

April 18, 2019

**Annual Report - Water Year 2018**  
**Scotts Valley Water District**  
**Groundwater Management Plan**

SCOTTS VALLEY WATER DISTRICT  
SANTA CRUZ COUNTY, CALIFORNIA

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**Appendix A.** Hydrographs of SVWD Production Wells

**Appendix B.** Hydrograph for Wells with Transducers

# **1 EXECUTIVE SUMMARY**

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The Scotts Valley Water District (SVWD or District), located in Santa Cruz County, serves water to residents and businesses within an area of approximately 5.5 square miles that includes most of the City of Scotts Valley as well as some unincorporated areas north of the City. Groundwater from the Santa Margarita Groundwater Basin (SMGB) is the sole source of potable water supply for the District.

SVWD formally adopted its Groundwater Management Plan in 1994 under Assembly Bill 3030 (AB3030). Annual reports describing the groundwater conditions in the Scotts Valley area and the District's management programs have been prepared since 1994.

Rainfall in Water Year (WY) 2018 was 24.3 inches, which is 58% of average rainfall. Since the drought that ended in WY2015, rainfall has been a cumulative 21 inches above normal, with WY2017 having close to record high rainfall. Although, from the start of the drought in October 2011 through September 2018, rainfall is still a cumulative 33 inches below average.

Groundwater pumped by SVWD in WY2018 was 1,211 acre-feet, which is 31 acre-feet less than WY2017. Since WY2003, the District's groundwater production has declined by over 900 acre-feet (about 45%). SVWD derives nearly all of its potable groundwater supply from the Lompico and Butano aquifers. In WY2018, approximately 73% of SVWD's groundwater production was from the Lompico aquifer and 26% was from the Butano aquifer.

Groundwater pumped in the Groundwater Reporting Area (GWRA) by municipal and private pumpers in WY2018 was 1,838 acre-feet. Eighty percent of groundwater pumped in the GWRA is derived from the Lompico aquifer.

SVWD maintains a number of ongoing activities to support the sustainable management of the groundwater resource including water use efficiency, recycled water program, and water audit and loss control program. In WY2018, recycled water deliveries were approximately 196 acre-feet. Since WY2002, approximately 2,320 acre-feet of recycled water has been delivered for use. Cumulative recycled water deliveries equate to banking almost twice the volume of groundwater that was pumped by SVWD in WY2018.

Groundwater quality in SVWD's production wells is good. Iron and manganese treatment ensures that the concentrations of these constituents in delivered water is below the secondary maximum contaminant level. Volatile organic compounds (VOC) are below

detectable levels in all production wells, except SVWD Wells #9 and #11A which continue to have detections of VOCs that are below their maximum contaminant levels.

SVWD is being informed about the remediation activities at regulated environmental compliance sites within the District. These sites have introduced primarily VOCs into the groundwater. The Camp Evers Combined Site remediation is complete and the case closed. The Watkins-Johnson Superfund site remediation is edging towards closure but still needs to complete the source control component of the remedial action to ensure protectiveness over the long-term. The Scotts Valley Dry Cleaners site continued operation of the soil vapor extraction and air sparging systems in their current configuration. These are remediation systems for the unsaturated soils above the groundwater table so no groundwater is extracted, only soil vapor. Their consultant is also recommending researching environmental data and past use history of the former nearby airport to assess potential source(s) for the elevated PCE and TCE concentrations detected in their distal sampling location. The Watkins-Johnson and Scotts Valley Dry Cleaners groundwater remediation systems have been shut down since 2016 and 2015, respectively.

Groundwater elevations in all aquifers in the GWRA are generally higher than what has been experienced over the past 10 years. Even though groundwater levels in the portion of the Santa Margarita aquifer in the southern end of the District declined 10 feet in WY2018 from very high levels in WY2017, levels at the end of WY2018 remain higher than they have been historically.

Groundwater levels in both the Monterey formation and Lompico aquifer continue upward trends especially over the past two years. Specifically, Lompico aquifer groundwater levels have increased up to 15 feet over the past two years. Model-estimated change in Lompico aquifer groundwater in storage reflects this trend with a net increase in storage of 731 acre-feet. Model results indicate that groundwater in aquifer storage increased by 1,987 acre-feet in WY2017 but decreased by 1,065 acre-feet in WY2018, for a net increase of 922 acre-feet in the Scotts Valley area over the past two years.

## **2 INTRODUCTION**

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### **2.1 District Overview**

The Scotts Valley Water District (SVWD or District) was formed under the County Water District Law, specifically California Water Code Section (CWC§) 30321, and received certification from the California Secretary of State in 1961. SVWD covers an area of about 5.5 square miles (Figure 1) in northern Santa Cruz County, and is located approximately five miles inland from the Monterey Bay. SVWD provides water to a majority of the residents and businesses in and around the City of Scotts Valley. Groundwater is the sole source of potable water supply for SVWD, so careful management is necessary to sustain the resource.

SVWD has been actively managing groundwater since the early 1980's; with the goals of increasing water supply reliability and protecting local water supply sources. In 1983, SVWD instituted a Water Resources Management Plan to monitor and manage water resources in the Scotts Valley area. In 1994, SVWD formally adopted a Groundwater Management Plan ([GWMP], Todd Engineers, 1994) in accordance with Assembly Bill 3030 (AB 3030), also known as the Groundwater Management Act (CWC §10750 *et seq.*).

### **2.2 Groundwater Management Goals and Objectives**

The overall purpose of the GWMP is to provide a planning tool that helps guide the District in managing the quantity and quality of its groundwater supply, and to comply with the requirements of AB3030. The main goal of the GWMP is to better manage the sole source aquifers serving the community's drinking water. The goal of the SVWD GWMP is stated as:

*“By implementation of a groundwater management plan for Scotts Valley, SVWD hopes to preserve and enhance the groundwater resource in terms of quality and quantity, and to minimize the cost of management by coordination of efforts among agencies.”*

Development of Basin Management Objectives (BMOs) are required for the GWMP under CWC §10753.7(a)(1) as a systematic process to support groundwater basin management. The BMOs for SVWD are currently summarized as:



- Encouraging public participation through an annual report of groundwater management activities and its presentation at one or more public meetings.
- Coordinating with other local agencies.
- Continued monitoring and evaluation of groundwater conditions.
- Implementing groundwater augmentation projects.
- Investigating groundwater quality and preventing groundwater contamination.

These BMOs continue to guide the SVWD groundwater management program and serve as the major objectives of groundwater management for the District.

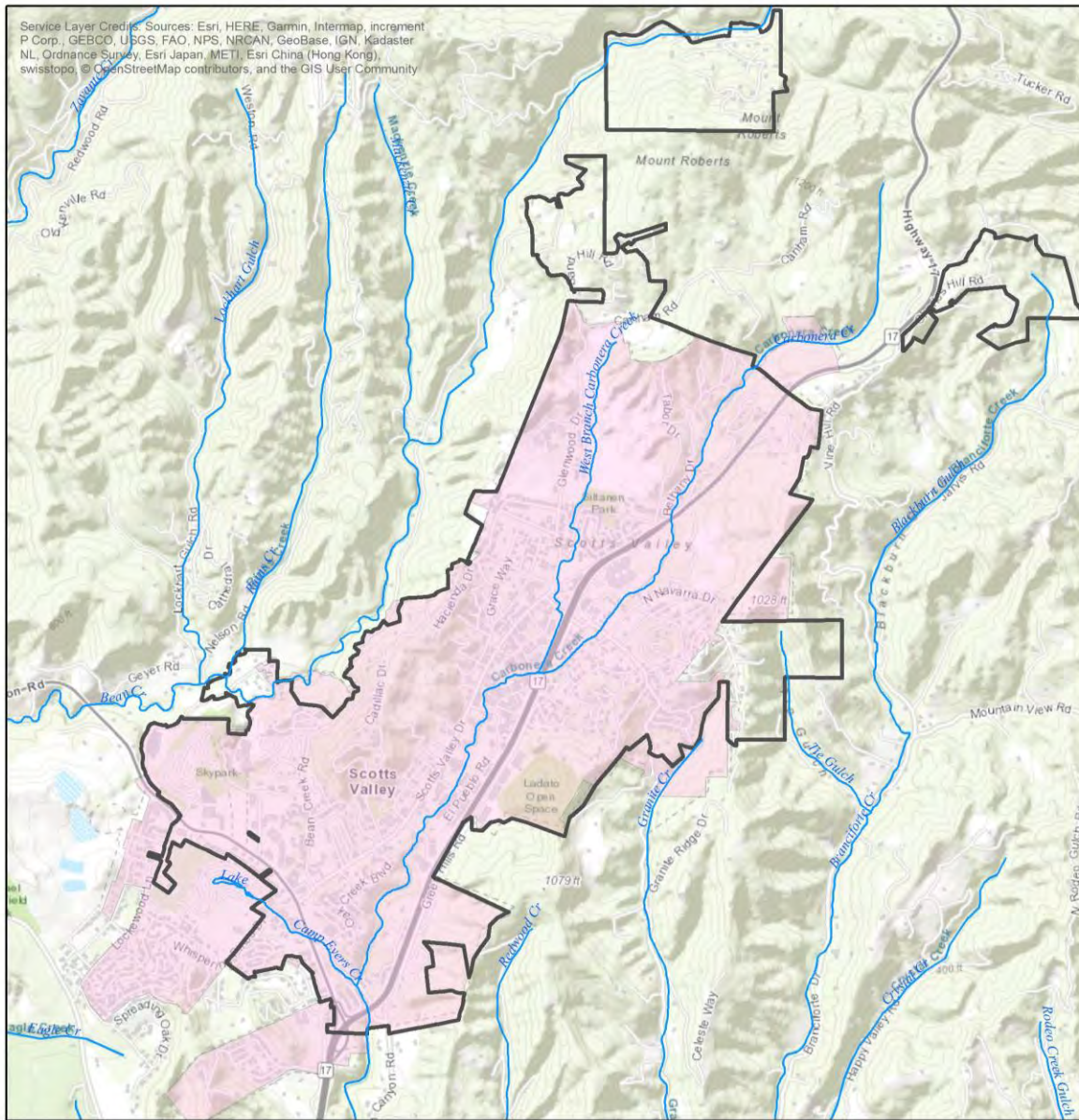
## **2.3 Annual Report Format**

An annual report is a key part of implementing the GWMP. The annual report evaluates and documents progress on meeting the GWMP goals and BMOs, and identifies any concerns that should be monitored or addressed. This annual report is a management-level summary of groundwater conditions and groundwater management activities conducted by the District during Water Year (WY) 2018. The annual report is presented to the SVWD Board of Directors, distributed among local agencies and stakeholders, and made available to the public at the SVWD office and website.

The District has been producing annual reports since 1994. The format of the annual report has evolved over time to meet the needs of the District. Starting with in 2013, the format of the annual reports began following a two-year cycle with a more comprehensive report provided in even years. Based on past experience, there are only incremental year-to-year changes in the basin; therefore, the two-year cycle provides a more cost- effective approach to accomplish the objectives of the annual report.

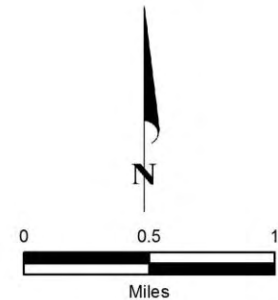
The odd year annual reports (2013 and 2015) are concise summaries focused on District operations whereas the even year annual reports (2014 and 2016) provide a more regional assessment that includes an evaluation of data from neighboring water districts and private suppliers, an assessment of water quality issues, an assessment of Basin conditions and the results from of the updated basinwide groundwater model.

In order to evaluate groundwater conditions within the context of California's climate, data in the annual report are typically reported over a water year defined as the period from October 1 through September 30 of the following year. This period captures the cause and effect relationship on groundwater conditions of the typical rainy winter season followed by low rainfall and higher pumping during the summer.



## EXPLANATION

- Scotts Valley Water District
- City of Scotts Valley



**Figure 1. Scotts Valley Water District Location Map**

## **3 GROUNDWATER MANAGEMENT AREA**

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### **3.1 Groundwater Basin**

#### **3.1.1 Santa Margarita Groundwater Basin**

The Santa Margarita Groundwater Basin (SMGB or Basin) covers approximately 33.2 square miles in the Santa Cruz Mountains. The SMGB forms a roughly triangular area that extends from Scotts Valley in the east, to Boulder Creek in the northwest, to Felton in the southwest (Figure 2). Groundwater is an important source of water supply for many residents living within the SMGB and is the primary water supply for SVWD.

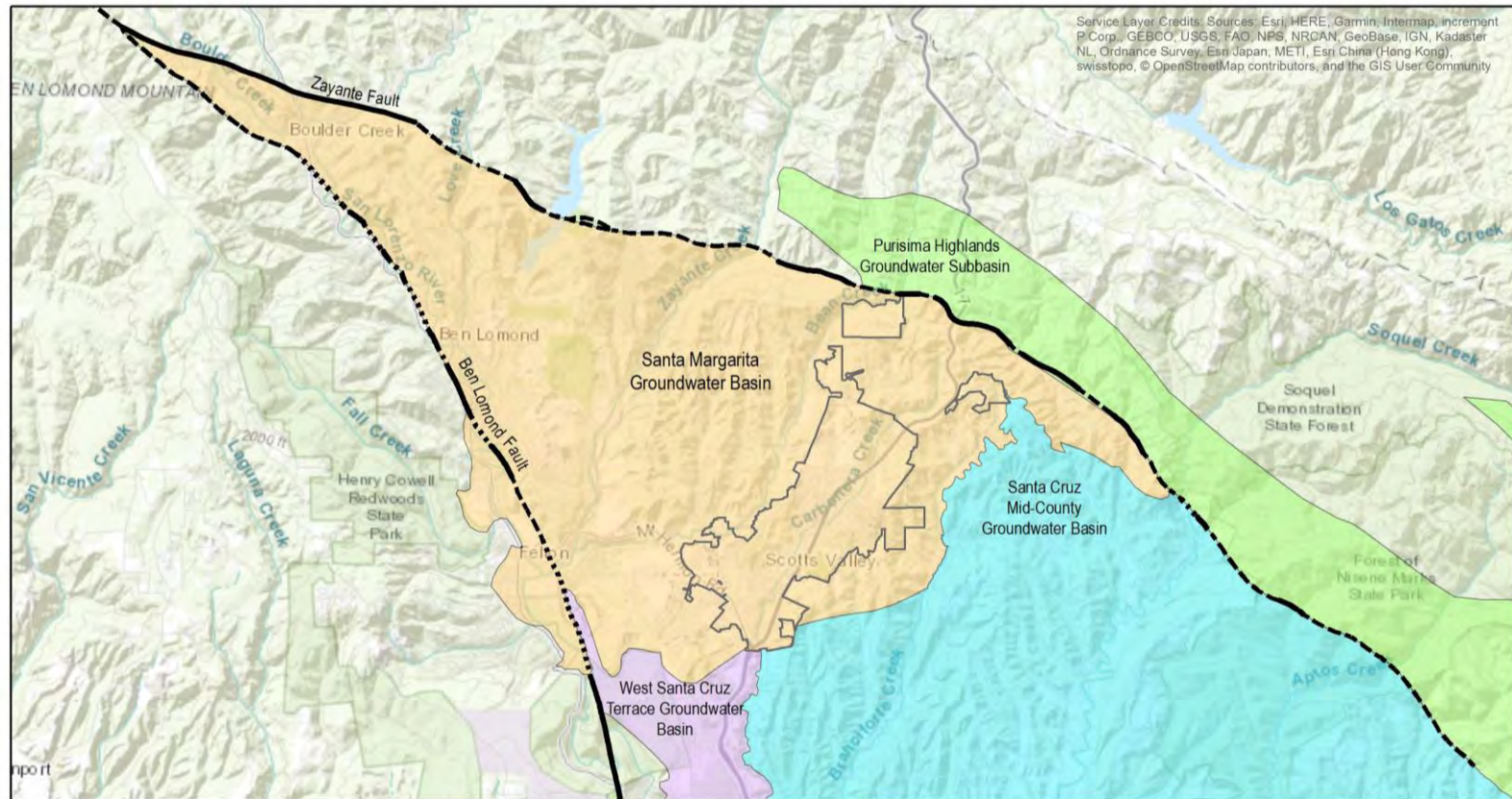
The SMGB consists of a sequence of sandstone, siltstone, and shale underlain by granite that lie within a geologic trough called the Scotts Valley Syncline. This sequence of sedimentary rocks is divided into several geologic formations. Formations are defined by the type of rock and their relative geologic age based on studies by the United States Geological Survey (Clark, 1996, 1981, Muir, 1981, Brabb et al, 1997, McLaughlin et al, 2001). In the SMGB, the sandstone units serve as the primary aquifers that supply the majority of groundwater production for the local water supply. The Basin's main aquifers are:

- Santa Margarita Sandstone (Santa Margarita aquifer),
- Monterey Formation,
- Lompico Sandstone (Lompico aquifer), and
- Butano Formation (Butano aquifer).

The SMGB is a geologically complex area that was formed by the same tectonic forces that created the Santa Cruz Mountains. The Basin is bounded by two regional faults, the Ben Lomond Fault to the west and the Zayante Fault to the north (Figure 2).

Figure 3 presents a geologic cross-section illustrating the highly folded sedimentary layers in the SMGB. Figure 4 indicates where the cross-section runs through the Basin and shows the location of both production and monitoring wells. The deepest part of the Basin is located near SVWD Wells #3B and #7A where the basin is over 1,500 feet thick. The Basin's geological complexity is reflected by variability of the geologic layers. For example, in some areas the Santa Margarita and Lompico aquifers are separated by the Monterey aquifer, whereas in other parts of the basin the Santa Margarita and Lompico aquifers are in contact with one another. This geological complexity exerts a strong influence on groundwater flow in the Basin.

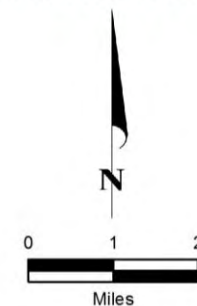




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## EXPLANATION

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|--|---|
| <span style="border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span> Scotts Valley Water District                  | Mapped USGS Faults  |
| <span style="background-color: orange; display: inline-block; width: 20px; height: 10px;"></span> DWR 2016 Interim Update Groundwater Basins   | <span style="border-bottom: 2px solid black; width: 20px; display: inline-block;"></span> Fault, certain                |
| <span style="background-color: lightblue; display: inline-block; width: 20px; height: 10px;"></span> Santa Margarita                           | <span style="border-bottom: 2px dashed black; width: 20px; display: inline-block;"></span> Fault, approximately located |
| <span style="background-color: lightgreen; display: inline-block; width: 20px; height: 10px;"></span> Santa Cruz Mid-County                    | <span style="border-bottom: 2px dotted black; width: 20px; display: inline-block;"></span> Fault, concealed             |
| <span style="background-color: lightyellow; display: inline-block; width: 20px; height: 10px;"></span> Purisima Highlands Groundwater Subbasin |   |
| <span style="background-color: lightpurple; display: inline-block; width: 20px; height: 10px;"></span> West Santa Cruz Terrace                 |   |



**Figure 2. Santa Margarita Groundwater Basin**

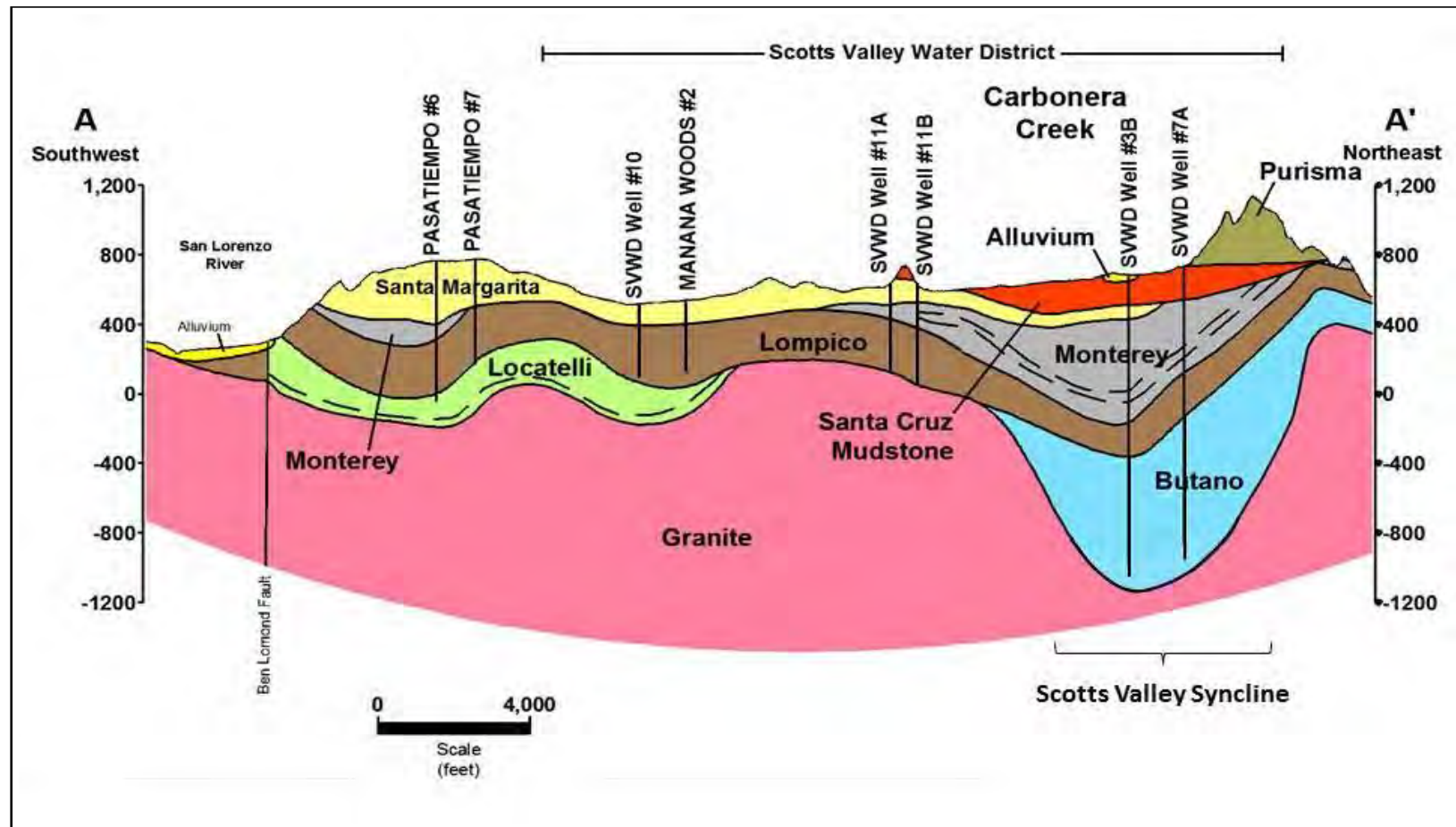
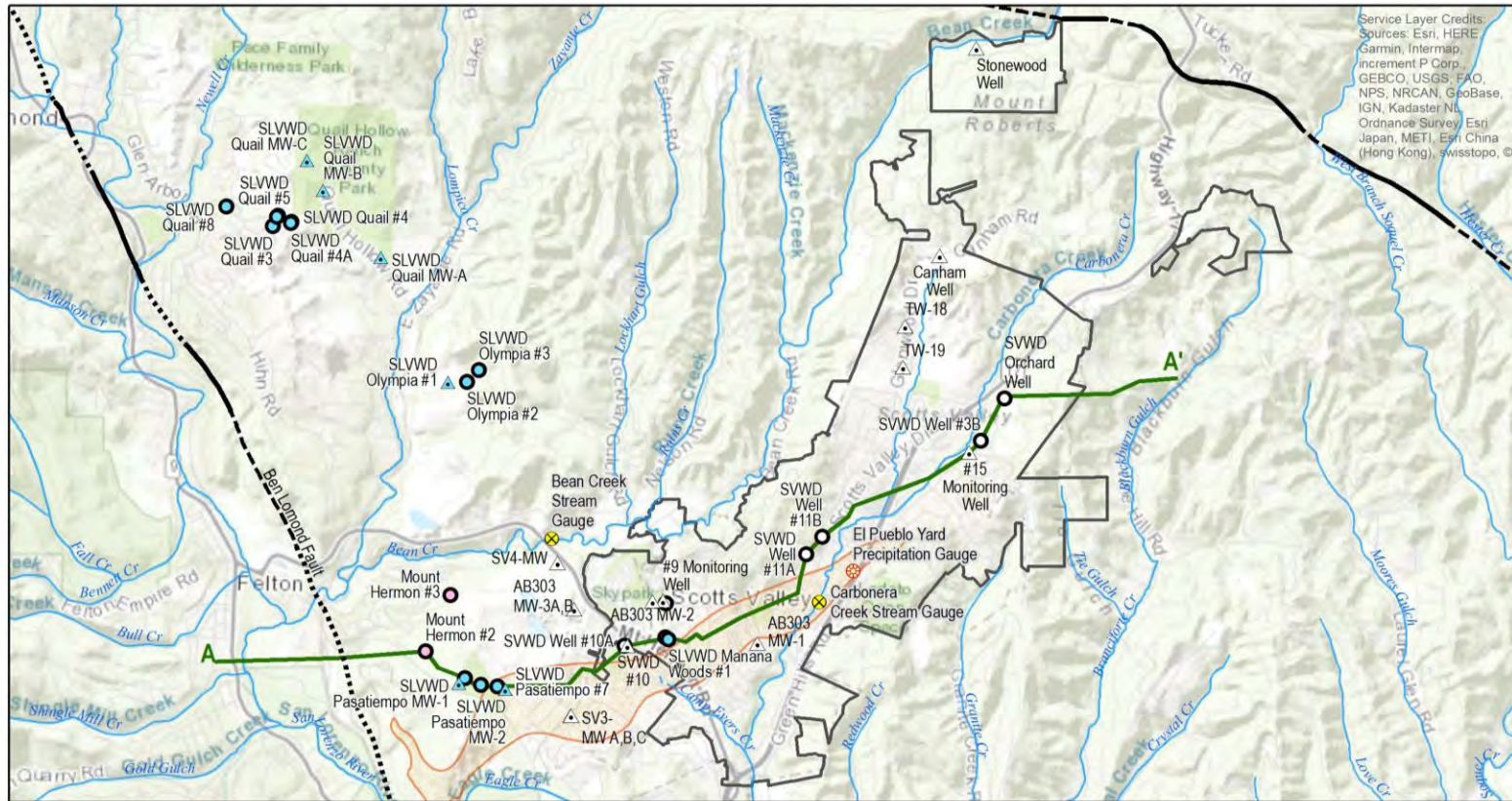


Figure 3. Geologic Cross-Section through the Scotts Valley Area

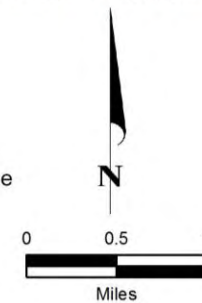




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## EXPLANATION

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|--|--|
| □ Scotts Valley Water District Gauge Locations | ● GWMP Precipitation Gauge   |
| ○ Production Well Location                     | ⊗ GWMP Stream Gauge  |
| ● SVWD   | □ Location of Direct Contact between the Santa Margarita Sandstone and the Lompico Sandstone |
| ● SLVWD  | — Geologic Cross-Section Location  |
| ● Mount Hermon                                 |  |
| Monitoring Well Locations                      |  |
| ▲ SLVWD  |  |
| ▲ SVWD   |  |



**Figure 4. Cross-Section and Well Locations**

### 3.1.2 DWR Groundwater Basins

California's groundwater basins and subbasins are defined in the Department of Water Resources' (DWR) 2016 Bulletin 118-Interim Update (DWR, 2016). The interim update includes the SMGB as shown on Figure 2. In 2016, modified basin boundary was submitted by SVWD and approved by DWR as part of a process established for local agencies under the Sustainable Groundwater Management Act (SGMA) to request that DWR revise the boundaries of a groundwater basin or subbasin, including the establishment of new subbasins.

The approved Santa Margarita Groundwater Basin (SMGB) formally defines an area that is already being managed as an integrated and cohesive basin by local public agencies. The majority of the SMGB covers an area not previously recognized by DWR as a groundwater basin because the basin is defined by a series of stacked aquifers rather than surficial alluvium, which was the basis for former DWR basins. The basin expands the former Scotts Valley Groundwater Basin (Bulletin 118 basin number 3-27) to include parts of the former Felton Area basin (Bulletin 118 basin number 3-50) and the former Santa Cruz Purisima Formation basin (Bulletin 118 basin number 3-21). The SMGB's eastern boundary coincides with the also modified Santa Cruz Mid-County Groundwater Basin (SCMGB).

The SMGB is primarily defined by the areal extent of a stacked sequence of aquifers but also includes a secondary jurisdictional (internal boundary) area that honors the SVWD service area. The internal boundary modification was included so that SVWD's service area lies only in a single basin. Including all of SVWD in a single basin supports sustainable groundwater management by focusing SVWD's groundwater management responsibilities on the connected aquifers that supplies its wells. Matching the basin to the jurisdictional boundaries allows for a single Groundwater Sustainability Plan (GSP) to cover the shared resource, improve and streamline governance for the shared resource, and allow for easier public communication.

## 3.2 Groundwater Management Area

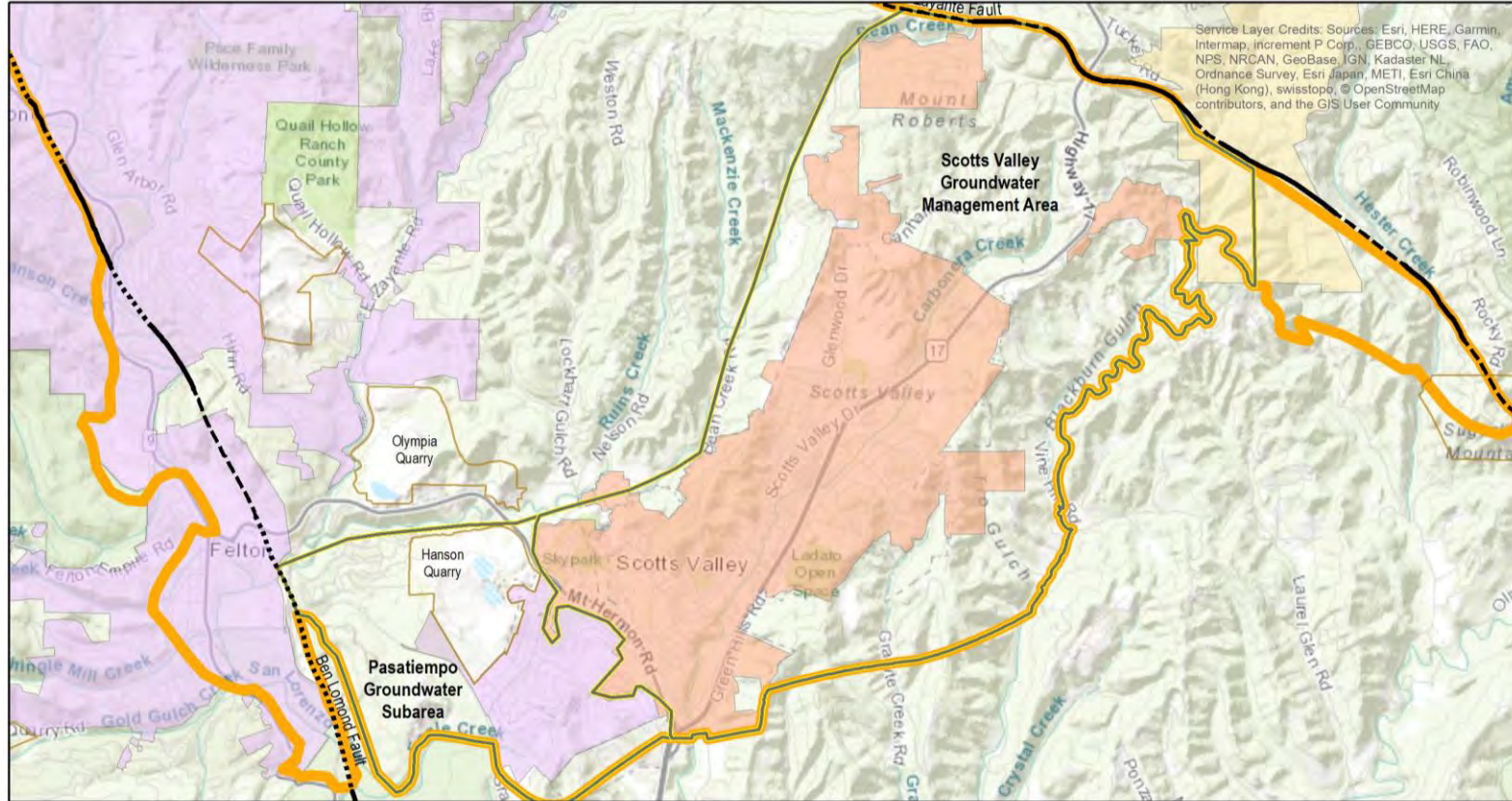
This annual report focuses on the portion of the SMGB that underlies the SVWD and adjacent areas. Two groundwater management areas are defined in this report for easy reference to key portions of the Basin. The management areas have been revised from annual reports prior to 2016 to match the modified boundary of the SMGB in the DWR's 2016 Bulletin 118 Interim Update.

The groundwater management areas include:

- The SVWD Groundwater Management Area (SVWD GWMA) includes the portion of the SMGB served primarily by the SVWD. The SVWD GWMA is bounded by Bean Creek on the north, Hanson Quarry on the west, and the SMGB boundary to the south and east (Figure 5).
- The Groundwater Reporting Area (GWRA) includes both the SVWD GWMA and the Pasatiempo Groundwater Subarea. The Pasatiempo Groundwater Subarea includes the portion of the SMGB served by the San Lorenzo Valley Water District Southern District and by the Mount Hermon Association, and is bounded by the SVWD GWMA on the east, Bean Creek to the north, and the SMGB boundary to the south and the Ben Lomond Fault to the west (Figure 5).

The SVWD GWMA represents the portion of the SMGB where the District is actively involved in groundwater management. The GWRA adds adjacent areas to provide a broader context for a more regional approach to groundwater management. For the most part, the annual report collects and assesses data from the GWRA to support SVWD's groundwater management activities in the SVWD GWMA.

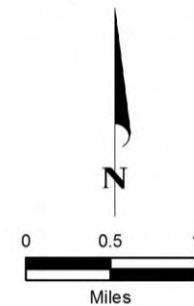




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## EXPLANATION

- |   |   |
|---|---|
| <b>Water Districts</b>                              | <b>DWR 2016 Interim Update Groundwater Basins</b> |
| Scotts Valley Water District                        | Santa Margarita                                   |
| San Lorenzo Valley Water District                   | <b>Mapped USGS Faults</b>                         |
| Soquel Creek Water District                         | Fault, certain                                    |
| Groundwater Reporting Area with Management Subareas | Fault, approximately located                      |
| Quarry Location                                     | Fault, concealed                                  |



**Figure 5. SWD Groundwater Management and Reporting Areas**

### 3.3 Historical Groundwater Issues

Starting in the late 1960s, groundwater levels in many parts of the SMGB, especially in the Lompico aquifer, experienced significant declines with cumulative totals of up to 200 feet in some areas. Between the mid-1990s and mid-2000s, the rate of decline slowed as a balance between recharge and production was approached. The greatest declines occurred between the late 1960s and mid-1990s. A variety of factors are assumed to have contributed to these declines, including:

- Increased groundwater pumping due to residential and industrial growth in the area.
- Reduced recharge from the surface to groundwater due to an increase in impermeable land surface associated with urbanization.
- Reduced recharge during extended periods of below average rainfall.

Since the mid-2000s, groundwater levels in the GWRA have generally stabilized at the above stated groundwater levels. While the stabilization of groundwater levels in recent years is promising, understanding the history and controlling factors that influence these groundwater level trends provides important context for making future sound groundwater management decisions.

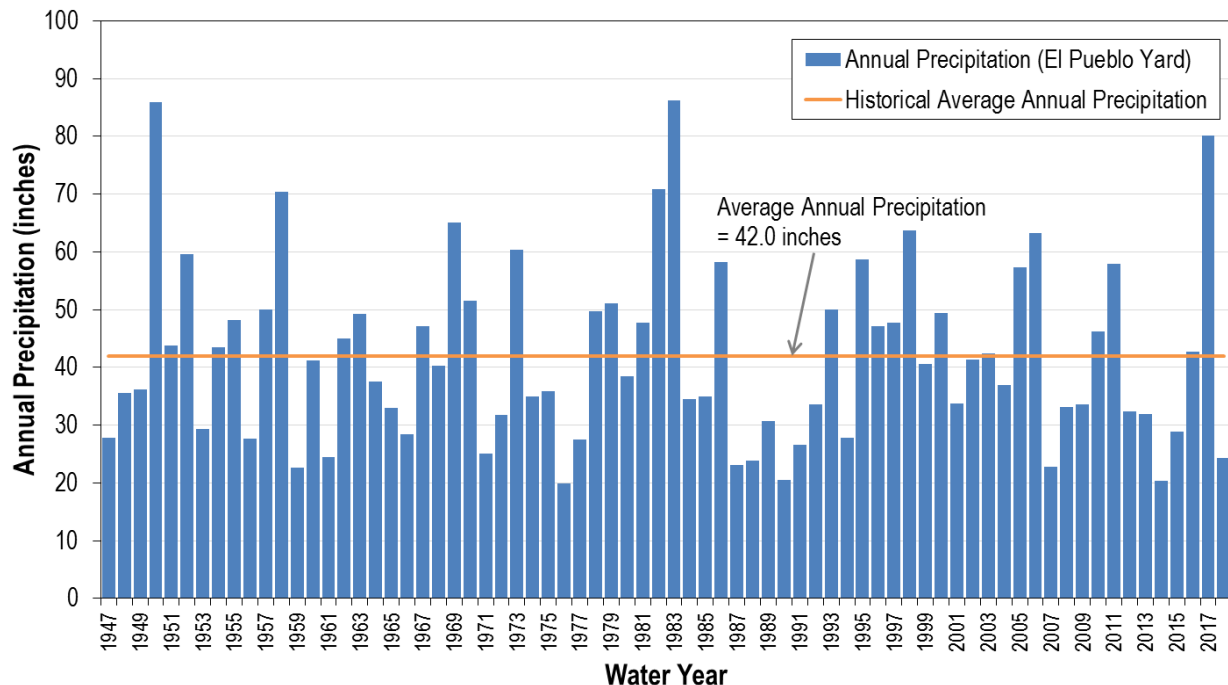
Decreased groundwater levels have resulted in less groundwater stored in the Basin. Groundwater in storage in the SMGB has been reduced by an estimated 25,000 acre-feet, with storage losses in the GWRA making up about 3,000 acre-feet of storage loss in the Santa Margarita aquifer and 13,000 acre-feet storage loss in the Lompico aquifer.

## 4 WATER SUPPLY SUMMARY

### 4.1 Precipitation Summary

Precipitation is the primary source of groundwater recharge through both direct percolation of rainfall through the soil and infiltration of runoff through streambeds. Therefore, evaluating annual precipitation is a key component of understanding water supply trends and groundwater conditions in the SVWD GWMA. Average annual precipitation in Scotts Valley is 42 inches based on measurements collected since 1947 (Figure 6). In this period, the highest annual rainfall in Scotts Valley was 86.2 inches in WY1983, and the lowest annual rainfall was 20.3 inches in WY2014.

For WY2018, precipitation was 24.3 inches, or about 58% of average (Figure 6). WY2018 is one of eight of the past twelve years with below average precipitation. The cumulative rainfall deficit over the twelve-year period from October 2006 through September 2018 is 50 inches below average. From the start of the recent drought in October 2011 through September 2018, rainfall is a cumulative 33 inches below average.



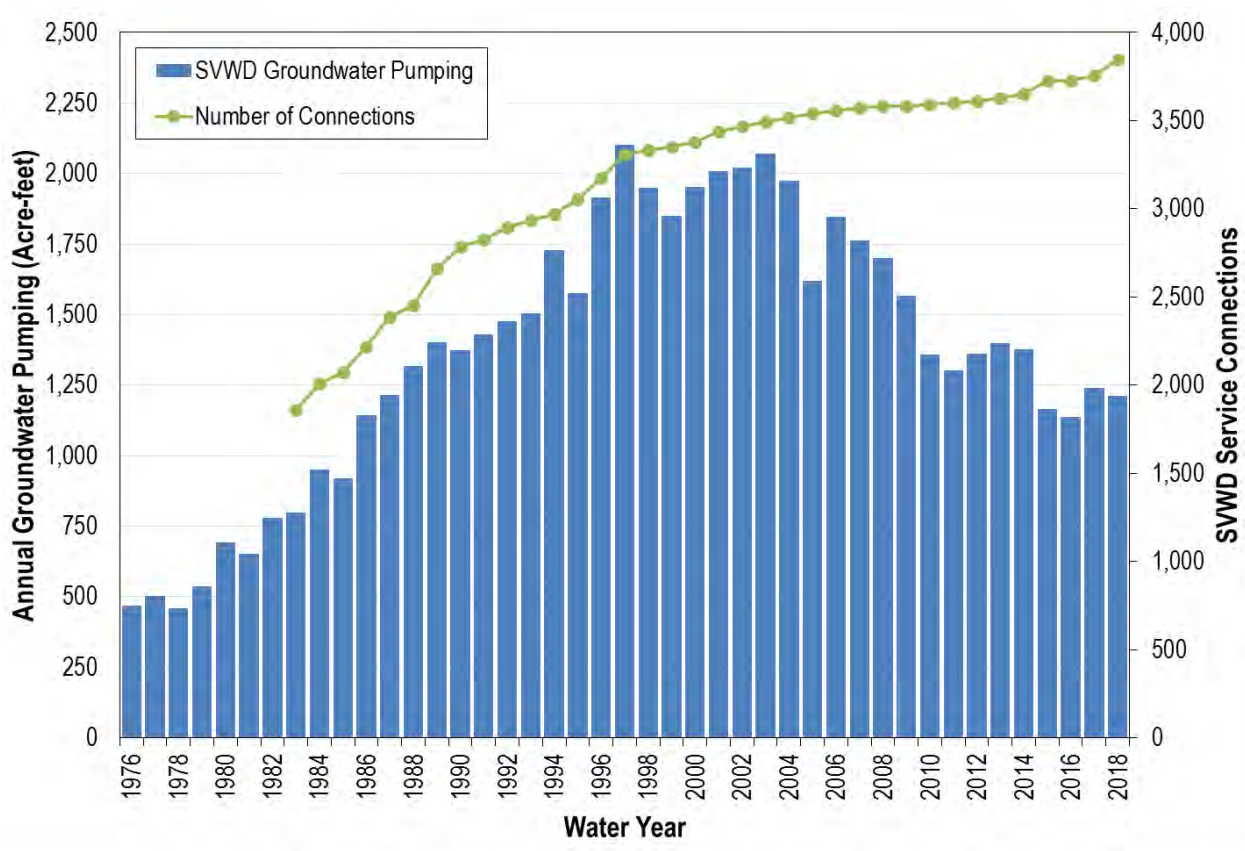
**Figure 6. Annual Precipitation for Scotts Valley by Water Year**

## 4.2 SVWD Water Supply

SVWD relies primarily on groundwater from the SMGB for providing potable water to its customers. Recycled water is also available for non-potable uses such as landscape irrigation.

### 4.2.1 Groundwater

Groundwater pumping by SVWD in WY2018 was 1,211 acre-feet (Figure 7), which was 31 acre-feet less than WY2017. The decline of 240 acre-feet in groundwater pumping observed between WY2014 and WY2015 is likely in response to successful water use efficiency efforts due to the drought at that time. Note that SVWD reports groundwater production and not pumping. Production is the difference between groundwater pumped and process water that is not put in the distribution system. Production volumes will therefore be less than the volumes reported here as groundwater pumping.



**Figure 7. Annual SVWD Groundwater Pumping**



Although WY2017 and WY2018 had slightly more pumping than WY2015 and WY2016, groundwater pumped is less than what was pumped prior to the drought. WY2018 pumping continues an overall downward trend in groundwater pumping over the past 15 years.

In WY2018, the District obtained about 86% of its total water supply from the Lompico and Butano aquifers (Table 1). An estimated 884 acre-feet was extracted from the Lompico aquifer, which is the basin's highest producing aquifer. An estimated 322 acre-feet was extracted from the Butano aquifer in WY2018, making it the second highest producing aquifer for the District.

The aquifers are currently being pumped well below their historical maximum annual pumping volumes (Table 1). Annual groundwater pumping from both the Lompico and Butano aquifers has declined since WY2014. For the Lompico aquifer, WY2018 pumping was 40% lower than the high of 1,483 acre-feet in WY2003. Similarly, WY2018 pumping in the Butano aquifer was 56% lower than the high of 735 acre-feet in WY1997.

**Table 1. WY2009 to WY2018 SVWD Groundwater Pumping by Aquifer and Recycled Water Usage (in acre-feet)**

Aquifer	Historical Maximum	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018
Monterey	426 (1984)	16	3	3	4	35	23	0	2	6	4
Lompico	1,483 (2003)	1,047	1,009	969	964	1,020	989	896	814	923	884
Butano	735 (1997)	443	346	320	383	345	365	237	323	312	322
Groundwater	2,100 (1997)	1,507	1,357	1,292	1,351	1,400	1,376	1,133	1,139	1,242	1,211
Recycled Water	200 (2013)	146	134	163	184	200	199	184	195	162	196
<b>Total Water Supply</b>	<b>2,096 (2003)</b>	<b>1,653</b>	<b>1,491</b>	<b>1,455</b>	<b>1,535</b>	<b>1,600</b>	<b>1,575</b>	<b>1,317</b>	<b>1,334</b>	<b>1,404</b>	<b>1,407</b>

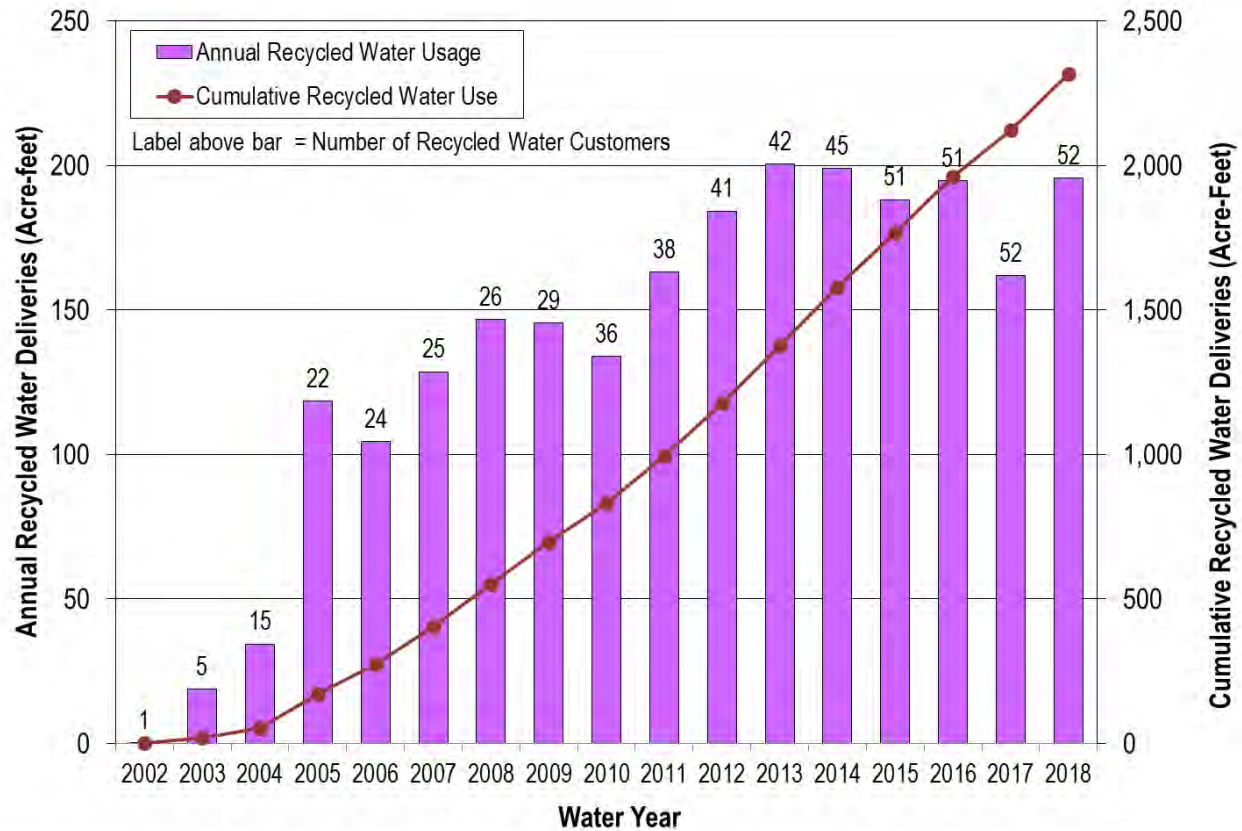
SVWD Wells #10, #10A, #11A and #11B produce exclusively from the Lompico aquifer, whereas SVWD Wells #3B, #7A, and the Orchard Well which is #7A's replacement, are screened across both the Lompico and Butano aquifers. Based on results of the groundwater model (Kennedy/Jenks, 2015), 60% of the groundwater pumped from SVWD Wells #3B, #7A, and the Orchard well is from the Butano aquifer and 40% is from the Lompico aquifer. This pumping distribution has been applied for past pumping (Table 1), so the values may differ from past annual reports.

The revised geologic interpretation has SVWD Well #9 screened completely within the Monterey Formation rather than the Santa Margarita aquifer (Kennedy Jenks, 2016a). This change is reflected on Table 1. The maximum estimated groundwater pumped from the Monterey Formation was 426 AF in WY1984 when groundwater levels were about 200 feet higher. Due to low groundwater levels, SVWD Well #9 has been used sparingly over the past nine years. In WY2018, the Monterey Formation accounted for less than 0.3% of the total SVWD groundwater pumped.

#### **4.2.2 Recycled Water Deliveries**

Recycled water deliveries of approximately 196 acre-feet in WY2018 are increased from WY2017 deliveries, and are similar to deliveries in WY2015 and WY2016 (Table 1). The Recycled Water Program has issued a total of 52 permits for recycled water use (excluding renewals), with no new permits issued in WY2018 (Figure 8).

From WY2002 through WY2018, approximately 2,318 acre-feet of recycled water has been delivered to customers (Figure 8). The cumulative use of the Recycled Water is equivalent to 190% of the District's groundwater pumping in WY2018. Since recycled water is used in-lieu of pumped groundwater, it can be assumed that an equivalent volume of groundwater has remained in the SMGB and is available to support current and future water supply needs.

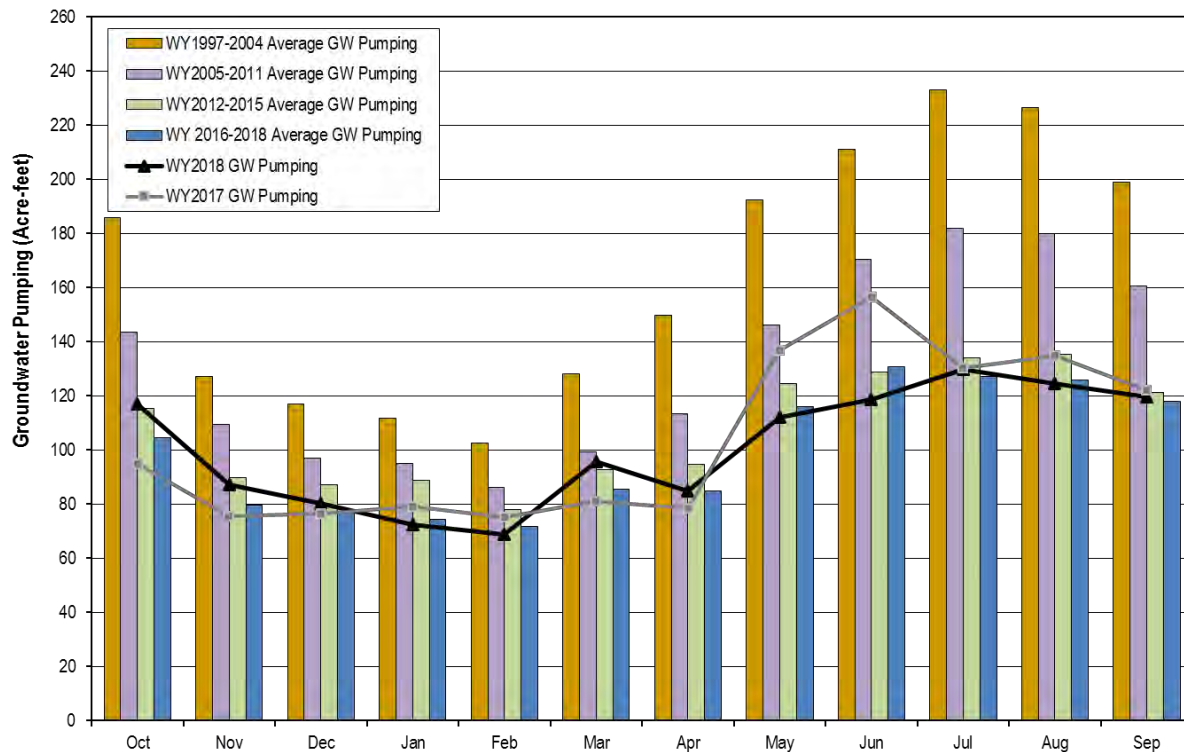


**Figure 8. Annual and Cumulative Recycled Water Deliveries**

#### 4.2.3 Changes in Water Pumping by Month

Groundwater pumping is highest in the dry season months of May through October and lowest in the wetter months of December through March due to seasonal changes in outdoor use. The timing of increased outdoor water use typically shifts with the amount of springtime precipitation. If March through May rainfall is above average, outdoor water usage tends to be below-average, whereas below-average spring rain tends to increase outdoor water use.

To assess if there are changes in SVWD water use trends, a comparison of the District's recent monthly groundwater pumped is compared to average groundwater pumped from earlier periods when water use was higher. The results are shown on Figure 9.



**Figure 9. SVWD Monthly Groundwater Pumping Comparison**

Figure 9 shows four historical average monthly groundwater extraction rates. The first period represents the period of highest historical water use from WY1997 through WY2004, when the average annual groundwater pumped was about 1,980 acre-feet. The second period presents the period of declining groundwater extraction from WY2005 to WY2011, when the average annual groundwater pumped was about 1,630 acre-feet. The third period covers the recent drought from WY2012 through WY2015 when the average annual groundwater pumped was about 1,330 acre-feet. The fourth period includes the three years since the drought through to WY2018 where the average annual groundwater pumped has been about 1,200 acre-feet. Monthly pumping volumes for the four periods are included on Figure 9 as separate vertical bars.

Comparing historical averages to average monthly groundwater pumping for WY2016 through WY2018, monthly groundwater pumped is well below pre-drought historical averages, and even below monthly pumping during the recent drought (except for the month of June). Monthly pumping differences are most pronounced during the summer months of May through October (Figure 9). The difference between the maximum and minimum monthly pumping in WY2018 is 61 acre-feet, while in 1997 it was 133 acre-feet. This



indicates that water use efficiency measures focused on reducing outdoor water usage, primarily landscape irrigation, have been very effective.

SVWD maintains a number of ongoing programs to support the sustainable management of its groundwater resource including the use of recycled water, water use efficiency and water loss reduction programs. These programs have contributed to reduced water demands that results in less groundwater pumping. Other factors that can influence water demand include variations in the weather, economic conditions, and the number and type of customers.

### **4.3 Regional Groundwater Pumping**

In addition to SVWD, groundwater in the GWRA is pumped for water supply purposes by other water purveyors, small water systems, and private pumpers. Groundwater has also been pumped historically for purposes of environmental remediation and for industrial uses. Figure 10 provides a summary of annual groundwater pumped by user type in the GWRA. The users include:

- San Lorenzo Valley Water District (SLVWD) – SLVWD’s Pasatiempo and Mañana Woods systems are within the GWRA. Groundwater pumped by SLVWD in the GWRA was about 225 acre-feet in WY2017 and 320 acre-feet in WY2018. These volumes remain lower than pre-drought (pre-WY2012) pumping by SLVWD in the GWRA, which generally was greater than 330 acre-feet per year. SLVWD pumping from wells outside the GWRA is not included here. Recent pumping is from the Lompico aquifer.
- Mount Hermon Association (MHA) – Pumping by MHA was 145 acre-feet in WY2017 and 129 acre-feet in WY2018. WY2015 had the lowest pumping on record at 114 acre-feet. The high was 232 acre-feet in WY2008. Groundwater pumped is derived from the Lompico aquifer.
- Industrial Wells – Historically, most industrial groundwater pumping was carried out by the Hanson Quarry before the quarry was closed in 2004. Currently, no large industrial wells are identified in the GWRA. The maximum industrial pumping was 485 acre-feet in WY1987. Groundwater pumping was primarily from the Santa Margarita and Lompico aquifers.
- Environmental Remediation – no groundwater for environmental remediation has been pumped since WY2016. The Watkins-Johnson and Scotts Valley Dry Cleaners groundwater remediation systems have been shut down since

2016 and 2015, respectively. Historical pumping for remedial purposes was primarily from the Santa Margarita aquifer.

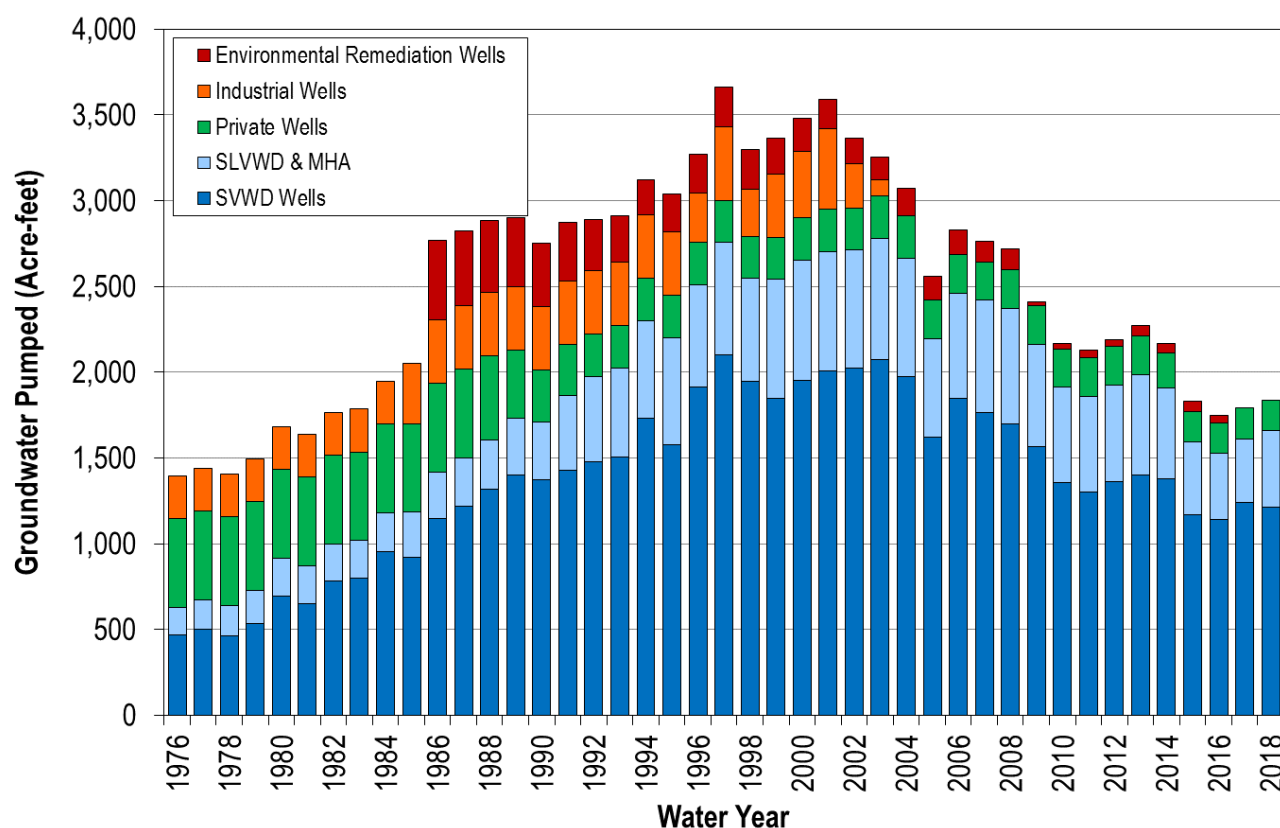
- Private Wells – Pumping from private wells for domestic use, golf course irrigation, landscape ponds and irrigation is not metered, but is estimated at approximately 178 acre-feet in the GWRA for WY2018 (Table 2). The maximum historical private pumping estimate was 381 acre-feet in WY1987 (Todd, 1998). We assume that private pumping has remained the same as WY2015 and WY2016. Private pumpers extract groundwater from the Santa Margarita, Monterey and Lompico aquifers. Appendix A of the WY2016 annual report describes the assumptions used to estimate private pumping.

**Table 2. Summary of WY2018 Private Groundwater Pumping in the GWRA and SMGB (in acre-feet)**

Groundwater Use	Groundwater Reporting Area	Santa Margarita Groundwater Basin
Domestic (assume 0.24 acre-feet per connection)	82	243
Valley Gardens Golf Course	67	67
Small Water Systems	29	37
<b>Total Private Supply</b>	<b>178</b>	<b>347</b>

Annual groundwater pumping from the GWRA has continued to decline over the past several years. Total groundwater pumping in the GWRA was estimated at 1,838 acre-feet in WY2018 (Table 3). This represents a 48 acre-foot decrease in GWRA pumping from WY2017. Total GWRA pumping in WY2018 was 50% less than a high of 3,679 acre-feet in WY1997 (Figure 10). The long-term reduction is due to decreased pumping by water purveyors combined with the elimination of industrial groundwater use and environmental remediation pumping.

Table 3 summarizes total groundwater pumping in the GWRA by aquifer. In the GWRA for WY2018, about 80% of the total pumping is from the Lompico aquifer, 18% is from the Butano aquifer, and the remaining 3% is from the Santa Margarita and Monterey aquifers. Larger municipal and private wells typically pump from the Lompico and Butano aquifers which can sustain higher pumping rates. The Santa Margarita and Monterey aquifers are generally pumped by lower-capacity private wells.



**Figure 10. Regional Groundwater Pumping in GWRA by User Type**

**Table 3. WY2009 to WY2018 Groundwater Pumped in the GWRA by Aquifer (in acre-feet)**

Aquifer	Historical Maximum	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018
Santa Margarita	894 (1987)	40	53	63	56	74	71	74	57	14	14
Monterey	587 (1984)	62	49	49	50	82	66	37	39	43	41
Lompico	2,705 (2003)	1,862	1,782	1,743	1,739	1,537	1,425	1,449	1,322	1,421	1,462
Butano	738 (1997)	446	349	323	386	576	608	237	323	312	322
<b>Total</b>	<b>3,665 (1997)</b>	<b>2,410</b>	<b>2,233</b>	<b>2,178</b>	<b>2,231</b>	<b>2,270</b>	<b>2,169</b>	<b>1,797</b>	<b>1,740</b>	<b>1,790</b>	<b>1,838</b>

## 4.4 SVWD Production Wells

SVWD currently operates six production wells: SVWD Wells #3B, Orchard, #9, #10A, #11A, and #11B. The locations of these wells are shown on Figure 4.

### 4.4.1 Condition of Production Wells

Understanding the condition of the currently active SVWD production wells is necessary to help ensure a reliable water supply for the District. Table 4 provides additional details regarding well completions. The service life of a well is difficult to predict and is dependent on several variables. Age of the well is one key indicator. The ages of the active SVWD wells range from 10 to 37 years old.

SVWD Wells #9 and #11A have limited capacity due to their inability to sustain pumping rates. It is believed that SVWD Well #9 is perforated entirely in the Monterey aquifer (Kennedy Jenks, 2016a), which is a poorer-quality and lower-yielding aquifer. SVWD Well #11A's capacity is limited because of a number of factors, including limited saturated aquifer thickness, its well design is likely not optimal, and because of local variations in aquifer properties (Feeney, 2015). Because of the emergency replacement of the collapsed SVWD Well #7A with the Orchard Well in WY2017, planning for a replacement well for SVWD Well #11A has been put on hold.

Most wells show some corrosion over time. Corrosion of the metal in well screens and casing is typically the result of chemical processes related to the high content of dissolved gases (e.g., carbon dioxide, oxygen or hydrogen sulfide) or high concentrations of certain constituents such as chloride. Wells constructed with dissimilar metals, such as stainless steel screens and high-strength low-alloy (HSLA) or mild steel casings are known to suffer from galvanic corrosion where the metals are joined. SVWD Wells #10A, #11A, and #11B are all constructed with dissimilar metals. Conditions at the existing SVWD production wells are continued to be monitored for signs of corrosion.

SVWD Well #3B was producing sand in late 2017 and has since been patched and is not producing sand anymore. Should sanding reoccur, plans to rebuild or replace the well will be made.

**Table 4. Summary of Well Completion Data for Currently Active SVWD Production Wells**

SVWD Well Name	Year Installed	Screened Interval Depth (feet bgs) <sup>1</sup>	Casing Material	Last Video Log	Most Recent Rehabilitation
Well #3B	1995	700-730, 880-1050, 1180-1370, 1400-1670	16-inch diameter stainless- steel well casing, 0.040- inch slot well screen	2017	Mar-2007: Pump, motor & wire replacement. Late 2017: Well casing is corroded and bottom of the well is filled with sand. Pump has been lifted and well is currently not sanding
Orchard Well (replaced Well #7A)	2018	705-784, 805-1063, 1084-1455	14-inch diameter stainless- steel well casing, 0.050- inch louver well screen	Feb- 2018	Newly installed
Well #9	1980	155-195, 315-355	12-inch diameter mild steel casing, 0.080-inch slot well screen	Jan- 2014	Jan-2014: Mechanical &/or chemical rehab; and pump, motor & wire replacement
Well #10A	2007	280-380, 400-450	12-inch diameter well casing, HLSA steel to 154 feet and stainless steel below; 0.040-inch stainless steel wire-wrap screen	Jun- 2012	Jun-2012: Mechanical &/or chemical rehab; and pump, motor & wire replacement  Full rehab planned for Mar- 2017
Well #11A	1997	399-419, 459-469, 495-515	mild steel well casing, 12- inch diameter to 401 feet and 10-inch diameter below, 0.012-inch stainless steel wire-wrap screen	Sep- 2007	Sep-2007: Pump, motor & wire replacement
Well #11B	1999	348-388, 423-468, 500-515	mild steel well casing, 14- inch diameter to 343 feet and 12-inch diameter below, 0.012-inch stainless steel wire-wrap screen	Jan- 2019	Jun-2018: Airlift re- development which inadvertently removed natural filter pack and well is sanding.  In 2019: A downhole sand separator will be installed to remove sand from the groundwater before being pumped to the surface

 Note: <sup>1</sup>feet bgs = feet below ground surface

#### 4.4.2 Groundwater Pumping by Well

Groundwater pumping varies from year to year to meet the local water demand. To meet changing demands, pumping is shifted between production wells. Groundwater pumping is also shifted between wells to allow for maintenance. In WY2018, SVWD Wells #3B, #10A, #11B, and the new Orchard Well were the highest producing wells (Table 5) and provided 97 percent of SVWD's potable groundwater supply. These wells are currently being operated substantially below their historical maximum annual pumping volumes as shown in Table 5.

**Table 5. WY2009 to WY2018 SVWD Groundwater Pumping by Well (in acre-feet)**

SVWD Well	Historical Maximum	WY2009	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015	WY2016	WY2017	WY2018
#3B	409	235	150	226	143	208	273	160	257	167	337
#7A	991	504	427	312	501	368	335	236	281	354	0
Orchard	-	-	-	-	-	-	-	-	-	-	200
#9	426	16	3	3	4	35	23	0	2	6	4
#10	489	1	1	<1	0	0	0	0	0	0	0
#10A	544	397	357	362	378	391	429	374	331	333	371
#11A	152	36	20	1	13	59	19	39	22	34	39
#11B	683	319	400	397	323	339	298	324	246	348	260
Total	2,077 (2003)	1,507	1,357	1,292	1,351	1,400	1,376	1,133	1,139	1,242	1,211

#### 4.4.3 Groundwater Levels in Production Wells

Historical groundwater levels collected and reported for the production wells include both pumping (dynamic) and non-pumping (static) conditions. Monitoring dynamic and static groundwater levels provides a means for evaluating well performance. If well efficiency declines over time, this may be indicated by increasing differences between static and dynamic groundwater levels, thereby demonstrating the well is in need of maintenance.

Furthermore, when groundwater levels decline below the top of the well screen, there is a potential to reduce well efficiency from air entrapment, mineral precipitation, biofouling,

or corrosion resulting in lower pumping rates and higher operating costs. Analysis of dynamic and static groundwater levels in active production wells show the following for WY2018:

- SVWD Well #3B: both the dynamic and static groundwater levels are above the top of the upper well screen. The difference between dynamic and static groundwater levels has remained fairly consistent.
- SVWD Well #10A, #11A, and #11B: the dynamic groundwater levels are below the top of the upper well screen and static groundwater levels for these wells are above the top of the upper well screen. The difference between dynamic and static groundwater levels has remained fairly consistent in #11A and #11B. There was a slight drop in dynamic pumping levels around 2013 but those levels have stabilized and continued to drop over time.

Appendix A contains hydrographs for all SVWD production wells showing dynamic and static groundwater levels, and screen depths. There is not enough data collected for the Orchard Well yet to analyze, however, what dynamic and static groundwater level data are available is included in Appendix A.

## 5 GROUNDWATER QUALITY ASSESSMENT

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SVWD promotes water quality protection by monitoring groundwater quality, and by operating water treatment facilities to ensure that water delivered to customers meets all drinking water standards. SVWD also reviews activities at environmental remediation sites and provides feedback to the regulatory agencies responsible for these sites.

The District annually prepares and makes available the “*Scotts Valley Water District Water Quality Report*” to keep customers informed on water quality issues. This report follows the content and format required by law and provides the public with detailed results of water quality testing, a description of the water source, answers to common questions about water quality, and other useful water quality information. The District Water Quality Reports are available at <http://svwd.org/your-water/water-quality>.

### 5.1 SVWD Groundwater Quality and Treatment

SVWD monitors water quality at the groundwater production wells for the constituents required by the Safe Drinking Water Act and under Title 22 of the California Code of Regulations. Groundwater is sampled from the SVWD production wells for inorganic minerals, trace metals, total dissolved solids (TDS), pH, volatile organic compounds (VOCs), and methyl-tert-butyl ether (MTBE). Results of water quality analysis are reported to the California Department of Drinking Water (CDDW).

#### 5.1.1 Groundwater Quality

Under the Safe Drinking Water Act, the USEPA and CDDW have set primary maximum contaminant levels (MCL) associated with public health risks as drinking water standards for various chemicals and constituents. These include industrial chemicals including VOCs and MTBE, and naturally occurring constituents such as arsenic. Secondary MCLs (SMCL) exist for constituents that are not defined as public health risks but require treatment for taste, odor, and other aesthetic issues. These include iron, manganese, sulfate and TDS. MTBE has both an MCL and SMCL.

Table 6 provides a summary of the constituents of concern for untreated groundwater in the SVWD production wells. Historically, the VOCs tetrachloroethene (PCE), trichloroethylene (TCE) and cis-1,2-dichloroethylene (cis-1,2-DCE) along with MTBE have been detected in low concentrations in SVWD Well #9. Groundwater samples collected in WY2018 had low detections of cis-1,2-DCE, TCE and MTBE which were below their respective MCLs.



**Table 6. WY2016 Summary of Key Water Quality Constituents in Raw Groundwater**

SVWD Well	VOCs	MTBE	Arsenic	Chromium-6	Iron & Manganese	Sulfate	TDS
#3B	ND	ND	ND	ND	Below SMCL	Below SMCL	Above SMCL
Orchard	ND	ND	ND	ND	Above SMCL	Below SMCL	Below SMCL
#9	Below MCL	Below SMCL	ND	ND	Below SMCL	Below SMCL	Above SMCL
#10A	ND	ND	ND	ND	Above SMCL	Below SMCL	Below SMCL
#11A	Below MCL	ND	Below MCL	ND	Above SMCL	Below SMCL	Above SMCL
#11B	ND	ND	Above SMCL	ND	Above SMCL	Below SMCL	Below SMCL

Notes: ND – not detected in any samples collected in WY2018  
 Above MCL or SMCL – At least one sample in WY2018 exceeded respective primary MCL or secondary MCL  
 Below MCL or SMCL – Constituent detected in levels below respective primary MCL or secondary MCL

Chlorobenzene is a VOC that continues to be detected in SVWD Well #11A at concentrations up to 0.97 micrograms per liter ( $\mu\text{g/L}$ ), consistent with historical levels, and below the MCL of 70  $\mu\text{g/L}$ . For both Well #9 and Well #11A, the source of contaminants has not been defined but is considered to be related to one of the known environmental compliance sites in the vicinity.

Chromium-6 and arsenic are naturally-occurring constituents that can be present in SVWD groundwater wells. These constituents result from the natural dissolution of minerals within the aquifers. Of those, arsenic is the only constituent in SVWD production wells where the concentrations occur near its primary MCL of 10  $\mu\text{g/L}$ :

- Concentrations in SVWD Well #11B ranged from 8.8 to 12  $\mu\text{g/L}$  in WY2018.
- Concentrations in SVWD Well #11A ranged from non-detect to 4.6  $\mu\text{g/L}$  in WY2018, and
- Concentrations in all other SVWD wells were below the detection limit of 1  $\mu\text{g/L}$  (Table 6).

In addition to chromium-6 and arsenic, there are other naturally-occurring constituents that are typical in the SVWD production wells which are regulated by a SMCL for aesthetic issues such as a taste, odor, or staining, i.e., iron, manganese, sulfate and TDS (Table 5).

These constituents require treatment but do not represent public health concerns. There were no major changes in the concentration or occurrence of these constituents in WY2018.

### 5.1.2 Groundwater Treatment

SVWD treats groundwater extracted from wells to reduce concentrations of certain constituents that are above or approaching MCLs or SMCLs. In addition, the District treats groundwater for hydrogen sulfide for aesthetic reasons, even though it is not a regulated compound. SVWD treats groundwater at four water treatment plants (WTPs) prior to distribution. Table 7 summarizes the four groundwater treatment plants used by SVWD. By applying the appropriate treatment technology, the District is able to deliver potable water that meets regulatory standards and is safe to drink.

**Table 7. Summary of Water Treatment Processes Applied by SVWD**

Water Treatment Plant	SVWD Wells	Aquifer	Chemicals of Concern	Treatment Type
Orchard Run	#3B & Orchard Well	Butano & Lompico	Iron, manganese, and hydrogen sulfide	Air stripper, chlorination, dual media filtration, and sequestering agent
SVWD Well #9	#9	Monterey	Sulfate, VOCs, and hydrogen sulfide	Chlorination and granular activated carbon (GAC) filtration
SVWD Well #10	#10 & #10A	Lompico	Iron, manganese, VOCs, and hydrogen sulfide	Air stripper, chlorination, dual media filtration, sequestering agent, and standby GAC filtration
El Pueblo	#11A & #11B	Lompico	Iron, manganese, and arsenic	pH adjustment, chlorination, dual media filtration, and sequestering agent

## 5.2 Environmental Compliance Sites

To protect its potable water supplies and more effectively manage its groundwater basin, SVWD stays informed about local environmental compliance sites in the SVWD GWMA where groundwater quality has been impacted by pollution or chemical spills. Figure 11 shows the locations of environmental sites with known groundwater impacts, and their relationship to SVWD groundwater production wells. These include the following sites:

- Watkins-Johnson Superfund site at 440 Kings Village Road (Cleanup Status: Open - Eligible for Closure)
- Scotts Valley Dry Cleaners Site located at 272 Mount Hermon Road (Cleanup Status: Open - Site Assessment)
- Camp Evers Combined Site associated with four current and former gasoline stations located at the intersection of Scotts Valley Drive and Mount Hermon Road (Cleanup Status: Completed - Case Closed)
- Shaffer, Meisser & Rogers Property at 4556 Scotts Valley Drive (Cleanup Status: Completed - Case Closed)
- Hacienda Drive Shell Site located at 1 Hacienda Drive (Cleanup Status: Completed - Case Closed)
- Kings Dry Cleaners site at 222 Mount Hermon Road (Cleanup Status: Open - Verification Monitoring)
- Former Frank's Auto Dismantlers at 700 Mount Hermon Road (Cleanup Status: Open - Site Assessment, but inactive)

The following is an overview of the remaining active environmental compliance sites in the GWRA. More detailed information for these sites is available from the State Water Resources Control Board (SWRCB) GeoTracker website at <https://geotracker.waterboards.ca.gov/> and the Department of Toxic Substances Control (DTSC) Envirostor web site at [www.envirostor.dtsc.ca.gov/public](http://www.envirostor.dtsc.ca.gov/public).

### 5.2.1 Watkins-Johnson Superfund Site

The Watkins-Johnson site is located at 440 Kings Village Road in Scotts Valley (**Figure 11**). Watkins-Johnson is a former semiconductor manufacturer. The site is a Federal Superfund Site, and remediation activities are under the jurisdiction of USEPA Region 9. The site's current owner is 400 Kings Village, LLC). The site is of interest to SVWD

because of its proximity to SVWD Well #9, which is located approximately 400 feet south of the Superfund site. Two contaminants in particular are present at this site: PCE and TCE, both with a drinking water MCL of 5 micrograms per liter ( $\mu\text{g/L}$ ). Shallow groundwater extraction by the RA-2 remediation system was deactivated on July 5, 2016 and a draft Groundwater Remedial Action Completion Report (RACR) submitted to the USEPA on December 6, 2016.

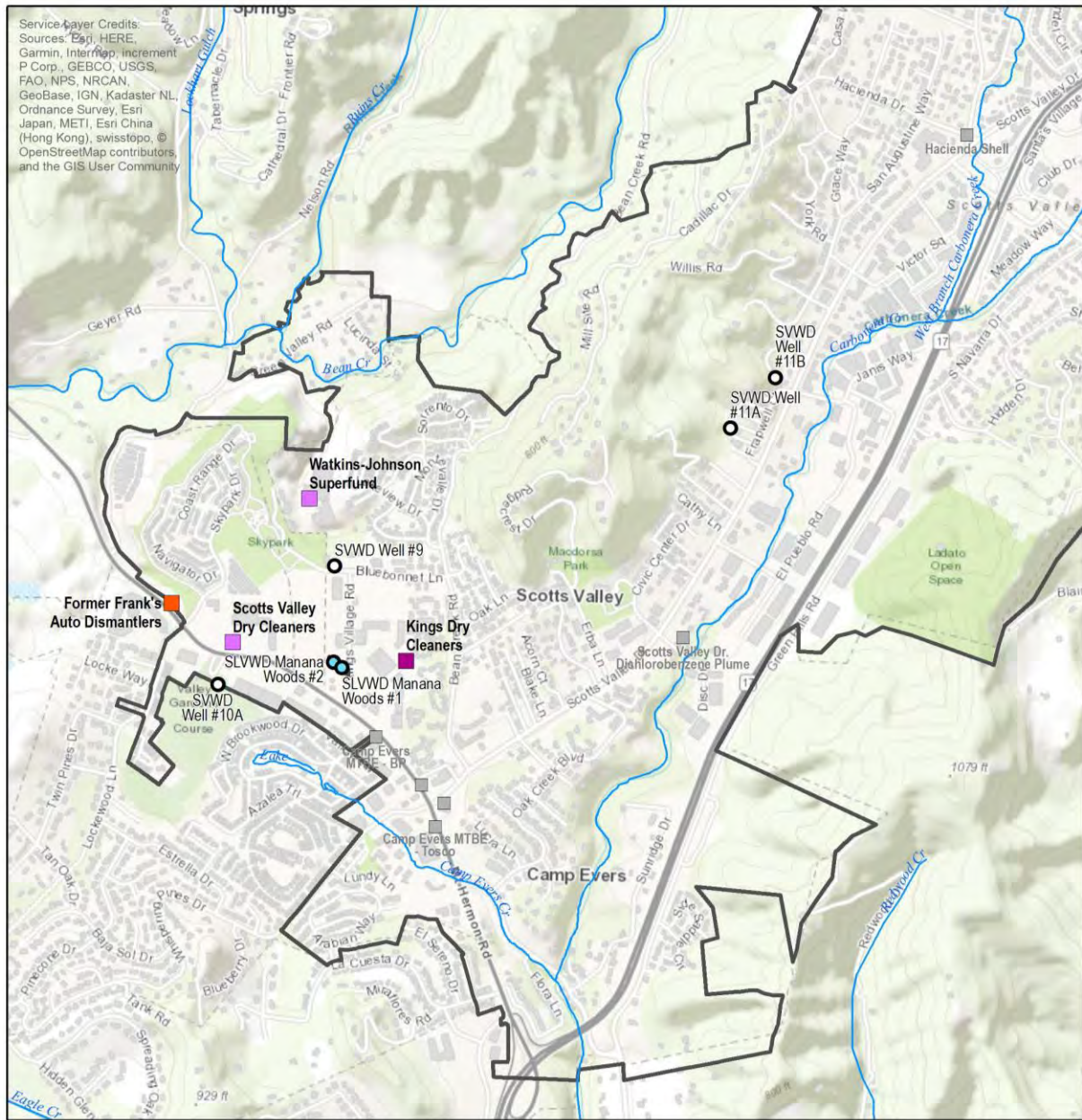
The draft RACR report certifies that the clean-up standards set forth in the Consent Decree and in the Record of Decision (ROD) have been met. The RACR additionally concludes that all phases of the work, including operations and maintenance (O&M) are complete; and that no additional periodic review, or response action is warranted. On November 7, 2018, the USEPA issued a letter that states Watkins-Johnson has not completed the remedial action, contrary to assertions in the draft RACR. The USEPA acknowledges that Watkins-Johnson has demonstrated to USEPA's satisfaction that it has attained the groundwater cleanup standards set forth in the Watkins-Johnson record of decision. To complete the remedial action, however, Watkins-Johnson must complete the source control component of the remedial action to ensure protectiveness over the long-term. Actions required to complete the remedial action include:

- 1) Complete additional response work related to vapor intrusion, and
- 2) Implement institutional controls and conduct ongoing maintenance to protect and maintain the integrity of the cap (asphalt parking lot, concrete slabs, and buildings) to prevent direct exposure to residual soil contamination, prevent the leaching of contaminants into the groundwater, and implement institutional controls to prevent a threat to human health from vapor intrusion.

The site owner has yet to respond to the USEPA's letter from November 7, 2018.

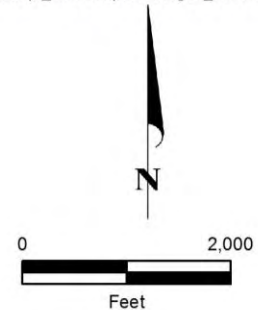
No groundwater quality monitoring has taken place since 2016 when the maximum PCE concentration at an onsite well (WJ-43) was 24  $\mu\text{g/L}$ , and the maximum PCE concentration at an offsite well (KV-7) was 78  $\mu\text{g/L}$ . The maximum TCE at an onsite well (WJ-41) was 1.8  $\mu\text{g/L}$ , and the maximum TCE concentration at an offsite well (KV-6) was 3.6  $\mu\text{g/L}$ .





## EXPLANATION

- Environmental Site Status
- Completed - Case Closed
  - Open - Eligible for Closure
  - Open - Remediation
  - Open - Verification Monitoring
  - Open - Site Assessment
  - Scotts Valley Water District



**Figure 11. Locations of Environmental Compliance Sites**

## 5.2.2 Scotts Valley Dry Cleaners

The Scotts Valley Dry Cleaners site is located at 272 Mount Hermon Road (Figure 11). Site clean-up is overseen by the Central Coast Regional Water Quality Control Board (RWQCB). This site is of interest to SVWD because of its proximity to SVWD Well #10A and Well #9. SVWD has installed a granulated activated carbon (GAC) treatment system at SVWD Well #10 WTP as a precautionary measure.

Remedial technologies that have been employed at the site include, soil vapor extraction (SVE), dual phase extraction, groundwater extraction, and permanganate solution injection. From July 2005 to August 2015, groundwater was extracted from shallow (perched) zone wells for treatment and discharge to the City of Scotts Valley's storm drain system under an NPDES Permit.

A revised *Soil Gas Assessment Work Plan* was approved by RWQCB in February 2018. To assess the extent of chlorinated VOCs, specifically PCE and TCE in soil gas, ten dual completion soil gas wells surrounding the dry cleaners building were installed by Terraphase Engineering (Terraphase) to a depth of between 5 to 10 feet below ground, and two sub-slab soil gas wells were installed within the Scotts Valley Dry Cleaners Building in May 2018. The report documenting this work is titled *Soil Gas Assessment Report*, dated August 21, 2018.

One of the findings of the assessment were detections of elevated PCE and TCE at the most distal soil gas well. Because this result is anomalous relative to all other samples, Terraphase suggested in their report that this may indicate an unrelated VOC source, such as the former airport, is impacting the vadose zone and causing the detections. As there are also other detections of PCE in the soil gas, Terraphase recommended a number of further tasks, including continued operation of the SVE and air sparging systems in their current configuration. They also recommend researching environmental data and past use history of former airport to assess potential source(s) for the elevated PCE and TCE concentrations detected in the distal sampling location.

In response to the findings in the *Soil Gas Assessment Report*, RWQCB appeared to agree with the recommendations in the report. Additionally, RWQCB is recommending offsite monitoring wells, including some Watkins-Johnson wells. Email correspondence between RWQCB and Terraphase in October 2018 indicates that monitoring well ownership transfer agreements have been delayed due to legal negotiations with Watkins-Johnson representatives, and in one instance, denial of access to a monitoring

well that is purportedly being used by a private resident who is claiming ownership and rights to the water.

No groundwater has been sampled at the site since WY2016, even though in WY2016 PCE continued to be detected at concentrations up to 3.2 µg/L in the well MW-13A, but continued to be below detectable levels in two deeper monitoring wells, located approximately 100 and 250 feet north, respectively from SVWD Well #10A. These results are consistent with the findings of the Watkins-Johnson report (ARCADIS, 2015) that migration of PCE in the regional aquifers is through the Santa Margarita aquifer towards the north and away from SVWD Well #10A.

### 5.2.3 Kings Dry Cleaners

The Kings Dry Cleaners site is located at 222 Mount Hermon Road (Figure 11). Site clean-up is overseen by the County of Santa Cruz Environmental Health Division (CSCEHD). The site of the former dry cleaning facility is now a retail ice cream parlor. The site is 1,300 feet upgradient from the nearest SVWD production well (SVWD #9), and approximately 690 feet away from SLVWD inactive Mañana Woods production wells.

The soil and groundwater assessment report in October/November 2009 confirmed that groundwater was not affected by dry-cleaning operations. Two deep monitoring wells down to 221 feet and 225 feet, respectively, were destroyed under permit in July 2017, as directed by the RWQCB. There are ongoing investigation to determine if previously detected, elevated concentrations of PCE in soil vapor at the site pose a vapor intrusion risk to building occupants.

### 5.2.4 Inactive Sites

Inactive sites, which have been approved for site closure or have been found to pose little threat to groundwater, are listed below and also included on Figure 11. See previous annual reports for site descriptions or visit SWRCB's GeoTracker website for comprehensive information on these sites (<https://geotracker.waterboards.ca.gov/>).

- Camp Evers combined site (remediation complete and case closed);
- Shaffer, Meisser & Rogers Property (Scotts Valley Drive Chlorobenzene Plume) [remediation complete and case closed];
- Hacienda Drive Shell Site (remediation complete and case closed); and
- Frank's Auto Dismantlers (case still open but not active).

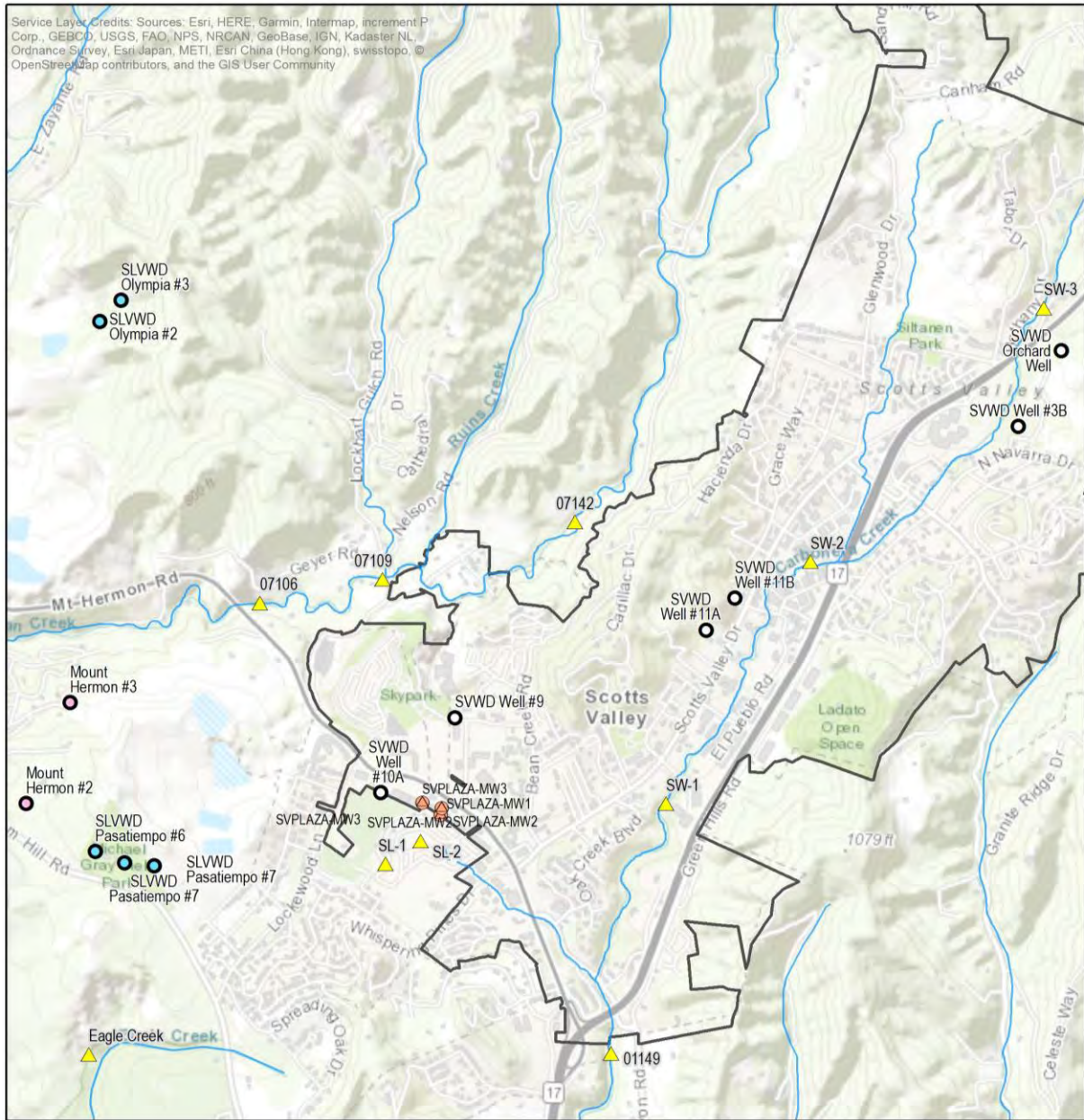
## 5.3 Recycled Water Program

The Regional Water Quality Control Board permit for recycled water use includes a Monitoring and Reporting Program (MRP), which requires effluent monitoring and system performance monitoring. The MRP Order No. 01-067 details recycled water monitoring requirements, standard observations, distribution system inspections, and reporting requirements.

The presence of nitrate in recycled water has been noted in effluent samples, which is typical of treated wastewater. USEPA has established a primary drinking water MCL of 10 milligrams per liter (mg/L) for nitrate reported as nitrogen (nitrate as N). Nitrate in the City's recycled water during WY2018 ranged from 1.3 to 5.7 mg/L, with an average of 3.2 mg/L (City of Scotts Valley, 2019). Nitrogen removal efficiency at the plant ranged from 53% to 78%.

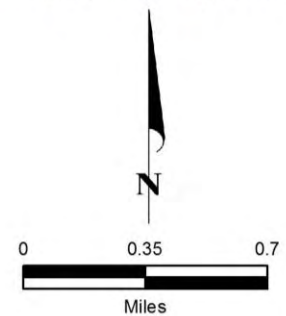
Although neither groundwater nor surface water monitoring is required by the permit, the District has performed this monitoring as part of meeting the basin management objective of monitoring changes in water quality. Figure 12 shows the location of the monitoring features in relation to production wells. During WY2018, however, no samples were collected from surface water sites or groundwater wells. There has been no evidence of increases in nutrients or salts based on the sampling data conducted in previous years.





## EXPLANATION

- Scotts Valley Water District
- RWMP Shallow Groundwater Monitoring Well
- ▲ RWMP Surface Water Monitoring Locations
- Production Well Location
  - SVWD
  - SLVWD
  - Mount Hermon
- Streams



**Figure 12. Recycled Water Management Plan (RWMP) Monitoring Locations**

## **6 GROUNDWATER CONDITIONS**

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This section provides a summary of the data and analysis of groundwater conditions in the GWRA, including an assessment of changes in groundwater levels and aquifer storage.

### **6.1 Aquifer Conditions**

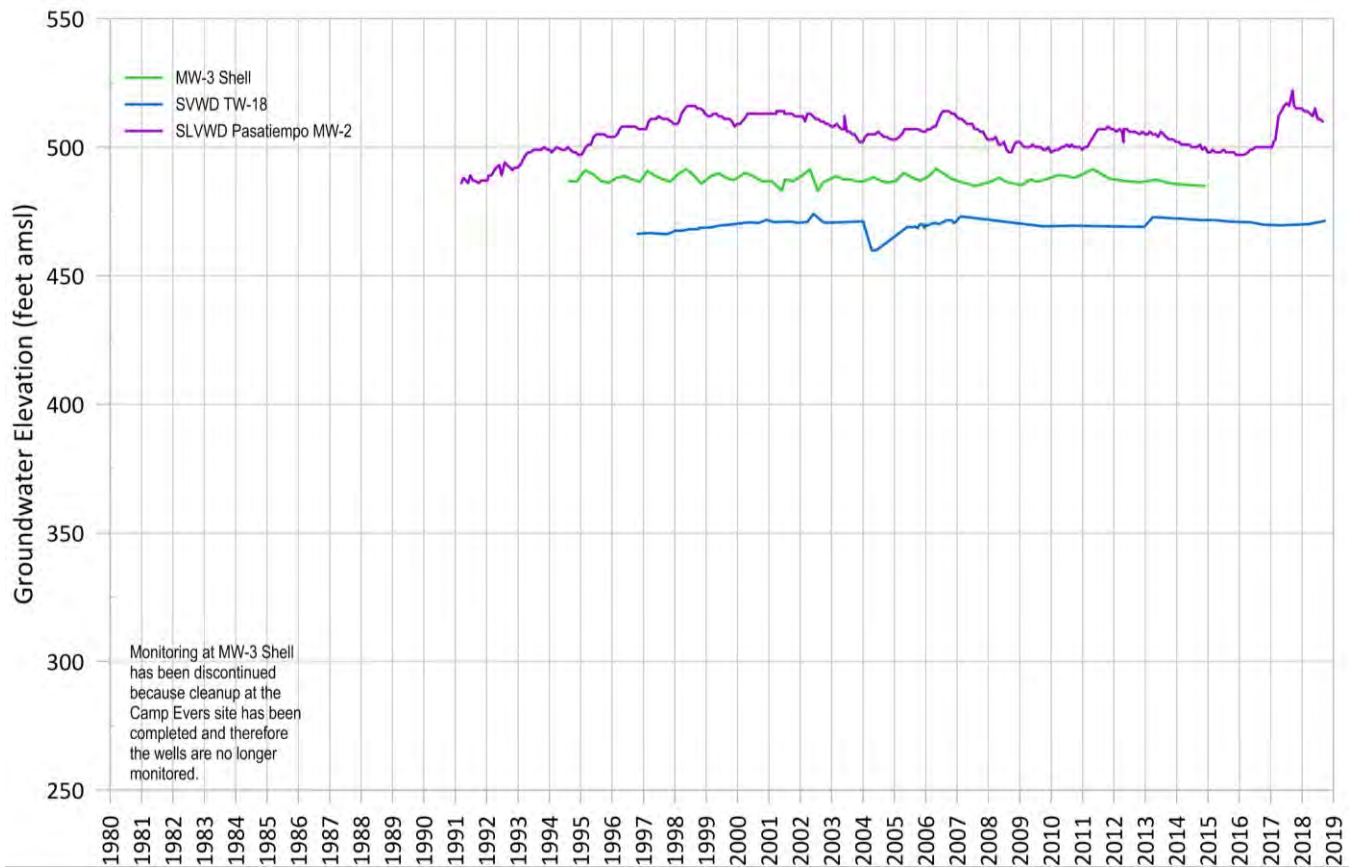
#### **6.1.1 Santa Margarita Aquifer**

The Santa Margarita aquifer consists of sandstone that has widespread surface exposures throughout the Scotts Valley area. As part of the revised geological interpretations in this area, the Santa Margarita aquifer is considered to be about 30 to 50 feet thick over much of the Scotts Valley area and thickens to the north and west towards the Bean Creek and Pasatiempo subareas (Kennedy/Jenks, 2015).

Figure 3 shows a geologic cross-section illustrating the variable thickness of the Santa Margarita aquifer. The Santa Margarita aquifer is the shallowest primary aquifer in the SMGB, so it was developed first by both municipal and private water users. Being the shallowest aquifer, where it is exposed at the ground surface, it is recharged by direct percolation of rainfall. Where there are impervious surfaces over the Santa Margarita aquifer, percolation potential is not lost if the runoff is allowed to be collected and infiltrated in a local percolation location, such as those low impact development (LID) projects described in Section 7.1.6,

Figure 13 provides groundwater elevation hydrographs for three representative Santa Margarita aquifer monitoring wells from different locations across the GWRA. The three well locations are shown on Figure 4. Unfortunately, the Shell's MW-3 monitoring well has been removed because when the Camp Evers cleanup ended, the wells that were part of the monitoring program were destroyed.

Figure 13 shows that overall, the groundwater elevations in the Santa Margarita aquifer vary by a range of 5 to 30 feet over the period of record, with a pattern that appears to correspond to climatic conditions. In general, groundwater levels in the Santa Margarita aquifer have remained relatively stable for the past 30 years. Note that Figure 13 and subsequent aquifer specific hydrographs have a vertical scale of 300 feet to show the groundwater elevation variations of all the aquifers at the same scale.



**Figure 13. Groundwater Hydrographs for the Santa Margarita Aquifer**

Groundwater levels for SLVWD's Pasatiempo MW-2 and SVWD's TW-18 monitoring well on Figure 13 show how different areas of the aquifer respond differently to rainfall and pumping. SVWD's TW-18 monitoring well is located over two miles away from municipal wells that historically pumped from the Santa Margarita aquifer. Because of this distance, groundwater levels in the well do not show seasonal fluctuations related to pumping. The groundwater level trend over time has remained very stable. This suggests that the Santa Margarita aquifer in the northern portion of the District has not had much change in groundwater in storage for over ten years. Years when there has been above-average rainfall, when you might expect to see an increase in levels (1995-1998, 2005-2006, 2010-2011, 2017), there are no noticeable increases in groundwater levels in this well. This may indicate that groundwater levels in this part of the District are in equilibrium and that recharge from above-average rainfall results in increased natural discharge and not a change in storage with associated increase in groundwater levels.

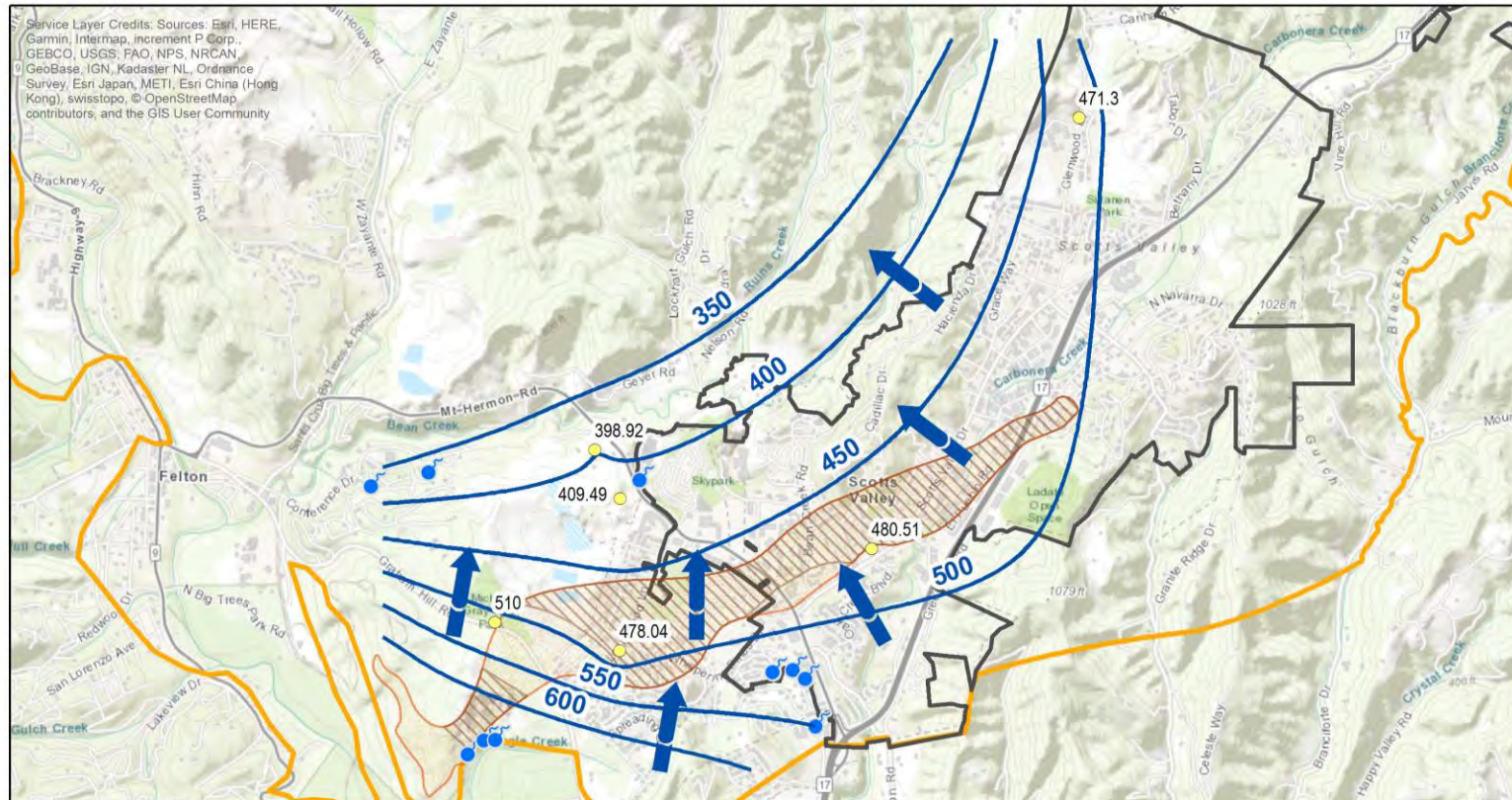
The southern portion of the District, where SLVWD's Pasatiempo MW-2 monitoring well is located, is an area where there has historically been more Santa Margarita aquifer pumping by



SVWD and SLVWD. Currently neither of these agencies pump from the Santa Margarita aquifer. The well's hydrograph on Figure 13 shows both smaller seasonal fluctuations, and larger fluctuations which correspond to periods of above-average rainfall (1995-1998, 2005-2006, 2010-2011, 2017). Of note, in WY2017 there was an increase in groundwater levels of 16 feet that peaked in June. This increase is probably mostly a result of record rainfall in WY2017, but it does also coincide with the year SLVWD stopped pumping their wells screened in the Santa Margarita aquifer. The peak groundwater levels in June indicate that it takes several months for direct rainfall percolation to make its way down to the water table and recharge the Santa Margarita aquifer. The groundwater levels in the well declined 10 feet in WY2018 from the peak in June 2017 despite there being no municipal pumping. This may have occurred because WY2018 was a below average rainfall year and recharge was limited. Nevertheless, groundwater levels at the end of the water year are higher than they have been for the majority of the life of the well.

Figure 14 presents a groundwater elevation map of the Santa Margarita aquifer for September 2018. In general, groundwater in the Santa Margarita aquifer flows from higher elevations, where the Santa Margarita aquifer is exposed at the surface and direct recharge occurs, toward lower elevations where groundwater is discharged at springs or creeks. The highest groundwater elevations in the Santa Margarita aquifer are found in the uplands south and northeast of Scotts Valley. The lowest groundwater elevations are found along Bean Creek, where groundwater discharges into the creek. As depicted on the hydrographs, little change in the overall groundwater flow pattern has occurred.

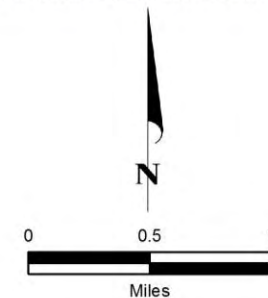
Portions of the Santa Margarita aquifer are unsaturated. As shown on Figure 3 and Figure 14, there are areas where the Lompico aquifer directly underlies the Santa Margarita aquifer. Declining groundwater levels in the Lompico aquifer have caused the Santa Margarita aquifer in these areas to become either unsaturated or to have depressed groundwater levels. Percolating rainfall and surface water in this area passes through the Santa Margarita aquifer as groundwater recharge to the Lompico aquifer.



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## EXPLANATION

- Santa Margarita Groundwater Well Location with Elevation, feet amsl
- Santa Margarita 2018 Groundwater Elevation Contour, feet amsl
- ▭ Scotts Valley Water District
- ▭ Santa Margarita Groundwater Basin
- Springs
- ▨ Inferred Unsaturated Area in 2018
- Location of Direct Contact between the Santa Margarita Sandstone and the Lompico Sandstone
- ↑ Groundwater Flow Direction



**Figure 14. Santa Margarita Aquifer Groundwater Elevation Contour Map, September 2016**

### 6.1.2 Monterey Formation

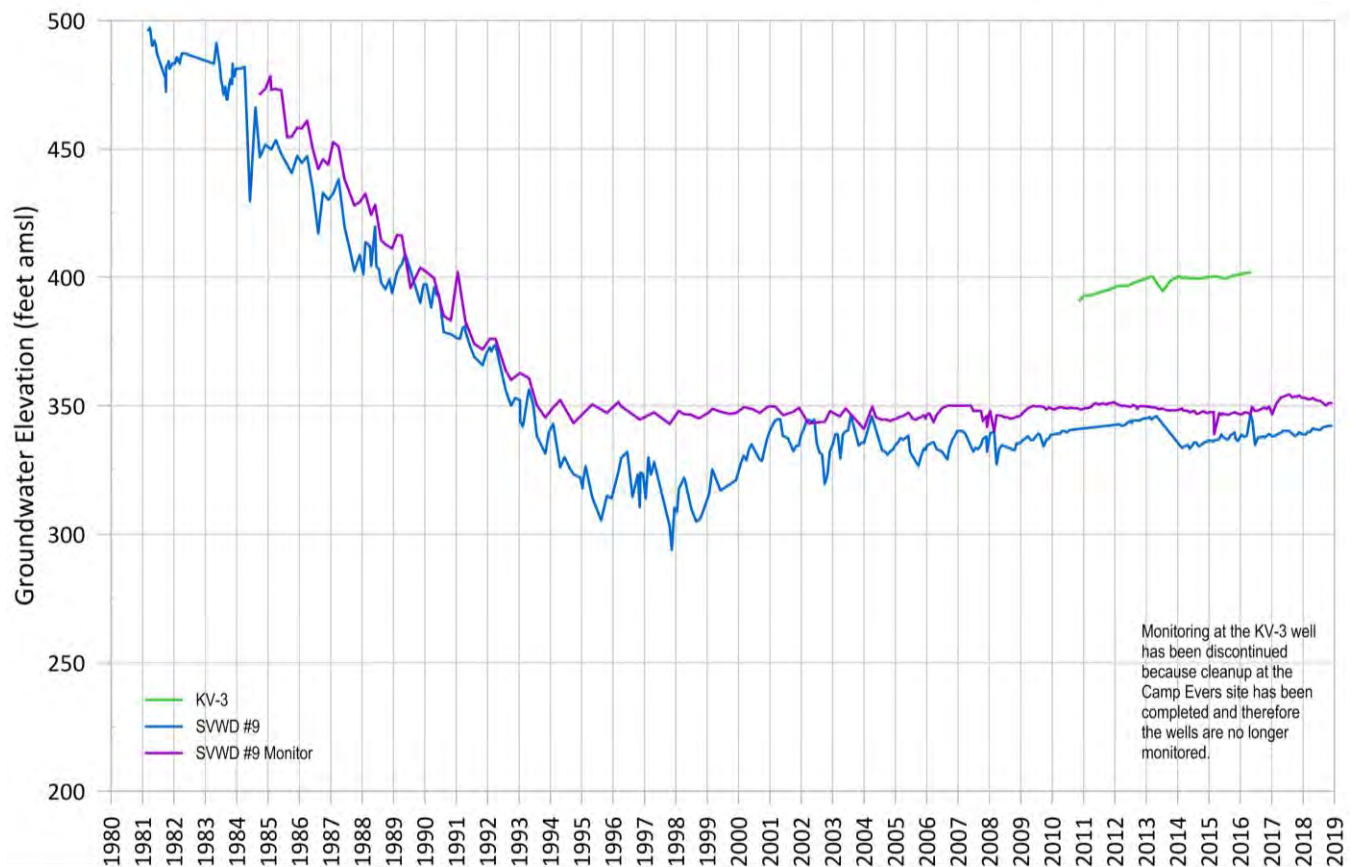
The Monterey formation is primarily composed of mudstone, shale, and siltstone. This composition makes the Monterey formation a regional aquitard that separates the Santa Margarita and Lompico aquifers. However, the gradational geologic transition from the underlying Lompico sandstone means that the lower Monterey formation contains several sandstone interbeds that can locally produce groundwater for smaller municipal and private wells.

As noted in Section 3.2.1, the revised geologic interpretation for SVWD Well #9 is that it is screened completely within the Monterey formation (Kennedy/Jenks, 2015). As shown on the hydrograph on Figure 15, SVWD Well #9 experienced over 200 feet of groundwater level decline during the 1980's and early 1990's that diminished its water supply potential significantly. A groundwater level decline occurred over WY2013 and WY2014, likely in response to the increased pumping in the Monterey formation during this time (Table 1). Groundwater levels in SVWD Well #9 have risen slowly since WY2006, but are still about 150 feet below elevations prior to 1980.

The historical groundwater trend in SVWD Well #9 follows a trend similar to that observed in wells completed in the Lompico aquifer. The interpretation is that in the 1980's, when groundwater levels in the Lompico aquifer were higher, it was able to recharge the sandier layers in the lower Monterey formation where SVWD Well #9 is completed. After the Lompico aquifer groundwater levels declined in the mid-1980s, this recharge was greatly diminished such that SVWD Well #9 was no longer able to sustain its earlier pumping rates. Groundwater elevations in the Monterey formation are currently stable to slightly increasing. The Monterey formation is no longer used to produce water for SVWD.

Because of limited wells completed within the Monterey formation with available groundwater level data, a groundwater elevation contour map cannot be constructed for the aquifer.





**Figure 15. Groundwater Hydrographs for the Monterey Aquifer**

### 6.1.3 Lompico Aquifer

The Lompico aquifer is typically a 300 to 400 feet thick medium-grained sandstone that becomes thinner and more fine-grained to the north and east across the SMGB (Clark, 1981, Brabb et al, 1997). The Lompico sandstone is found throughout most of the basin; however, the unit only outcrops along the basin margins. Figure 3 shows a geologic cross-section illustrating the complex character of the Lompico aquifer across the area.

The Lompico aquifer is the primary water producing aquifer in the SMGB and provides a large percentage of the municipal water supply, especially in the Scotts Valley area. In WY2018, approximately 77% of the GWRA groundwater pumped was from the Lompico aquifer (Table 3). This pumping has contributed to declines in groundwater levels in the Lompico aquifer in the past.

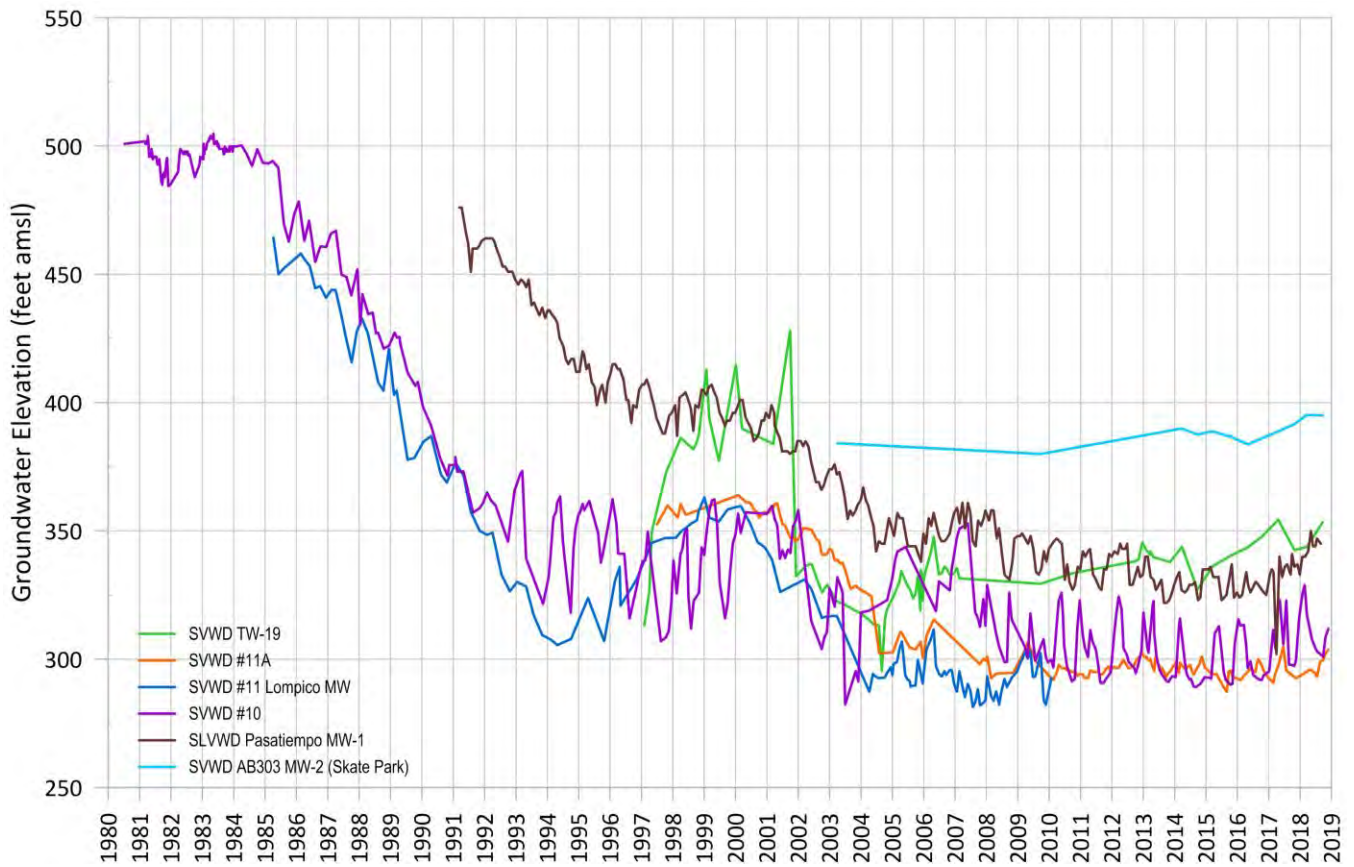
Figure 16 provides groundwater elevation hydrographs for six representative Lompico aquifer wells from different locations across the GWRA. The well locations are shown on

Figure 4. SVWD monitoring wells TW-19 and SVWD AB303 MW-2 (Skate Park) are measured continuously with electronic data transducers (Appendix B includes more detailed hydrographs of these wells).

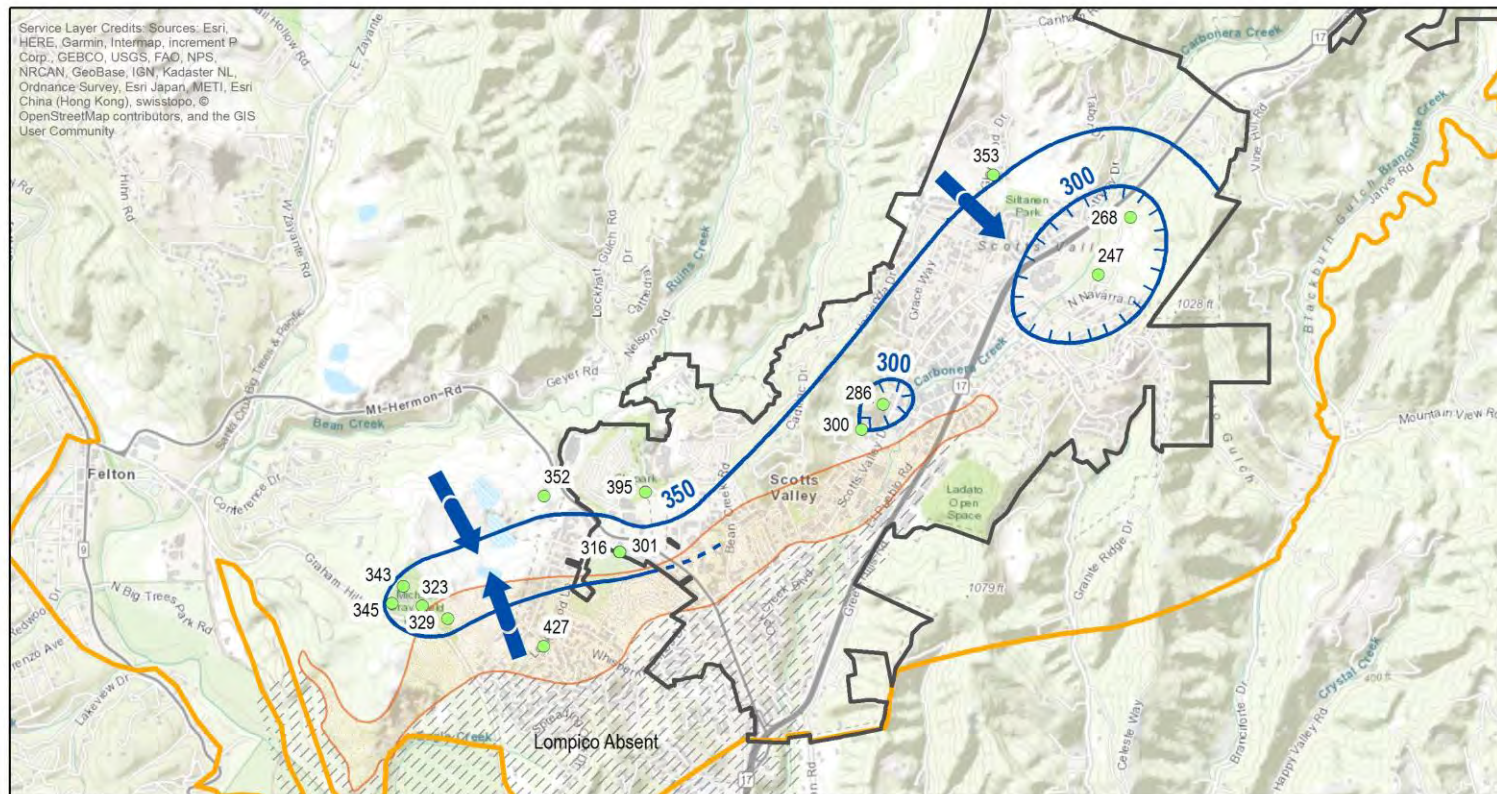
As evident on Figure 16, Lompico aquifer groundwater levels have declined by 150 to 200 feet relative to pre-pumping levels across the GWRRA. The greatest decline in groundwater levels occurred from 1984 to 1994. From 1995 to 1999, groundwater levels stabilized or increased in some areas. From 1999 to 2004, groundwater levels declined another 50 feet. Since 2005, groundwater levels have fluctuated within a more narrow range; although, groundwater levels in Pasatiempo MW-1 and SVWD #10 continued to decline up to 20 to 30 feet until 2010; thereafter groundwater levels have fluctuated within a more narrow range like the other wells on the hydrograph. It is noticeable that several of the wells on Figure 16 show a trend of increasing groundwater levels over the past two years with up to 15 feet of rise recorded.

Figure 17 presents a groundwater elevation map of the Lompico aquifer for September 2018. Lompico aquifer wells are generally limited to the southern margin of the basin due to the great depth of the Lompico aquifer in the center of the Basin. The general pattern shown on Figure 17 is a broad area of depressed groundwater levels forming a trough along the southern margin of the basin. The individual production wells are shown as isolated areas of increased drawdown. To the north, the higher groundwater elevations are interpreted to represent groundwater flow from the center of the basin towards the pumping centers in the south. Higher groundwater levels along the far southern margin may reflect influence from inflow from the Santa Margarita aquifer.





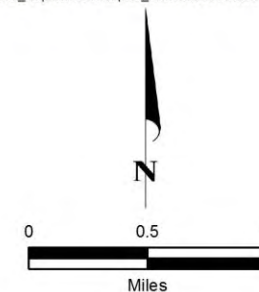
**Figure 16. Groundwater Hydrographs for the Lompico Aquifer**



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## EXPLANATION

- Santa Margarita Groundwater Basin
  - Scotts Valley Water District
  - Lompico Groundwater Well Location with Elevation, feet amsl
  - 2018 Lompico Groundwater Elevation Contours, feet amsl
  - Groundwater Elevation Contour
  - - - Groundwater Depression Contour
  - - - Uncertain Contour
  - Lompico Absent
  - Location of Direct Contact between the Santa Margarita Sandstone and the Lompico Sandstone
- ↑ Groundwater Flow Direction



**Figure 17. Lompico Aquifer Groundwater Elevation Contour Map, September 2018**

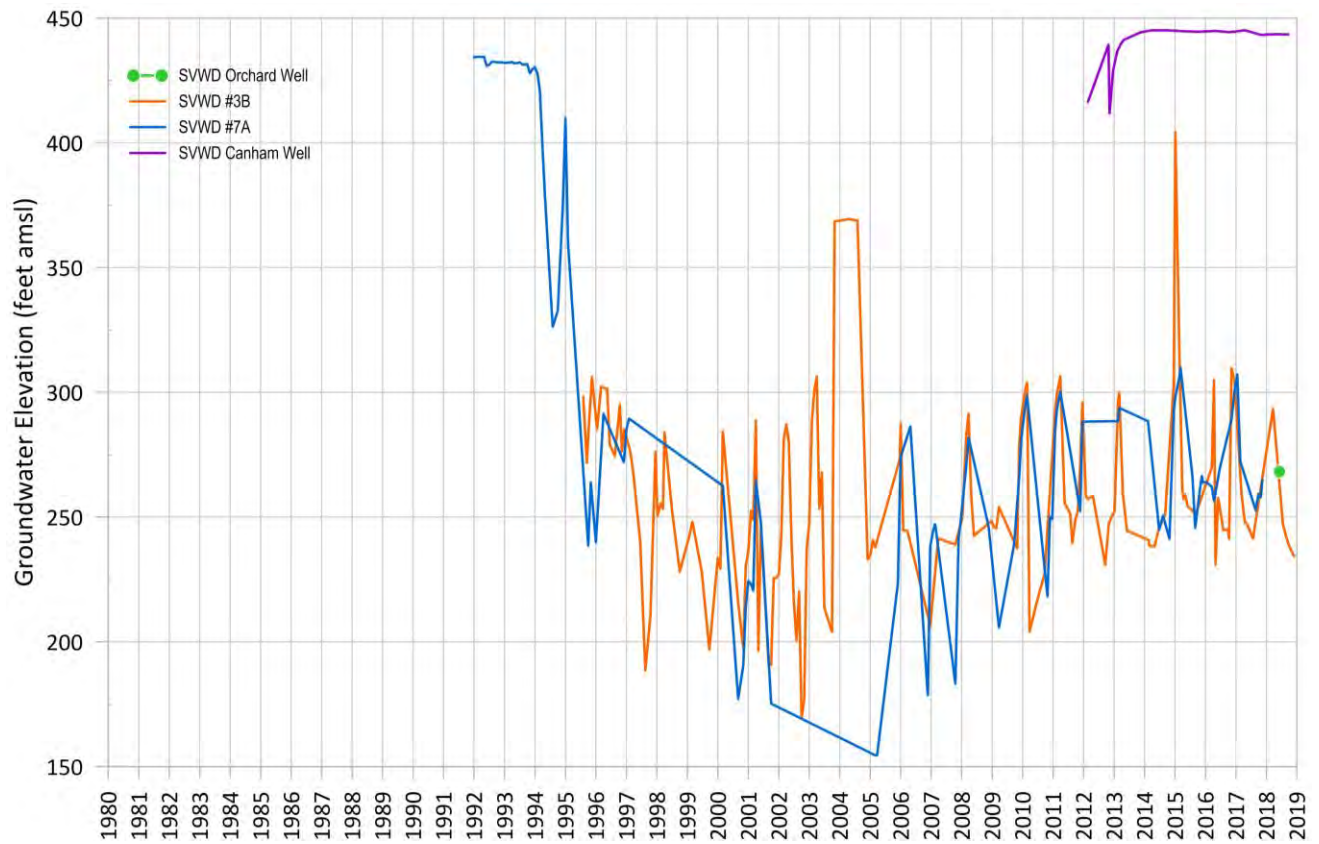
#### 6.1.4 Butano Aquifer

The Butano aquifer is a significant water-producing aquifer in the SMGB for SVWD, with 27% of groundwater pumped by the District produced from this aquifer in WY2018. The Butano aquifer is a deep, thick sedimentary unit that consists largely of sandstone with interbeds of mudstone, shale, and siltstone. It is geologically complex and typically occurs at depths greater than 1,000 feet under much of the SMGB. The Butano aquifer forms a wedge along the northern portion of the SMGB (Figure 3) and has been mapped in surface outcrops along the northern SMGB margin.

During the first few years of SVWD pumping from this aquifer (WY1993 to WY1995), groundwater levels in SVWD Well #7A declined nearly 200 feet relative to pre-pumping levels (Figure 18). However, since SVWD Well #7A is completed in both the Lompico and Butano aquifers, it is unclear whether this drop in groundwater levels reflects conditions in the Butano aquifer or the observed decreases in the Lompico aquifer. From 1996 to 2006, static groundwater levels at SVWD Well #3B and #7A fluctuated seasonally within an elevation range of 200 to 300 feet above mean sea level (amsl). With decreased pumping after 2006, groundwater levels have increased over 50 feet and have remained fairly stable since 2010. The seasonal range in groundwater levels is typically 50 feet, but can be as much as 100 feet.

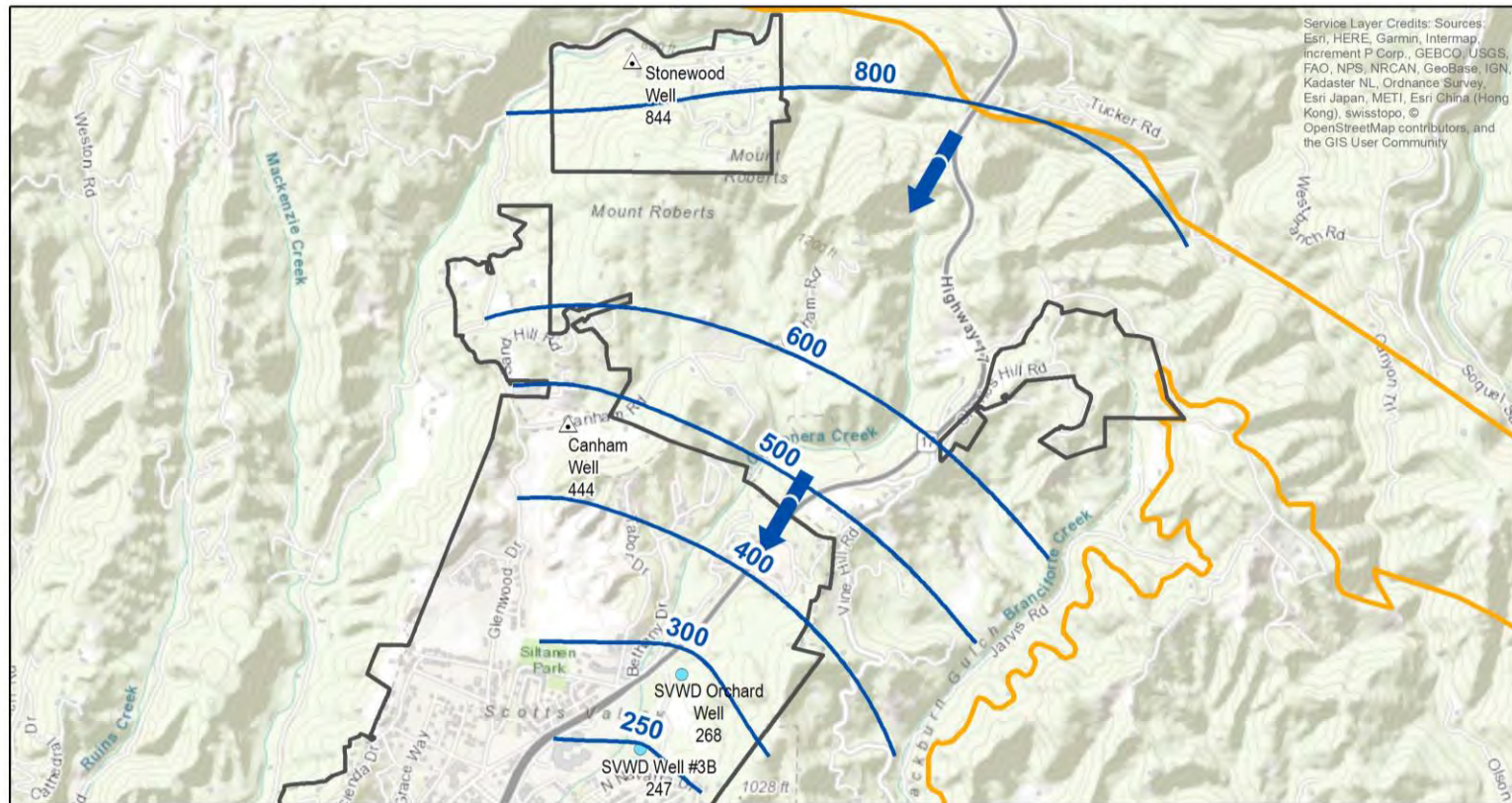
Due to its great depth, there are currently only two dedicated monitoring wells in the Butano aquifer. Groundwater levels for the SVWD Canham monitoring well are plotted on Figure 18. The Canham well is located 0.9 miles northeast of the nearest District wells, SVWD Wells #3B and #7A (Figure 3). Its groundwater levels are generally very stable. The second Butano aquifer monitoring well is SVWD Well #15 Monitor Well, which is equipped with an electronic data transducer that continuously measures groundwater levels, and is located 500 feet from municipal production well SVWD #3B. The hydrograph for this well is not included on Figure 18 because its levels fluctuate strongly in response to pumping at nearby SVWD Well #3B and #7A, and adding it to the hydrograph obscures the other data. Its hydrograph is included in Appendix B. The groundwater elevation data for SVWD Well #15 Monitor Well shows about a 100-foot decline when SVWD Well #3B is pumping, and about a 20-foot decline when SVWD Well #7A/Orchard Well is pumping. However, over its period of record, including during the WY2012 through WY2015 drought, groundwater level response to pumping remained consistent with no indication of a decline in groundwater levels over the drought or any other overall trend.





**Figure 18. Groundwater Hydrographs for the Butano Aquifer**

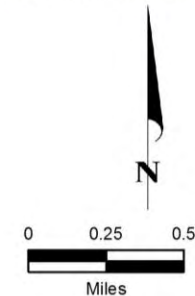
**Figure 19** presents a groundwater elevation map of the Butano aquifer for WY2018. Groundwater flow is mostly north to south, from the area of the Stonewood Well towards the actively pumping SVWD Wells #3B and #7A. Groundwater elevation contours curve around to the east to account for the relatively low ground surface elevations in Blackburn Gulch.



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## EXPLANATION

- Butano 2018 Groundwater Elevation Contour, feet amsl
- ▭ Scotts Valley Water District
- ▭ Santa Margarita Groundwater Basin
- △ Butano Monitoring Well Location with Elevation, feet amsl
- Butano Production Well Location with Elevation, feet amsl
- ➔ Groundwater Flow Direction



**Figure 19. Butano Aquifer Groundwater Elevation Contour Map, September 2018**



## 6.2 Aquifer Storage Analysis

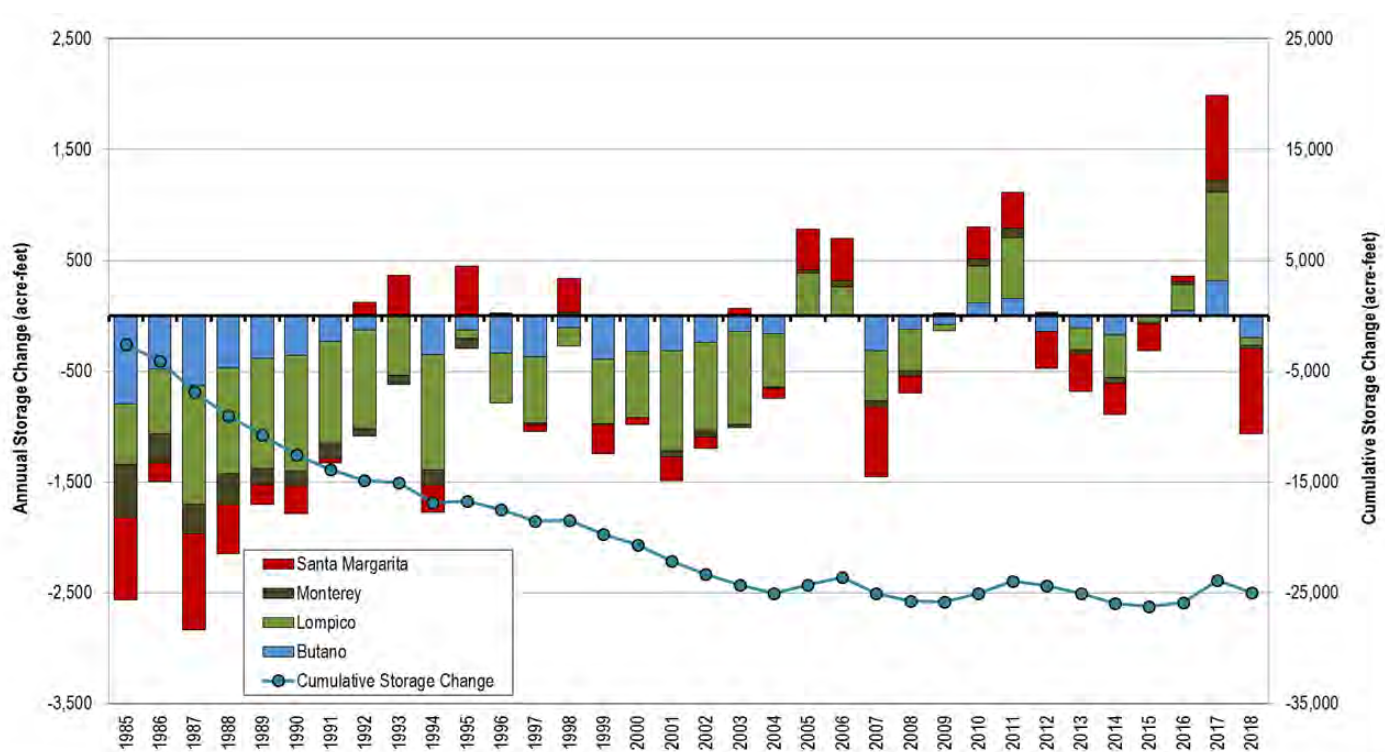
Aquifer storage is a measure of the volume of groundwater present in the aquifer. The change in aquifer storage measures the increase or decrease in the volume of groundwater in the aquifer resulting from changes in groundwater levels, primarily in response to variations in annual precipitation and groundwater pumping.

Because of the geologic complexity of the SMGB, the SMGB groundwater model provides a quantitative tool to evaluate the changes in groundwater conditions over time. The SMGB groundwater model is calibrated from WY1985 through WY2014. Updates to model pumping and hydrology took place at the end of WY2014 (to include WY2013 and WY2014 data), at the end of WY2016 (to include WY2015 and WY2016 data), and as part of preparing this year's annual report (to include WY2017 and WY2018 data). The groundwater model is updated using procedures outlined in the SMGB Model Technical Report (Kennedy/Jenks, 2015). As pointed out in Section 3.3, the Santa Margarita Groundwater Agency should consider revising private well pumping in the model during its upcoming efforts to improve the groundwater model for purposes of using it to help develop sustainable management criteria for the Basin's GSP.

The results of the model-based calculations for change in aquifer storage since WY1985 are shown on Figure 20. Table 8 provides a summary of the long-term change in aquifer storage per aquifer as calculated by the updated SMGB model. Figure 20 and Table 8 indicate that groundwater storage in the GWRAs increased by 1,987 acre-feet in WY2017 as a result of it being a very wet year and decreased by 1,065 acre-feet in WY2018 as a result of it being a below average rainfall year. Over WY2017 and WY2018 there was a net increase of 922 acre-feet of groundwater in storage (Table 8).

Examining cumulative changes over different time periods, the model results show that during the drought years of WY2012 through WY2015, the cumulative decline in aquifer storage was 2,328 acre-feet. The recent drought-related storage decline was much less than the storage decline experienced during the WY1985 to WY1992 drought, which was a decline of 14,834 acre-feet. The greater decline occurred, in part, because average pumping was 290 acre-feet per year more than it was in the WY2012-2015 drought.

The cumulative storage change line on Figure 20 clearly shows that since 2004, when SVWD's pumping started declining (Figure 7), ongoing cumulative storage declines have been halted. WY2018 cumulative storage change is the same as it was in 2004 (Figure 20), and is attributed primarily to reduced pumping.



**Figure 20. Historical Change in Aquifer Storage for Groundwater Reporting Area**

**Table 8. Model-Simulated Change in Aquifer Storage for the GWRA by Aquifer (in acre-feet)**

Aquifer	WY1985 through WY1992	WY2005 through WY2011	WY2012 through WY2015	WY 2016	WY 2017	WY 2018
<b>Annual Average Change in Aquifer Storage (acre-feet)</b>						
Santa Margarita	-310	91	1,201	55	763	-773
Monterey	-201	20	-74	25	109	-23
Lompico	-793	92	-635	251	800	-68
Butano	-378	-93	-419	48	315	-200
<b>Total</b>	<b>-1,682</b>	<b>111</b>	<b>-2,328</b>	<b>379</b>	<b>1,987</b>	<b>-1,065</b>

## **7 GROUNDWATER MANAGEMENT PROGRAMS**

SVWD has actively managed groundwater in the SVWD GWMA since the early 1980s in an effort to increase water supply reliability and to protect local water supply sources. This section provides a summary of these programs conducted by the District to meet the BMOs.

### **7.1 Groundwater Augmentation Projects**

One of the key BMOs is to implement groundwater augmentation projects. Current programs focus on water use efficiency, recycled water use and conjunctive use projects.

#### **7.1.1 Water Use Efficiency Program**

Water use efficiency reduces the overall demand for groundwater, and thus helps to sustain groundwater levels and long-term groundwater extraction. In recent years, SVWD has implemented numerous policies and programs to encourage water use efficiency among customers through coordinating public outreach activities, issuing monetary rebates to customers, and implementing best water use efficiency management practices. A more detailed description of SVWD's water use efficiency activities can be found on the water use efficiency section of the District's website at: <http://www.svwd.org/water-use-efficiency>.

Of particular note since the last annual report is the District's focus on water loss control. In 2016, District staff used AWWA M36 software to calculate an updated Water Audit Validity Score. For 2016, the District received a validated score of 51 out of 100; in 2017 its validated score was 53 out of 100. Priority areas that are identified for attention included meter data from District sources, estimation of variable production cost, and customer metering accuracies. Table 9 provides a summary of estimated water loss from WY2010 through WY2015. It should be noted that the percentages of water loss in Table 9 are slightly overestimated because the groundwater production used in the calculation is groundwater pumped and not production. The District defines production as groundwater pumped less water treatment process water, i.e., water produced for transmission to customers.

**Table 9. Unaccounted-for Water Estimates WY2010-WY2015 (in acre-feet)**

	WY2010	WY2011	WY2012	WY2013	WY2014	WY2015
Groundwater Production	1,358	1,302	1,362	1,400	1,377	1,133
Potable Water Delivered	1,240	1,160	1,208	1,248	1,157	995
Percent Water Loss	9%	11%	11%	11%	16%	12%

Source: 2015 Urban Water Management Plan (Kennedy/Jenks, 2016b)

Full system leak detection survey was completed in 2015. The report from the consultant, M.E. Simpson, indicated only a few minor distribution system leaks that were repaired immediately. In addition to system leaks, the District has also operated a leak detection program for customers since 1996. Customers who have spikes in water consumption are sent a courtesy “leak letter” informing them of an increase in water usage and suggesting that there may be a leak at their property. Customers who repair leaks may be eligible for an adjustment on their water bill. In February 2016, the Leak Adjustment Policy was changed to a Leak Adjustment Program, simplifying the process and increasing staff efficiency for implementation.

A significant percentage of District losses are potentially the result of meters that are under-reporting deliveries. The District began a three-year meter change out program in 2016 coupled with an Automated Metering Infrastructure (AMI) system-wide deployment. The District retained TritonAMI to determine which automated metering system would work best. Presently, water meters are radio read every other month. AMI allows for hourly recording of consumption data that is uploaded daily and stored in a cloud-based database. The information can be accessed by the District and customers to gain a better understanding of their water use patterns and to provide alerts about unusual fluctuations in water use.

### 7.1.2 Recycled Water Program

Recycled water is used in-lieu of groundwater for permitted non-potable uses, mainly for landscape irrigation. This augments the water supply and helps to meet water use efficiency goals. Since all of the recycled water use sites are located within the SMGB, the entire recycled water usage represents an equivalent reduction in groundwater pumping. Groundwater not pumped from the basin is assumed to be available for future beneficial use. Recycled water deliveries by SVWD historically and in WY2018 is reported in Section 4.2.2.

The Recycled Water Program is a cooperative effort between SVWD and the City of Scotts Valley. Recycled water is produced at the City of Scotts Valley Tertiary Treatment Plant, where it undergoes additional treatment including nitrate removal, ultra-violet disinfection, and chlorination. Recycled water is then distributed by SVWD to customers through a designated pipeline system. The City of Scotts Valley has passed an ordinance mandating use of recycled water for new construction where economically feasible.

Since August 2015, SVWD has operated a Recycled Water Fill Station located on Kings Village Road from May to October. All District customers and City residents are eligible to receive up to 250 gallons of free recycled water per day for permitted uses.

In April 2016, the City of Scotts Valley and Pasatiempo Golf Club reached an agreement for the City to provide treated wastewater to the golf course for irrigation. This allows Pasatiempo Golf Club to reduce its reliance on potable water from the City of Santa Cruz during peak-use months when irrigation demand is high. In support of this regional effort, SVWD released 10% of its total recycled water allocation in exchange for compensation that can be applied toward funding future projects. The District did not have a current identified use for the amount of recycled water that it supplied to the golf course.

### **7.1.3 Regional Intertie Project**

The District led a grant application effort to obtain Proposition 50 Water Security funding from the CDDW for constructing emergency intertie pipelines and pump stations between adjacent water systems for sharing water during a water emergency. The grant provided 44% funding for the project. Construction was completed in Spring 2016. For the GWRA, the interties of interest include the following connections:

- SVWD and the SLVWD Southern District,
- SLVWD Northern and Southern Districts, and
- SLVWD and the Mount Hermon Association.

The construction of the intertie between the SLVWD Northern and Southern Districts provides a means for utilizing surface water by SLVWD that could allow for reduced groundwater pumping in the GWRA.

The intertie was not activated in WY2018.



#### **7.1.4 Regional Water Supply MOA**

The District is party to a Memorandum of Agreement (MOA) with SLVWD, City of Santa Cruz and County of Santa Cruz to explore and evaluate potential projects for the conjunctive use of surface and groundwater resources in the Santa Margarita basin and San Lorenzo River watershed.

#### **7.1.5 Santa Margarita Groundwater Basin ASR Project**

Over the past two years, the groundwater model has been used to evaluate a proposed City of Santa Cruz aquifer storage and recovery (ASR) project. The modeling was used to identify benefits or detriments to the basin resulting from the proposed ASR project. This project is ongoing, and additional modeling taking place in WY2019.

#### **7.1.6 Low Impact Development Projects**

Low impact development (LID) projects consist of applying stormwater best management practices (BMPs) – such as infiltration basins, vegetated swales, bio-retention and/or tree box filters – to retain and infiltrate stormwater that is currently being diverted into the storm drain system. The infiltrated stormwater recharges the shallow aquifers in a manner similar to natural processes. The infiltration helps augment groundwater levels, and sustains groundwater contributions to stream baseflow that supports local fishery habitats. A complicating factor in implementing LID projects in the Scotts Valley area is that there is no centralized stormwater collection system, which limits the ability to do large scale projects to direct groundwater augmentation to the most beneficial areas.

The District has installed monitoring equipment to assess the performance of the facilities, and WY2018 was the first full water year that infiltration data for these facilities are available. The total amount of stormwater infiltrated at the three LID facilities in the SVWD service area in WY2018 was 22.44 acre-feet.

##### **Transit Center LID**

The District obtained grant funding through a Santa Cruz County Prop 84 grant from the SWRCB for the planning, design, and construction of a LID retrofit at the Scotts Valley Transit Center site (Figure 21). The design included construction of a vegetated swale, a below-ground infiltration basin, and pervious pavement. Construction began in October 2016 and was completed in May 2017. In WY2018, a total of 1.75 acre-feet was infiltrated at this location.

**Woodside HOA LID**

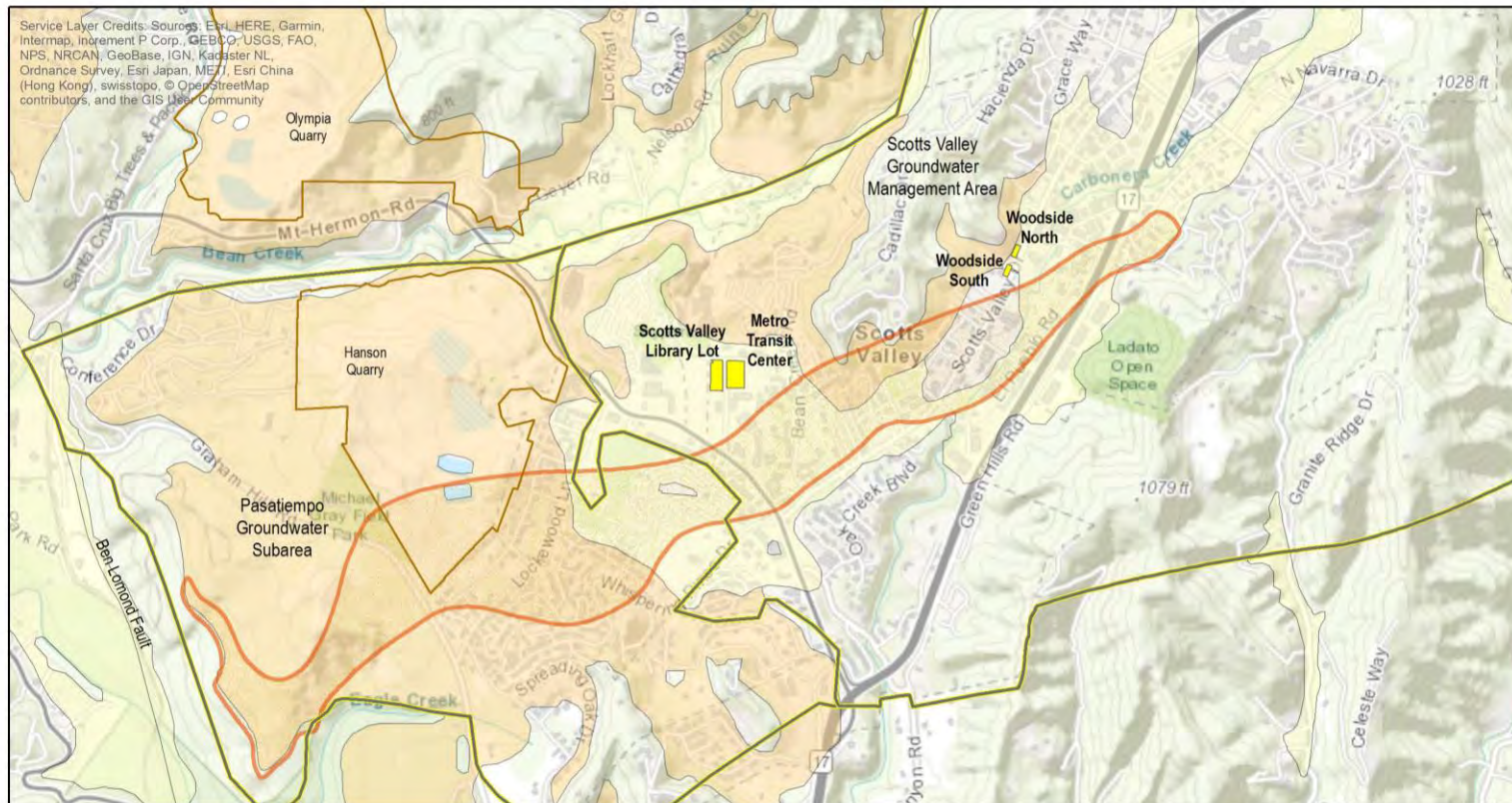
As part of the Prop 84 grant match, the District worked with a local developer to install a stormwater recharge facility at the Woodside HOA along Scotts Valley Drive (Figure 21). This facility includes a large below-ground infiltration basin. Stormwater is routed from the development to the basin where it can percolate down into the groundwater. Initial hydrology reports estimated recharge on the order of 20 to 40 acre-feet per year (Ruggeri, Jensen and Azar, 2010). In WY2018, a total of 17.3 acre-feet was infiltrated at this location.

**Scotts Valley Library LID**

An earlier grant-funded project installed a below-ground infiltration basin at the Scotts Valley Library (Figure 21). In WY2018, a total of 3.39 acre-feet was infiltrated at this location.

All three LID facilities overlie Santa Margarita sandstone (Figure 21). Figure 21 shows the location of the LID facilities in relation to surface geology and the area where the Santa Margarita aquifer directly overlies the Lompico aquifer due to the absence of the less permeable Monterey formation. Because the LID facilities are not located in the area where the Monterey formation is missing, there is less potential of the LID facilities recharging the Lompico aquifer.

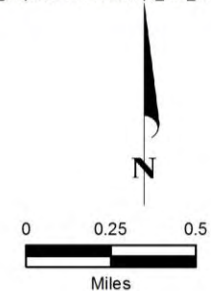
In addition to large LID projects as described above, the District is part of the Strategic and Technical Resources Advisory Groups for Ecology Action's regional sponsorship of the Prop 84 LID Incentives Grant. District staff provided input on rating criteria for the landscape certification program and the structure in the grant reporting. Through 2018, 32 SVWD customers were awarded grant incentives for making stormwater management improvements to their properties, with strategies such as rainwater harvesting, lawn and hardscape removal, and stormwater retention methods, such as swales and rain gardens. According to SVWD staff records, the program provided 31,733 square-feet of permeable recharge area.



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## EXPLANATION

- Low Impact Development Projects
- Location of Direct Contact between the Santa Margarita Sandstone and the Lompico Sandstone
- Quarry Location
- Groundwater Management Areas
- Santa Margarita Outcrops
- Alluvium
- Santa Margarita Sandstone



**Figure 21. Location of Low Impact Development Projects**

### **7.1.7 Purified Recycled Water Recharge Project**

In WY2019, the District will commence environmental impact report (EIR) preparation for a groundwater replenishment project using advanced treated purified wastewater. Groundwater replenishment Alternative 3, where the facilities are located at the District's El Pueblo Yard, is the recommended project alternative (Kennedy/Jenks Consultants, 2017). The El Pueblo site has existing infrastructure that can be reused, including reuse of wells SVWD #11A and #11B for injection. Direct injection of water provides a direct means of replenishing water to an aquifer and raising groundwater levels, without relying on the variable natural recharge process. Modeling results show that the project could add 560 acre-feet per year into the Lompico aquifer, and groundwater levels could increase approximately 150 to 190 feet over 15 to 20 years.

## **7.2 Groundwater Management Activities**

### **7.2.1 Sustainable Groundwater Management**

SVWD actively participates in the Santa Margarita Groundwater Agency (SMGWA), the Basin's Groundwater Sustainability Agency (GSA), formed per the Sustainable Groundwater Management Act (SGMA) of 2014. The District is a member of the SMGWA, comprising the SVWD, San Lorenzo Valley Water District, and the County of Santa Cruz. The Board of Directors of the SMGWA includes two Board members from each of the member agencies, one from the County, one from the City of Scotts Valley, one from the City of Santa Cruz, one from the Mount Hermon Association Community Water System, and two private well owner representatives. The SMGWA Board meets monthly. The SMGWA will oversee the groundwater management activities of the SMGWB under the requirements of SGMA and will start development of its Groundwater Sustainability Plan (GSP) in 2019. The GSP is required to be submitted to DWR by January 31, 2022.

### **7.2.2 Santa Margarita Basin Groundwater Model**

SVWD received a Prop 84 Planning Grant in 2011 as part of the Santa Cruz IRWMP to update the existing SMGB Groundwater Model developed by ETIC (2006). The SMGB Groundwater Model provides a quantitative tool to assess regional groundwater conditions for the entire SMGB to support groundwater management and design of water augmentation projects. Kennedy/Jenks Consultants updated, calibrated, and improved the model, especially with respect to its ability to accurately evaluate groundwater-surface water interactions and verified the model's applicability across the entire SMGB, not just



the GWRA. The model was also updated with the most recent geological interpretations and incorporated improvements in modeling techniques and software. The technical report (Kennedy/Jenks, 2015) is available on the District's website at <http://svwd.org/resources/reports>.

There have been minor updates to the model carried out by HydroMetrics WRI in 2016/2017. In WY2018, the SMGWA commissioned an evaluation of the model based on its ability to support GSP development. The evaluation included a series of recommended updates related to the model's hydrogeologic framework, recharge and evapotranspiration inputs, model calibration and uncertainty, and SGMA objectives. Updates to the model are expected to be made as part of developing the Basin's GSP.

## 7.3 Groundwater Management Monitoring Program

The BMOs include provisions for ongoing monitoring of groundwater conditions, which is a requirement of Groundwater Management Act (CWC§ 10750 *et. seq.*) The following provides a brief overview of the monitoring program.

### 7.3.1 SVWD Data Collection

As part of the GWMP, the District has run a Groundwater Management Monitoring Plan for over 20 years to assess groundwater conditions in the GWRA. The SVWD Groundwater Management Monitoring Program provides a systematic procedure for data collection to support the District in assessing the hydrologic conditions of the SMGB in the GWRA. The primary components of this Monitoring Program are:

**Groundwater Levels** - Groundwater elevation data collected by SVWD, other local agencies, environmental remediation sites, private entities, and consultants.

**Groundwater Pumping** - Groundwater pumping compiled by SVWD and nearby groundwater users.

**Precipitation** - Precipitation data measured by SVWD and other nearby gauges.

**Water Quality** - Water quality data collected by SVWD, private entities, and environmental compliance sites.

The current Groundwater Management Monitoring Plan was presented in the 2008 annual report. The current monitoring locations are shown on Figure 4 and the monitoring wells



are listed in Table 10. The list has been amended to include newly constructed wells and remove inaccessible or destroyed wells.

The results, analysis and interpretation of data collected for the Groundwater Management Monitoring Program are incorporated into and discussed throughout this annual report. The database that was set up as part of the Groundwater Management Monitoring Program was updated with data from WY2015 and WY2016. Although, this annual report does not contain a comprehensive listing of the District's database, but the database can be made available by contacting the District.

To further supplement the Groundwater Management Monitoring Plan, three monitoring wells currently have electronic data transducers installed for collecting continuous groundwater level data. The data collected by the transducers provide a key data set for evaluating long-term aquifer responses to pumping and recharge; The data collected by the transducers provide a key data set for evaluating long-term aquifer responses to pumping and recharge that will be included in future reports; however, the District's experience is that the very deep monitoring wells are not always suitable for the proper functioning of transducers. In WY2014, transducers in the Butano aquifer monitoring wells: Canham Well and Stonewood Well were removed. One of the transducers removed has been redeployed recently in monitoring well SVWD AB303 MW-2. Table 10 identifies the wells currently equipped with transducers.

**Table 10. Wells Used for the Groundwater Management Monitoring Program**

Well Name	Well Owner	Top of Casing Elevation (feet msl)	Primary Producing Formation	Screen Interval Depth (feet bgs)
<b>SVWD Production Wells – Measurements taken monthly for both static and dynamic levels</b>				
SVWD Well #3B	SVWD	672.47	Butano	700-730, 880-1050, 1180-1370, 1400-1670
SVWD Orchard Well	SVWD	723	Butano	705-784, 805-1063, 1084-1455
SVWD Well #9	SVWD	528.14	Monterey	155-195, 315-355
SVWD Well #10 (to be destroyed in FY2020)	SVWD	510.85	Lompico	190-220, 240-270, 325-355
SVWD Well #10A	SVWD	512.00	Lompico	280-380, 400-450
SVWD Well #11A	SVWD	602.60	Lompico	399-419, 459-469, 495-515
SVWD Well #11B	SVWD	587.95	Lompico	348-388, 423-468, 500-515
<b>SVWD Monitoring Wells - Key Indicator Wells – Measurements taken monthly</b>				
#15 Monitoring Well <sup>2</sup>	SVWD	660	Lompico, Butano	700-1100
#9 Monitoring Well	SVWD	528	Monterey	N/A
<b>SVWD Monitoring Wells - Measurements taken semi-annually</b>				
SVWD AB303 MW-1 <sup>1</sup>	SVWD	561.07	Santa Margarita	114-124
SVWD AB303 MW-2 <sup>2</sup>	SVWD	524.22	Lompico	705-715, 810-850
SVWD AB303 MW-3A <sup>1</sup>	SVWD	522.69	Lompico	630-680
SVWD AB303 MW-3B <sup>1</sup>	SVWD	522.11	Santa Margarita	120-125
Canham Well	SVWD	782.78	Butano	1,281-1,381
Stonewood Well	SVWD	898.54	Butano	799-859
SV1-MW (filled with sand)	SVWD	704.3	Santa Margarita	60-80
SV3-MW A	SVWD	584.65	Santa Margarita	60-80
SV3-MW B	SVWD	584.65	Santa Margarita	100-110
SV3-MW C	SVWD	584.65	Lompico	150-160
SV4-MW	SVWD	447.79	Santa Margarita	50-60
TW-18 <sup>1,2</sup>	SVWD	715.03	Santa Margarita	285-345
TW-19 <sup>1,2</sup>	SVWD	659.49	Lompico	960-1060

Notes: <sup>1</sup>Groundwater level measurement data submitted to DWR CASGEM Program

<sup>2</sup>Equipped with electronic data transducer

feet msl = elevation in feet relative to mean sea level

feet bgs = depth in feet below ground surface

### 7.3.2 CASGEM Program

In 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) program was established to develop a statewide monitoring program to track seasonal and long-term trends in groundwater elevation by establishing a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. Participation in CASGEM is typically a requirement for receiving DWR grants.

The Santa Cruz County Environmental Health Services is coordinating the DWR reporting responsibilities for all of Santa Cruz County. SVWD supports this effort by providing groundwater elevation data collected as part of the District's groundwater management activities. Table 10 indicates the wells that are reported to DWR for the CASGEM program. Reported data are available on the DWR website at:

<http://www.water.ca.gov/groundwater/casgem/>.

## 7.4 Stakeholder Outreach

Two BMOs address public participation in groundwater management activities and coordination with local agencies. The District uses several methods to accomplish this BMO. SVWD discusses groundwater management related activities in noticed regular public meetings of the SVWD Board of Directors. Notification of future meetings and agendas are made publicly available prior to the meeting. Copies of the agenda packages including staff reports are available for public review on the SVWD web site ([www.svwd.org](http://www.svwd.org)).

- SVWD encourages public participation through the development of its Groundwater Management Program annual reports. Copies of the annual report are publicly available on the District's website at <http://svwd.org/resources/reports>.
- SVWD actively participates in the SMGWA and the Santa Cruz Integrated Regional Water Management Group, both forums for developing collaborative solutions with local agencies.
- The District's 2015 Urban Water Management Plan (UWMP) filed with DWR is available at: <http://svwd.org/resources/reports>. The UWMP assesses the District's water supply, guides water use efficiency efforts, and provides a Water Shortage Contingency Plan to be implemented during times of water shortage. The UWMP is required to be updated every five years.

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## 9 ACRONYMS & ABBREVIATIONS

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AMI .....	Automated Metering Infrastructure
amsl .....	above mean sea level
ASR.....	aquifer storage and recovery
bgs .....	below ground surface
BMO .....	Basin Management Objectives
BMP .....	best management practice
CASGEM .....	California Statewide Groundwater Elevation Monitoring
CDDW .....	California Division of Drinking Water
DCE .....	dichloroethylene
DWR.....	California Department of Water Resources
GAC.....	granular activated carbon
GPD .....	gallons per day
gpm .....	gallons per minute
GAC.....	granualted activiated carbon
GSA .....	Groundwater Sustainability Agency
GSP .....	Groundwater Sustainability Plan
GWMP .....	Groundwater Management Plan
GWRA.....	Groundwater Reporting Area
IRWMP .....	Integrated Regional Watershed Management Plan
JPA.....	Joint Powers Agreement
LID.....	low impact development
LTCP .....	Low-Threat Closure Policy
MCL .....	maximum contaminant level
mg/L .....	milligrams per liter
MHA .....	Mount Hermon Association
MRP.....	Monitoring and Reporting Program
MTBE .....	methyl-tert-butyl ether
NPDES .....	National Pollutant Discharge Elimination System
NPL .....	National Priorities List
O&M .....	operations and maintenance
PCE.....	tetrachloroethene
RACR .....	Groundwater Remedial Action Completion Report
RWQCB .....	Central Coast Regional Water Quality Control Board
SCMGB .....	Santa Cruz Mid-County Groundwater Basin
SGMA .....	Sustainable Groundwater Management Act



SLVWD .....	San Lorenzo Valley Water District
SMCL .....	secondary maximum contaminant level
SMGB .....	Santa Margarita Groundwater Basin
SMGBAC .....	Santa Margarita Groundwater Basin Advisory Committee
SMGWA .....	Santa Margarita Groundwater Agency
SVWD .....	Scotts Valley Water District
SWRCB .....	State Water Resources Control Board
TCE .....	trichloroethylene
TDS .....	total dissolved solids
µg/L .....	micrograms per liter
USEPA .....	United States Environmental Protection Agency
UWMP .....	Urban Water Management Plan
VOC .....	volatile organic compounds
WTP .....	water treatment plant
WY .....	Water Year