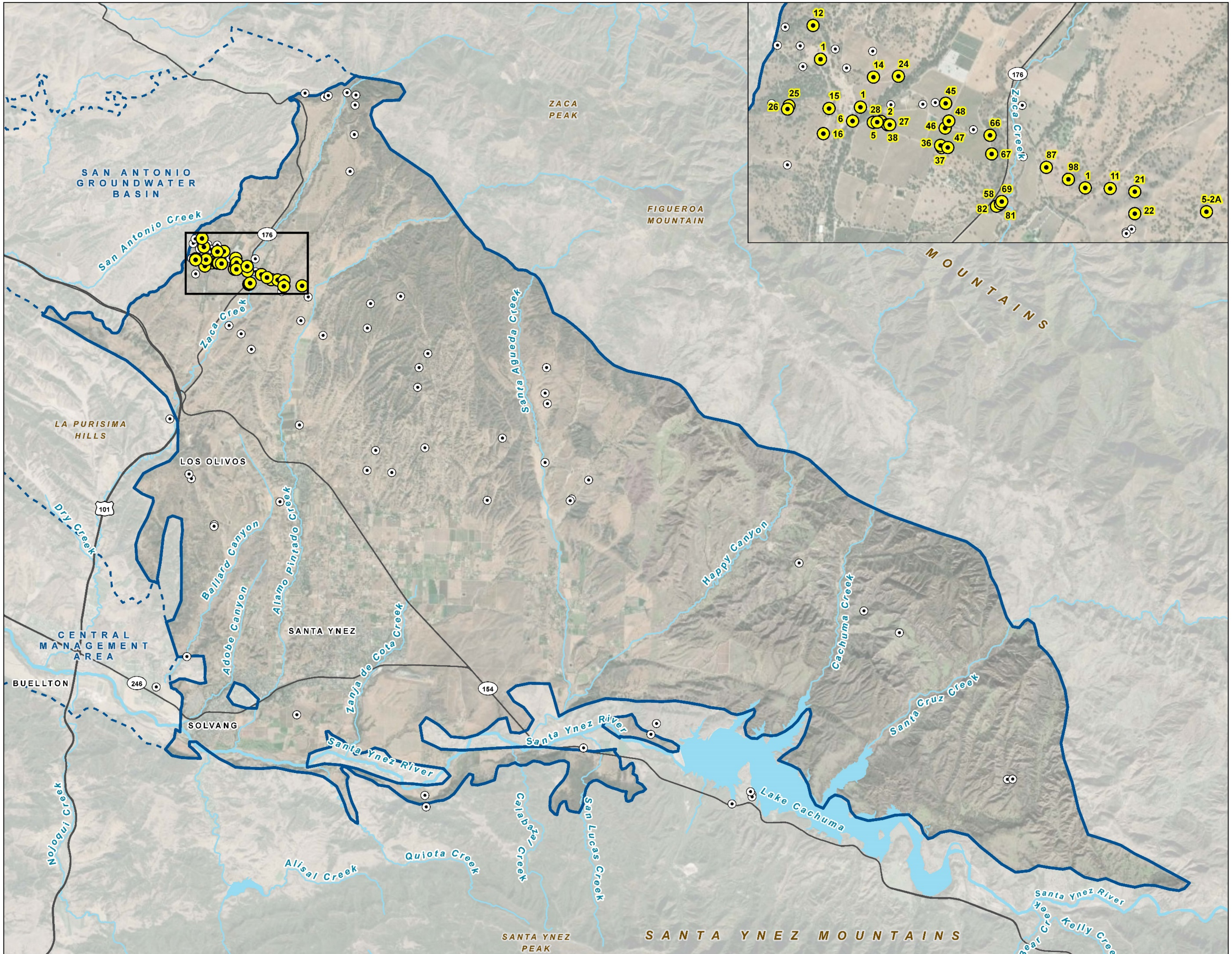
The bedrock below and surrounding the Basin consists of a variety of non-water-bearing rocks of Tertiary, Cretaceous and Jurassic age. These are older impermeable rocks below and surrounding the basin, separated by and faults including the Little Pine Fault Zone to the north and Santa Ynez River Fault zone to the south. These rocks include the Monterey Formation; Sisquoc Formation; Sandstone of Hurricane Deck (also known as the Temblor Sandstone); Vaqueros Sandstone; Sespe Formation; Espada Formation; and the Diabase, Serpentinite and the Franciscan Assemblage (Figure 3-4). Few water wells are completed within these formations, which are all outside of the Basin.

Characteristic of the Coast Range, the oldest of these rocks represent ophiolites, which consist of very old igneous and metamorphic rocks from the Jurassic and Cretaceous ages. These rocks formed at great depth and were scraped off of the ocean floor when it subducted (dived below) rocks on the land.

# FIGURE 3-3

## Oil and Gas Wells

Groundwater Sustainability Plan
Eastern Management Area




## LEGEND

Active Well

Inactive Well

Eastern Management Area Basin Boundary

**All Other Features**

Major Road

Watercourse

Waterbody

N

0 5,000 10,000 15,000

Feet

GSI Water Solutions, Inc.

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_3_Oil_Gas_Wells.mxd, npalmer

### 3.1.2.2 Surficial Geology

The Basin is a wedge-shaped, northwest-trending trough filled with sediments that have been folded and faulted by dynamic regional tectonics. The Basin is bounded by faults on the north and east along the base of the San Rafael Mountains and to the south near the Santa Ynez River by older low-permeability rocks. The boundary to the northwest is defined as the shared border with the San Antonio Creek Valley Groundwater Basin, which is a topographic watershed divide west of Zaca Creek Canyon, but not necessarily a geologic barrier to groundwater flow.

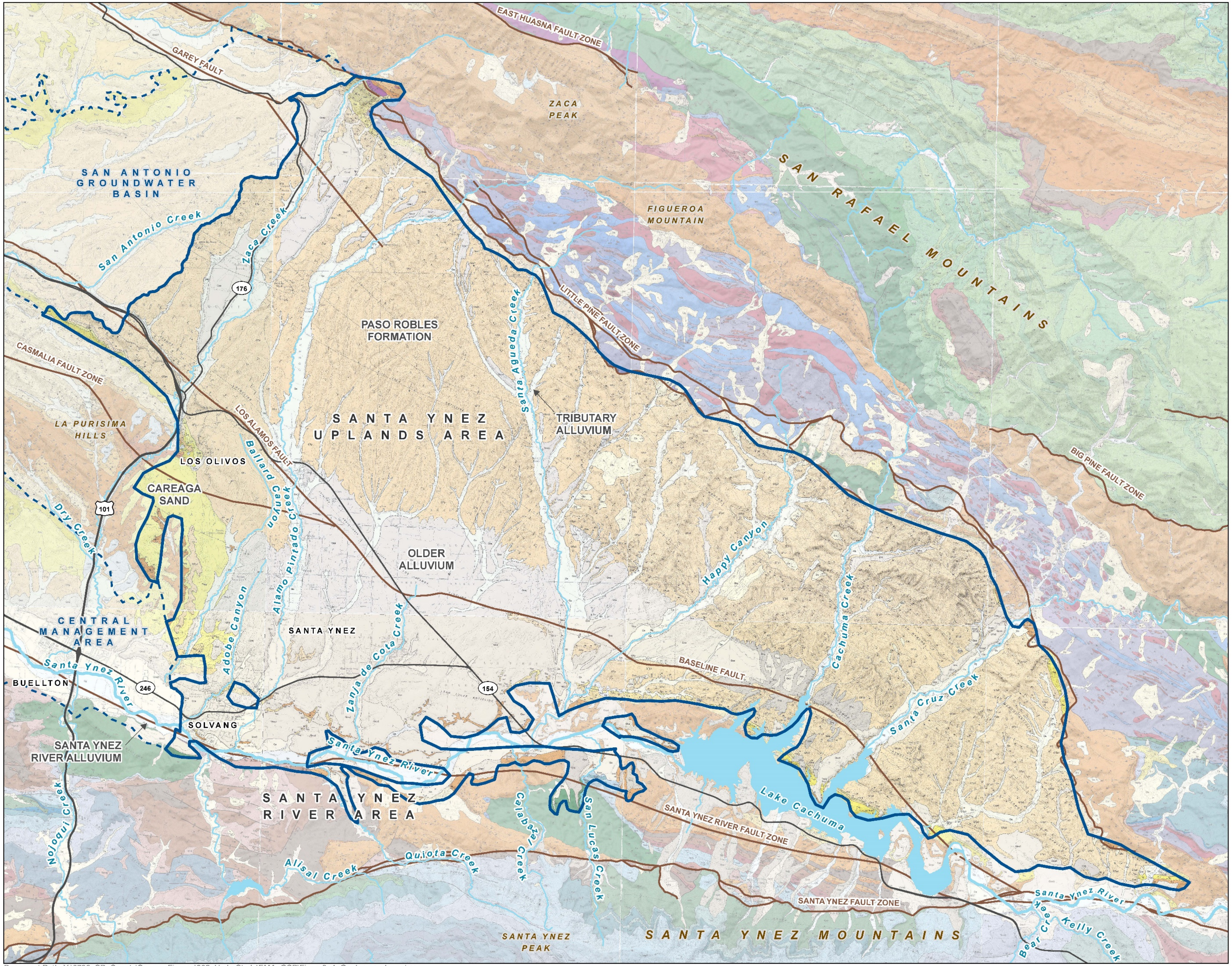
The surficial geology and major fault systems within and surrounding the Basin are presented as Figure 3-4. In the lowland between the Santa Ynez Mountains and the San Rafael Mountains, the non-water-bearing rocks that underlie the Basin are folded in response to regional tectonic forces. This folding determined the areas where the unconsolidated water-bearing sediments could accumulate to form the aquifers within the Basin. Several synclines and anticlines exist throughout the complexly folded bedrock units within the EMA. The Santa Ynez River flows on top of a relatively younger alluvium that overlies the much older Monterey Formation, which was uplifted closer to the surface, due to faulting and folding in this portion of the Basin.

As shown on Figure 3-4, the Basin is filled with an unconsolidated to weakly consolidated Tertiary-aged marine sandstone deposit, referred to as the Careaga Sand (Tca and Tcag) and non-marine Pliocene- and Pleistocene-aged sand, gravel, silt, and clay deposits that comprise the Paso Robles Formation (QTp). In this report the authors have combined the use of the two members of the Careaga Sand (Cebada and Graciosa members) to reflect how this materials is managed in the EMA. These water-bearing formations in the EMA extend to a depth of more than 1,500 feet below ground surface (bgs) with a maximum thickness up to 3,500 feet in the deepest part of the EMA. Overlying these formations are the Quaternary-aged Older Alluvium (Qoa), Santa Ynez River Alluvium (Qg), and Tributary Alluvium (Qa) that each range in thickness from 10 to 150 feet, depending upon location. These similar alluvium materials in the Santa Ynez River and along the Santa Ynez Uplands tributaries are both referred to as Younger Alluvium in the CMA and WMA.

**FIGURE 3-4**

**Geologic Map**

Groundwater Sustainability Plan
Eastern Management Area




**LEGEND**

Eastern Management Area Basin Boundary

**Geology**

- Qa – Tributary Alluvium
- Qg – Santa Ynez River Alluvium
- Qoa – Older alluvium
- QTp – Paso Robles Formation
- Tcag – Careaga Sand
- Tm – Monterey Formation
- Fault

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

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#### 3.1.2.3 Geologic Cross-Sections

**§ 354.14 Hydrogeological Conceptual Model**

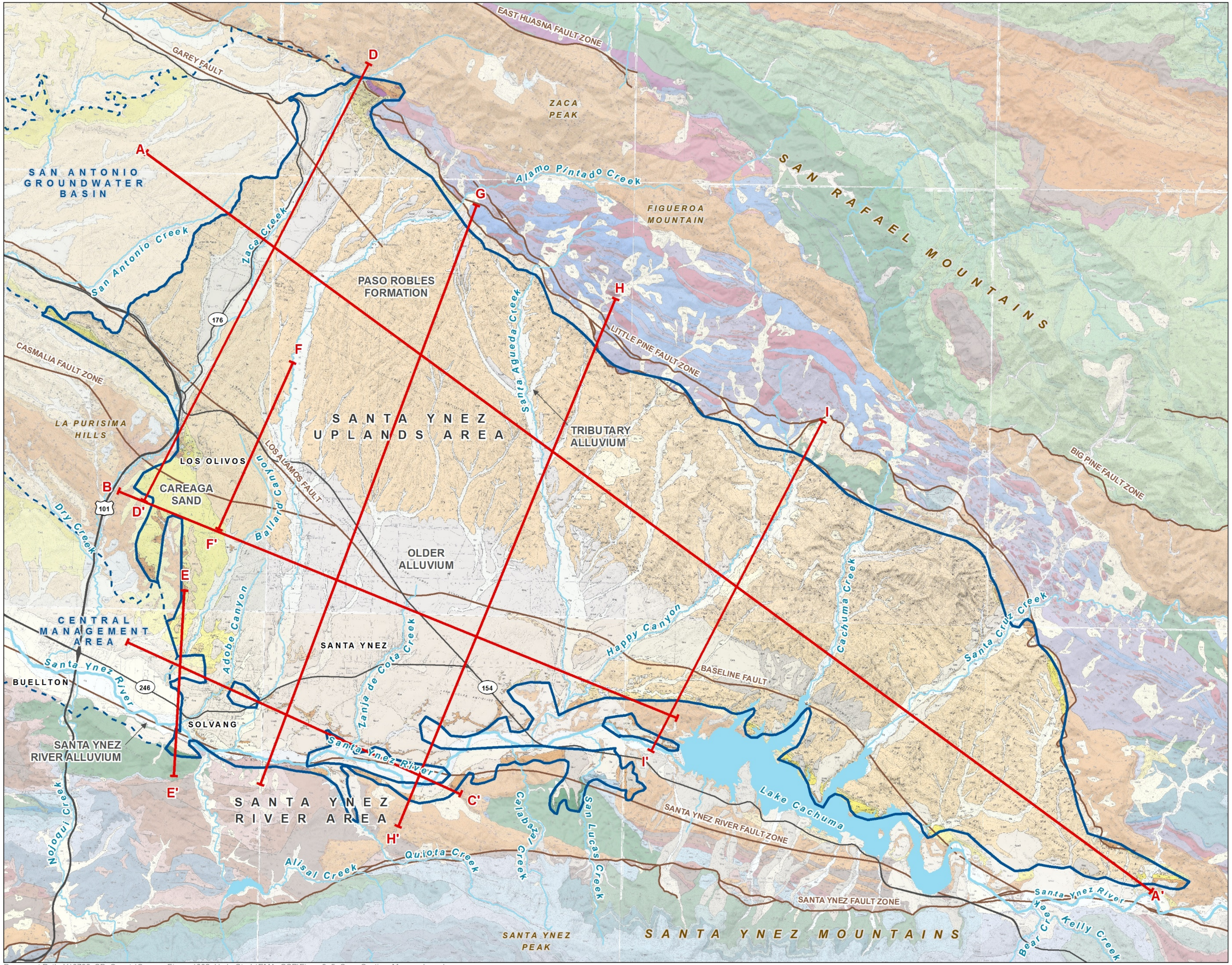
**(c) The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.**

Several geologic cross sections were created to depict the complex geology throughout the EMA, the locations of which are presented on Figure 3-5. Geologic cross sections are provided as Figure 3-6 through Figure 3-15.

# FIGURE 3-5

## Geologic Cross Section Location Map

Groundwater Sustainability Plan
Eastern Management Area




**LEGEND**

- Cross Section Line
- Eastern Management Area Basin Boundary

**Geology**

- Qa – Tributary Alluvium
- Qg – Santa Ynez River Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tcag – Careaga Sand
- Tm – Monterey Formation
- Fault

**All Other Features**

- Major Road
- Watercourse
- Waterbody

Date: November 20, 2020
Data Sources: ESRI, USGS, Maxar 2019

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The geologic cross sections were created with the three-dimensional (3D) geologic modeling tool Leapfrog. The 3D model will be used to characterize and illustrate the geologic and hydrogeologic setting that will be used to and support the decision-making process regarding sustainable groundwater management criteria. The 3D model was created for this GSP based on the best-available data from a variety of local, regional, and state-wide sources of geologic and hydrogeologic data, as presented on Table 3-2. Details of how the geologic framework model was prepared are presented in Appendix D.

**Table 3-2. Summary of Data Used for Geologic Model**

| Data Type | Source | Coverage | Period of Record |
|---|---|---|---|
| Borehole Lithology (including oil and gas well geophysical logs) | DWR, ID No. 1, SYRWCD, Solvang, California Geologic Energy Management Division, USGS | 131 boreholes within or adjacent to EMA | Current |
| Well Screen Intervals | DWR, ID No. 1, SYRWCD, Cities, USGS NWIS | 279 wells within EMA | Current |
| Digital Elevation Model (DEM) 10-meter resolution | National Elevation Dataset (NED), USGS EROS Data Center | Entire model domain | Current |
| Surficial Geology | Dibblee (1987a, 1987b, 1988a, 1988b, 1993a, 1993b, 1993c, 1994, 2005) | Entire EMA | |
| Geologic Cross Sections | Dibblee (4 Sections: 1993a, 1993b, 1993c, 1994), Fugro (1 Section: 2007), Hopkins (4 Sections: 2003) ), USGS (3 Sections: 1951, 1968) | Within and surrounding EMA | |
| Water Level Data[1] | USGS NWIS (includes CASGEM and County data), USBR, City of Solvang, ID No. 1 | Wells within and surrounding EMA | 1905 to present |

Notes

1 Water level data and associated groundwater contour maps have not yet been incorporated into the model.

DWR = California Department of Water Resources
NWIS = National Water Information System
USBR = U.S. Bureau of Reclamation
EMA = Eastern Management Area
SYRWCD = Santa Ynez River Water Conservation District
USGS = U.S. Geological Survey

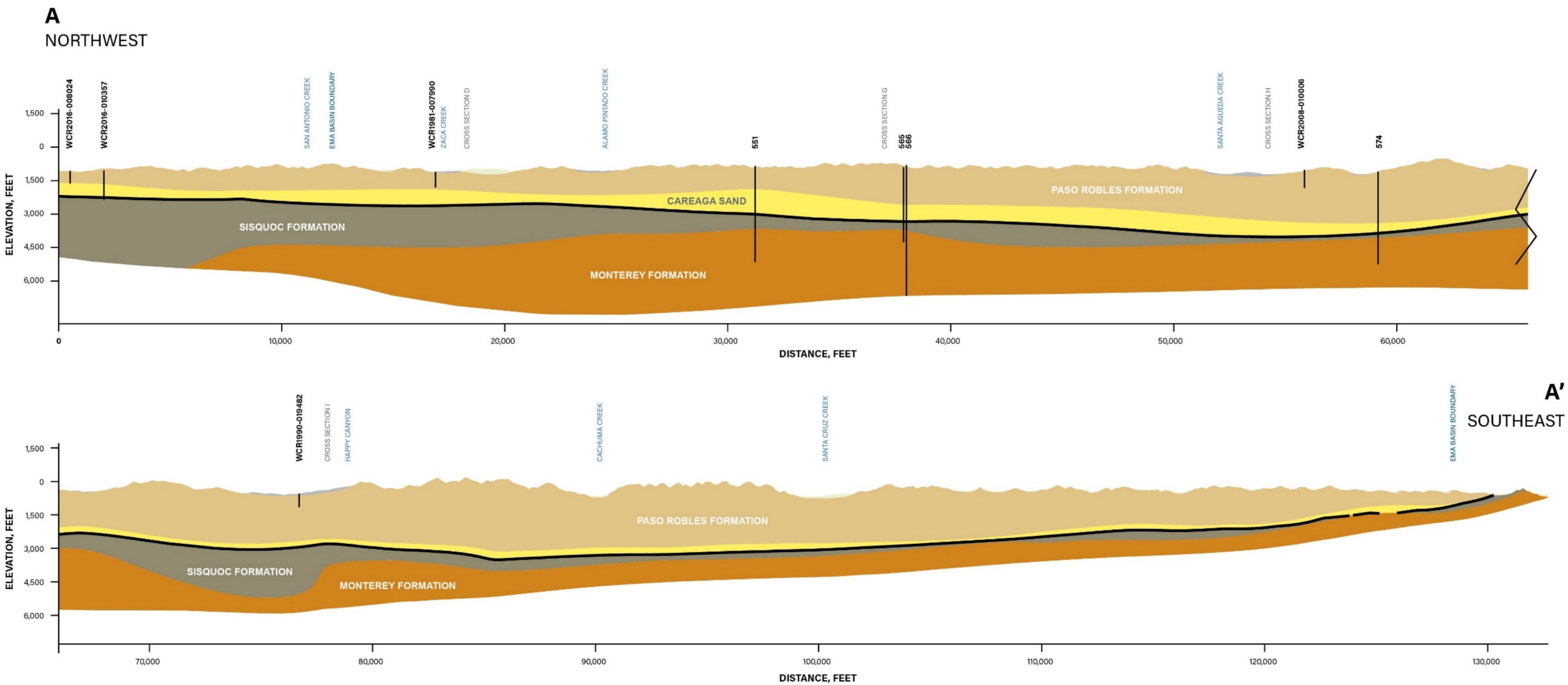
The 3D geologic model represents the most complete understanding of the local geologic setting and distribution of principal aquifers and aquitards. The 3D geologic model also provided input data for the numerical groundwater flow model presented in Section 3.3 below. The 3D geological model will be updated as warranted as the understanding of the EMA changes. Geophysical characterization is underway within the EMA, the results of which will be used to update the 3D geologic model, numerical groundwater model, and geologic cross sections.

As shown in the cross sections, non-water-bearing rocks surround and underlie the EMA, and include the Sisquoc and Monterey Formations. These formations are also evident at the surface within the southern portion of the EMA, north of the Santa Ynez River. These older bedrock units have generally low permeability, contain poor quality groundwater, and do not yield substantial quantities of water to wells.

Water-bearing geologic formations shown on Figure 3-4 and the geologic cross sections include the Paso Robles Formation, Careaga Sand, Santa Ynez River Alluvium, and Tributary Alluvium. The geologic cross sections show the relationships between the darker-colored non-water-bearing geologic units of the Sisquoc and Monterey Formations, and the lighter-colored water-bearing geologic formations.

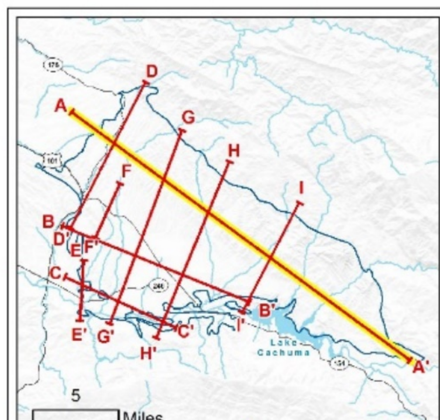
The descriptions of the geologic formations presented on the geologic cross sections, their lateral extent, and physical properties are presented in Section 3.1.3.

NOTE TO READER: the geologic cross sections are derived from the geologic model, due to be updated following input from the SkyTEM and tTEM surveys, which are in process.




## NOTE TO READER

These geologic cross sections are provided in draft format. The cross sections are derived from the geologic model, which will be updated following input from the geophysical surveys, which are in process. The final versions of these cross sections will comply with § 354.14(c).




## LEGEND

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-6**

**Cross Section A**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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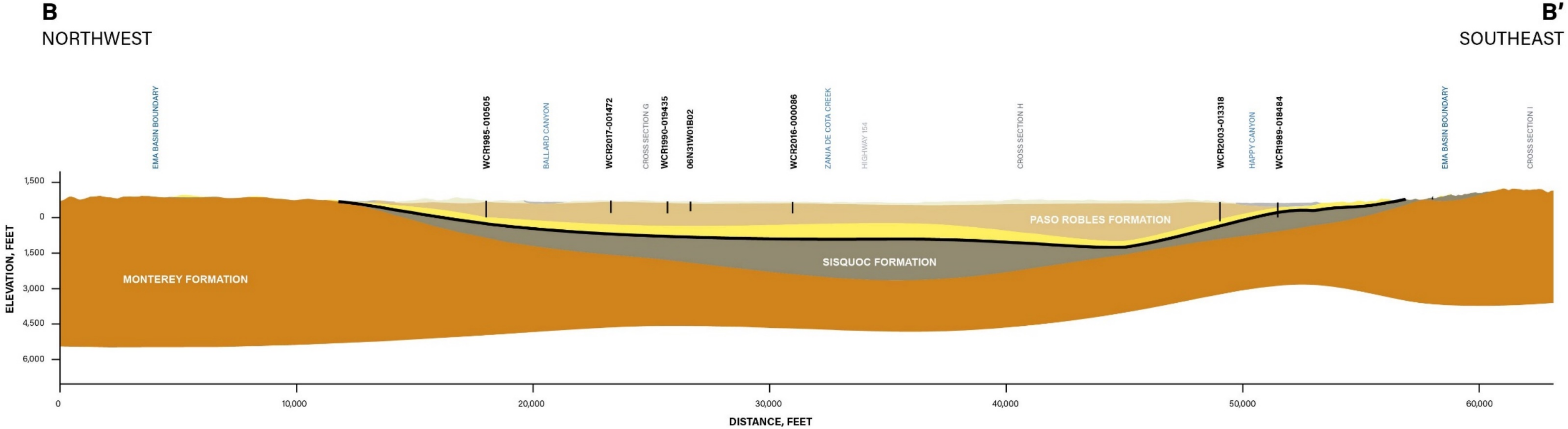
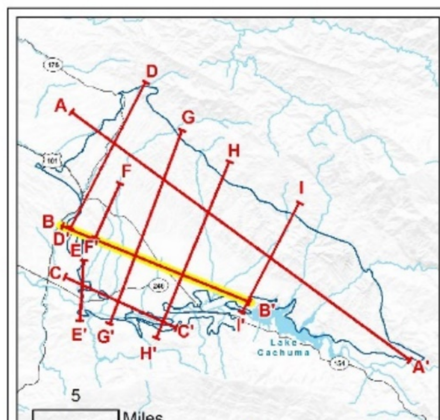



**NOTE TO READER**

These geologic cross sections are provided in draft format. The cross sections are derived from the geologic model, which will be updated following input from the geophysical surveys, which are in process. The final versions of these cross sections will comply with § 354.14(c).




**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-7**

**Cross Section B**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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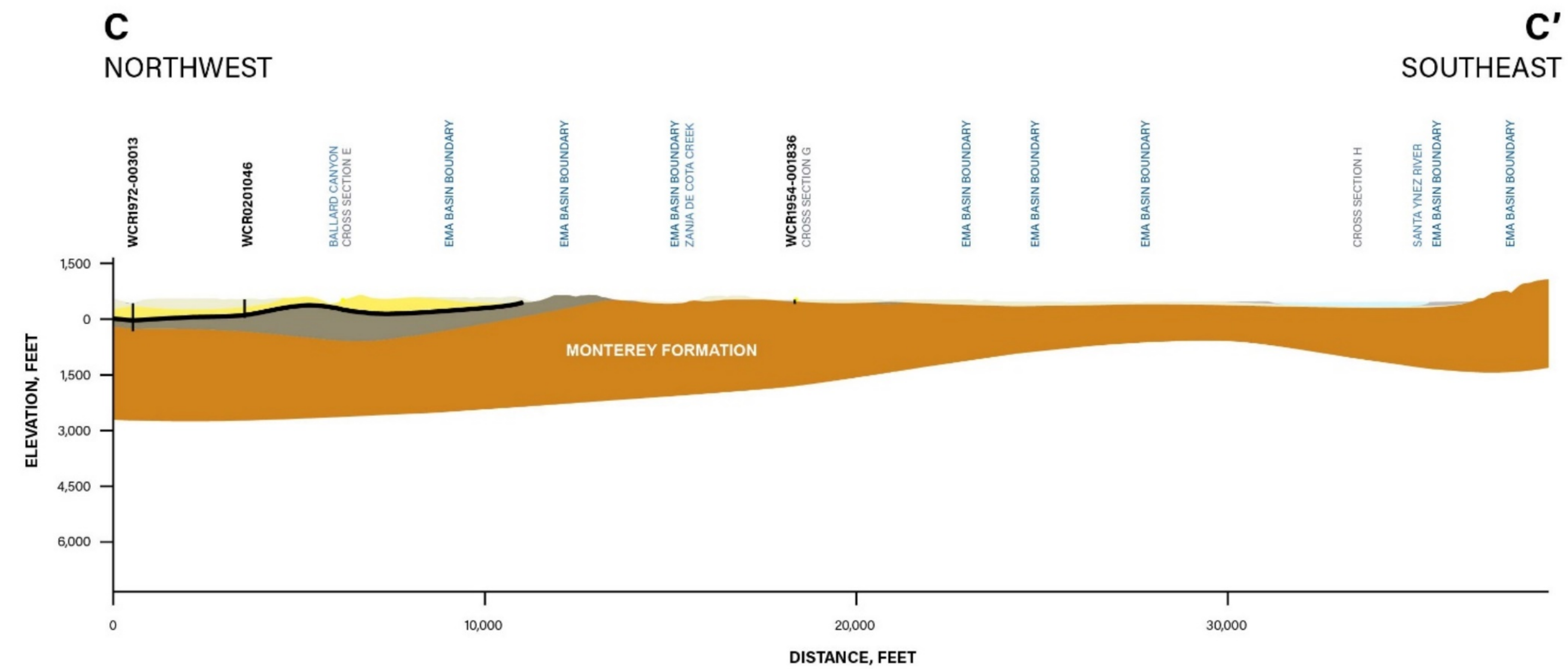
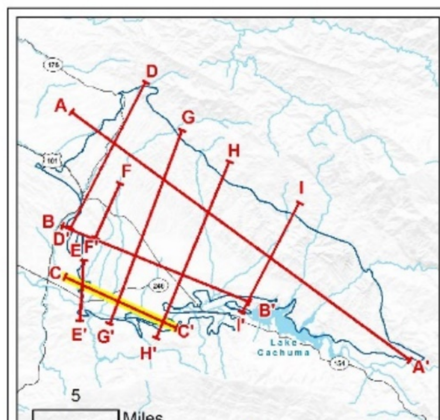



**NOTE TO READER**

These geologic cross sections are provided in draft format. The cross sections are derived from the geologic model, which will be updated following input from the geophysical surveys, which are in process. The final versions of these cross sections will comply with § 354.14(c).




**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-8**

**Cross Section C**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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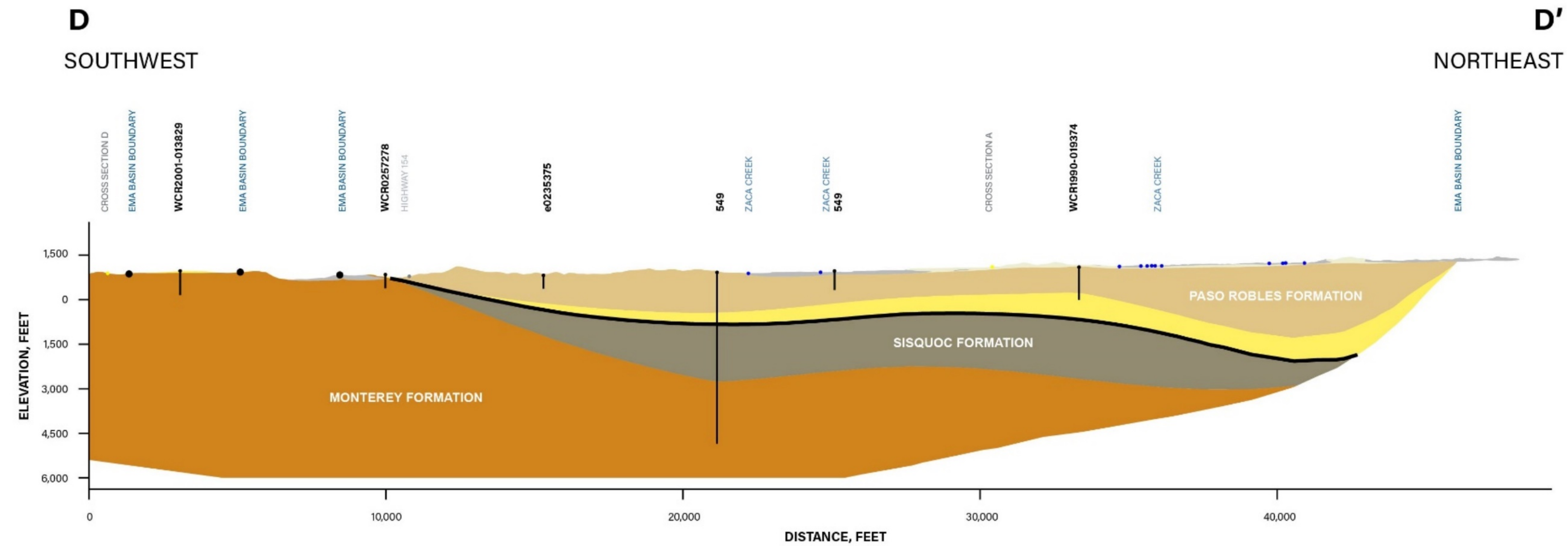
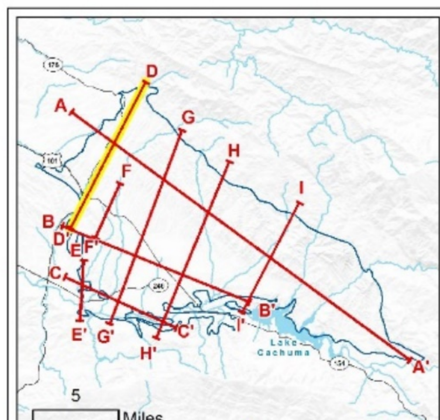



**NOTE TO READER**

These geologic cross sections are provided in draft format. The cross sections are derived from the geologic model, which will be updated following input from the geophysical surveys, which are in process. The final versions of these cross sections will comply with § 354.14(c).




**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-9**

**Cross Section D**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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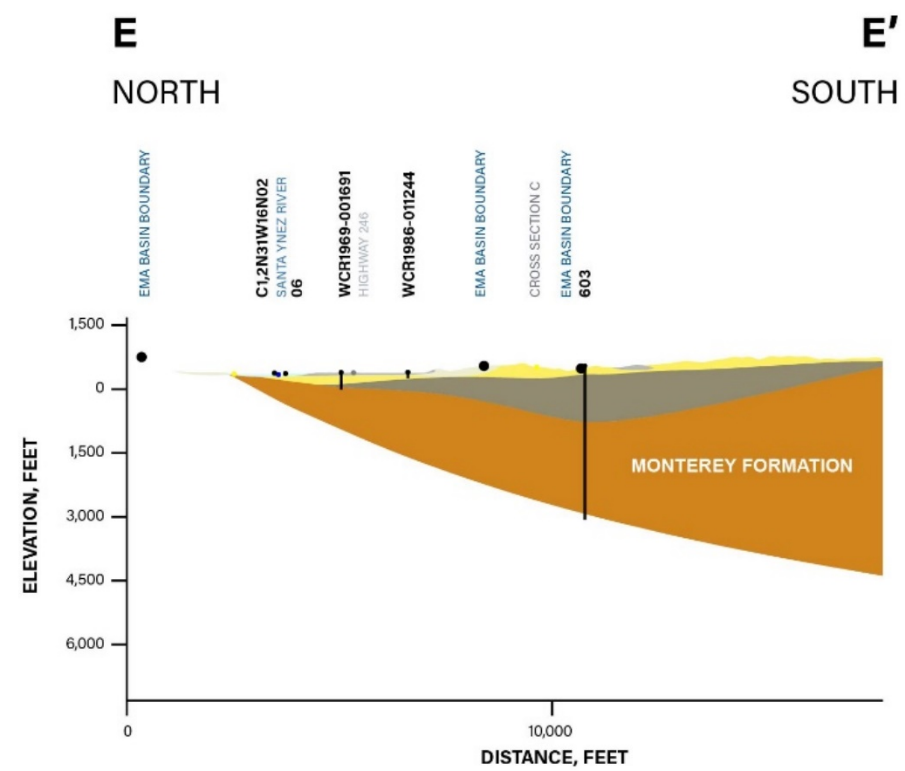


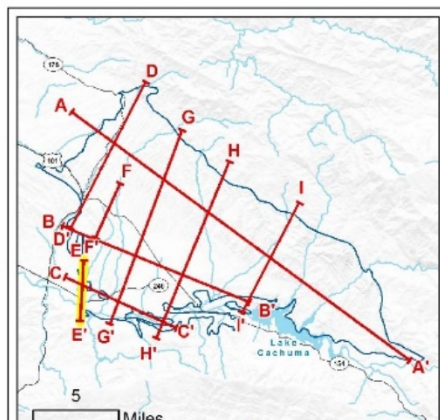


**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-10**

**Cross Section E**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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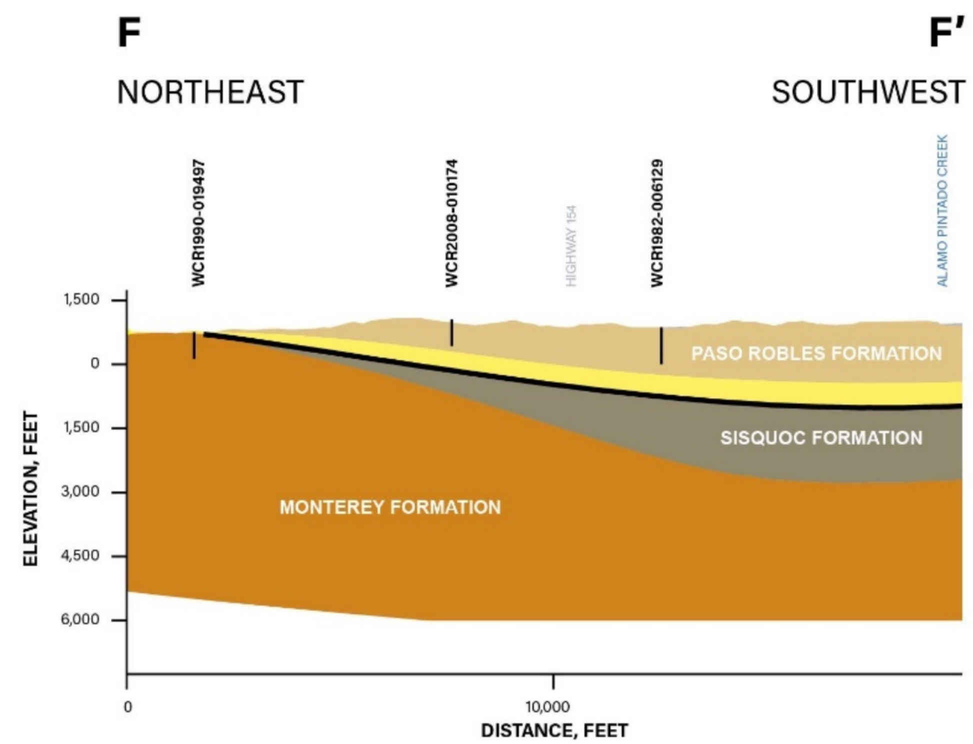


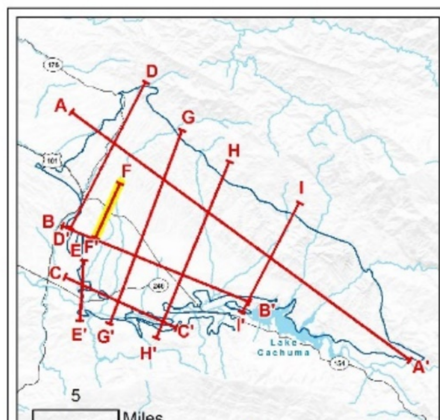


**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

## FIGURE 3-11
### Cross Section F
Groundwater Sustainability Plan
Eastern Management Area

Water Solutions, Inc.

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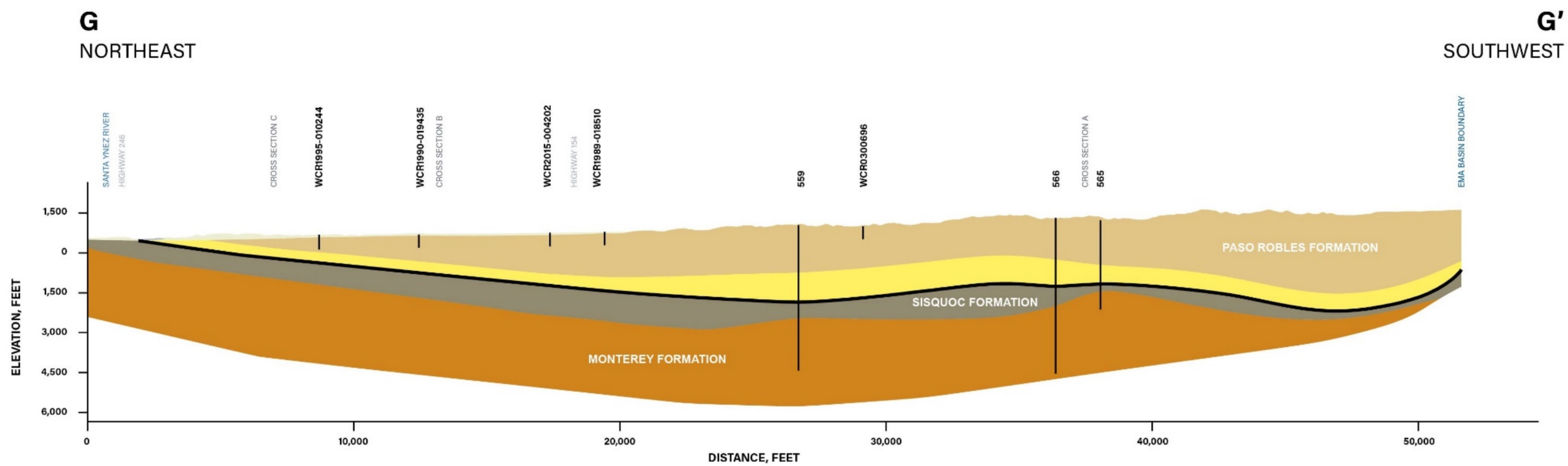


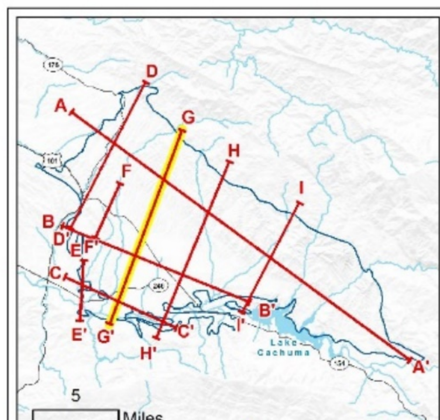


**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-12**

**Cross Section G**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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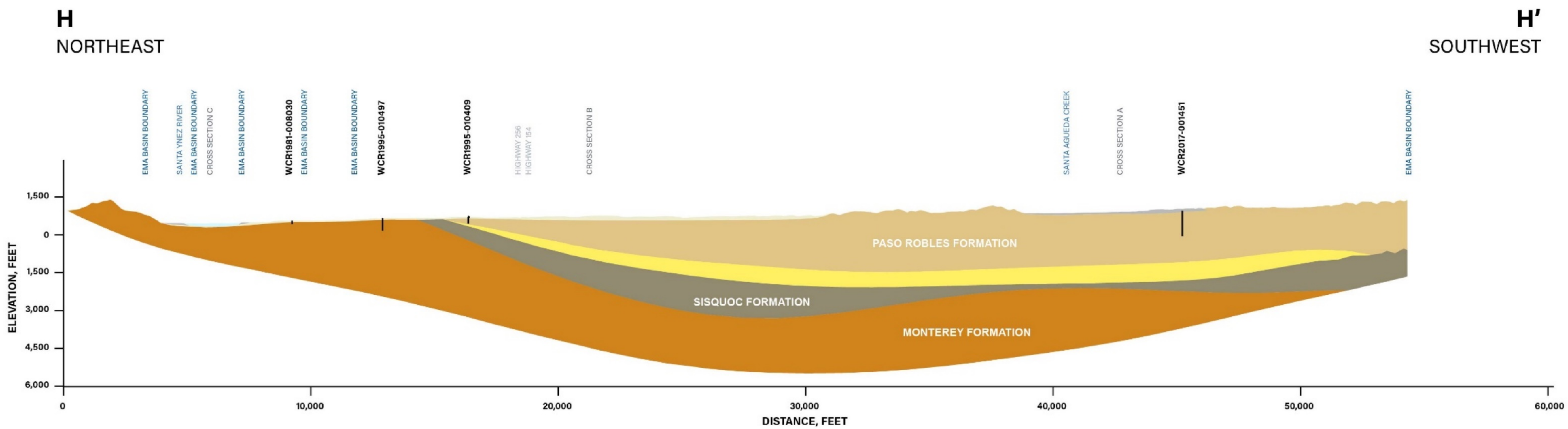


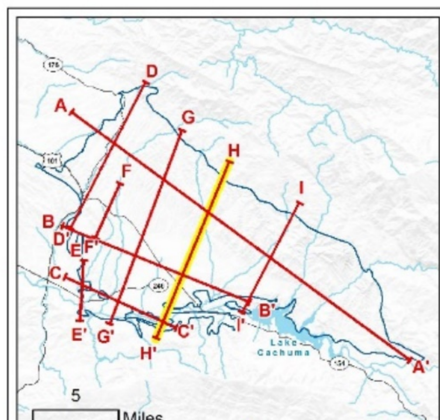


**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-13**

**Cross Section H**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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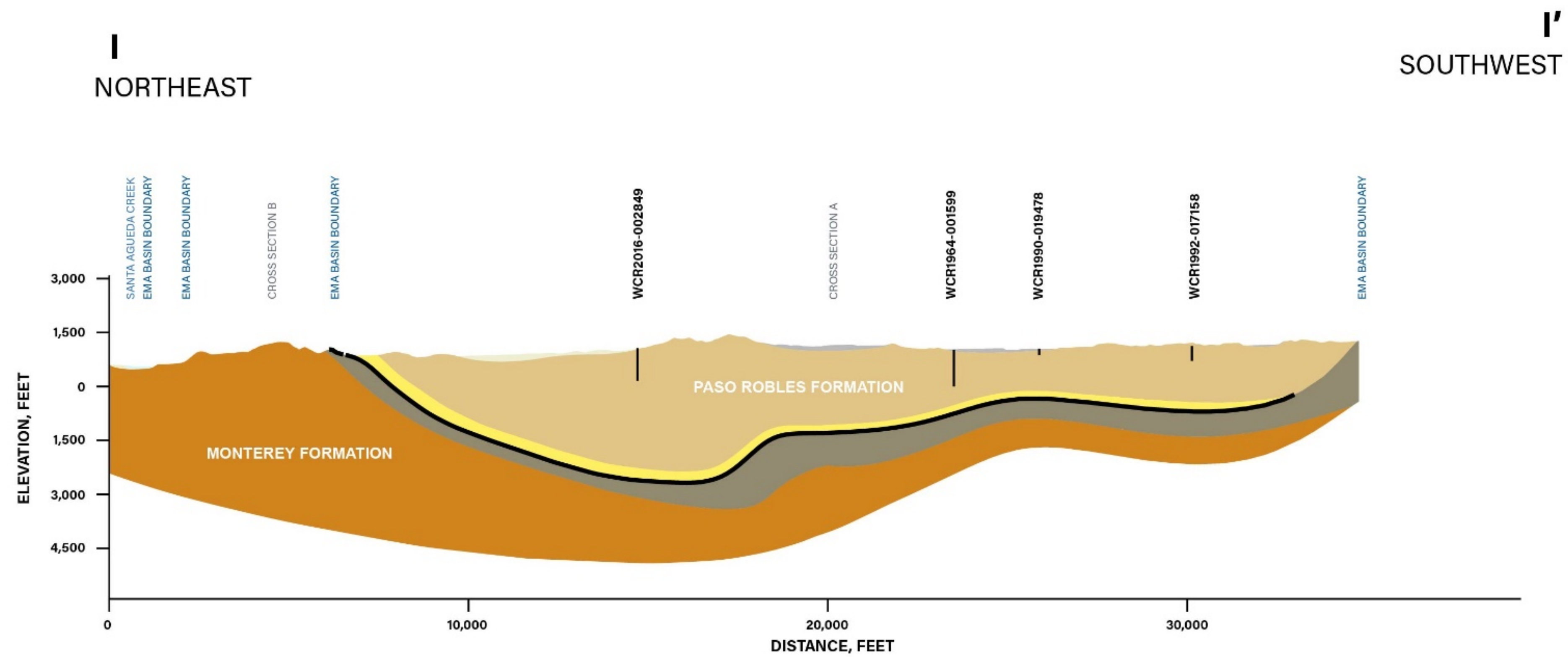


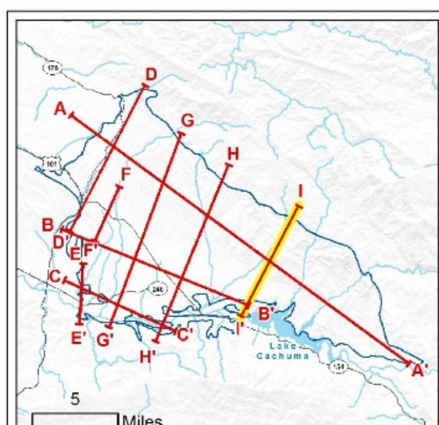


**LEGEND**

- Qa – Tributary Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tca – Careaga Sand
- Basin Bottom
- Tsq – Sisquoc Formation
- Tm – Monterey Formation

**FIGURE 3-14**

**Cross Section I**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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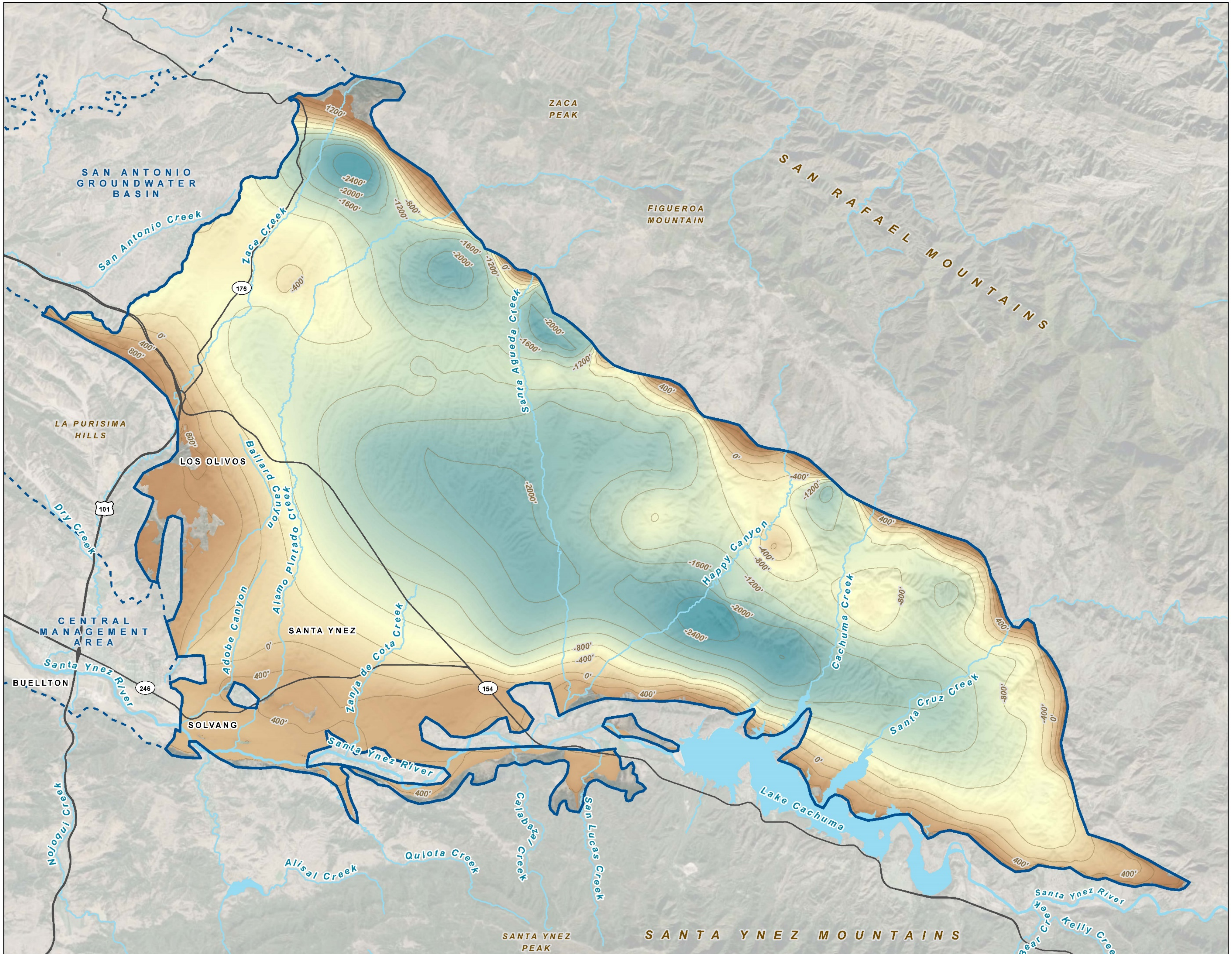


# FIGURE 3-15

## Basin Bottom

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

Eastern Management Area Basin Boundary

**Base Elevation of Aquifers**

1,830'

-2,750'

Elevation of Aquifer Contour, 400'

**All Other Features**

Major Road

Watercourse

Waterbody

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

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### 3.1.3 Principal Aquifers and Aquitards

The following sections describe the principal aquifers in the Basin[3] including physical properties, hydrogeologic characteristics, structural features within and bounding the EMA, the water quality within the EMA, and the primary beneficial uses of groundwater.

> **§354.14 Hydrogeological Conceptual Model.**
>
> **(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:**
>
> **(4) Principal aquifers and aquitards, including the following information:**
>
> **(A) Formation names, if defined.**

#### 3.1.3.1 Principal Aquifers

Aquifers are commonly named based upon the presence of water-bearing sand and gravel deposits grouped together into similar zones. Aquifers can be vertically or horizontally separated by fine-grained layers (called aquitards) that can impede movement of groundwater between aquifers. A total of four principal aquifers have been identified in the EMA, as presented in Table 3-3. The Paso Robles Formation and Older Alluvium have similar characteristics and have been combined into a single principal aquifer. Pumping from the Santa Ynez River Alluvium is managed as surface water by the SWRCB, and not managed by the Basin's GSAs. No aquitards or faults are known to impede groundwater flow within EMA (discussed further in Section 3.1.3.4 below).

**Table 3-3. Principal Aquifers in the Basin**

| Principal Aquifer | Formation Names | Map Symbol |
|---|---|---|
| Santa Ynez River Alluvium [1, 2] | Santa Ynez River Alluvium | Qg |
| Tributary Alluvium[2] | Tributary Alluvium | Qa |
| Paso Robles Formation | Paso Robles Formation | QTp |
| | Older Alluvium | Qoa |
| Careaga Sand | Careaga Sand | Tca and Tcag |

[1] Pumping from the Santa Ynez River Alluvium is managed as surface water by the SWRCB and is not subject to management by the Basin's GSAs under SGMA.
[2] The Santa Ynez River Alluvium and Tributary Alluvium are referred to as "Younger Alluvium" in the CMA and WMA.

The main criterion for defining the water-bearing geologic formations in the EMA as principal aquifers is that they exhibit both sufficient permeability and storage potential for the movement and storage of groundwater such that wells can reliably produce groundwater in sufficient quantities on a long-term basis. Another criterion is that the groundwater produced from the geologic formation must have generally acceptable

[3] The Basin boundary as defined by DWR Bulletin 118 (Bulletin 118 boundary) (DWR, 2016) is shown on Figure 3-4. The Bulletin 118 boundary does not everywhere include the full lateral extent of basin sediments. The Bulletin 118 boundary also includes older, relatively impermeable non-basin geologic units in places. The discrepancies between the Bulletin 118 boundary and the surficial geology may be corrected in a future Basin Boundary Modification Request.

quality. Groundwater of a conductivity of 3,000 micromhos/centimeter is considered as the maximum limit for basin groundwater quality in similar groundwater basins (DWR, 1979). Application of these two criteria, along with the historical understanding and ongoing management of the aquifer system, limits definition of the EMA's sediments to the four principal aquifers listed in Table 3-3. Descriptions of these aquifers are presented in Section 3.1.3.3 below.

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

**§ 354.14 Hydrogeological Conceptual Model**

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

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

**(3) The definable bottom of the basin.**

While the watershed that drains surface water into the EMA encompasses a much larger area, Bulletin 118 defines the groundwater basin within the EMA as shown on Figure 3-1 (DWR, Bulletin 118 Basin 3-15).

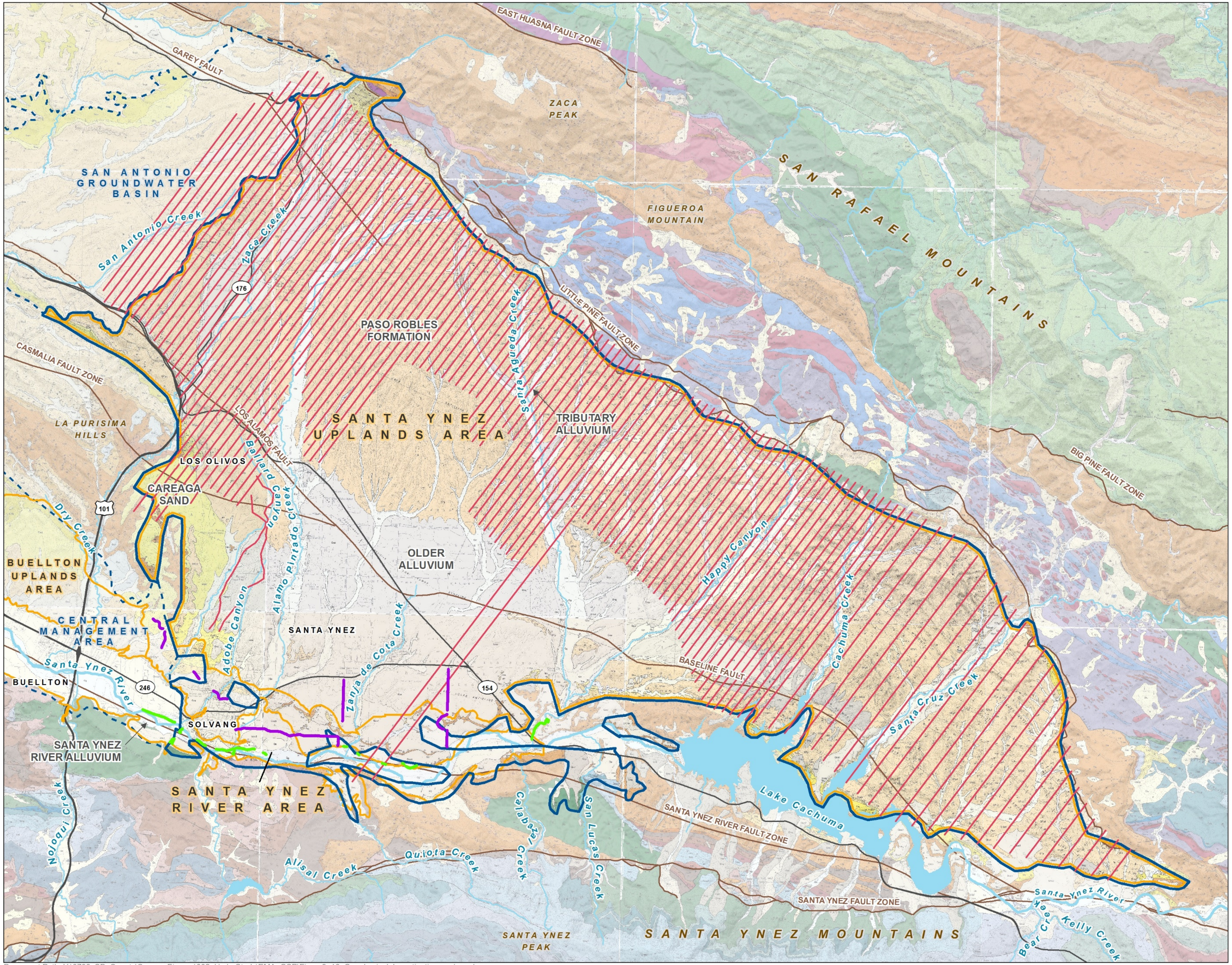
The Santa Ynez Uplands area covers a majority of the EMA, including the northern 130 square miles (87 percent) of the 150 square miles of the EMA. To the north and east of Los Olivos, the Santa Ynez Uplands area abuts the dissected foothills of the San Rafael Mountains and the Zaca Creek area in the Purisima Hills on the west. The Santa Ynez Uplands extends to the east end of Lake Cachuma (Figure 3-4). The subsurface of Santa Ynez Uplands primarily consists of the Paso Robles Formation (upper part) and Careaga Sand (lower part), above which the valleys are filled to shallow depth with Tributary Alluvium as presented on Figure 3-4.

The Santa Ynez Uplands is separated from the Santa Ynez River area to the south by a ridge of impermeable bedrock. The Santa Ynez River Alluvium extends outside of the EMA, both upstream and downstream of the EMA, for a total length of 36 miles between the upstream Bradbury Dam (to the east) to the Lompoc Plain to the west, passing the cities of Buellton and Lompoc (Santa Barbara County, 2011).

The Basin's bottom elevation within the EMA is shown on Figure 3-16. In the Santa Ynez Uplands, the bottom of the Basin is the base of the water-bearing formations and includes the Paso Robles Formation and/or Careaga Sand. Together, the base of these water-bearing formations is an irregular surface formed as the result of folding, faulting, and erosion. The depth of these materials extends to a maximum depth of approximately 3,500 feet in some areas.

With limited exceptions, the Tributary Alluvium is located in several north-south trending tributaries to the Santa Ynez River and overlies either the Paso Robles Formation or Careaga Sand within the Santa Ynez Uplands. In these areas, the base of the underlying Paso Robles Formation or Careaga Sand is the bottom of the groundwater basin. Further south, near the bedrock ridge between the Santa Ynez Uplands and Santa Ynez River, the Tributary Alluvium overlies directly on the Monterey Shale bedrock. In these areas, the contact between the alluvium and bedrock is the bottom of the groundwater basin.

The Santa Ynez River Alluvium overlies the Monterey Shale (non-water-bearing) bedrock in most of the EMA, except for a small area near Solvang where it overlies Careaga Sand. The top of the Monterey Shale bedrock is considered the base of the groundwater basin. While some of the bedrock units underlying the water-bearing materials may produce limited quantities of water, the water is generally of poor quality, especially within the Monterey Shale, and of limited volume and therefore in accordance with SGMA is not considered part of the Basin for the purposes of this GSP.




# FIGURE 3-16

## Areas of Geophysical Investigation

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

- SkyTEM (to be flown mid-November 2020)
- Towed Electromagnetic Survey (tTEM)
- Seismic Refraction Survey
- Eastern Management Area Basin Boundary

**Geology**

- Qa – Tributary Alluvium
- Qg – Santa Ynez River Alluvium
- Qoa – Older Alluvium
- QTp – Paso Robles Formation
- Tcag – Careaga Sand
- Tm – Monterey Formation
- Fault

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 20, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

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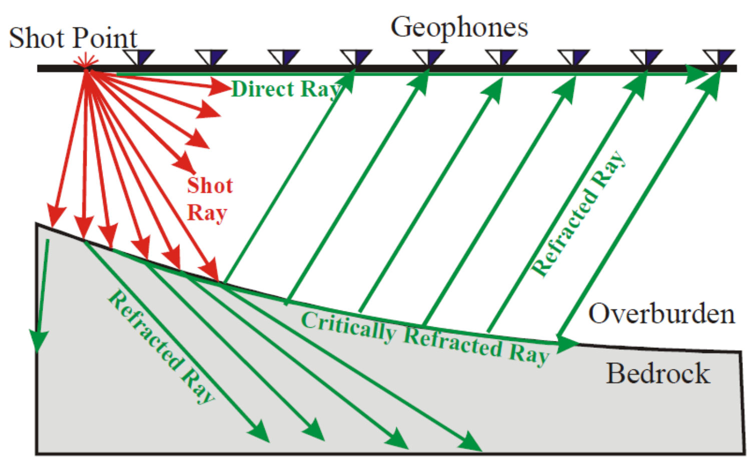
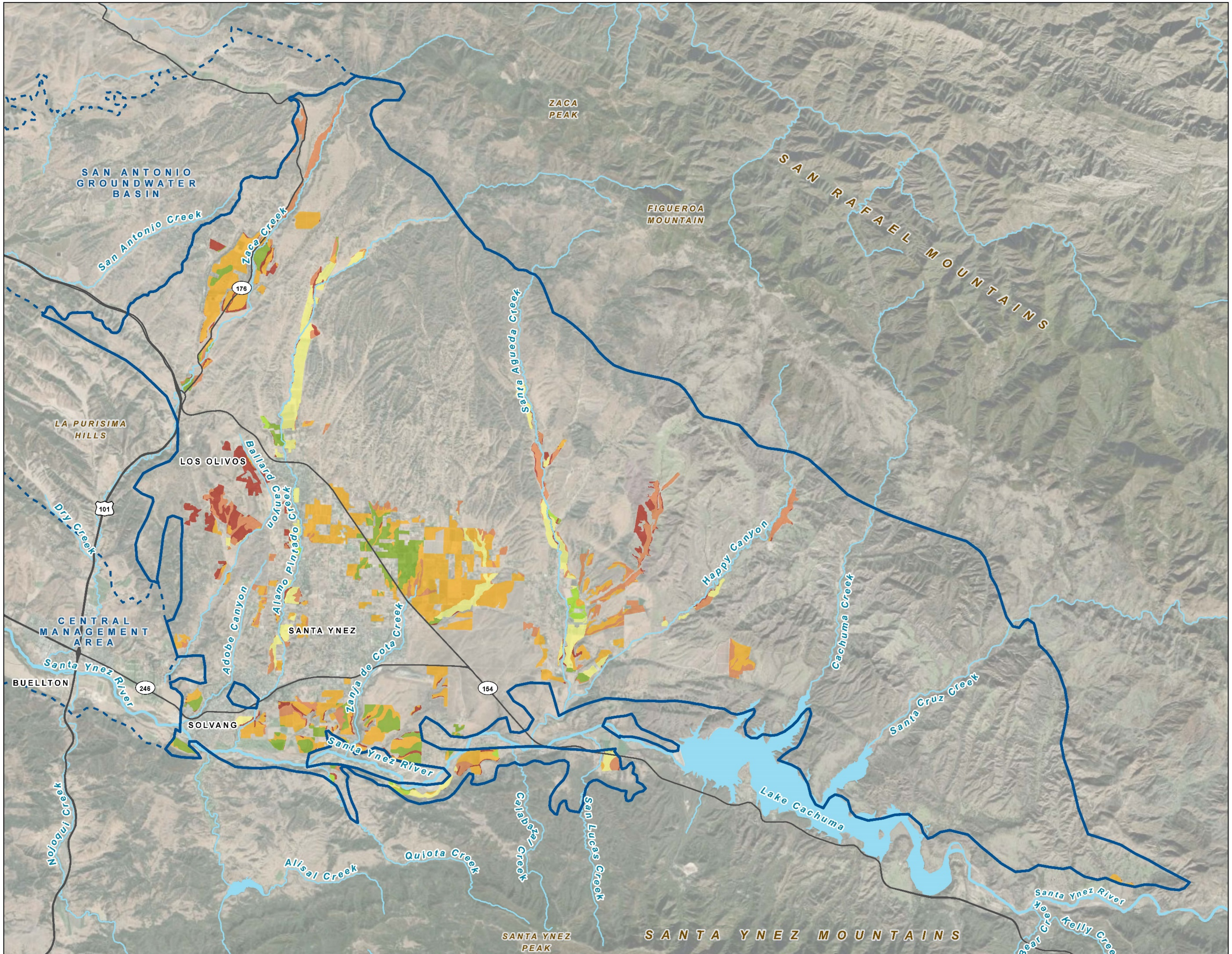
#### 3.1.3.2.1. Basin Boundary Refinements - Geophysical Investigation

A series of geophysical surveys were conducted to provide additional information about the boundary between the EMA and CMA and about the nature of the connection between several of the north-south trending tributaries (e.g., Alamo Pintado Creek) within the Santa Ynez Uplands and the Santa Ynez River Alluvium (Figure 3-16). These geophysical surveys included a variety of both land-based and aerial methods. The land-based methods included seismic refraction and transient electromagnetic (tTEM) surveys that were conducted in September 2020. An aerial based electromagnetic survey using transient electromagnetic method (TEM) called SkyTEM is an electromagnetic survey that will be conducted using a helicopter in November 2020. Results from the seismic refraction survey are described here. The tTEM and SkyTEM results may or may not be available in time to include in this GSP, but will be included in any future GSP updates.

As discussed in Section 3.1.2.2 above, geologic maps of the EMA show a bedrock ridge in the southwestern portion of the Basin. The bedrock ridge is believed to constrain groundwater flow between the Santa Ynez Uplands to the north and the Santa Ynez River Alluvium to the south (Hoffman et al., 1996). Groundwater in portions of the Santa Ynez Uplands may contribute some quantity of recharge to the Tributary Alluvium, which subsequently contributes to recharge to the Santa Ynez River Alluvium and the rest of the Basin downstream of the EMA. This is not well defined and so is a data gap and is described further in the data gaps section. The groundwater discharging from the Santa Ynez Uplands also may flow through notches in the bedrock, which have been scoured out by erosive flows within ancient tributaries of the Santa Ynez River. These notches associated with the major tributaries to the Santa Ynez River have been filled to a limited depth with alluvium, the depth and extent of which are the subject of geophysical exploration conducted in support of this GSP. The areas where the geophysical investigations were conducted are presented on Figure 3-16.




The diagram to the right presents an example of the seismic refraction method. Seismic energy provided by a source (shot) located on the surface radiates out from the shot point, either traveling directly through the upper layer (direct arrivals), or traveling down to, and then laterally along, higher-velocity layers (refracted arrivals) before returning to the surface. The refracted energy is detected on the surface using a linear array (or spread) of geophones spaced at regular intervals. Beyond a certain distance from the shot point, the refracted signal is observed as a first-arrival signal at the geophones (arriving before the direct arrival). Observation of the travel times of the direct and refracted signals provides information on the depth profile of the refractor. for determining depth to bedrock and bedrock structure.




# FIGURE 3-17

## Potential Recharge Areas

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

Eastern Management Area Basin Boundary

**Soil Agriculture Groundwater Banking Index (SAGBI) Rating**

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

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

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The results of the seismic refraction survey suggest that the depth to bedrock varies between approximately 35 and 200 feet below ground surface along the survey transects (Figure 3-16).A picture of one of these seismic refraction survey lines along Meadowlark Road is shown to the right. Generally, the depth to bedrock tends to decrease with proximity to the mapped bedrock highs—which helps confirm the presence of a flow-restricting bedrock ridge—while the bedrock lows correspond to areas that are filled with alluvium and transmit groundwater through the notches. Some of the cross sections show significant undulations in the interpreted bedrock surface, which could indicate a degree of scouring by ancient tributaries, and thus a permeable conduit for groundwater to flow through. Although there are uncertainties concerning lithological interpretations, the cross sections provide important details about the geometries of permeable and impermeable sediments, which are essential to quantifying the amount of groundwater flowing out of the Santa Ynez Uplands.

The other ground-based geophysical survey consisted of a tTEM system, employed to provide data that could refine the geometry, layering, and estimated hydraulic properties of the shallow subsurface materials (0 to 250 feet). The tTEM equipment is designed for detailed 3D geophysical and geological mapping of the shallow subsurface (0 to 250 feet) in a fast and cost-efficient way. The tTEM survey was conducted to characterize the geometry of the major tributaries where they join the Santa Ynez River and perhaps also the interaction of groundwater and surface water in the Santa Ynez River channel. Results from this survey were not available at the time of this writing but will be presented in future revisions of the GSP.

Note to Reader: Interpretation of tTEM will be completed along with the completion of aerial geophysics following completion of aerial survey to be conducted in November 2020.

#### 3.1.3.3 Physical Properties of Aquifers and Aquitards

**§ 354.14 Hydrogeological Conceptual Model**

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

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

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

The following section presents a description of the physical properties of each Principal Aquifer. These descriptions are based on technical studies and geologic interpretation compiled from the best available data. The locations of these aquifers are presented on Figure 3-4.

The physical properties of each of the principal aquifers are summarized on Table 3-4.

No significant confining aquitard units are known to exist in the EMA. , although Locally confined conditions may be observed in wells completed in the Paso Robles Formation, due to the known heterogeneity in this aquifer, which includes clayey layers and gravel lenses of significant areal extent.

The hydraulic properties of wells completed in the principal aquifers were estimated based on published values (Upson and Thomasson, 1951; Dibblee, 1958; French and Lemiuerre, 1968; Hoffman et al., 1996; Hopkins, 2003) and pumping test analyses for wells compiled for creation of this GSP. These data were supported by data included in well completion reports reviewed by GSI. These best available data provide a basis for estimating aquifer properties for the principal aquifers. Aquifer testing data were compiled for wells completed within the Paso Robles Formation, Careaga Sand, and Santa Ynez River Alluvium; only the Tributary Alluvium lacked supporting aquifer testing data. These hydraulic properties are employed as inputs for the numerical groundwater flow model, whose development and results are presented in Section 3.3. The estimated aquifer properties presented on Table 3-4 and in the paragraphs below include usage of the following aquifer characteristics:

- **Hydraulic conductivity:** the rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient (feet per day).
- **Transmissivity:** the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient (square feet per day).
- **Storativity:** the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. Also commonly referred to as the storage coefficient, storativity is the sum of the confined storage coefficient (specific storage times saturated thickness) and the specific yield (unitless).
- **Specific Capacity:** the rate of discharge of a water well per unit of water level drawdown (gallons per minute per foot of drawdown).
- **Flow:** the rate at which water is discharged from a water well during operation (gallons per minute).

Data sources include pumping tests compiled from the County Environmental Health Service for water purveyors and mutual water companies including the following:

- Oak Trail Estates
- Midland School
- Santa Ynez Rancho Estates
- Rancho Ynecita
- Woodstock Ranch
- Walking M Ranches
- Alisal Ranch Golf Course
- Meadowlark Ranches
- City of Solvang
- ID No. 1

These data and reports (some of which include interpretation of the data) were reviewed to estimate hydraulic properties, principally hydraulic conductivity and well production characteristics. The type of aquifer testing conducted varied between shorter-term step-rate tests, and longer-term constant-rate tests conducted for up to 24 hours. The distribution of these wells in the Basin was generally sufficient to represent the variability of aquifer hydraulic properties throughout the EMA.

## Table 3-4. Physical Properties of each Principal Aquifer

| Principal Aquifer | Principal Location (Lateral Extent) | Vertical Extent (feet) | Hydraulic Conductivity (feet / day) | Storativity (unitless) | | Porosity |
|---|---|---|---|---|---|---|
| | | | | Sc | Sy | (Vol/Vol) |
| Paso Robles Formation | Santa Ynez Uplands, outcropping across approximately 70 percent of EMA, except for along the river, tributary channels, and older alluvial terraces within 1 to 2 miles of river | 0 to 3,500<br>Av. Thickness: 1,500 bgs | 0.2 to 96<br>Average:18 | $1.0 \times 10^{-2}$ | Paso Robles: 0.04 | Paso Robles: 0.15 |
| (includes Older Alluvium) | Draped atop Paso Robles Formation from terraces near river up to 1 to 2 miles upslope from river | Surface to 150<br>Av. Thickness: 60 bgs | 70 to 280<br>Average: 136 | $6.0 \times 10^{-4}$ | Older Alluvium: 0.1 | Older Alluvium: 0.2 |
| Careaga Sand | Deeply buried beneath Santa Ynez Uplands, rising to near-surface near and beneath City of Solvang | Below Paso Robles Formation and Santa Ynez River Alluvium<br>200 to 900<br>Av. Thickness: 800 bgs | 0.8 to 20<br>Average: 7.5 | $8.0 \times 10^{-4}$ | 0.05 | 0.12 |
| Santa Ynez River Alluvium | Santa Ynez River | Surface to 60<br>Av. Thickness: 42 bgs | 100 to 600<br>Average: 260 | $4.2 \times 10^{-4}$ | 0.23 | 0.3 |
| Tributary Alluvium | Along principal tributaries in Santa Ynez Uplands | Surface to 70<br>Av. Thickness: 35 bgs | 100 to 500 (est.)<br>Average: 200 | $3.5 \times 10^{-4}$ | 0.2 (estimated) | 0.3 |

Notes

Av. = average

Est. = estimated

Sc = specific yield

Sy = storage coefficient

Vol = volume

The following paragraphs provide information about each of the principal aquifers, including descriptions of the vertical and lateral extent of each, its hydraulic conductivity and storativity, as well as the general production capacity of wells completed in each aquifer.

##### 3.1.3.3.1. Paso Robles Formation (Aquifer)

The Paso Robles Formation (QTp on Figure 3-4) makes up the majority of the groundwater storage within the EMA. The Paso Robles Formation extends laterally throughout Santa Barbara and San Luis Obispo County. Locally, this aquifer is present in the Santa Ynez Uplands area of the EMA, extending from the ground surface to approximately 3,500 feet below ground and forms an extensive aquifer where saturated.

The Paso Robles Formation is a Plio-Pleistocene-aged, predominantly non-marine terrestrial unit made of relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay. These layers are often described on drillers logs as “shale gravel.” The formation was deposited in alluvial fan, floodplain, and lake depositional environments derived from materials from the surrounding the San Rafael and Santa Ynez Mountains. Seashells are reported in some well logs near the base of the Paso Robles Formation, suggesting a near-shore marine depositional environment. The formation is unconsolidated and poorly-sorted. The sand and gravel beds within the unit have a high percentage of Monterey shale gravel fragments and generally have moderately lower permeability compared to the shallow, unconsolidated alluvial sand and gravel beds. Typically, the formation is sufficiently thick such that water wells completed in the Paso Robles Formation produce up to several hundreds of gallons per minute.

For the purpose of groundwater management, the Paso Robles Formation is considered a single unit. However, considerable variability is known to exist within the formation throughout the EMA and indeed the entire Basin. Whereas the upper part consists of relatively coarse-grained materials typical of alluvial fan deposits, the lower part of the complexly folded Paso Robles Formation is finer-grained. The coarser-grained potions of the Paso Robles Formation yield groundwater to wells at higher flow rates than the underlying portions.

Based on aquifer tests for 20 wells completed in the Paso Robles Formation located throughout the EMA, the hydraulic conductivity of the Paso Robles Formation varies between 1 foot and 100 feet per day. Based on these aquifer tests, as well as published reports, the upper part of the formation was assigned a hydraulic conductivity for use in this report and the numerical groundwater model of 20 feet per day and the lower part was assigned a value of 10 feet per day (USGS, 1951). The hydraulic conductivity ranges between approximately 400 feet and 200,000 feet per day, which reflects the heterogeneity of the aquifer hydraulic properties of these materials in the EMA. The storativity ranges from 0.01 for confined storage with a specific yield of around 0.04. The pumping rates for wells completed in this formation can range between less than 100 gallons per minute (gpm) to as much as 1,500 gpm, depending largely on length of the aquifer perforated by individual wells.

Because of the similarity of the materials, the Older Alluvium is proposed to be managed in conjunction (as part of) the Paso Robles Formation aquifer. These Older Alluvium deposits (Qoa on Figure 3-4), which are also referred to as Terrace Deposits, are located throughout the southern portion of the Santa Ynez Uplands (Figure 3-4). These deposits are terraces of dissected older alluvial sands and gravels overlying the Paso Robles Formation to a maximum depth of 150 feet. This formation is very similar to, and made up of the same materials as, the Paso Robles Formation it overlies, and therefore it is difficult to distinguish from the Paso Robles Formation. The Terrace Deposits are not considered a reliable aquifer per se, because of their shallow depth and tendency to be dewatered during drought conditions (Hoffman et al., 1996). Several wells are completed in both the Terrace Deposit and Paso Robles Formation materials. Because of the similarity of these materials, these will be managed together as one aquifer, referred to as the Paso Robles Formation.

#### 3.1.3.3.2. Careaga Sand (Aquifer)

The Careaga Sand (Tcag and Tca on Figure 3-4) is present at the surface in flanks of Purisima Hills and San Rafael Mountains. In the subsurface, this sand is present below the Paso Robles Formation in the Santa Ynez Uplands and below the Santa Ynez River gravels near Solvang. In the Santa Ynez Uplands, the Careaga Sand is approximately 800 feet thick below the Paso Robles Formation.

The Careaga Sand consists of fine-grained to medium-grained, uniform, massive, marine sand with some gravel and limestone. Some of the Careaga Sand contains fossils in areas west of the EMA. Where the Careaga Sand is exposed at ground surface in the Purisima Hills, a considerable amount of water from precipitation and streamflow can recharge this unit. Two members of the Careaga Sand include the upper Graciosa member (Tcag), which is relatively coarse, and the lower Cebada member (Tca), which is relatively fine-grained, These members are managed as a single aquifer within the EMA.

Generally, the Careaga Sand is less conductive than the overlying Paso Robles Formation and wells completed in this formation typically provide relatively less water. Based on published values, the hydraulic conductivity of the Careaga Sand is approximately 10 feet per day (USGS, 1951), which is similar to the lower end of the range of hydraulic conductivities for the Paso Robles Formation. Pumping test data from a total of six wells completed in the Careaga Sand aquifer indicated that hydraulic conductivity ranges between approximately 2 feet and 20 feet per day. Aquifer tests for wells completed in the Careaga Sand ranged between 12 and 325 gpm. Because of its limited lateral extent of the aquifer relative the Paso Robles Formation within the Santa Ynez Uplands and the greater depth to this formation outside of the western portion of the Uplands, fewer wells are completed in the Careaga Sand than in the overlying Paso Robles Formation. Wells completed within the Careaga Sand often have sanding problems, especially for wells completed in the lower Cebada member, because of the uniform fine nature of the material.

The storativity of the Careaga Sand is made up of a confined storage of approximately 0.008 and a specific yield of 0.05 (both of which are unitless).

#### 3.1.3.3.3. Santa Ynez River Alluvium (Aquifer)

The Santa Ynez River Alluvium (on Figure 3-4) consists of deposits of alluvium (river- or stream-related) materials associated with the Santa Ynez River. These deposits are made up of gravels and sands (Upson and Thomasson, 1951 and Dibblee, 1988), which extend to a depth of 35 to 60 feet. The average saturated thickness is 30 to 40 feet. The Santa Ynez River Alluvium is much coarser than the Paso Robles Formation and Careaga Sand sediments, which make up the Santa Ynez Uplands part of the Basin (Stetson, 2004c).

The Santa Ynez River Alluvium aquifer is everywhere unconfined with high to very high transmissivity. Specific capacity values for wells completed in the Santa Ynez River Alluvium in the aquifer range from 20 gallons per minute per foot (gpm/ft) to 60 gpm/ft and at production rates as high as 1,000 gpm. Overall, within the EMA, the average hydraulic conductivity of the Santa Ynez River Alluvium aquifer is estimated to be between 100 feet per day and 600 feet per day. Based on a re-analysis of well test data presented by Hopkins (2003), the average hydraulic conductivities of the Santa Ynez River Alluvium are estimated to be 260 feet per day. Given the unconfined nature of water stored in the Santa Ynez River Alluvium, the storativity of these materials is dominated by the specific yield, expected to range between 0.20 and 0.25. Stetson (2004) cites (Wilson, 1958) as a reliable source to employ an average specific yield of 0.23.

The water within the Santa Ynez River Alluvium is managed as surface water by the California State Water Resources Control Board (SWRCB) and is not subject to management under SGMA.

#### 3.1.3.3.4. Tributary Alluvium (Aquifer)

The Tributary Alluvium (see Figure 3-4) consists of alluvial deposits within the tributaries that flow from north to south from the Santa Ynez Upland in the north, flowing into either the upstream Lake Cachuma or into the Santa Ynez River in the south. Two tributaries feed Lake Cachuma directly from the Santa Ynez Uplands, Santa Cruz Creek and Cachuma Creek. Below Bradbury Dam, the Santa Ynez River flows west into and through the EMA, where it is joined by major tributaries from the Santa Ynez Uplands area, including Santa Agueda Creek, Zanja de Cota Creek, and Alamo Pintado Creek (Figure 3-1).

These stream channels incise the Paso Robles Formation and Older Alluvium materials in the Santa Ynez Uplands area and consist of Quaternary Alluvium deposited along the course of these tributary streams. The Tributary Alluvium is made up of thin deposits of silt, sand, and gravel. The depths of these materials vary widely but extend to an estimated depth of 70 feet or less bgs.

This Tributary Alluvium aquifer is usually not considered a reliable aquifer on its own because of its shallow depth and its tendency to become dewatered during drought periods (Hoffman et al., 1996). Several wells in tributary valleys are completed both in the Tributary Alluvium and in the underlying Paso Robles Formation, which are hydraulically connected in places. These wells appear to benefit from the higher hydraulic conductivity of the shallow alluvium and the contribution of the greater storage capacity and saturated thickness of the underlying Paso Robles Formation. Pumping tests and water levels from these wells represent the combined influence of these two aquifers and therefore have higher transmissivity values than wells that penetrate only the portions of the Paso Robles Formation not in contact with the Tributary Alluvium.

The composition and hydraulic properties of the Tributary Alluvium materials are similar to composition and hydraulic properties of the Santa Ynez River Alluvium, which are both coarser than the Paso Robles Formation and Careaga Sand sediments, with higher permeability. Based on the similarity of these material descriptions, and a lack of published aquifer properties or aquifer tests, the aquifer properties are assumed to be similar, as presented on Table 3-4.

Based on these criteria, the hydraulic properties are estimated as an average hydraulic conductivity of 200 feet per day, with a storativity dominated by the specific yield of 0.2 (unitless; Table 3-4).

#### 3.1.3.4 Groundwater Flow Barriers

**§354.14 Hydrogeological Conceptual Model.**

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

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

The EMA portion of the Basin is well-bounded by bedrock below the four principal aquifers, which contain and control the storage and movement of groundwater. Several faults are located within the water-bearing materials in the EMA. The Santa Ynez River Fault Zone crosses below the Santa Ynez River area. Likewise, the Baseline Fault and associated Los Alamos Fault and Casmalia Fault Zone, presented on Figure 3-4, cross the Santa Ynez Uplands area in a general southeast to northwest trend. These faults do not exhibit vertical offset of adjacent materials and are not believed to be barriers to groundwater flow. Instead they are likely semi-permeable because of the interbedded (layered) nature of the underlying Paso Robles Formation (Hoffman et al., 1996).

The total volume of groundwater that discharges as subsurface outflow from the higher-elevation Santa Ynez Uplands into the lower-lying Santa Ynez River along the southern border is relatively small (USGS, 1968), due to the presence of impermeable bedrock. Limited groundwater flow appears to occur in gaps between bedrock outcrops. Within the tributaries to the Santa Ynez River, the Tributary Alluvium has limited saturated thickness (e.g., 0 feet to 60 feet), thus restricting groundwater flow significantly (Hoffman et al., 1996, and recent geophysical survey summarized in Section 3.1.3.2.1 above).

Fine-grained zones are present within the Paso Robles Formation Aquifer; however, these zones are generally not laterally continuous and do not represent regional groundwater flow barriers.

The sediments of the Paso Robles Formation are heterogenous and have undergone a high degree of tectonic deformation. Consequently, vertical heterogeneity in the water-bearing properties of the Paso Robles are the result of alternating coarse-grained beds and fine-grained beds. These fine-grained zones act as local confining beds, and are likely the cause of the localized artesian conditions that were historically reported in some wells screened within the Paso Robles Formation in Happy Canyon and along Alamo Pintado Creek (USGS, 1968; Figure 3-25).

The Careaga Sand consists of fine- to medium-grained sand with some silt and abundant pebbles. Drillers logs from wells drilled into this unit do not indicate the presence of confining beds that may create barriers to flow in the Careaga Sand aquifer.

### 3.1.3.5 Groundwater Recharge and Discharge Areas

**§354.14 Hydrogeological Conceptual Model.**

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

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

This section describes areas of significant natural areal recharge and discharge within the EMA. Quantitative information about natural and anthropogenic recharge and discharge is provided in Section 3.3.

#### 3.1.3.5.1. Groundwater Recharge Areas

Within the Santa Ynez Uplands area of the EMA, groundwater recharge occurs as distributed areal percolation of precipitation (particularly in areas where the units are exposed at ground surface), and infiltration into and through streambeds, agricultural return flows, septic system return flows (leachate), and water system distribution losses. Within the Tributary Alluvium in the Santa Ynez Uplands, portions of the stream are "losing," where groundwater contributes to groundwater recharge into the underlying Paso Robles Formation. Percolation of precipitation is the principal component of groundwater recharge, as discussed in Section 3.3.

Groundwater recharge to principal aquifers also occurs directly from the underlying bedrock along the San Rafael Mountains to the north and east and from the Santa Ynez Mountains to the south. This direct recharge—from the mountains and also through runoff from the mountains, which subsequently percolates into the ground—are components of "mountain front recharge." The magnitude of this recharge is discussed in more detail in Section 3.3 along with the other processes of groundwater recharge. Recharge to the Santa Ynez River Alluvium occurs through percolation of precipitation as well as from upstream Lake Cachuma releases and discharge from the Santa Ynez Uplands Tributaries.

Based on data provided by the California Soil Resource Lab at University of California (UC) Davis and the UC Agricultural and Natural Resources Department, a map presenting the areas of potential groundwater recharge is presented on Figure 3-17Figure 3-18. The major factors that were considered for potential groundwater recharge areas include the following:

- Deep soil percolation
- Root zone residence time
- Topography
- Chemical limitations
- Soil surface condition (UC Davis and UC-ANR, 2020).

Areas with soils that have excellent recharge properties are shown in dark green, moderate recharge properties are shown in yellow, and areas with poor recharge properties are shown in orange and red. As shown on the map, the areas of excellent, good, and moderately good ratings are together located along tributary valleys of the Alamo Pintado and Santa Agueda Creeks, as well within areas of Older Alluvium (above Paso Robles Formation) in the Santa Ynez Uplands. Notably, a few excellent areas are located south of the town of Santa Ynez along the northern bank of the Santa Ynez River.

# FIGURE 3-18

## Seeps and Springs

Groundwater Sustainability Plan
Eastern Management Area


**LEGEND**

- Seep/Spring
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

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#### 3.1.3.5.2. Groundwater Discharge Areas

Natural groundwater discharge areas in the EMA include springs and seeps, groundwater discharge to surface water, and evapotranspiration (ET) by phreatophytes. Phreatophytes are plants with roots that tap into groundwater in the alluvium along creeks and streams. Springs and seeps identified by the USGS based on the National Hydrology Dataset (NHD) are shown on Figure 3-18.

Springs are located in the San Rafael mountain ranges north of the EMA and at three locations within the Santa Ynez Uplands: one in the Purisima Hills, one near Cachuma Creek, and another at the eastern portion of the EMA. Based on the elevation of mapped springs and seeps, it is likely that these discharge groundwater from bedrock outside of the EMA and from limited, perched water-bearing zones in the Santa Ynez Uplands. The single mapped spring within the EMA occurs within the Paso Robles Formation and likely indicates occasional artesian groundwater conditions within steeply dipping strata of gravel and sand, which are exposed high within confined or partially confined areas by less permeable beds of silt and clay (USGS, 1968).

Groundwater discharge as subsurface outflow from the Santa Ynez Uplands portion of the EMA is relatively small (USGS, 1968). This groundwater discharge from the higher-elevation Santa Ynez Uplands into the lower-lying Santa Ynez River along the southern border of this area is limited, due to the impermeable bedrock and the relatively limited thickness of saturated alluvium within the major tributaries in this area (Hoffman et al., 1996 and recent geophysical survey summarized in Section 3.1.3.2.1 above). The extent and quantity of any groundwater discharge from the groundwater basin into the Tributary Alluvium has not been confirmed or quantified. Conceptually, it is believed that this discharge occurs primarily as surface water flow leaving the tributaries.

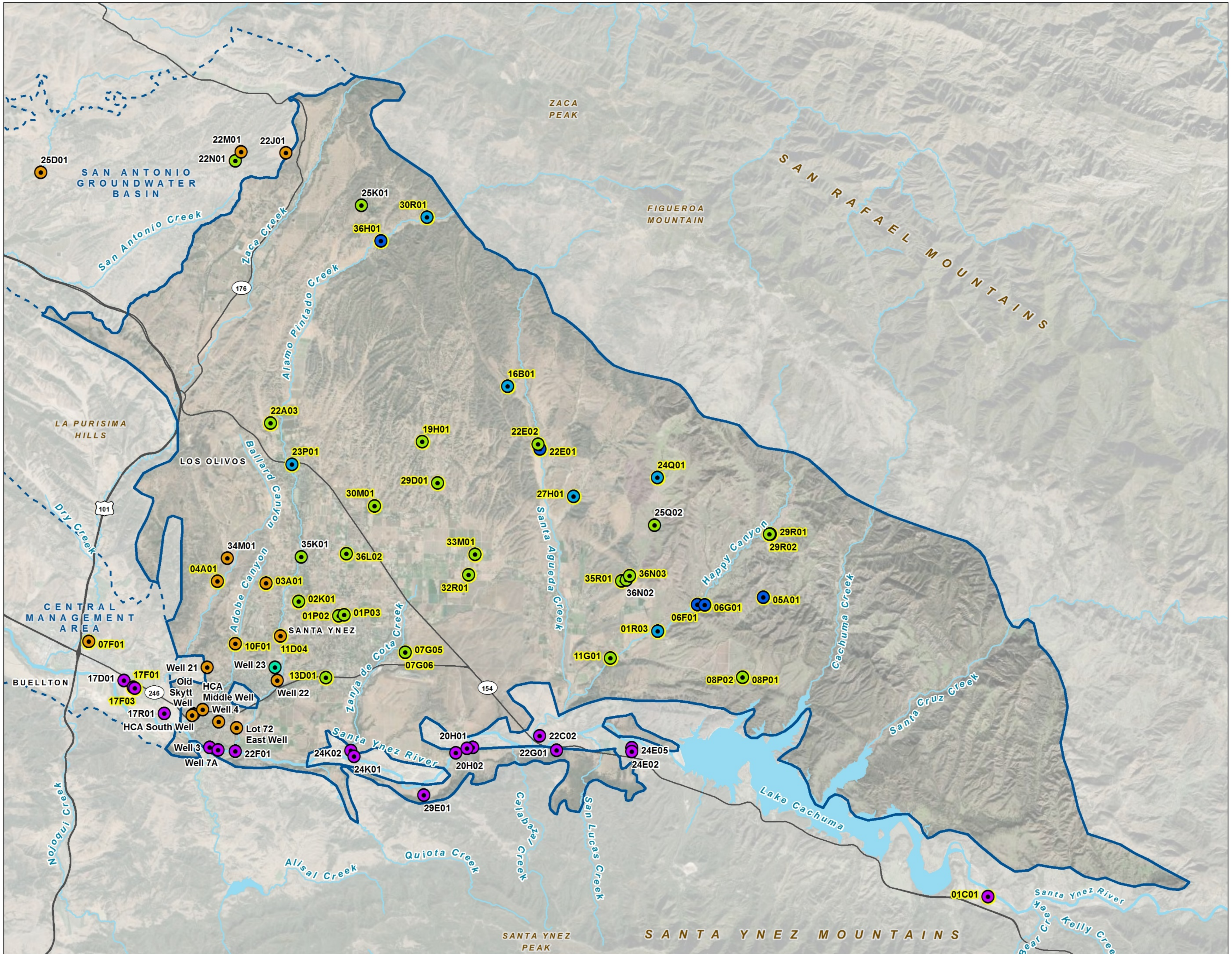
A limited amount of groundwater discharge (subsurface flow) leaves the Santa Ynez Uplands via the tributary valleys of Zaca Creek, Ballard Canyon, Adobe Canyon, and a minor gap in the Purisima Hills. The amount of this underflow from the Santa Ynez Uplands will be examined during calibration of the numerical flow model being completed for this GSP (which will be revised when the GSP is written). Very small quantities of flow may occur through fractures in the bedrock (chert deposits) in consolidated rocks in the Ballard Canyon area (USGS, 1968) and may be less than 100 acre-feet per year (pending current groundwater modeling).

Water discharges from the EMA as underflow from the Santa Ynez River Alluvium every year (Stetson, 2004 among others).

# FIGURE 3-19

## Representative Wells

Groundwater Sustainability Plan
Eastern Management Area




## LEGEND

- Well
- County Monitoring Program Well
- Eastern Management Area Basin Boundary

**Aquifer Zone**

- Tributary Alluvium
- Tributary Alluvium/Paso Robles Formation
- Santa Ynez River Alluvium
- Paso Robles Formation
- Paso Robles Formation/Careaga Sand
- Careaga Sand

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

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#### 3.1.3.6 Water Quality

> **§354.14 Hydrogeological Conceptual Model.**
>
> **(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:**
>
> **(4) Principal aquifers and aquitards, including the following information:**
>
> **(D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.**

This section presents a general discussion of the natural groundwater quality in the EMA. A more complete discussion of the distribution and concentrations of specific constituents is presented in Section 3.2.3. The general water quality of the EMA is based on the results from water quality samples collected and analyzed for various studies and programs for compliance with regulatory programs, sampling conducted by the United States Geologic Survey (USGS), data from the USGS National Water Information System (NWIS), and SWRCB's GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA) Program database.

Groundwater quality in the EMA is suitable for potable and agricultural uses. Since implementation of the SGMA, exceedances of maximum contaminant levels (MCLs) for gross alpha and trihalomethane were reported in three potable water supply wells. Wells classified as potable include both municipal and domestic wells. Exceedances of secondary MCLs (SMCLs) were reported in 11 potable water supply wells and exceedances of water quality objectives (WQOs) set by the RWQCB were reported in 35 potable water supply wells. None of the MCL exceedances are attributable to retail water providers in the basin. Summary tables of general groundwater quality are provided in Section 3.2.3.

#### 3.1.3.7 Primary Beneficial Uses

> **§354.14 Hydrogeological Conceptual Model.**
>
> **(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:**
>
> **(4) Principal aquifers and aquitards, including the following information:**
>
> **(E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.**

Groundwater within each of the principal aquifers has many beneficial uses within the EMA including agricultural use, municipal and industrial use, domestic use, and environmental uses, particularly where groundwater is connected to surface water that supports groundwater dependent ecosystems (GDEs). This section summarizes the primary uses of water produced from each of the principal aquifers. Fourteen mutual water companies, along with many individual private well owners, rely on groundwater to satisfy water demands for agricultural, rural domestic, and golf course irrigation uses from all four of the principal aquifers.

#### 3.1.3.7.1. Paso Robles Formation and Careaga Sand

Groundwater produced from the Paso Robles Formation and Careaga sand is used for a variety of beneficial uses by municipal water purveyors, mutual water companies, and private pumpers. The municipal water purveyors that pump water from these principal aquifers include ID No. 1 and the City of Solvang, entities that provide water from these and other sources for municipal and industrial, agricultural, and domestic uses within their service areas. The water from these agencies is blended with water from other sources for distribution to customers. Private pumpers and mutual water companies provide water from the same wells for both agricultural and domestic potable uses. The volumes of water provided from each of these sources and beneficial uses are provided in Section 3.3.

#### 3.1.3.7.2. Santa Ynez River Alluvium

Water users who pump from the Santa Ynez River Alluvium in the EMA include ID No. 1, the City of Solvang, as well as downstream communities, farms and ranches. The City of Solvang and ID No. 1 pump from Santa Ynez River Alluvium wells, as well as wells completed in the Careaga Sand aquifer and the Paso Robles Formation. The City of Solvang and ID No., 1 also receive imported SWP water directly. Water pumped from the Santa Ynez River Alluvium is managed by the SWRCB and is not subject to management by the GSAs within the Basin. SYRWCD ID No. 1 provides water for its customers as part of a conjunctive use strategy, using supplies from several sources—including the SWP, Cachuma Project Water, and groundwater pumped from both the Santa Ynez Uplands area and water pumped from the Santa Ynez River Alluvium–to provide reliability in a wide range of hydrologic conditions (Santa Barbara County, 2011). The service areas for ID No. 1 and the SYRWCD are illustrated on Figure 2-4.**Cachuma Project.** Prior to 1998, SYRWCD ID No. 1 (ID No. 1) received local surface water deliveries directly from the Cachuma Project and from the Santa Ynez River Alluvium wells (4cfs and 6cfs wellfields and collector well), by extracting water from the Santa Ynez River Alluvium, which is fed in part by water released from Lake Cachuma. The flow of the river is intermittent, carrying flood flows from both tributary watersheds downstream of Bradbury Dam and occasional spills from Lake Cachuma when the reservoir is full. The river also receives flow from Lake Cachuma releases during summer months when water is released by the USBR to fulfill downstream water rights and when releases occur to support fish migration, spawning, and habitat maintenance in the river. These releases are governed by State Water Rights Order 2019-0148. Downstream releases are governed by two water accounts that accrue credits (acre feet of water in the reservoir) which can be used to provide groundwater recharge to areas downstream of the dam. Releases are seldom made in wet years when downstream water basins retain water throughout the summer and fall. During other years, releases are made in late spring, summer, or early fall (NMFS, 2000).

**Santa Ynez River Alluvial Pumping.** Pumping from the Santa Ynez River Alluvium is conducted under a pending application for a water rights permit from SWRCB Division of Water Rights. The City of Solvang (formerly referred to as the Solvang Municipal Improvement District) has a right to "extract water from the gravels of the River for use within the District" (not to be confused with the SYRWCD). Similar water rights are held and exercised by ID No. 1, Alisal River Golf Course, as well as downstream communities, farms and ranches. Use of this water is governed by the SWRCB and not governed by SGMA. Primary among these is the Water Rights Order 2019-0148 and the 2000 Biological Opinion from the National Marine Fisheries Service. In accordance with the order, SYRWCD may call for water releases from Lake Cachuma to recharge downstream groundwater (Santa Barbara County, 2011). The Biological Opinion establishes flow targets associated with steelhead habitat maintenance at key reaches of the river.

#### 3.1.3.7.3. Tributary Alluvium

Groundwater pumped from the Tributary Alluvium occurs within the Santa Ynez Uplands for domestic and agricultural uses for private well owners. The quantity of wells that rely solely upon this aquifer is limited because this aquifer is usually not considered a reliable aquifer on its own, due to its shallow depth and its tendency to become dewatered during drought periods (Hoffman et al., 1996). Because of this limitation, many wells are completed and produce groundwater from both the Tributary Alluvium and the underlying Paso Robles Formation, which are hydraulically connected.

### 3.1.4 Data Gaps and Uncertainty

**§354.14 Hydrogeological Conceptual Model.**

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

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

This section summarizes several portions of this HCM that constitute data gaps, focused primarily on those data gaps that that "could affect the ability of the Plan to achieve the sustainability goal" (§ 354.38 [a]) for the EMA. The adequacy of the monitoring networks to achieve this goal is discussed in Section 5.

Per the SGMA regulations, a data gap:

> "refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed."

This section also presents the authors' estimates of the levels of uncertainty with regard to the principal data relied upon for this HCM.

#### 3.1.4.1 Groundwater Elevations

Central to the understanding of groundwater conditions within the EMA is reliable, frequent, and well-distributed water elevation data for each of the principal aquifers. Groundwater elevation data are fundamental to assessing whether there are undesirable results for any sustainability indicator. Based on the importance of this parameter, regular monitoring of groundwater elevations throughout the EMA in each of the principal aquifers must be conducted. USBR monitors groundwater level in wells in the Santa Ynez River on a monthly basis within the EMA. Between the late 1970s and 2019, water levels were measured in wells in the spring months only. As of 2019, approximately 45 wells were measured by Santa Barbara County staff in the spring months and 3 wells were monitored in the fall months. However, in the fall of 2020, this groundwater monitoring was expanded to include more complete groundwater monitoring such that in October 2020, Santa Barbara County staff measured groundwater levels in 20 wells within the EMA. Refer to Figure 3-19.

Because of this lack of water level measurement during the post-irrigation season, it is recommended that fall water level measurements are collected and the monitoring program is expanded to include more wells completed within the Tributary Alluvium and within the Paso Robles Formation near the shared border with the San Antonio Creek Valley Groundwater Basin.

#### 3.1.4.2 Fault Influence on Groundwater Flow

The current understanding of groundwater flow across the Baseline fault is that the Baseline fault is either permeable or semipermeable and does not constitute a barrier to groundwater flow. The addition of groundwater monitoring located on either side of the fault would clarify the relationship of water levels across the fault and, by extension, its potential role in controlling groundwater flow. Selection of wells for this purpose should be considered when expanding the groundwater monitoring network.

#### 3.1.4.3 Well Completion Data

The construction details about most of the for many wells included in the monitoring network is not unknown. The accurate understanding of the completion of each well construction is central to its usefulness in accurately representing is important to interpret and assign groundwater levels to the appropriate principal within the aquifer. To comply with SGMA regulations, the water level within a well must represent a single aquifer, a condition which requires the accurate understanding of the completion of the well. As discussed further in Section 5, the well completion information in the monitoring network should be determined by the use of either video logs of wells and/or encouragement of owners to provide any well completion information wells included in the water level monitoring program.

#### 3.1.4.4 Subsidence Monitoring

Because there is a lack of data to fully monitor subsidence, the authors suggest encouraging the State of California to continue funding TRE Altamira InSAR ground surface elevation monitoring.

#### 3.1.4.5 Streamflow Monitoring

The volumetric contribution of tributary streamflow to both groundwater recharge and surface water inflow out of the Santa Ynez Uplands area into the Santa Ynez River is not well measured. Installation or reinstallation of streamflow gauges on the major tributaries near their confluence with the Santa Ynez River along with routine field measurement of flow at two locations along Alamo Pintado, and Santa Agueda Creeks would aid in the quantification of flow and understanding of surface water-groundwater interactions.

## 3.2 Groundwater Conditions [§354.16]

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

This section describes the current and historical groundwater conditions in the principal aquifers within the Basin. In accordance with the SGMA emergency regulations, current conditions are any conditions occurring after January 1, 2015. By implication, historical (or legacy) conditions are any conditions occurring prior to January 1, 2015. This section focuses on information required by the GSP regulations and information that is important for developing an effective plan to achieve sustainability. The organization of this section aligns with the six sustainability indicators specified in the GSP regulations, including the following:

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

Variations in climatic conditions directly affect groundwater conditions. Climate affects both (1) recharge to the Basin, which rises significantly during wet periods in response to increase precipitation and (2) water use, which can increase in response to prolonged drought in the absence of rainfall and/or supplemental water supplies. This section includes a limited discussion of the variability of groundwater conditions in response to climatic variability. The discussion of the volumes of surface water and groundwater flowing into and out of the EMA portion of the Basin in the historical water budget discussion, Section 3.3, also includes a more thorough discussion of the variability of groundwater conditions in response to climatic variability.

### 3.2.1 Groundwater Elevations

#### 3.2.1.1 Groundwater Elevation Contours

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

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

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

Groundwater elevation conditions are largely based on water level data collected by the USGS through the National Water Information System (NWIS), a database maintained by the USGS for the acquisition, processing, review and storage of water data. The available water level data in the EMA were collected by the USGS and Santa Barbara County as part of the Water Data for the Nation program in a joint funding agreement with Santa Barbara County Water Agency. In the spring of 2019, the County of Santa Barbara took responsibility for annual groundwater level monitoring in the EMA after the USGS discontinued their monitoring efforts. Additional groundwater elevation data for wells were obtained from the City of Solvang, USBR and several mutual water companies. A summary of the groundwater water level data compiled for use in this GSP, as presented on Table 3-5.

**Table 3-5. Summary of Available Groundwater Level Data**

| Source | Coverage | Period of Record |
|---|---|---|
| USGS (NWIS) includes California Statewide Groundwater Elevation Monitoring (CASGEM), local agencies and County data | 583 wells within and surrounding EMA | 1905 to present |
| U.S. Bureau of Reclamation (USBR) | 13 wells within Santa Ynez River | 1976 to present |
| City of Solvang | 10 wells | 2008 to present |
| Mutual water companies | Several wells in Santa Ynez Uplands | Recent years |

From these wells, 78 were selected (depending on the year and season) based on quality of data and period of record for each well for incorporation into the groundwater elevation assessment. Additional information about the monitoring network is provided in Section 5.3.

The set of wells used in the groundwater elevation assessment was selected based on the following criteria:

- The wells have groundwater elevation data for spring 2018.
- Sufficient information exists to assign the well to either of the four principal aquifers.
- Groundwater elevation data were deemed representative of static conditions.

Based on these data, groundwater elevation contour maps were created for the four principal aquifers for the spring 2018 period. Prior to the late 1970s, the USGS and/or County of Santa Barbara conducted water level monitoring throughout the EMA in the spring and fall, typically in April and October of each year. Since the late 1970s, very limited groundwater monitoring is conducted in the fall throughout the County. These fall monitoring events include one or two wells within the EMA; thus, there is limited understanding of groundwater levels following the summer irrigation season. The locations of the wells selected as representative of the principal aquifers are shown on Figure 3-19. Reference elevations of these wells were surveyed by GSI in 2020 to satisfy SGMA regulations, which require vertical elevations of reference points (wellheads) to be measured to an accuracy of 0.5 feet, or best available information, relative to NAVD88.

Groundwater elevation contour maps were created for the spring 2018 period to assess current groundwater conditions, including flow directions and groundwater gradients. The contours are based on groundwater elevation measurements from the selected wells, as presented on Figure 3-20 through Figure 3-23. The groundwater elevation data that were deemed to be either unrepresentative of static conditions, obviously erroneous, or representative of more than a single aquifer were excluded from contouring. A summary of the gradients of each aquifer is presented as Table 3-6.

### Table 3-6. Lateral Gradients of Each Principal Aquifer

| Principal Aquifer | Location (Lateral Extent) | Horizontal Gradient (feet per foot) | Direction of Flow |
|---|---|---|---|
| Paso Robles Formation | Santa Ynez Uplands | 0.02 to 0.03 | South and southwest from the San Rafael Mountains |
| Careaga Sand | Santa Ynez Uplands | 0.014 to 0.02 | Southwest |
| Santa Ynez River Alluvium | Santa Ynez River | 0.0032 to 0.0047 | West following the Santa Ynez River |
| Tributary Alluvium | Santa Ynez Uplands | 0.017 to 0.019 | South and southwest following the tributaries |

#### 3.2.1.1.1. Paso Robles Formation

The groundwater elevation contours for the Paso Robles Formation for the spring of 2018 show groundwater elevations ranging from approximately 1,200 feet above North American Vertical Datum of 1988 (NAVD88) in the north to approximately 550 feet NAVD88 in the southern part of the Santa Ynez Uplands area.

Groundwater flow direction in the Paso Robles Formation aquifer is generally to the south-southwest with hydraulic gradients ranging from a high of approximately 0.03 feet per foot along the Santa Agueda Creek. Generally, throughout the majority of the Santa Ynez Uplands, the gradient is between 0.02 to 0.03 feet per foot throughout the Santa Ynez Uplands. A slight pumping trough is evident in the western portion of the Santa Ynez Uplands near Los Olivos.

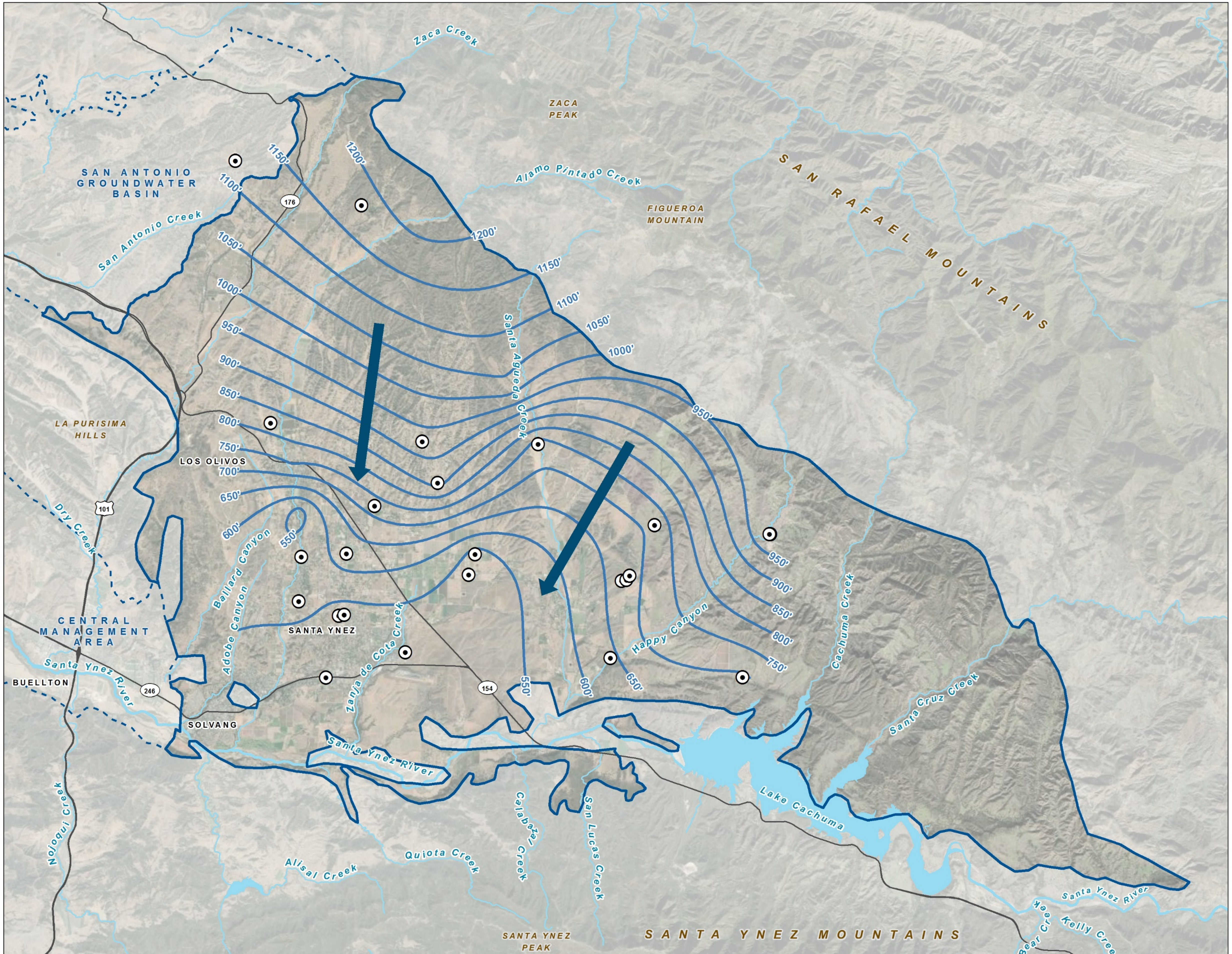
The conformity of the water-level contours indicates that, in general, the Paso Robles Formation may generally be considered as a single storage unit, as shown on Figure 3-20. Previous contouring of the Paso Robles Formation suggested that there were areas of partial confinement and local areas of perched groundwater within the formation (USGS, 1968; Hoffman et al., 1996 and others).

The Paso Robles Formation extends throughout the Santa Ynez Uplands, extending northwest without interruption into the adjacent San Antonio River Valley Groundwater Basin (refer to the geologic cross section of the area on Figure 3-6 and Figure 3-20). The water elevation contours in the area of the shared border with the San Antonio Basin in the northwest corner of the EMA's Santa Ynez Uplands suggest that the flow direction is perpendicular to the shared border such that groundwater would neither flow into nor out of the EMA. This apparent direction of groundwater flow in this area is based on groundwater elevation measurements in only two wells near the 5-mile shared border, and is therefore somewhat uncertain.

# FIGURE 3-20

**Paso Robles Formation Groundwater Elevation Contour Map, Spring 2018**

Groundwater Sustainability Plan
Eastern Management Area




**LEGEND**

- Paso Robles Formation Well
- Paso Robles Formation Groundwater Elevation, Spring 2018
- Groundwater Flow Direction
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

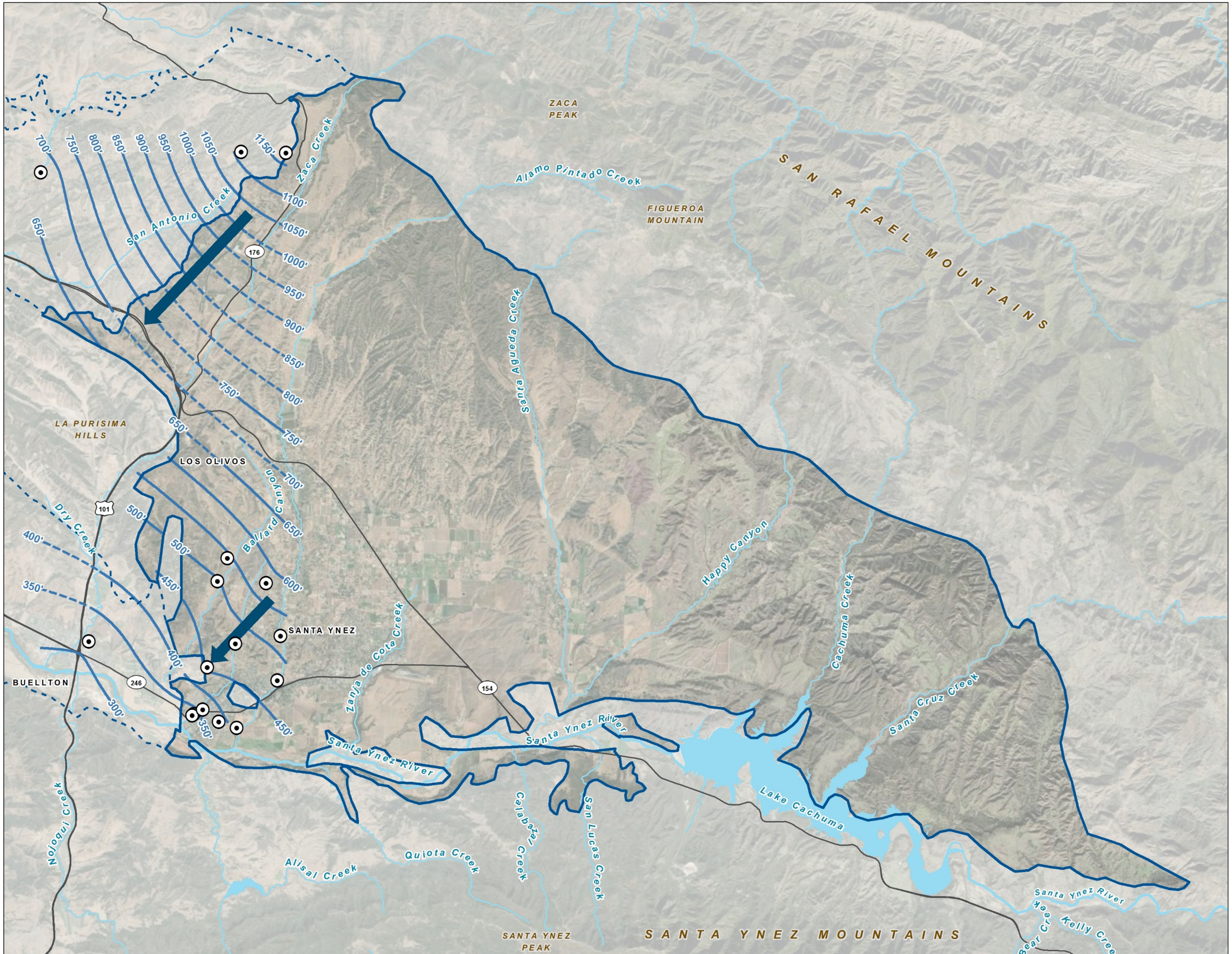
Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_20_Paso_Robles_Contours_Spring2018.mxd, abarry

#### 3.2.1.1.2. Careaga Sand

All of the known groundwater wells that are completed in the Careaga Sand are located in the western portion of the EMA. The Careaga Sand crops out west of the City of Solvang and dips towards the east, under the Paso Robles Formation at depths too deep for a typical production well. Consequently, groundwater contours for the Careaga Sand are restricted to the western portion of the EMA.

In spring 2018, Careaga Sand groundwater elevations ranged from approximately 1,150 feet above NAVD88 in the north to approximately 320 feet NAVD88 in the southern part of the Basin.

Groundwater flow direction in the Careaga Sand is generally to the south-southwest with hydraulic gradients ranging from 0.014 feet per foot near the City of Solvang to approximately 0.02 feet per foot in the northwest portion of the Santa Ynez Uplands near the shared border with the San Antonio Basin. Near the southwestern border with the CMA, the groundwater flow is towards the CMA, the magnitude of which is discussed further in Section 3.3. At the shared border with the San Antonio Basin, however, the direction of flow is uncertain because very few wells exist in that area. The few wells that do exist suggest that the hydraulic gradient in the area is perpendicular to the groundwater basin boundary, which would indicate that no appreciable flow enters or leaves the EMA along that border. This uncertainty of the groundwater flow direction along the San Antonio Basin boundary is identified as a data gap.




# FIGURE 3-21

## Careaga Sand Groundwater Elevation Contour Map, Spring 2018

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

- Careaga Sand Well
- Careaga Sand Groundwater Elevation, Spring 2018 (dashed where inferred)
- Groundwater Flow Direction
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_21_Careaga_Contours_Spring2018.mxd, abarry

#### 3.2.1.1.3. Santa Ynez River Alluvium

In spring 2018, Santa Ynez River Alluvium groundwater elevations range from approximately 800 feet NAVD88 in the southeast to approximately 340 feet NAVD88 in the southwestern part of the Basin. Note, as previously mentioned, subsurface flow within the Santa Ynez River Alluvium is considered to be surface water by the SWRCB and is not regulated under SGMA.

Water in the Santa Ynez River Alluvium follows the surface topography, flowing to the west along the alignment of the Santa Ynez River towards the CMA. Based on water level contours for the spring of 2018, the groundwater gradient in the River Alluvium ranges between 0.032 feet per foot near the San Lucas Bridge and 0.047 feet per foot near Solvang.

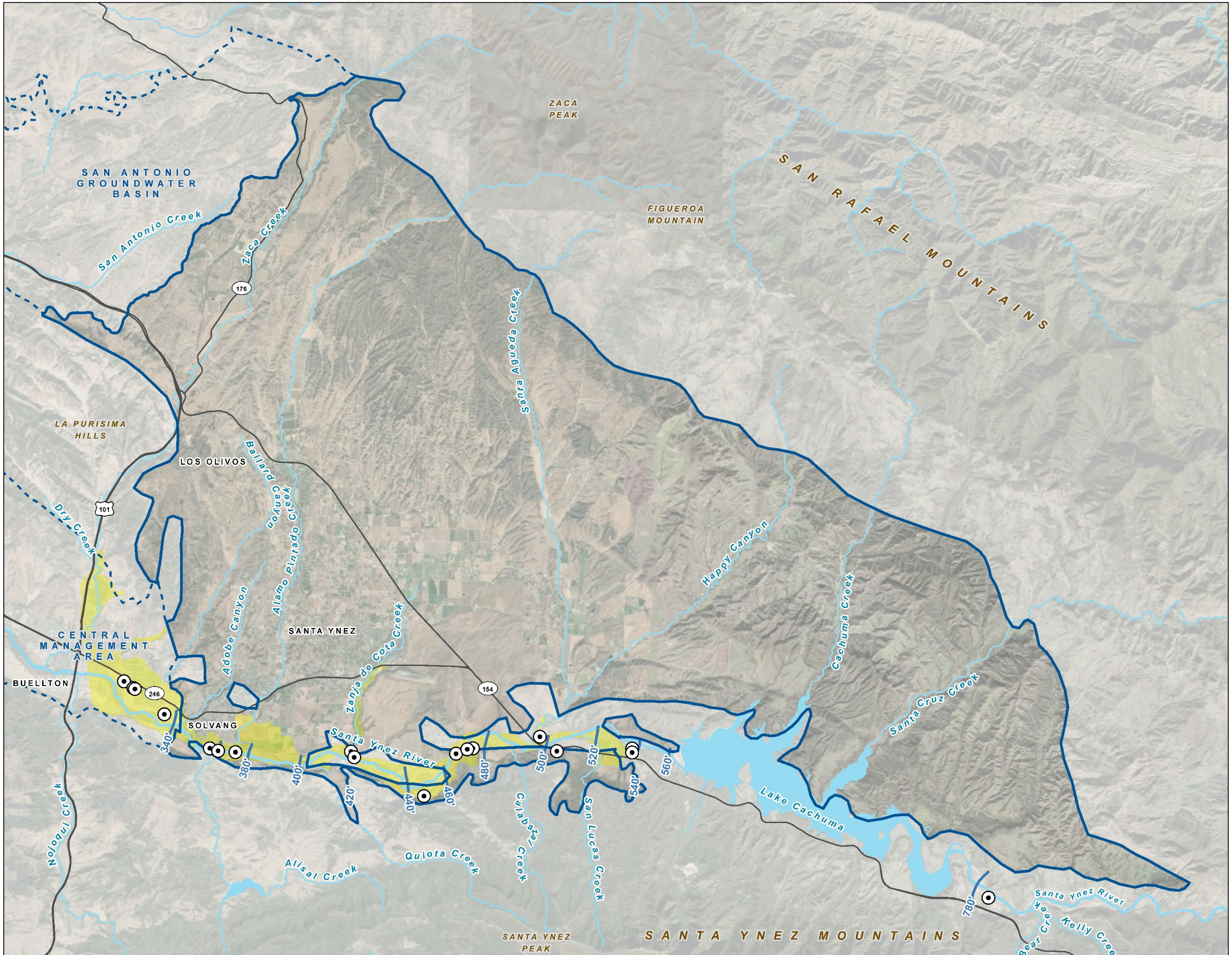
Inflow to this aquifer occurs from Bradbury Dam releases, as well as from the three major tributaries that flow from the Santa Ynez Uplands. This alluvium is not subject to overdraft (i.e., a progressive long-term drop in water levels) because the average annual flow to the Santa Ynez River (the main recharge source) is greater than the volume of the alluvial basin (Santa Barbara, 2011).

Numerical modeling of the Santa Ynez River suggests that about 86 percent of the inflow into the Santa Ynez River Alluvium is derived from the upstream Santa Ynez River, the remainder of which is derived from major tributaries from the Santa Ynez Uplands as well as from Quiota and Alisal Creeks from the south (Stetson, 2004c).

# FIGURE 3-22

**Santa Ynez River Alluvium Groundwater Elevation Contour Map, Spring 2018**

Groundwater Sustainability Plan
Eastern Management Area




**LEGEND**

- Santa Ynez River Alluvium Well
- Santa Ynez River Alluvium Groundwater Elevation, Spring 2018
- Santa Ynez Alluvium
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 13, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_22_SantaYnez_Contours_Spring2018.mxd, abarry

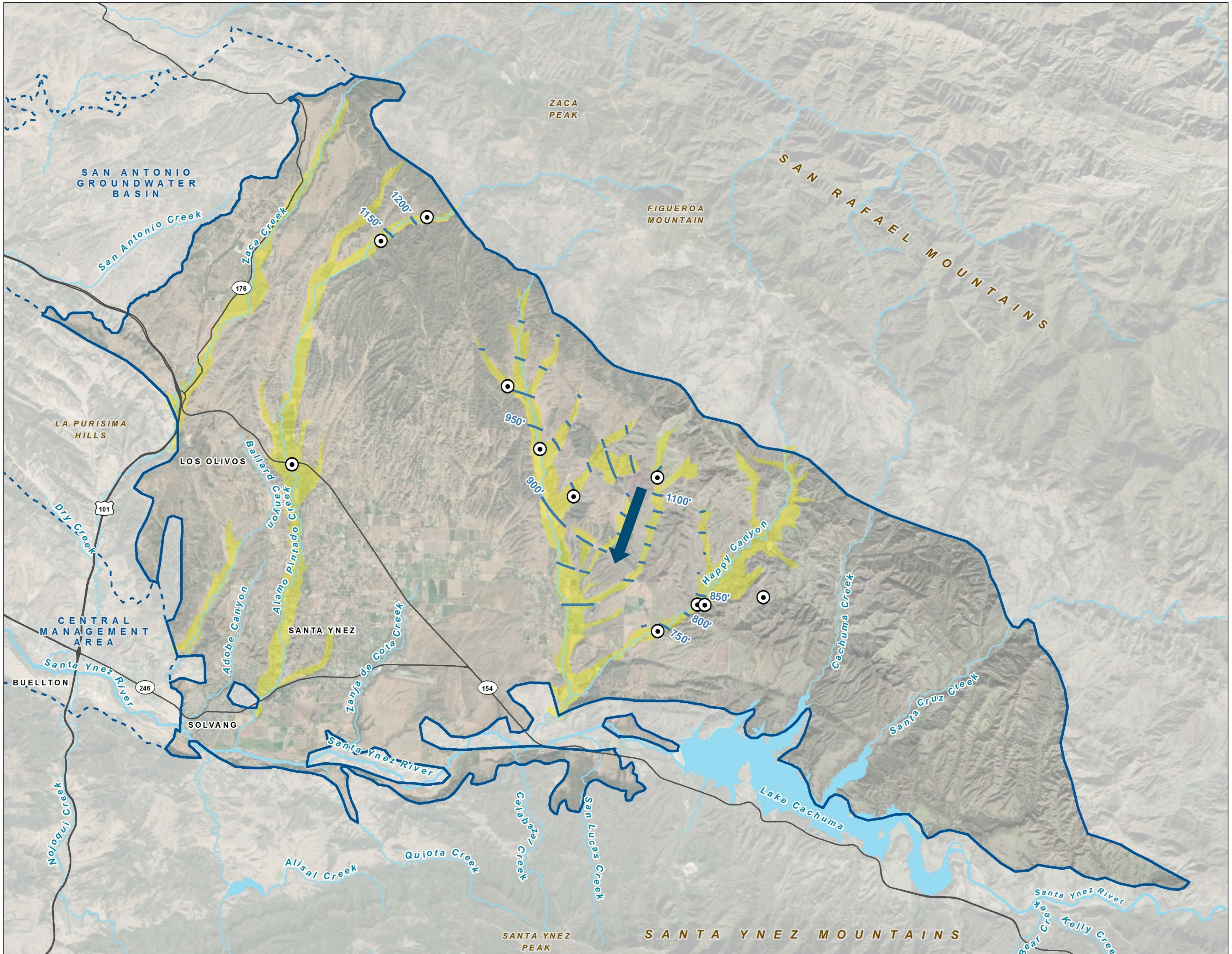
#### 3.2.1.1.4. Tributary Alluvium

One of the primary areas of groundwater recharge to the EMA occurs within the shallow alluvial sand and gravel beds in the tributaries where they are in direct contact with the Paso Robles Formation. Percolating groundwater moves readily through the Tributary Alluvium. (USGS, 1968). The tributary streams draining the Santa Ynez Uplands cross a relatively impermeable consolidated bedrock barrier on the south end of the Santa Ynez Uplands, along the north side of the Santa Ynez River (Upson and Thomasson, 1951).

Groundwater flow in the Tributary Alluvium generally follows the tributary valleys from north to south, following the alignment of the creeks and canyons in the Santa Ynez Uplands, towards the Santa Ynez River. The overall alluvial hydraulic gradient of the Tributary Alluvium is based on limited data at the northern end of the alluvial valleys generally and ranges from 0.0017 and 0.0019 feet per foot, along the topographic profile of the creeks.

Where the tributary valleys are narrow and the cross-sectional area of alluvial fill is minimal, groundwater levels intersect the thalweg of the tributary and become intermittent or perennial flow in the stream channels. Such narrowing occurs where stream channels have cut through the consolidated rocks that form the southern boundary of the Santa Ynez Uplands. During wet years, this can cause perennial flow in the lower reaches of creeks including Alamo Pintado, Santa Agueda, Zanja de Cota, Zaca, and Santa Cruz Creeks (USGS, 1968). All other groundwater that discharges naturally from this aquifer is either lost by evapotranspiration or discharged as underflow through thin, narrow strands of alluvium that line the valleys that are tributary to the Santa Ynez River.

In the spring of 2018, groundwater elevations in the Tributary Alluvium in the headwaters of Alamo Pintado Creek were approximately 1,150 feet to 1,200 feet, based on measurements from two wells. Within the headwaters of the Santa Agueda Creek and Marre Canyon, the groundwater elevation was lower, ranging between 900 feet and 1,000 feet. Groundwater elevations in the tributary alluvium of Happy Canyon varied between 750 feet and 850 feet. Groundwater elevation data were not available for the Tributary Alluvium in Zaca Creek, nor for large portions of Alamo Pintado and Santa Agueda Creeks.




# FIGURE 3-23

## Tributary Alluvium Groundwater Elevation Contour Map, Spring 2018

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

- Tributary Alluvium Well
- Tributary Alluvium Groundwater Elevation, Spring 2018
- Groundwater Flow Direction
- Tributary Alluvium
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_23_TributaryAlluvium_Contours_Spring2018.mxd, abarry

#### 3.2.1.2 Groundwater Hydrographs

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

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

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

In order to demonstrate the long-term variability and trends of groundwater elevations in the EMA, hydrographs for wells in the four principal aquifers were created. Representative wells presented on Figure 3-20 were chosen because they have sufficient periods of record to identify trends and/or responses to climatic conditions, are geographically distributed, and represent a single aquifer system.

##### 3.2.1.2.1. Paso Robles Formation

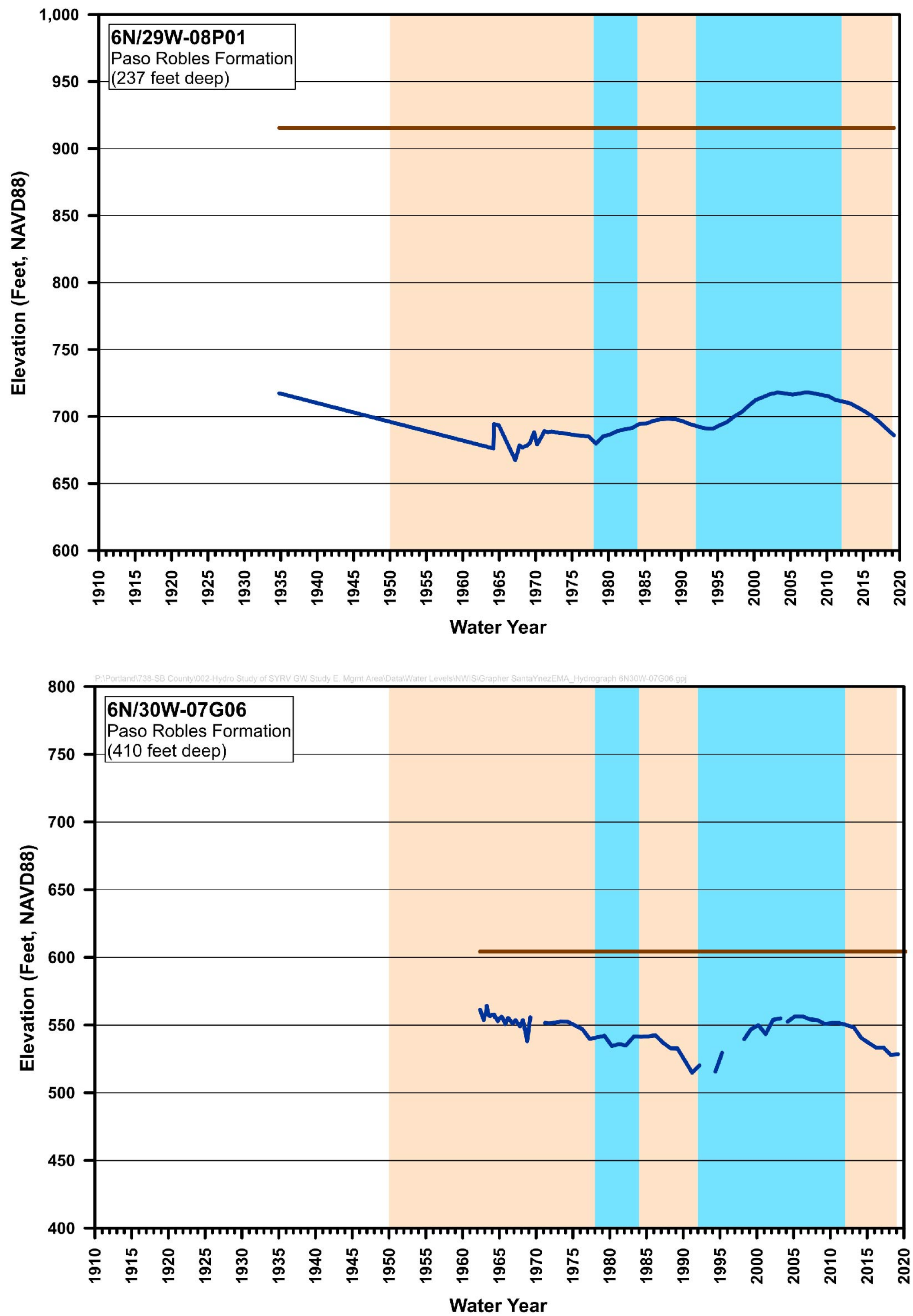
Representative hydrographs for four wells completed in the Paso Robles Formation are presented as Figure 3-24and Figure 3-25.

As required, these hydrographs present the water level elevation for the period of record relative to NAVD88 and the ground surface elevation to illustrate the depth to water. The hydrographs also present the periods of climatic variation, which were based on precipitation data representative of conditions in the EMA.

Overall, the Paso Robles Formation well hydrographs illustrate the long-term stability of water levels over time except during drought periods. Wells with long periods of record typically do not show drastic differences in water levels from the 1950s to present. However, water levels in the Paso Formation show a strong correlation with climatic conditions. Some wells show water elevation decreases of more than 100 feet during prolonged drought cycles, but most wells appear to fully recover within a few years when the drought conditions end. Changes in water level are likely also related to groundwater pumping as well. The Paso Robles Formation is the most productive and most widely pumped aquifer in the Basin. Increased pumping demand during dry-weather cycles in response to decreased areal recharge and increased pumping together likely contribute to declining water levels during periods of drought.

Seasonal fluctuations in water levels in the Paso Robles Formation appear to be relatively small (less than 30 feet). This observation is based on hydrographs that have water level records predating 1980, when the USGS began monitoring water levels annually in the spring, instead of bi-annually in the spring and fall.

Appendix D includes all of the representative hydrographs for the Paso Robles Formation.




LEGEND

Ground Surface Elevation

Groundwater Elevation

Dry Climatic Cycle

Wet Climatic Cycle

**FIGURE 3-24**

**Representative Paso Robles Formation Hydrographs: Wells -08P01 and -07G06**

Groundwater Sustainability Plan

Eastern Management Area

GSI Water Solutions, Inc.

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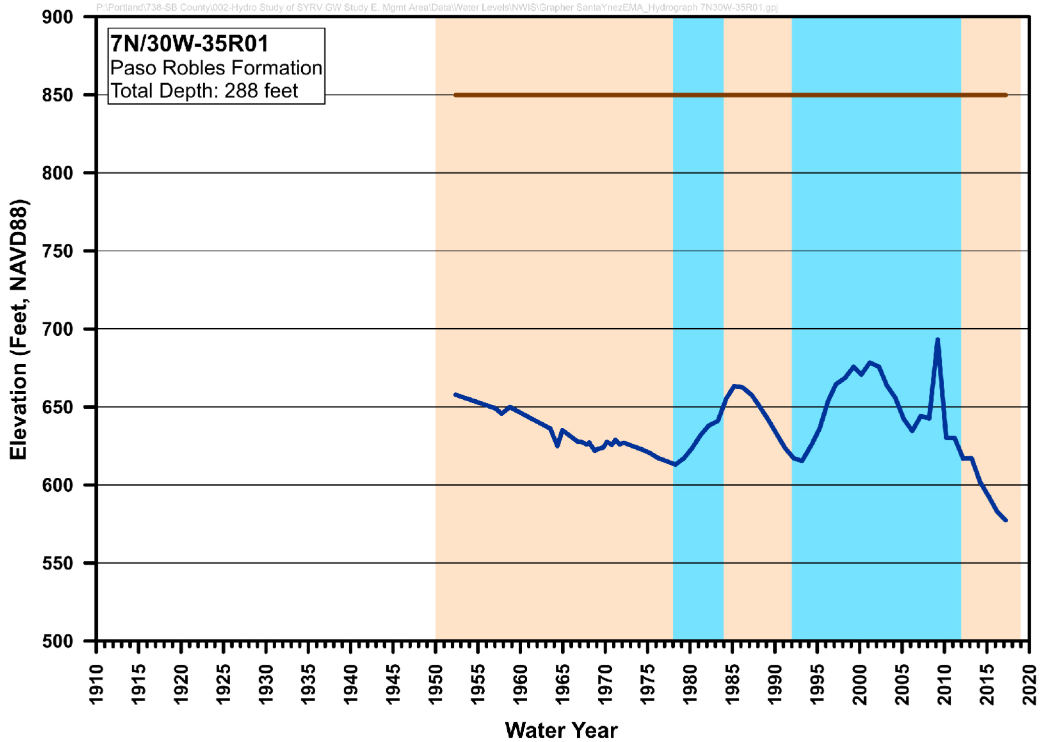
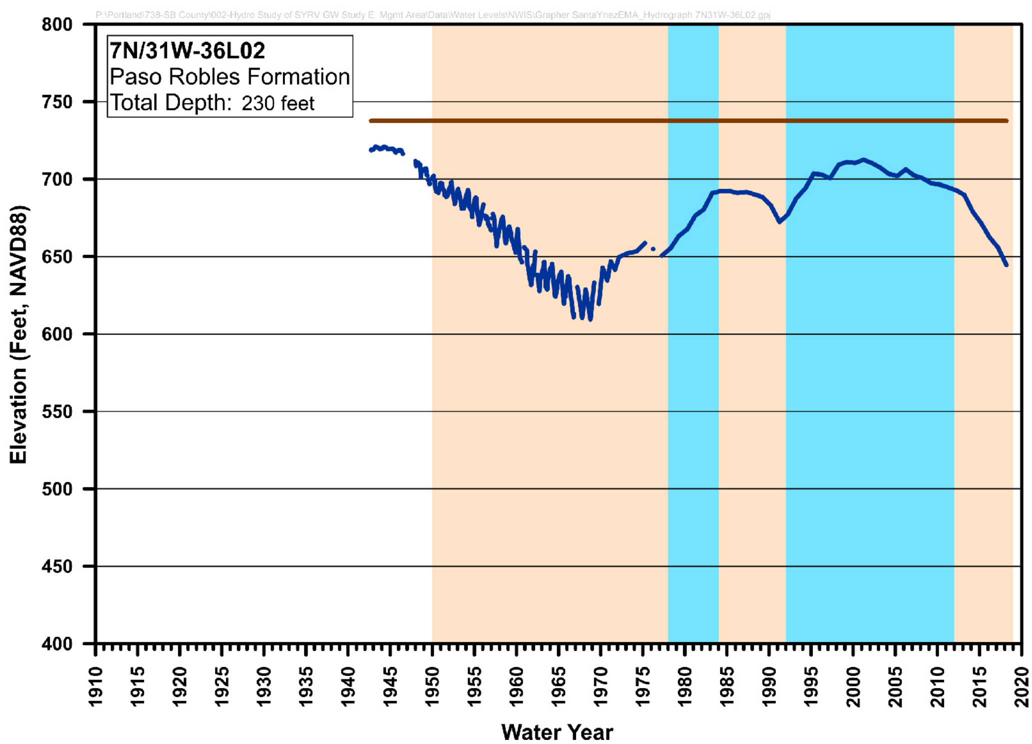



**LEGEND**

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

# FIGURE 3-25

**Representative Paso Robles Formation Hydrographs: Wells -35R01 and -36L02**

Groundwater Sustainability Plan
Eastern Management Area

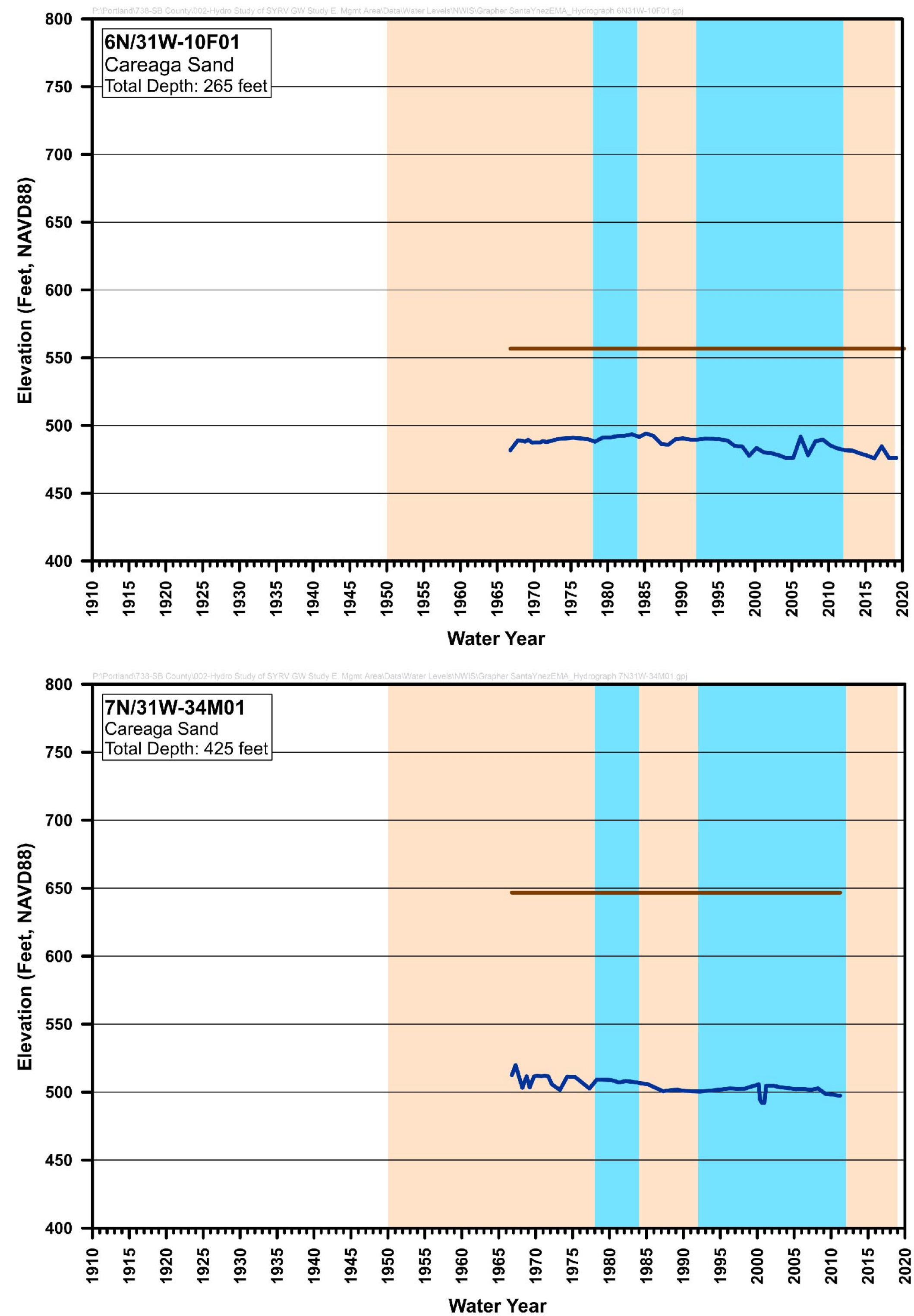
GSI Water Solutions, Inc.

Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP

#### 3.2.1.2.2. Careaga Sand

The Careaga Sand hydrographs presented on Figure 3-26 generally illustrate the long-term stability of water levels over the period of record for two representative wells with continuous data since the mid-1960s. These wells show minimal change in water level elevation from the 1960s to present. Water levels in some wells show muted correlation with climatic conditions, exhibiting minor decreases during drought conditions and rising water levels during wet periods.

One reason for the stable water levels in the Careaga Sand is that the formation is not pumped significantly relative to the Paso Robles Formation and Santa Ynez River Alluvium. Wells completed in the Careaga Sand typically have relatively low yields compared to the yields of the Paso Robles Formation. The volume of water extracted from the Careaga Sand aquifer is likely a small portion of the total available storage, which may explain why water levels do not show significant decline due to drought conditions.




LEGEND

Ground Surface Elevation

Groundwater Elevation

Dry Climatic Cycle

Wet Climatic Cycle

# FIGURE 3-26

**Representative Careaga Sand Hydrographs: Wells -10F01 and -34M01**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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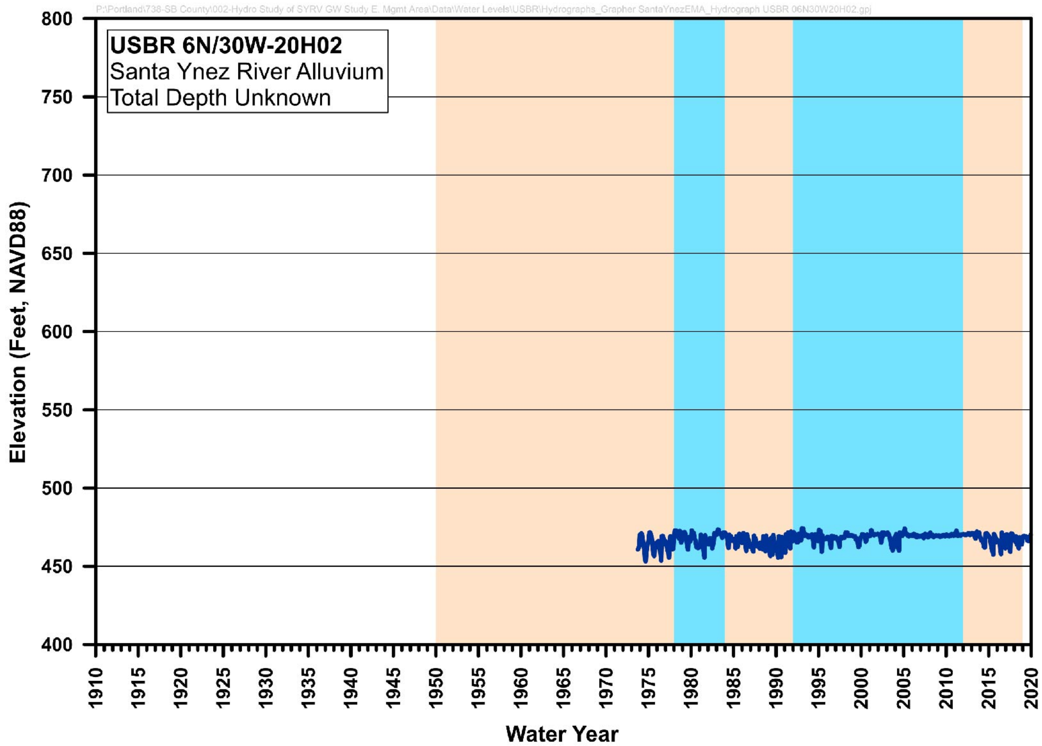
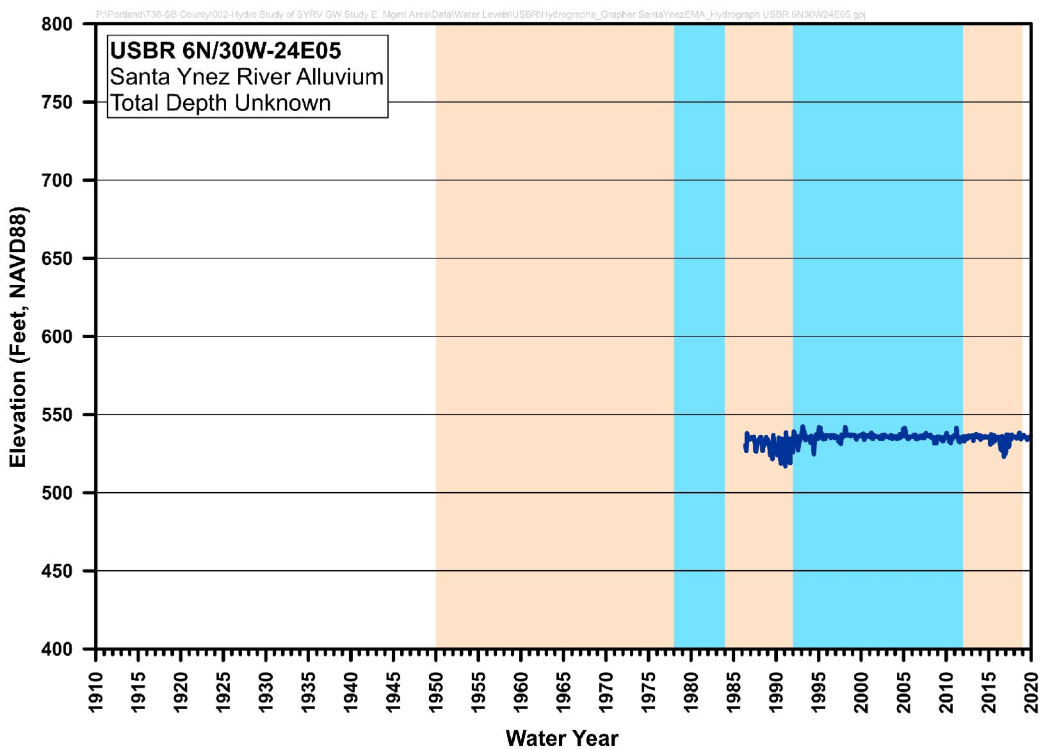
#### 3.2.1.2.3. Santa Ynez River Alluvium

Santa Ynez River Alluvium wells generally exhibit long-term stability in water levels over time. Wells with longer periods of record typically show little to no change in water level elevations, with the exception of minor seasonal fluctuations (generally less than 15 feet). However, the magnitude of this water level variation as a proportion of the saturated thickness is significant. As discussed throughout this Basin Setting, the elevations of water within the Santa Ynez River Alluvium are strongly affected by releases from Lake Cachuma to maintain flows for downstream water rights and habitat for steelhead (*Oncorhynchus [O.] mykiss)*. Hydrographs of two representative wells within the Santa Ynez River are presented as Figure 3-27.

Appendix D includes all of the representative hydrographs for wells completed the Santa Ynez River Alluvium.




**LEGEND**

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

## FIGURE 3-27

**Representative Santa Ynez River Alluvium Hydrographs: Wells –20H02 and -24E05**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

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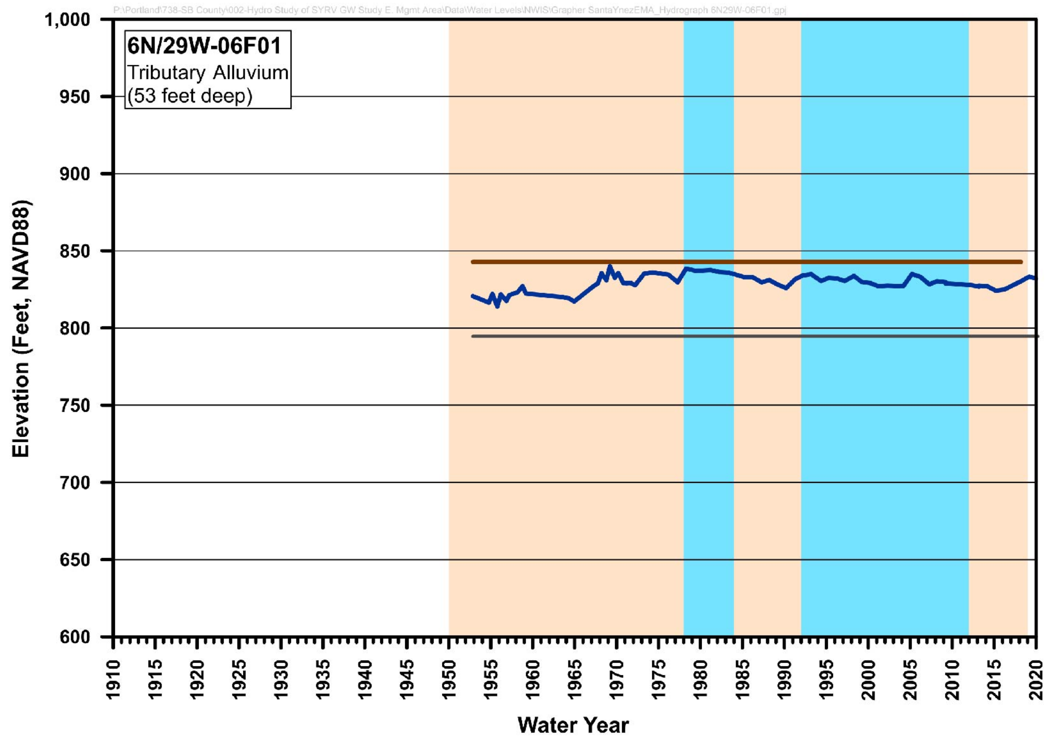
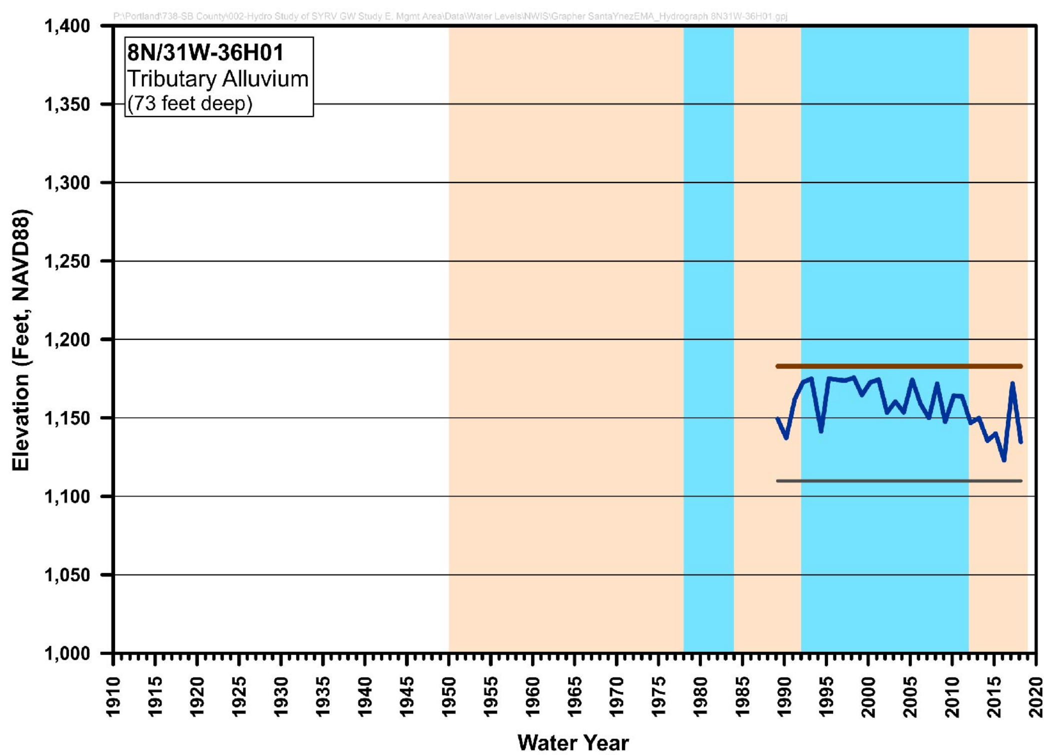
#### 3.2.1.2.4. Tributary Alluvium

Water levels in the Tributary Alluvium are variable because of the shallow completed depths of wells. Water levels in wells completed only in the Tributary Alluvium rapidly decline during drought periods. However, these wells benefit often from rapid recovery in response to any substantial seasonal rainfall in individual wet years. The hydrographs presented on Figure 3-28 show declining water levels in response to drought periods, but also demonstrate the ability of these alluvial aquifers to fully recharge during wet periods. Tributary Alluvium groundwater elevations are typically higher in spring than in the fall and generally fluctuate by 30 feet annually.

Appendix D includes the hydrographs for the wells completed wholly within Tributary Alluvium aquifer as well as hydrographs completed both in this shallow alluvium and the underlying Paso Robles (or Older Alluvium).




**LEGEND**

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

**FIGURE 3-28**

**Representative Tributary Alluvium Hydrographs: Wells –06F01 and –36H01**

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

### 3.2.2 Change of Groundwater in Storage

> **§354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:**
>
> **(b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.**

The changes in groundwater in storage within the EMA are discussed in Section 3.3 Water Budget.

### 3.2.3 Groundwater Quality Distribution and Trends

> **§354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:**
>
> **(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes**

This section provides a summary of the groundwater quality distribution and trends in the EMA. Water quality is presented in terms of beneficial use (potable water and agricultural irrigation), point sources of groundwater contamination, and naturally occurring constituents in groundwater. Groundwater quality samples were collected and analyzed throughout the Basin for various studies and programs. A broad survey of groundwater quality has been conducted by USGS as part of its GAMA Program. Historical groundwater quality data from USGS National Water Information System (NWIS) and the SWRCB GeoTracker GAMA database were compiled. Water quality data was also obtained for wells owned by municipal water purveyors as part of its State Division of Drinking Water (DDW) compliance monitoring program.

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

1. The constituent has a drinking water standard (MCL or SMCL).
2. The constituent has a basin WQO set by the Regional Water Quality Control Board (RWQCB).

While there are some wells that have constituent concentrations that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use or other anthropogenic activities. Elevated boron concentrations are naturally occurring in many central coast basins and elevated total dissolved solids (TDS), chloride, and sodium are often associated with rocks of marine origin that are present in the Basin. Projects and management actions implemented as part of this GSP are not anticipated to directly cause concentrations of any of these constituents in groundwater to increase.

#### 3.2.3.1.1. Groundwater Quality Suitability for Potable Water

Water quality data from potable water supply wells were analyzed to identify exceedances of drinking water standards. For purposes of this assessment, potable water quality is presented for wells that serve water for potable purposes, including both municipal and domestic wells. The data reviewed includes water quality analytical results from groundwater samples collected between January 1984 and March 2019 from 99 potable water supply wells in the EMA. Drinking water standards are established by federal and state agencies by setting concentration thresholds for certain groundwater constituents using MCLs and SMCLs. MCLs are regulatory thresholds and SMCLs are guidelines established for nonhazardous aesthetic considerations such as taste, odor, and color. WQOs are set by the RWQCB to protect beneficial uses of groundwater.

Groundwater in the EMA is generally suitable for potable water purposes. Constituents with reported concentrations at or above their respective MCL or SMCL for samples collected from potable water supply wells are presented in Table 3-7. None of the MCL exceedances are attributable to retail water providers in the Basin.

### Table 3-7. Summary of Potable Water and Agricultural Irrigation Water Quality

| Constituent | MCL (mg/L) | SMCL[1] (mg/L) | WQO (mg/L) | Number of Wells Sampled | Number of Wells with Constituent Concentrations at or Above the WQ Standard | Number of Samples | Number of Samples with Constituent Concentrations Above the WQ Standard | Maximum Constituent Concentration Reported (mg/L) | Mean Constituent Concentration Reported (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| **Potable Water Quality** | | | | | | | | | |
| Chromium | 0.05 | -- | -- | 58 | 1 | 293 | 1 | 0.059 | 0.017 |
| Fluoride | 2 | -- | -- | 58 | 1 | 239 | 1 | 15 | 0.34 |
| Gross Alpha[2] | 15 | -- | -- | 48 | 5 | 329 | 12 | 37.9 | 5.8 |
| Lead | 0.015 | -- | -- | 58 | 2 | 237 | 2 | 0.024 | 0.007 |
| Nitrate[3] | 10 | -- | 1 | 64 | 3 | 789 | 22 | 14 | 3.7 |
| Trihalomethanes | 0.080 | -- | -- | 51 | 1 | 207 | 1 | 0.094 | 0.0097 |
| Arsenic | 0.010 | -- | -- | 58 | 0 | 237 | 0 | 0.007 | 0.003 |
| Aluminum | 0.2 | 0.2 | -- | 58 | 2 | 227 | 2 | 0.470 | 0.096 |
| Iron | -- | 0.3 | -- | 58 | 20 | 272 | 43 | 15 | 12 |
| Manganese | -- | 0.05 | -- | 58 | 7 | 256 | 24 | 0.69 | 0.067 |
| Foaming Agents (MBAS) | -- | 0.5 | -- | 52 | 1 | 226 | 1 | 1.2 | 0.22 |
| TDS | -- | 1,000 | 600 | 58 | 3 | 238 | 10 | 1,700 | 630 |
| **Agricultural Irrigation Water Quality** | | | | | | | | | |
| TDS | -- | 1,000 | 600 | 312 | 172 | 1,409 | 694 | 5,910 | 822 |
| Chloride | -- | 500 | 50 | 301 | 160 | 1,096 | 476 | 218 | 70 |
| Boron | -- | -- | 0.5 | 193 | 10 | 727 | 17 | 1.2 | 0.68 |
| Sodium | -- | -- | 20 | 253 | 252 | 870 | 866 | 228 | 42 |

**Notes**

1. Upper SMCL (SWRCB, 2018)
2 Gross Alpha concentrations reported in picocuries per liter (pCi/L)
3. Nitrate reported as nitrogen.

MCL: maximum contaminant level
SMCL: secondary maximum contaminant level
WQO: water quality objective (SWRCB, 2019
mg/L: milligrams per liter

WQ: water quality
TDS: total dissolved solids
--: No value

#### 3.2.3.1.2. Groundwater Quality Suitability for Agricultural Irrigation

Groundwater in the Basin is generally suitable for agricultural purposes based on comparison with the basin WQOs as discussed in this section. This analysis focuses on wells that provide water for agricultural purposes. The agricultural suitability of groundwater within the EMA was evaluated using the following two metrics:

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

Groundwater quality data were evaluated from the NWIS and GeoTracker GAMA data sets. The data reviewed consists of 379 sampling events from 376 wells in the Basin collected between April 1978 and March 2019. Table 3-7 summarizes constituents with reported concentrations at or above their respective basin WQO.

Samples collected from 172 of 312 wells indicated total dissolved solids (TDS) concentrations exceeding the WQO (600 milligrams per liter [mg/L]) in 694 of 1,409 samples. Refer to Table 3-9. Wells with reported concentrations of TDS at or above the WQO are located in the Santa Ynez Uplands, adjacent to Santa Ynez River and its tributaries, with the largest number of wells in the southwest region portion of the EMA.

Concentrations of boron, sodium, and chloride have also been reported at concentrations exceeding the WQO in the EMA. These constituents are generally associated with salt-containing minerals that are naturally present in the watershed. Samples analyzed for concentrations of sodium from 252 of 253 wells exceeded the WQO (20 mg/L) in 866 of 870 samples (Figure 3-34). Wells with reported concentrations of sodium at or above the WQO are located in the uplands and adjacent to tributaries of the Santa Ynez River.

Samples analyzed for concentrations of chloride from 160 of 301 wells exceeded the WQO (50 mg/L) in 476 of 1,096 samples (Figure 3-31). Wells with reported concentrations of chloride exceeding the WQO are located in the Santa Ynez Uplands and adjacent to tributaries of the Santa Ynez River.

Analytical results for 17 water samples indicate some caution should be used if irrigating, specifically fruit (including grapes) (Hanson, Grattan, & Fulton, 2006), due to potential boron ion toxicity (SWRCB, 2019). Samples analyzed for concentrations of boron from 10 of 193 wells exceeded the WQO (0.5 mg/L) in 17 of 727 samples (Figure 3-33). Wells with reported concentrations of boron at or above the WQO are located in the Santa Ynez Uplands, adjacent to Santa Ynez River and its tributaries, with the largest concentrations of wells in the southwest region of the EMA.

#### 3.2.3.1.3. Distribution and Concentrations of Point Sources of Groundwater Constituents

Potential point sources of groundwater quality degradation were identified using the SWRCB GeoTracker data management system. Waste Discharge Requirement permits were also reviewed from the SWRCB GeoTracker data management system. Table 3-8 summarizes information from GeoTracker for open/active contaminated sites.

Figure 3-29 shows the locations of these potential groundwater contaminant point sources and the locations of completed/case closed sites. The single open/active case is Jim's Service Center (Site ID T0608300118) that was eligible for closure as of January 30, 2019 per the RWQCB Low Threat Closure Policy (SBCPHD, 2019). Site assessment reports indicate there are dissolved-phase benzene and methyl tert-butyl ether (MTBE) plumes in groundwater beneath the site. Alamo Pintado Creek was determined to be the sensitive downgradient receptor. Due to the measured groundwater gradient in the area of the site, the classification of Alamo Pintado Creek as a losing stream by the USGS NHD, and decreasing benzene and MTBE concentrations, a minimal threat to groundwater as a potable water source was determined (Flowline, 2018).

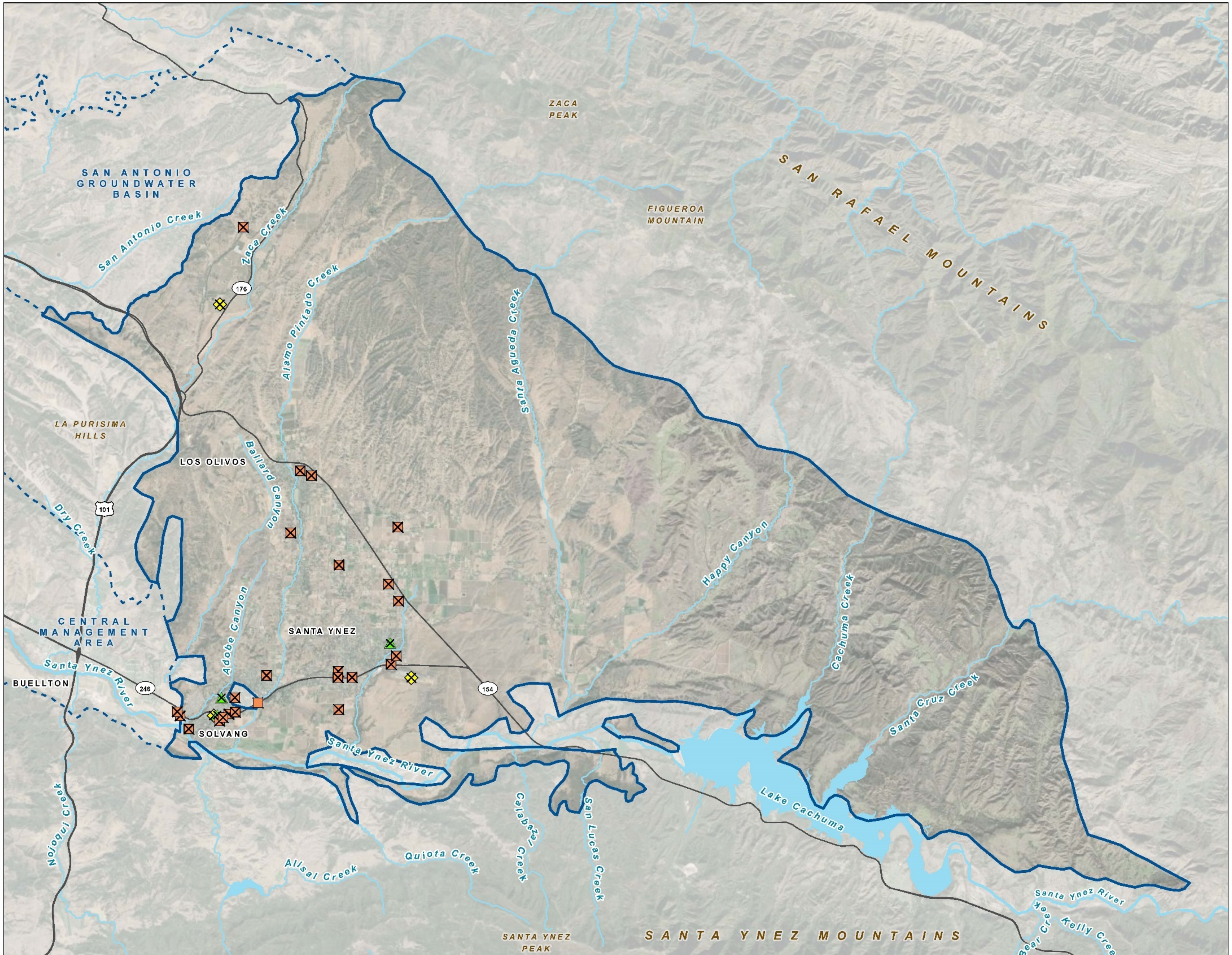
**Table 3-8. Potential Point Source of Groundwater Contamination (SWRCB, 2020)**

| Site ID/Site Name | Site Type | Constituent(s) of Concern | Status |
|---|---|---|---|
| Jim's Service Center (T0608300118) | LUST Cleanup Site | Benzene and methyl tert-butyl ether (MTBE) | Open – Eligible for Closure as of 1/30/2019 |

#### 3.2.3.1.4. Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

The distribution and concentration of naturally occurring groundwater constituents are discussed in the following subsections. Groundwater quality data were evaluated from the NWIS and GeoTracker GAMA data sets. The data reviewed consists of groundwater samples collected from 378 wells in the Basin between December 1941 and July 2020. Reported concentrations of each constituent are compared with their WQOs.

The constituents with reported concentrations at or above the respective WQO for all wells (for wells known to be completed in each principal aquifer) and for surface water samples are presented as Table 3-9. The following subsections focus on constituents with the potential to be impacted by groundwater management activities. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause constituent concentrations in groundwater to increase. Based on available data, wells with reported constituent concentrations in groundwater at or above the respective WQO are distributed throughout the EMA with increasing concentrations in the direction of the groundwater flow towards the southwest.




# FIGURE 3-29

## Location of Potential Point Sources of Groundwater Contaminants

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

- Active LUST Cleanup Site
- Inactive Cleanup Program Site
- Inactive DTSC
- Inactive LUST Cleanup Site
- Eastern Management Area Basin Boundary

**All Other Features**

- Major Road
- Watercourse
- Waterbody

**NOTES**

DTSC: Department of toxic substances control
LUST: Leaky underground storage tank

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_29_Cleanup_Sites.mxd, npalmer

### Table 3-9. Summary of Diffuse or Natural Groundwater Constituents: Entire EMA, Santa Ynez River Alluvium and Tributary Alluvium

| Constituent | MCL (mg/L) | SMCL[1] (mg/L) | WQO (mg/L) | Number of Wells Sampled | Number of Wells with Constituent Concentrations at or Above the WQ Standard | Number of Samples | Number of Samples with Constituent Concentrations Above the WQ Standard | Maximum Constituent Concentration Reported (mg/L) | Mean Constituent Concentration Reported (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| **Entire EMA** | | | | | | | | | |
| TDS | – | 1,000 | 600 | 312 | 172 | 1,409 | 694 | 5,910 | 660 |
| Chloride | – | 500 | 50 | 301 | 160 | 1,096 | 476 | 218 | 51 |
| Sulfate | – | 500 | 10 | 312 | 298 | 1,420 | 1,383 | 2,680 | 150 |
| Boron | – | – | 0.5 | 193 | 10 | 727 | 17 | 1.2 | 0.16 |
| Sodium | – | – | 20 | 253 | 252 | 870 | 866 | 228 | 47 |
| Nitrate[2] | 10 | – | 1 | 243 | 154 | 1.776 | 964 | 14 | 2.6 |
| **Santa Ynez River Alluvium** | | | | | | | | | |
| TDS | – | 1,000 | 600 | 2 | 2 | 21 | 21 | 1,030 | 906 |
| Chloride | – | 500 | 50 | 2 | 2 | 21 | 21 | 90 | 72 |
| Sulfate | – | 500 | 10 | 2 | 2 | 21 | 21 | 1,030 | 910 |
| Boron | – | – | 0.5 | 2 | 0 | 18 | 0 | 0.3 | 0.22 |
| Sodium | – | – | 20 | 2 | 2 | 21 | 21 | 342 | 290 |
| Nitrate[2] | 10 | – | 1 | 2 | 2 | 48 | 39 | 5.17 | 2.3 |
| **Tributary Alluvium** | | | | | | | | | |
| TDS | – | 1,000 | 600 | 2 | 1 | 7 | 1 | 629 | 532 |
| Chloride | – | 500 | 50 | 2 | 0 | 7 | 0 | 47 | 37 |
| Sulfate | – | 500 | 10 | 2 | 1 | 7 | 1 | 629 | 530 |
| Boron | – | – | 0.5 | 2 | 0 | 7 | 0 | 0.26 | 0.13 |
| Sodium | – | – | 20 | 2 | 2 | 7 | 7 | 77 | 32 |
| Nitrate[2] | 10 | – | 1 | 1 | 1 | 4 | 3 | 1.54 | 1.2 |

**Table 3-10. Summary of Diffuse or Natural Groundwater Constituents: Paso Robles Formation, Careaga Sand and Surface Water**

| Constituent | MCL (mg/L) | SMCL[1] (mg/L) | WQO (mg/L) | Number of Wells Sampled | Number of Wells with Constituent Concentrations at or Above the WQ Standard | Number of Samples | Number of Samples with Constituent Concentrations Above the WQ Standard | Maximum Constituent Concentration Reported (mg/L) | Mean Constituent Concentration Reported (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| **Paso Robles Formation** | | | | | | | | | |
| TDS | -- | 1,000 | 600 | 9 | 3 | 32 | 4 | 1,200 | 469 |
| Chloride | -- | 500 | 50 | 9 | 3 | 32 | 5 | 72 | 35 |
| Sulfate | -- | 500 | 10 | 9 | 3 | 32 | 4 | 1,200 | 470 |
| Boron | -- | -- | 0.5 | 9 | 0 | 32 | 0 | 0.329 | 0.096 |
| Sodium | -- | -- | 20 | 9 | 8 | 32 | 23 | 420 | 50 |
| Nitrate[2] | 10 | -- | 1 | 6 | 3 | 17 | 14 | 1.8 | 1.5 |
| **Careaga Sand** | | | | | | | | | |
| TDS | -- | 1,000 | 600 | 3 | 3 | 20 | 19 | 1,102 | 927 |
| Chloride | -- | 500 | 50 | 3 | 3 | 21 | 21 | 145 | 83 |
| Sulfate | -- | 500 | 10 | 3 | 3 | 20 | 19 | 1,102 | 930 |
| Boron | -- | -- | 0.5 | 3 | 0 | 13 | 0 | 0.3 | 0.22 |
| Sodium | -- | -- | 20 | 3 | 3 | 21 | 21 | 366 | 280 |
| Nitrate[2] | 10 | -- | 1 | 3 | 3 | 55 | 42 | 8.1 | 4.7 |
| **Surface Water** | | | | | | | | | |
| TDS | -- | 1,000 | 600 | 5 | 5 | 701 | 503 | 1,250 | 667 |
| Chloride | -- | 500 | 50 | 6 | 5 | 93 | 6 | 66.5 | 24 |
| Sulfate | -- | 500 | 10 | 6 | 5 | 701 | 503 | 1,250 | 670 |
| Boron | -- | -- | 0.5 | 6 | 0 | 87 | 0 | 0.441 | 0.25 |
| Sodium | -- | -- | 20 | 6 | 6 | 93 | 93 | 562 | 270 |
| Nitrate[2] | 10 | -- | 1 | 6 | 1 | 92 | 1 | 5.17 | 0.27 |

Notes

1. Upper SMCL (SWRCB, 2018)
2 Nitrate reported as nitrogen.

MCL: maximum contaminant level
SMCL: secondary maximum contaminant level
WQO: water quality objective (SWRCB, 2019)
mg/L: milligrams per liter
WQ: water quality
--: No value

These tables present a summary of the reported concentrations that are at or above the respective WQOs. The first table (Table 3-9) presents this data for the entire EMA, including wells for which no aquifer was assigned and then for wells known to be completed in the Santa Ynez River Alluvium and Tributary Alluvium. Likewise, aquifer-specific water quality for the Paso Robles Formation, Careaga Sand, and surface water samples are presented on Table 3-10.

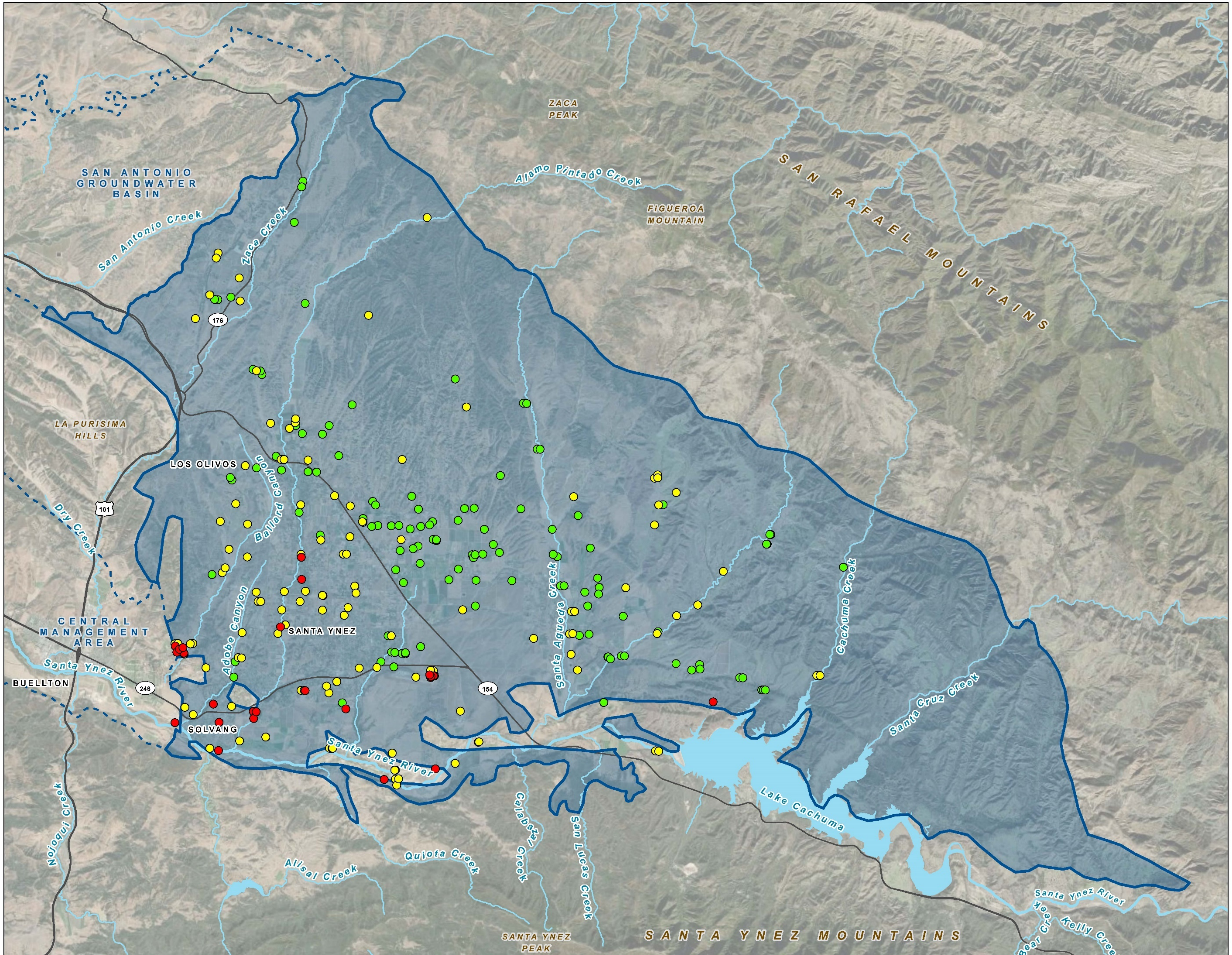
The following subsections focus on constituents with the potential to be impacted by groundwater management activities. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause constituent concentrations in groundwater to increase. Based on available data, wells with reported constituent concentrations in groundwater at or above the respective WQO are distributed throughout the EMA with increasing concentrations in the direction of the groundwater flow towards the southwest.

While there are some wells that have constituent concentrations that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated boron concentrations are naturally occurring in many central coast basins and elevated TDS, chloride, and sodium are often associated with rocks of marine origin that are present in the Basin.

#### 3.2.3.1.5. Total Dissolved Solids

Total dissolved solids (TDS) is defined as the total amount of dissolved minerals and salts in a given volume of water. TDS concentrations in groundwater were detected above the WQO of 600 mg/L in a total of 172 wells located in the EMA. The SMCL includes a recommended standard of 500 mg/L, an upper limit of 1,000 mg/L and a short-term limit of 1,500 mg/L (SWRCB, 2018). Several wells in the EMA have TDS concentrations exceeding SMCLs. The SMCL for TDS has been established for aesthetic considerations (including color, odor, and taste) rather than health-related concerns. Water quality data from wells with known zones of completion indicate mean TDS concentrations reported from wells screened in the Careaga Sand are greater than those collected in the shallower principal aquifers. Based on a review of the publicly available groundwater quality data summarized in the above tables and Figure 3-29, wells with TDS concentrations at or above the WQO are located in the Santa Ynez Uplands, adjacent to Santa Ynez River and its tributaries, with the largest concentrations of wells in the southwest (downgradient) region of the EMA.

Based on analytical results from 311 sampling events between October 1991 and May 2020, TDS concentrations in surface water samples collected from the Santa Ynez River and three of its tributaries are relatively stable over the period of record. Reported analytical results for TDS concentrations in surface water range from 403 mg/L to 1,250 mg/L with a mean of 670 mg/L. Surface water samples with reported TDS concentrations in the upper range were collected downstream. Sample analytical results of TDS concentrations are shown on Figure 3-30.




# FIGURE 3-30

## Total Dissolved Solids 2015-2018 Average

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

**Well Concentration**

***Total Dissolved Solids, mg/L***

- <600
- 600-1,000
- >1,000

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

### NOTES

1. The Water Quality Objective for Total Dissolved Solids is 600 mg/L.
2. The upper Secondary Maximum Contamination Level for Total Dissolved Solids is 1,000 mg/L.

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

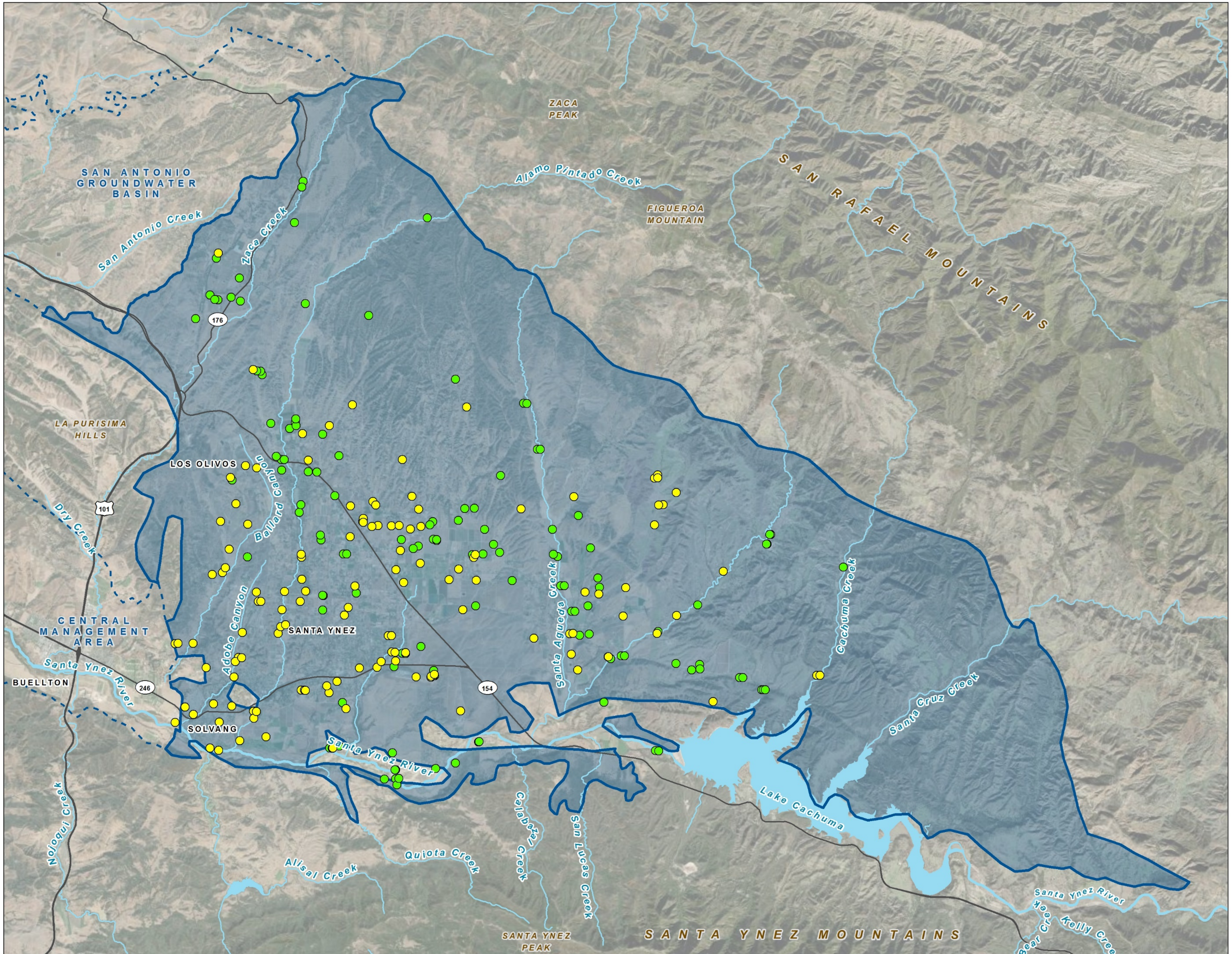
GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_30_TDS_Results.mxd, npalmer

#### 3.2.3.1.6. Chloride

Chloride concentrations in groundwater were detected above the WQO of 50 mg/L in a total of 160 wells located in the EMA. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018). Several wells in the EMA have chloride concentrations exceeding SMCLs. The SMCL for chloride has been established for color, odor and taste, rather than human health effects. Water quality data from wells with known zones of completion indicate mean chloride concentrations reported from wells screened in the Careaga Sand aquifer are greater than those collected in the shallower principal aquifers. Based on a review of the publicly available groundwater quality data summarized in the above tables and Figure 3-31, wells with chloride concentrations at or above the WQO are located in the uplands and adjacent to tributaries of the Santa Ynez River.

Based on analytical results from 43 sampling events between October 1991 and May 2020, chloride concentrations in surface water samples collected from the Santa Ynez River and four of its tributaries have increased over the period of record. Reported analytical results for chloride concentrations in surface water range from 6.2 mg/L to 66.5 mg/L with a mean of 19 mg/L.




# FIGURE 3-31

## Chloride Concentrations, 2015-2018 Average

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

**Well Concentration**

***Chloride, mg/L***

- < 50
- 50 - 250
- > 250

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

### NOTES

1. The Water Quality Objective for Chloride is 50 mg/L.
2. The upper Secondary Maximum Contamination Level for Chloride is 250 mg/L.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

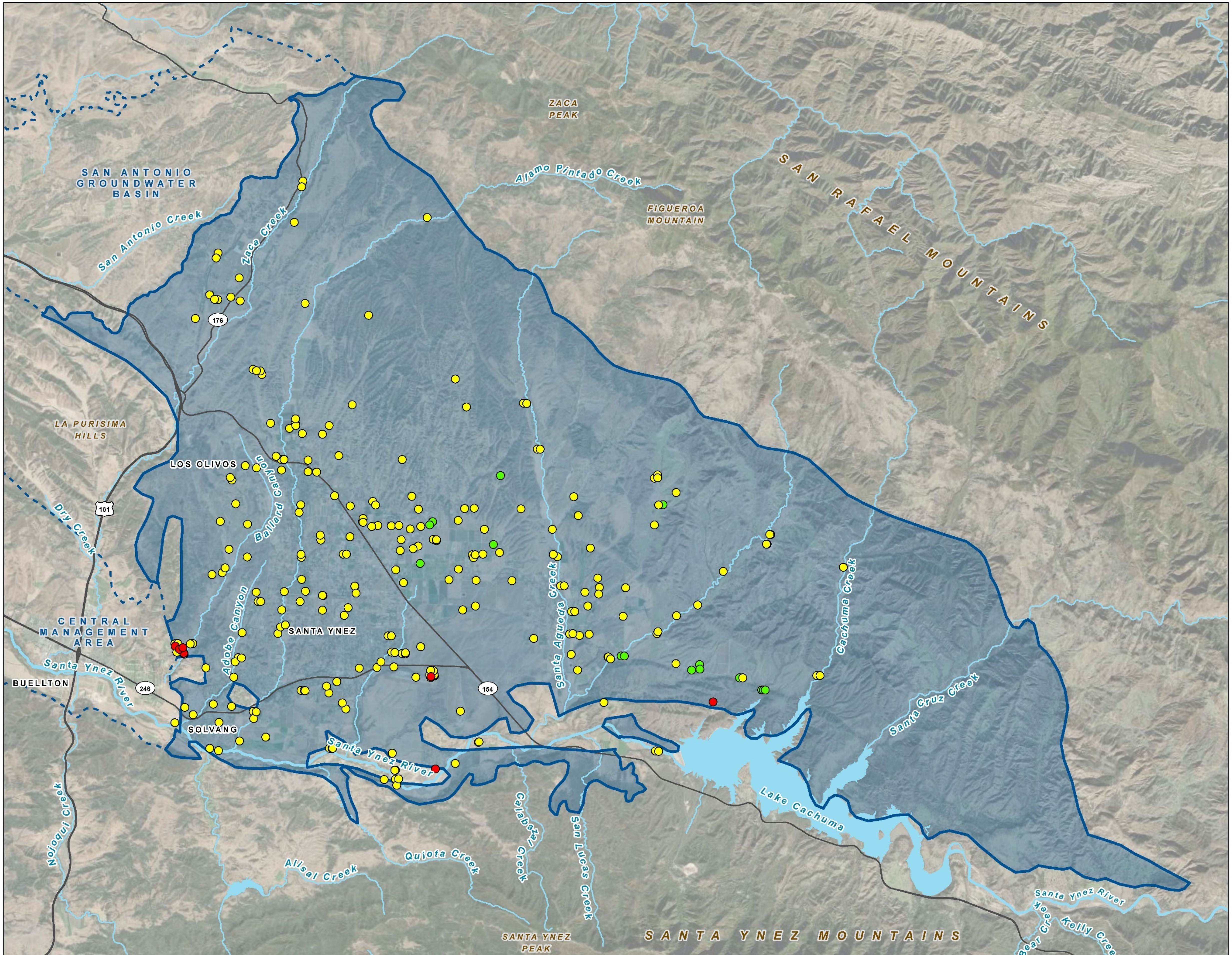
Date: November 20, 2020
Data Sources: ESRI, USGS, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_31_Chloride_Results.mxd, npalmer

#### 3.2.3.1.7. Sulfate

Sulfate concentrations in groundwater were detected above the WQO of 10 mg/L in 298 wells located in the EMA. The SMCL for sulfate was exceeded in seven wells. The SMCL for sulfate was established to avoid causing digestive problems in humans. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018). Samples collected from 298 of 312 wells indicated sulfate concentrations exceeding the WQO in 1,383 of 1,420 samples. Water quality data from wells with known zones of completion indicate mean sulfate concentrations reported from wells screened in the Santa Ynez River Alluvium and Careaga Sand aquifers are greatest. Based on a review of the publicly available groundwater quality data summarized on Table 3-9 and Table 3-10 and Figure 3-32, wells with sulfate concentrations at or above the WQO are located in the lowlands in the south and southwest region on the EMA.

Based on analytical results from 43 sampling events between October 1991 and May 2020, sulfate concentrations in surface water samples collected from the Santa Ynez River and four of its tributaries are relatively stable over the period of record. Reported analytical results for sulfate concentrations in surface water range from 161 mg/L to 562 mg/L with a mean of 261 mg/L.




# FIGURE 3-32

## Sulfate Concentrations, 2015-2018 Average

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

**Well Concentration**

***Sulfate, mg/L***

- <10
- 10-500
- >500

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

### NOTES

1. The Water Quality Objective for Sulfate is 10 mg/L.
2. The upper Secondary Maximum Contamination Level for Sulfate is 500 mg/L.

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

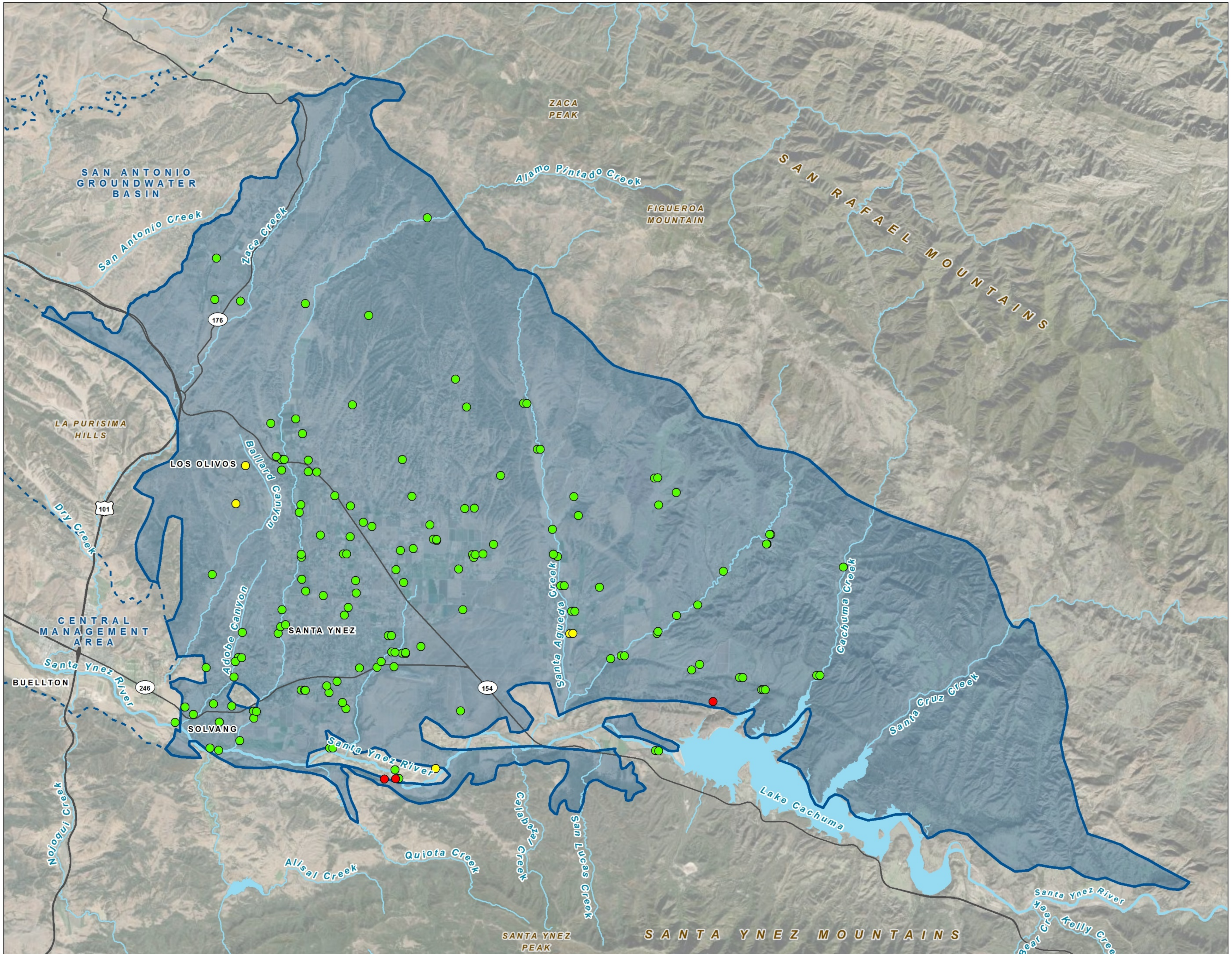
GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_32_Sulfate_Results.mxd, npalmer

#### 3.2.3.1.8. Boron

Boron concentrations in groundwater were detected above the WQO of 0.5 mg/L in a number of wells located in the EMA. Elevated Boron concentrations have been found to impact productivity of some agricultural crops, particularly vineyards. An SMCL has not been established for boron. Water quality data from wells with known zones of completion indicate mean boron concentrations reported from wells screened in the Santa Ynez River Alluvium and Careaga Sand aquifers are greatest. Based on a review of the publicly available groundwater quality data summarized in Table 3-9 and Table 3-10 and Figure 3-33, wells with boron concentrations at or above the WQO are located in the uplands, adjacent to Santa Ynez River and its tributaries, with the largest concentrations of wells in the southwest region portion of the EMA.

Based on analytical results from 42 sampling events between October 1991 and May 2020, boron concentrations in surface water samples collected from the Santa Ynez River and four of its tributaries are relatively stable over the period of record. Reported analytical results for boron concentrations in surface water range from 0.180 mg/L to 0.441 mg/L with a mean of 0.24 mg/L.




# FIGURE 3-33

## Boron Concentrations, 2015-2018 Average

Groundwater Sustainability Plan
Eastern Management Area

### LEGEND

**Well Concentration**

***Boron, mg/L***

- <0.5
- 0.5-1
- >1

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

### NOTES

1. The Water Quality Objective for Boron is 0.5 mg/L.

N

0 5,000 10,000 15,000
Feet

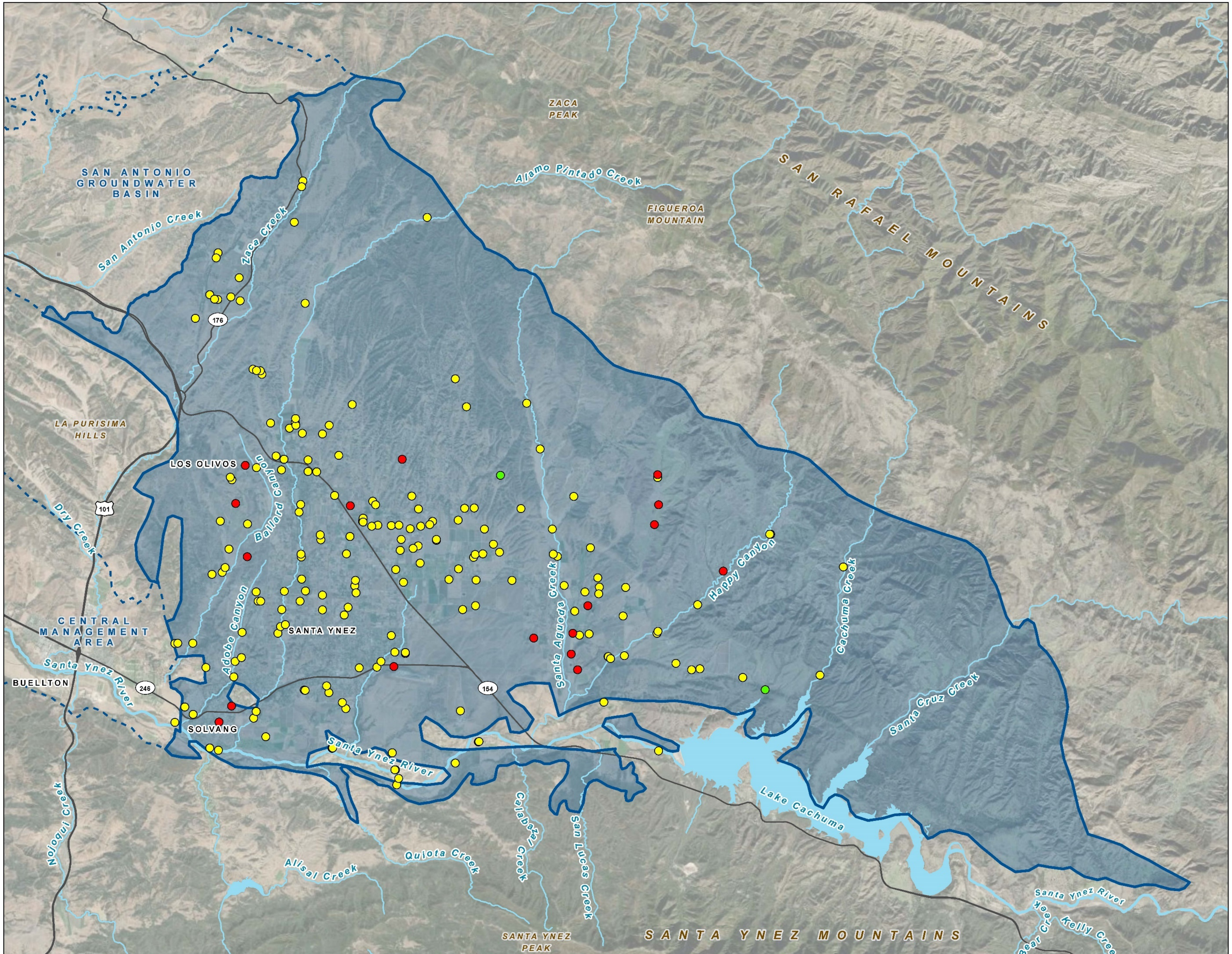
Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

#### 3.2.3.1.9. Sodium

Sodium concentrations in groundwater were detected above the WQO of 20 mg/L in the EMA. A SMCL has not been established for sodium. Water quality data from wells with known zones of completion indicate mean sodium concentrations reported from wells screened in the Santa Ynez River Alluvium and Careaga Sand are greatest. Based on a review of the publicly available groundwater quality data summarized in Table 3-9 and Table 3-10 and Figure 3-34, wells with sodium concentrations at or above the WQO are located in the Santa Ynez Uplands and adjacent to tributaries of the Santa Ynez River.

Based on analytical results from 43 sampling events between October 1991 and May 2020, sodium concentrations in surface water samples collected from the Santa Ynez River and four of its tributaries are relatively stable over the period of record. Reported analytical results for sodium concentrations in surface water range from 26.65 mg/L to 85.3 mg/L with a mean of 41.1 mg/L.




# FIGURE 3-34

**Sodium Concentrations, 2015-2018 Average**

Groundwater Sustainability Plan
Eastern Management Area

## LEGEND

**Well Concentration**

***Sodium, mg/L***

- <20
- 20-100
- >100

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

## NOTES

1. The Water Quality Objective for Sodium is 20 mg/L.

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

#### 3.2.3.1.10. Nitrate

Nitrate is a widespread constituent in California groundwater (California Department of Public Health, 2014). Elevated concentrations of nitrate in groundwater can be associated with agricultural activities, septic systems, confined animal facilities, landscape fertilizers, and wastewater treatment facilities. Nitrate is the primary form of nitrogen detected in groundwater. It is soluble in water and can easily pass through soil to the groundwater table. Nitrate can persist in groundwater for decades and accumulate to increased concentrations as more nitrogen is applied to the land surface each year (California Department of Public Health, 2014). Groundwater quality data are summarized in Table 3-9, Table 3-10, and Figure 3-35.

Nitrate concentrations in groundwater were detected above the WQO of 1 mg/L in the EMA. The MCL for nitrate has been established at 10 mg/L (SWRCB, 2020). Groundwater samples collected from 173 of 234 wells indicated nitrate concentrations exceeding the WQO in 939 of 1,706 samples. Analytical results of samples analyzed for the concentrations of nitrate ranged from 0.02 to 14 mg/L with a mean of 2.6 mg/L. Wells with nitrate concentrations exceeding the MCL are located within three localized areas near the towns of Santa Ynez and Ballard (Heal the Ocean, 2019). Water quality data from wells with known zones of completion indicate mean nitrate concentrations reported from wells screened in the Careaga Sand are greater than those collected in the shallower principal aquifers. Nitrate concentrations reported at or above the WQO are located west of Santa Agueda Creek and largely within the southwestern portion of the Uplands.

Based on analytical results from 42 sampling events between October 1991 and May 2020, nitrate concentrations in surface water samples collected from the Santa Ynez River and four of its tributaries, do not indicate any long-term trends. Analytical results for the surface water samples indicated nitrate concentrations ranging from 0.024 mg/L to 5.17 mg/L with a mean of 0.94 mg/L.

#### 3.2.3.1.11. Other Constituents

Constituents reported at concentrations at or above their respective MCL or SMCL include aluminum, iron, volatile organic compounds (VOC) benzene, toluene, ethylbenzene, xylene (collectively referred to as BTEX) MTBE, and chlorinated hydrocarbon 1,2-Dichloroethane (commonly known as ethylene dichloride [EDC]).

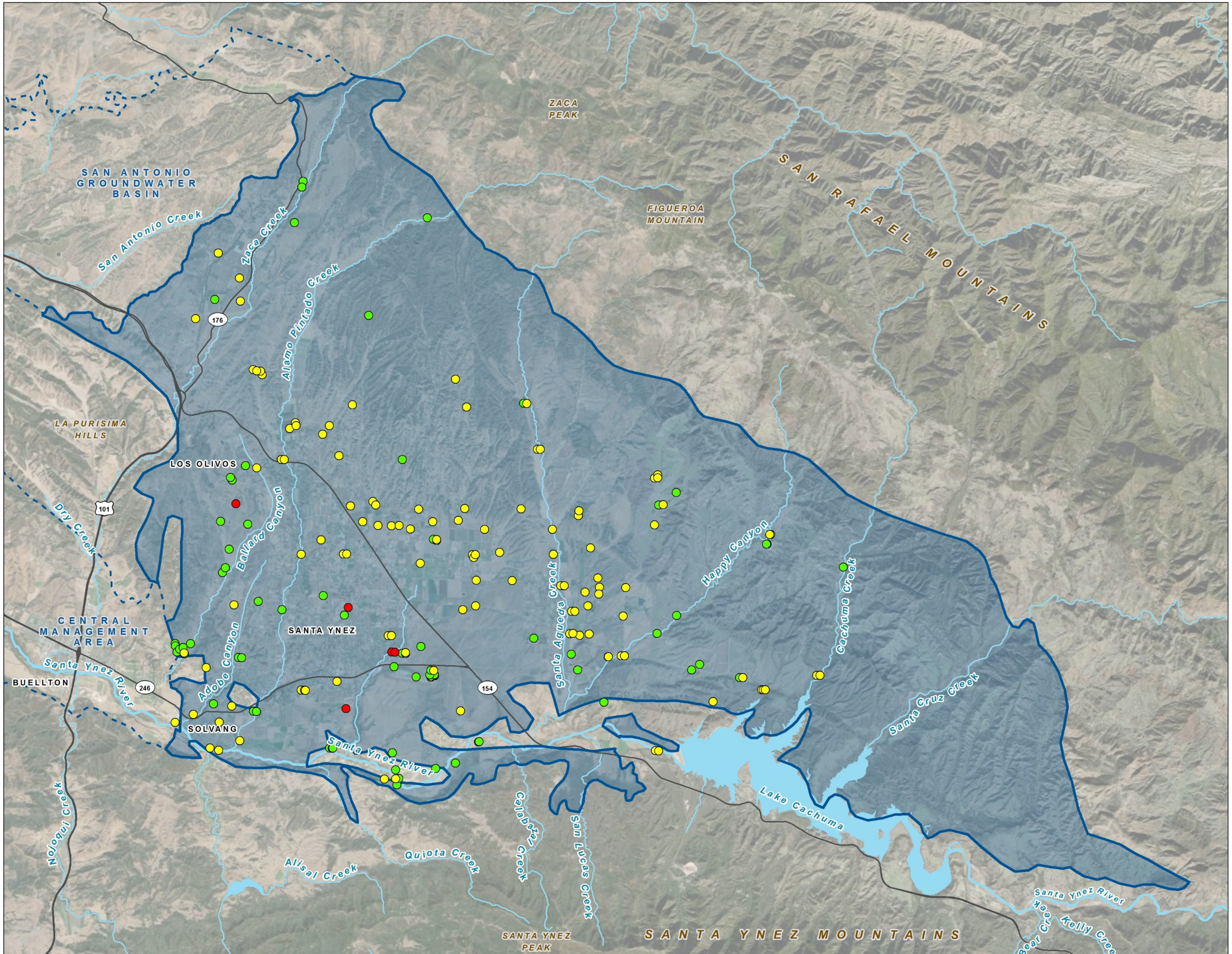
An MCL of 10 mg/L for hexavalent chromium recommend by the California Department of Public Health was adopted into the California Code of Regulations (CCR) in 2015. In 2017 the Superior Court of Sacramento County (Court) invalidated the MCL and ordered it removed from the CCR. The Court determined the MCL did not comply with all of the requirements in the Safe Drinking Water Act, including economic feasibility of complying with an MCL (SWRCB, 2017). A revised MCL for hexavalent chromium is being evaluated by the SWRCB. Hexavalent chromium is currently regulated under the MCL for total chromium of 0.05 mg/L. Concentrations of total chromium at or above the respective MCL from a potable water supply well was reported once in 2002 and not since.

Constituents reported at elevated concentrations that do not have an established MCL or SMCL, but do have an environmental screening level established for environmental cleanup sites, based on a human health risk assessment, and published by the San Francisco Regional Water Quality Control Board, include hexavalent chromium, magnesium, and potassium. Reported concentrations of the constituents discussed above are either single detections or concentrations that were reported historically and not solely after the implementation of the SGMA.

# FIGURE 3-35

## Nitrate Concentrations, 2015-2018 Average

Groundwater Sustainability Plan
Eastern Management Area




**LEGEND**

**Well Concentration**

***Nitrate, mg/L***

- < 1
- 1 - 10
- > 10

**All Other Features**

- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

**NOTES**

1. The Water Quality Objective for Nitrogen is 1 mg/L.
2. The Maximum Contamination Level for Nitrogen is 10 mg/L.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 20, 2020
Data Sources: ESRI, USGS, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_35_Nitrate_Results.mxd, npalmer

### 3.2.4 Land Subsidence

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

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

Land subsidence data for the EMA was compiled from the DWR's SGMA Data Viewer Web-based geographic information system (GIS) viewer (DWR, 2020). Reviewed DWR land subsidence data includes the following:

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

Figure 3-36 shows the InSAR measured subsidence in the Basin. The dark blue areas are areas with measured ground surface rise of between 0 feet and 0.25 feet. The teal area on Figure 3-36 is the area with measured ground surface drop of 0 feet to 0.25 feet. Random sampling of the 100-meter by 100-meter (328-foot by 328-foot) calculation grid cells indicates the greatest amount of subsidence in the Basin has occurred in the wedge-shaped area that is bound by and includes Los Olivos, State Highway 154, and the base of the San Rafael Mountains. Total measured subsidence in the area from June 13, 2015, through September 19, 2019, is less than 0.06 feet, or 0.015 feet per year. This is a minor rate of subsidence and is relatively insignificant and not a major concern for the Basin. However, ongoing subsidence over many years could add up to a more significant ground surface drop and the GSAs will continue to monitor annual subsidence.

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

Elevation data recorded from the UNAVCO CGPS Stations is presented on Figure 3-37, which includes time-series plots of subsidence. One of these stations is located near the Santa Ynez airport, while the other two stations are located in the periphery of the Basin and indicate what is occurring with regard to surface elevations regionally. Total subsidence, or uplift, recorded by the station within the EMA indicate that, since 2015, subsidence is 4 mm per year (plus or minus ~1 mm per year), for a total subsidence of 20 mm or 0.065 feet.

For the stations immediately surrounding the EMA during the approximately 19-year period of record (~2001 through 2020) total subsidence has been approximately plus or minus 10 millimeters, or 0.03 feet. This is a minor rate of subsidence or uplift and is insignificant.

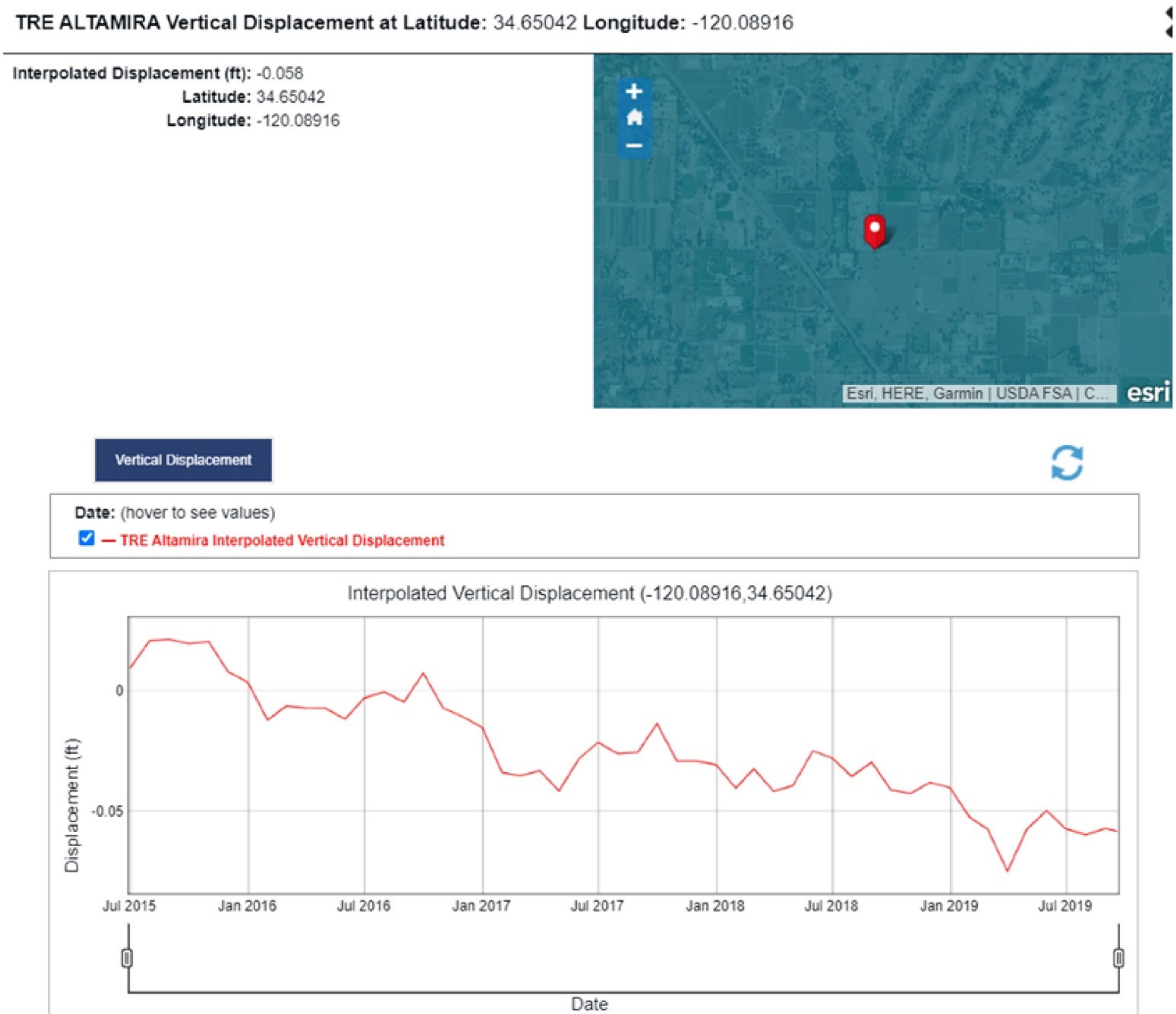
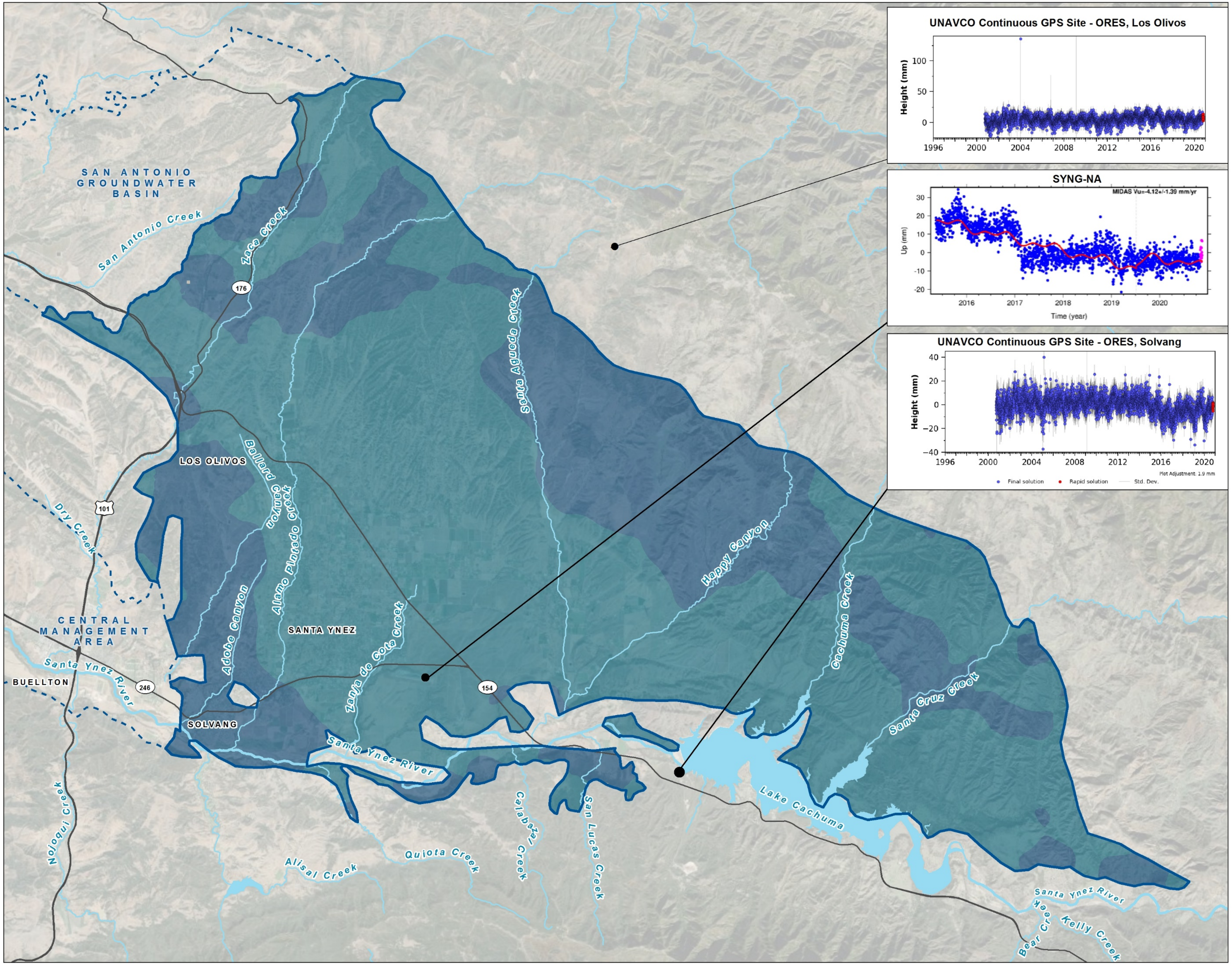



**FIGURE 3-36**

**InSAR Vertical Displacement Point Data**

Groundwater Sustainability Plan
Eastern Management Area

Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP




# FIGURE 3-37

## Total Subsidence, 2015 to 2019

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

Eastern Management Area Basin Boundary

**Land Subsidence**

***Vertical Displacement***

-0.25 to 0 ft

0 to 0.25 ft

**All Other Features**

Major Road

Watercourse

Waterbody

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 19, 2020
Data Sources: ESRI, USGS, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_37_Total_Subsidence_2015_2019_InSAR.mxd, abarry

### 3.2.5 Interconnected Surface Water Systems

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

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

Surface water bodies interact with groundwater in three basic ways, as follows (see also Figure 3-39).

- Upward migration of groundwater through the stream bed (gaining stream condition). This requires the elevation of the water table in the vicinity of the surface water body to be higher than the elevation of the surface water body surface.
- Downward migration of surface water from the stream bed into groundwater (losing stream condition). This condition requires the elevation of the water table in the vicinity of the surface water body to be lower than the elevation of the surface water body surface
- Some streams can have reaches with gaining conditions and other reaches with losing conditions.

Any connection of surface and groundwater systems can be affected by natural processes including prolonged wet periods or periods of drought, as well as anthropogenic processes, such land development, stream alteration, and pumping of surface water and/or groundwater. In addition to affecting the direction of water flow and volume of water exchanged between surface and groundwater systems, these processes can also affect water quality.

Based on acquired data, the classification of the streams within the EMA are presented in Figure 3-38, which are defined by the USGS NHD (USGS, 2020). The EMA includes many types of creeks, several which are perennial, some of which are intermittent, and others that are perennial in places and intermittent in other places.

According to the NHD dataset, the entire Santa Ynez River is defined as a perennial stream, as are several of its tributaries. Upstream of Bradbury Dam, perennial creeks include both Santa Cruz Creek and Cachuma Creek, which flow into Lake Cachuma. Below Bradbury Dam the other creeks classified as perennial include the following (in order from upstream to downstream): San Lucas Creek, Zanja de Cota Creek, Quiota Creek, and Alisal Creek. The entirety of three creeks are intermittent: Happy Canyon Creek, Alamo Pintado Creek, and Ballard Canyon. The upstream portions of Santa Agueda Creek and Zaca Creek are perennial and become intermittent downstream.

The following paragraphs discuss the current understanding of the relationship between surface water and groundwater flow. Notably, the Santa Ynez River flow and connection to groundwater is well documented and regulated. For the tributaries leading to the Santa Ynez River, however, the relationships between the streams and groundwater, though less well-documented, are discussed below.

#### 3.2.5.1 Tributary Alluvium

A significant source of recharge to the Paso Formation Aquifer occurs within the shallow alluvial sand and gravel beds of tributaries where they are in direct contact with the Paso Robles Formation. Percolating groundwater moves readily through the alluvium in the Santa Ynez Uplands (USGS, 1968). In these areas, the tributaries are losing streams, contributing to the groundwater in the underlying Paso Robles Formation (and Older Alluvium).

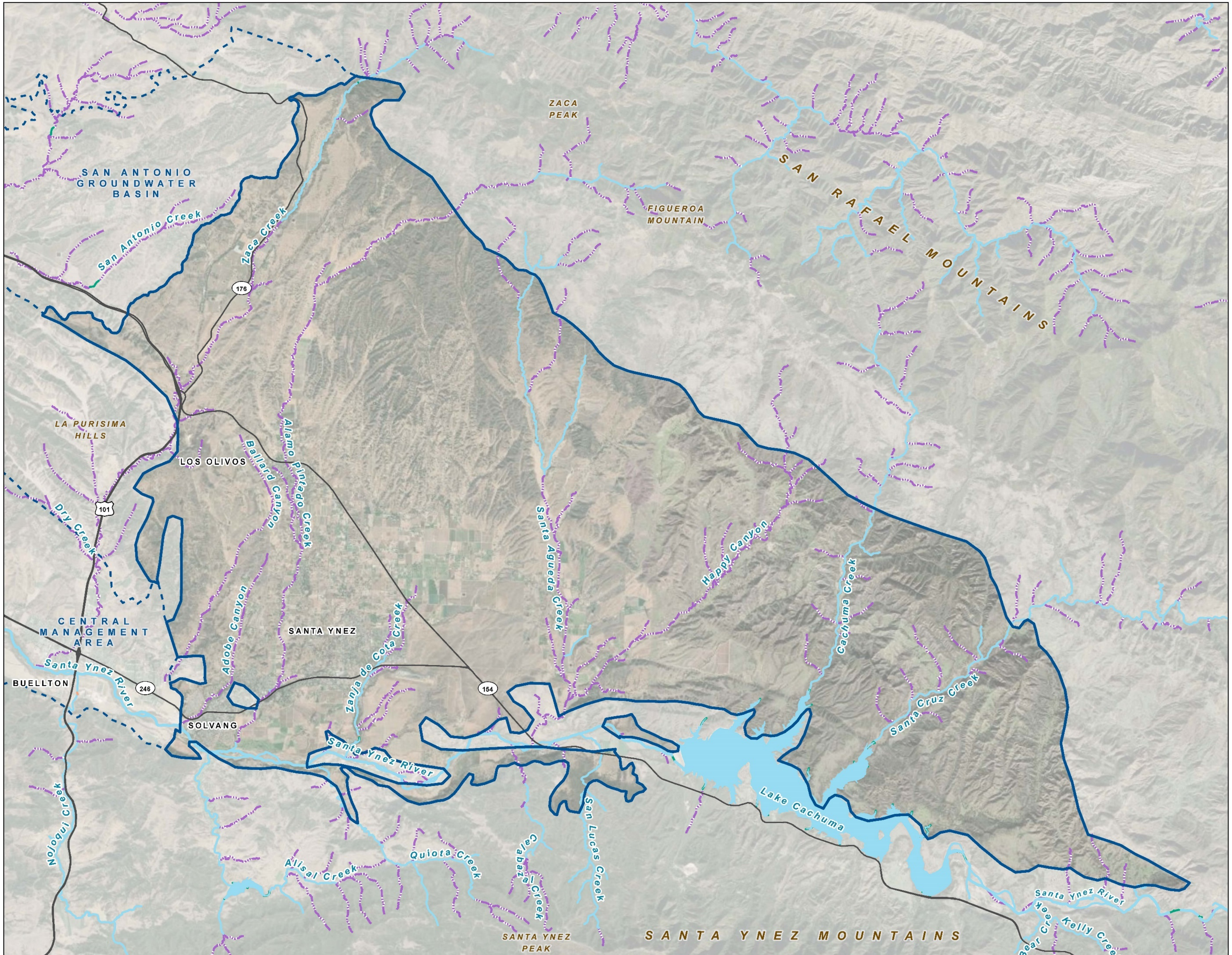
Further south, near the distal ends of the tributaries, the streams draining the Santa Ynez Uplands discharge into the north side of the Santa Ynez River. Groundwater in the Tributary Alluvium at these locations encounters relatively impermeable bedrock underlying the Santa Ynez River, which forces the groundwater to discharge to surface water (Upson and Thomasson, 1951).

As early as 1968, groundwater contours prepared by the USGS indicated that groundwater historically discharged into the alluvium of Alamo Pintado and Santa Cruz Creeks (USGS, 1968) from the Paso Robles Formation. The only exception to this condition in the groundwater basin was in the lower part of Happy Canyon where the water-level contours were convex downstream, indicating that underflow or surface flow in Happy Creek was discharging to the deeper the Paso Robles Formation (USGS, 1968; and Figure 3-39).

Where the valleys are narrow and the cross-sectional area of alluvial fill is decreased, groundwater may be forced to the surface and at times become intermittent or perennial flow in the stream channels. Such narrowing occurs where stream channels have cut through the consolidated rocks that form the south boundary of the Santa Ynez Uplands area. This causes perennial flow in Alamo Pintado, Santa Agueda, Zanja de Cota, Zaca, and Santa Cruz Creeks (Figure 3-38). All other groundwater that discharges naturally from the Basin is either transpired by plants or discharged as underflow through thin, narrow strands of alluvium that line the valleys tributary to the Santa Ynez River.

Santa Agueda and Alamo Pintado Creeks had streamflow gauging stations, which have been terminated. The only streamflow gauges that remain in the tributaries to the Santa Ynez River are within Alamo Pintado Creek and Santa Cruz Creek. Surface water flow has been estimated for Alisal, Santa Agueda, Zanja de Cota, Alamo Pintado, and Zaca Creeks for the period between 1941 and 2019 based on correlations with documented streamflow from old stream gauges that no longer exist (Stetson, 2008).

Streamflow measurements at distal ends of the major tributaries discharging to the Santa Ynez River is a data gap.




# FIGURE 3-38

**Stream Classifications**

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

**USGS NHD Stream Classification**

- Perennial
- Intermittent
- Artificial Path
- Connector
- Eastern Management Area Basin Boundary

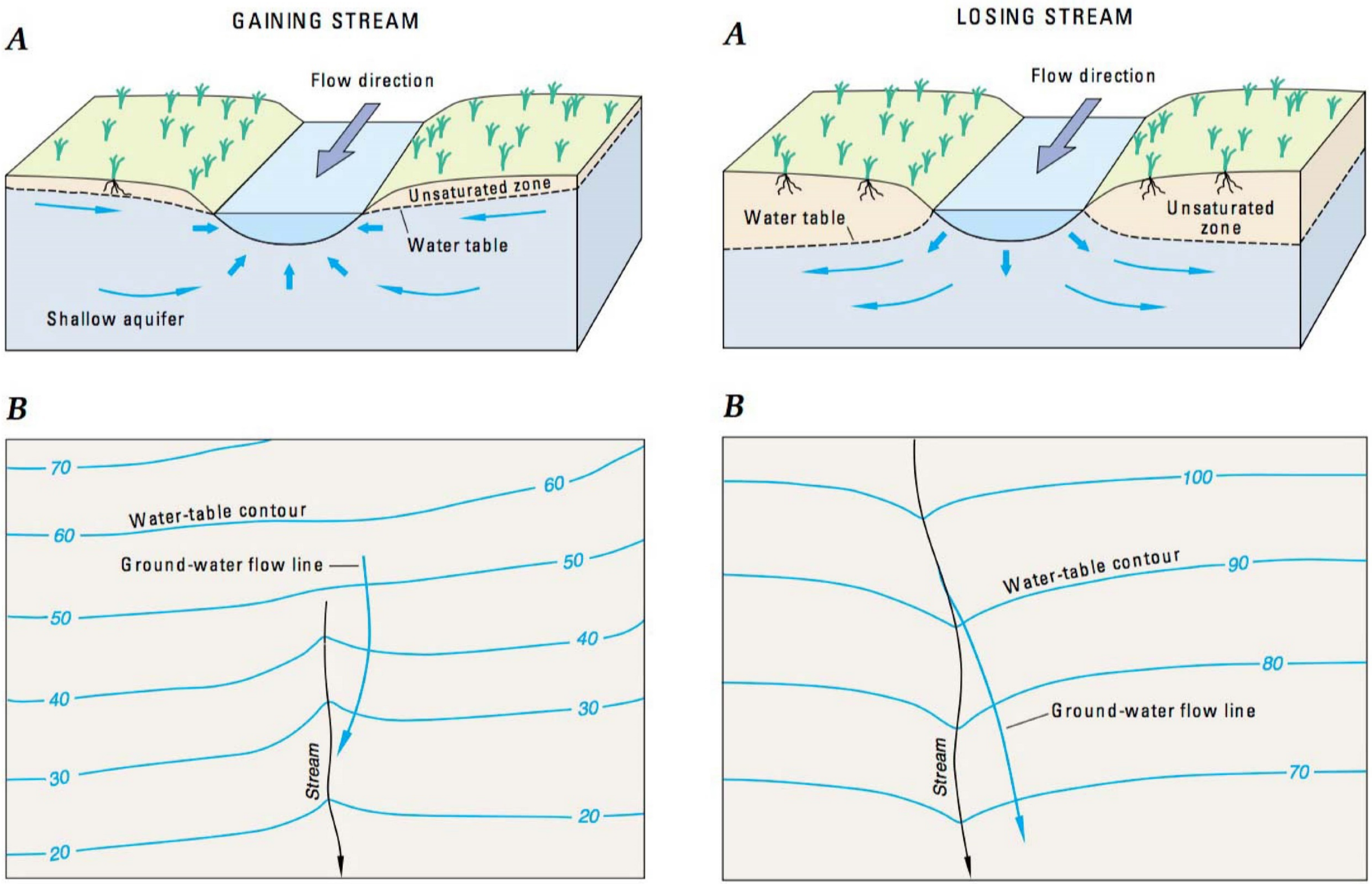
**All Other Features**

- Major Road
- Waterbody

Date: November 3, 2020
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_38_USGS_NHD_Stream_Classification.mxd, npalmer




# FIGURE 3-39

**Gaining and Losing Streams**

Groundwater Sustainability Plan
Eastern Management Area

Date: September 24, 2020
Data Sources: USGS

GSI Water Solutions, Inc.

#### 3.2.5.2 Santa Ynez River Alluvium

The Santa Ynez River flows through a shallow and narrow alluvial valley, which is largely constrained by low permeability bedrock beneath and on the flanks of the river. Within a downstream stretch of the river near the City of Solvang, the river flows on top of the Santa Ynez River Alluvium, which sits on top of Careaga Sand.

Inflow into this aquifer is regulated by Bradbury Dam releases, as well as inflow from the three major tributaries that flow from the Santa Ynez Uplands. Numerical modeling of the Santa Ynez River estimated that about 86 percent of the inflow into the Santa Ynez River Alluvium is derived from the upstream Santa Ynez River, the remainder of which is derived from major tributaries from the Santa Ynez Uplands as well as from Quiota and Alisal Creeks from the south (Stetson, 2004c).

Storage within the Santa Ynez River Alluvium is limited and it is highly susceptible to dewatering if surface flows are not available. To date, it has not been subject to overdraft because the average annual seepage from river flows has been greater than the volume of water demand in the Basin.

Diversions from the Santa Ynez River Alluvial Aquifer are regulated by the SWRCB because it is considered underflow associated with the Santa Ynez River.

### 3.2.6 Groundwater Dependent Ecosystems

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

**(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.**

SGMA and DWR's GSP regulations establish requirements for the identification of groundwater dependent ecosystems (GDEs), and if present, identification of impacts on GDEs from management actions in the EMA. GDEs are defined in the GSP Regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." Determination of whether an area within a groundwater basin contains GDEs is the responsibility of the GSAs. DWR created the Natural Communities Commonly Associated with Groundwater data set (hereafter referred to as the Natural Communities data set), to assist GSAs with identification of potential GDEs, the data for which is presented on Figure 3-40.

The Natural Communities data set is a compilation of 48 publicly available state and federal agency data sets that map vegetation, wetlands, springs, and seeps in California. A working group that includes DWR, CDFW, and The Nature Conservancy reviewed the compiled data set and conducted a screening process to exclude vegetation and wetland types less likely to be associated with groundwater and to retain types commonly associated with groundwater based on criteria described in Klausmeyer et al., 2018. Two habitat classes are included in the Natural Communities data set statewide:

- Wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions
- Vegetation types commonly associated with the subsurface presence of groundwater (phreatophytes)

The data included in the Natural Communities data set do not represent the determination of a GDE by DWR, but only the potential existence of a GDE. However, the Natural Communities data set can be used by GSAs as a starting point when approaching the task of identifying GDEs within a groundwater basin that are both classified as potential GDEs and are connected to groundwater (DWR, 2020).

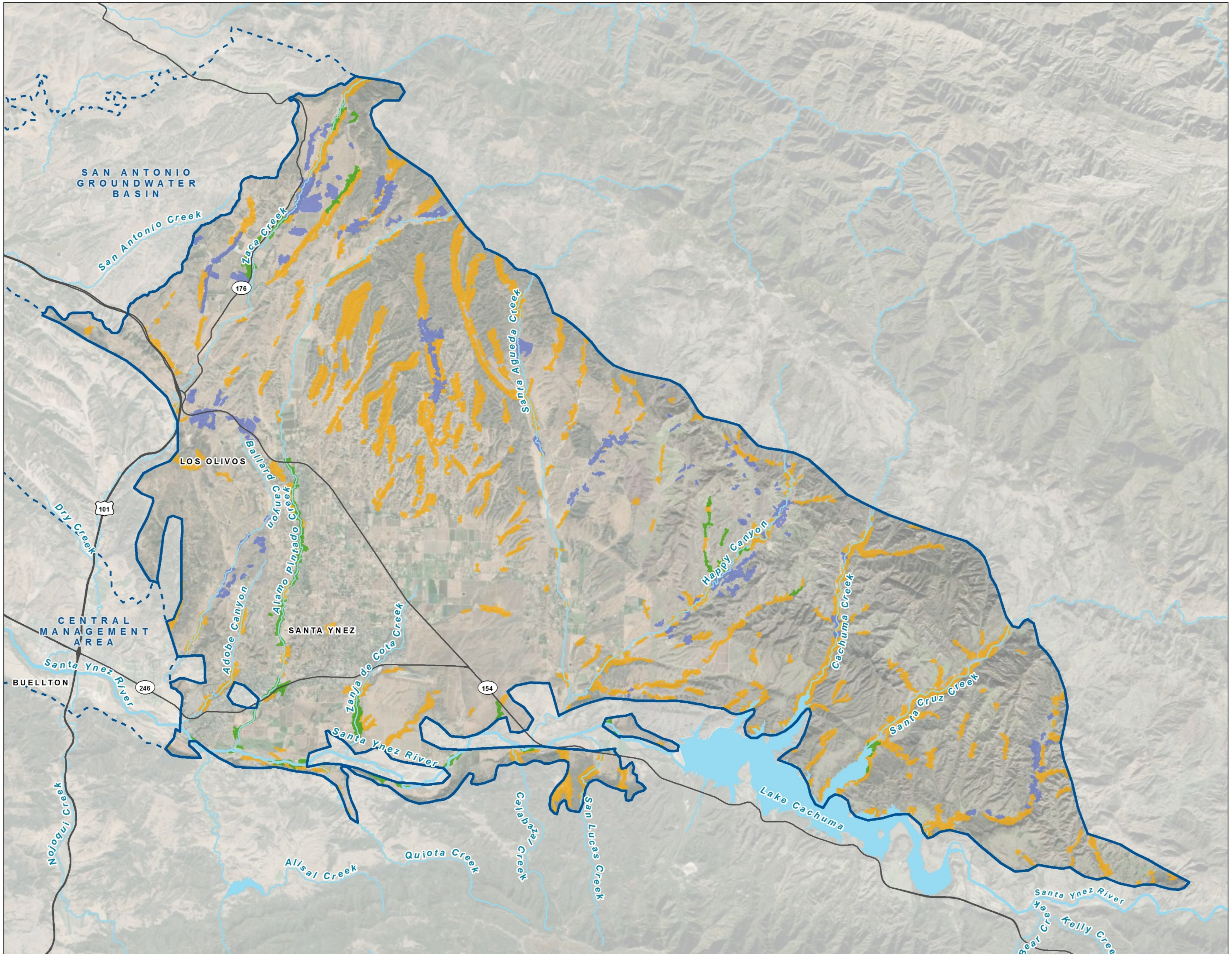
Based on review of the Natural Communities data set, no wetlands are located within the EMA, but three other types of vegetation communities are present:

- Coast Live Oak
- Valley Oak
- Riparian Mixed Harwood (Figure 3-40)

The Coast Live Oak and Valley Oak communities are located in the Santa Ynez Upland area along several north-south trending tributary valleys. Riparian Mixed Hardwood communities were identified based on aerial vegetative mapping within Happy Canyon, along the lower portion of Alamo Pintado Creek (south of Highway 154), along Zaca Creek and the southernmost portion of the Zanja de Cota Creek. This community is also mapped in places along the Santa Ynez River corridor.

There is a paucity of groundwater elevation data within a majority of the Tributary Alluvium located in the tributaries that cross the Santa Ynez Uplands. Because there is limited understanding of the depth and geometry of the bottom of the Tributary Alluvium and a lack of groundwater elevation data within that principal aquifer, it is not possible to determine the relationship between groundwater and potential GDEs located within these areas. This is a data gap.

The EMA GSA will not be responsible for managing any aspect of the Santa Ynez River and related groundwater system (including assessment of impacts to GDEs).




# FIGURE 3-40

## Natural Communities Commonly Associated with Groundwater - Potential Groundwater Dependent Ecosystems (GDEs)

Groundwater Sustainability Plan
Eastern Management Area

**LEGEND**

Eastern Management Area Basin Boundary

**Natural Communities Commonly Associated with Groundwater (NCCAG)**

- Coast Live Oak
- Valley Oak
- Riparian Mixed Hardwood

**All Other Features**

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 19, 2020
Data Sources: ESRI, USGS,NCCAG, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_40_Natural_Communities_Associated_with_GW.mxd, abarry