# NAPA COUNTY

# GROUNDWATER SUSTAINABILITY

## Annual Report – Water Year 2018

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# Napa County Groundwater Sustainability: Annual Report – Water Year 2018

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| Basin Analysis Report | *Napa Valley groundwater sustainability: a basin analysis report for the Napa Valley Subbasin (LSCE, 2016)* |
| BOS | Board of Supervisors |
| CASGEM | California Statewide Groundwater Elevation Monitoring |
| CCP | Center for Collaborative Policy |
| CGS | California Geological Survey |
| Cl | chloride |
| DMS | Database Management System |
| DWR | California Department of Water Resources |
| DFW | California Department of Fish and Wildlife |
| EC | electrical conductivity |
| ET | Evapotranspiration |
| eWRIMS | State Water Resources Control Board Electronic Water Rights Information Management System |
| GDE | Groundwater Dependent Ecosystem |
| GPM | Gallons per minute |
| GRAC | Groundwater Resources Advisory Committee |
| GSA | Groundwater Sustainability Agency |
| GSP | Groundwater Sustainability Plan |
| GWE | Groundwater Elevation |
| GWL | Groundwater Level |
| GWQ | Groundwater Quality |
| IRWMP | Integrated Water Resources Management Plan |
| LGA | Local Groundwater Assistance |
| LSCE | Luhdorff & Scalmanini, Consulting Engineers, Inc. |
| MCL | Maximum Contaminant Level |
| MST | Milliken-Sarco-Tulucay |
| NAVD88 | North American Vertical Datum of 1988 |
| NCFCWCD | Napa County Flood Control and Water Conservation District |
| NSH | Napa State Hospital |
| Plan | *Napa County groundwater monitoring plan 2013* |
| QA, Qa | Quaternary Alluvium |

| | |
|---|---|
| Qsb | Quaternary sedimentary basin |
| RCD | Resource Conservation District |
| RWMG | Regional Water Management Group |
| SGMA | Sustainable Groundwater Management Act |
| SMR | Soil moisture retention |
| Subbasin | Napa Valley Subbasin |
| SWN | State Well Number |
| SWP | State Water Project |
| SWRCB | California State Water Resources Control Board |
| Tss | Tertiary sedimentary rocks |
| Tsv | Tertiary Sonoma volcanic rocks |
| USGS | U.S. Geological Survey |
| UWMP | Urban Water Management Plan |
| WAA | Water Availability Analysis |
| WICC | Watershed Information & Conversation Council |
| WY | Water Year |

# EXECUTIVE SUMMARY

## ES 1 INTRODUCTION

This Report, *Napa County Groundwater Sustainability: Annual Report – Water Year 2018,* presents an update on groundwater conditions and water use in the Napa Valley Subbasin (Subbasin), as required by Section 356.2 of the GSP Regulations. As in the past, the Report also includes an update on groundwater conditions elsewhere in the county. This Report also provides an update on implementation of management actions presented in the 2016 Basin Analysis Report and 2018 Basin Analysis Report Amendment developed to maintain groundwater sustainability.[1]

Groundwater and surface water are highly important natural resources in Napa County. Together, the County and other municipalities, water districts, commercial and industrial operations, the agricultural community, and the general public, are stewards of available water resources. Everyone living and working in Napa County has a stake in protecting the county's groundwater resources, including groundwater supplies, groundwater quality, and associated watersheds (GRAC, 2014).

Since 2008, the County has implemented groundwater management actions to better understand groundwater conditions, conduct education and outreach, modify land use permitting, and develop other programs to assess and maintain groundwater sustainability. These efforts included the adoption of Goals and Policies in Napa County's 2008 General Plan, commencing new studies of the County's groundwater resources in 2009, and creation of a Groundwater Resources Advisory Committee (GRAC; 2011 to 2014) to spearhead management implementation and community outreach.

A Napa County Groundwater Monitoring Plan 2013 (Plan) was prepared to formalize and augment groundwater monitoring efforts conducted as part of a Comprehensive Groundwater Monitoring Program. The Plan recommended annual reports on groundwater conditions and modifications to the countywide groundwater monitoring program as needed. To date, four Annual Reports have been prepared (LSCE, 2015, 2016a, 2017a, and 2018b).

This is the second Annual Report prepared to also meet the annual reporting requirements of the Sustainable Groundwater Management Act (SGMA). In December 2016, Napa County submitted the Napa Valley Subbasin Basin Analysis Report (LSCE, 2016c) as an alternative to a Groundwater Sustainability Plan (GSP) in accordance with the GSP Regulations developed by the California Department of Water Resources (DWR).

## ES 2 GROUNDWATER RESOURCES GOALS AND MANAGEMENT OBJECTIVES

DWR has identified the major groundwater basins and subbasins in and around Napa County. The basins include the Napa-Sonoma Valley (which in Napa County includes the Napa Valley and Napa-Sonoma Lowlands Subbasins), Berryessa Valley, Pope Valley, and a small part of the Suisun-Fairfield Valley

[1] The 2018 Amendment to the Basin Analysis Report is also referenced as the Northeast Napa Management Area Report. See **Section 2.4.3** for more information.

Groundwater Basins (**Figure 2-1**). For purposes of local planning, understanding, and studies, the County has been subdivided into a series of groundwater subareas. These subareas were delineated based on major watersheds, groundwater basins, and the County's environmental resource planning areas (**Figure 2-2**).

The countywide groundwater level monitoring program includes the following objectives:

- Expand groundwater level monitoring in priority County subareas to improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify hydraulic connections in aquifer systems and aquifer-specific groundwater conditions, especially in areas where short- and long-term development of groundwater resources are planned;
- Detect the occurrence of natural or induced factors that affect groundwater levels and trends;
- Identify appropriate monitoring sites to further evaluate groundwater/surface water interaction and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; and update these analyses as additional data become available.

Based on the analysis of existing groundwater data and conditions described in the report *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a) and with input received from the Groundwater Resources Advisory Committee (GRAC), the key objectives for future groundwater level monitoring for each subarea are summarized in LSCE (2013a) and in **Section 3** of this Report.

## ES 2.1 Sustainable Groundwater Management Act

In September 2014, the California Legislature passed the Sustainable Groundwater Management Act (SGMA). SGMA changes how groundwater is managed in the state and includes certain requirements of local agencies managing groundwater basins or subbasins that DWR designates as medium priority or high priority. Previously under the California Statewide Groundwater Elevation Monitoring Program[2] (CASGEM), DWR classified California's groundwater basins and subbasins as either high, medium, low, or very low priority. The CASGEM priority classifications were made based on eight criteria that include the overlying population, the reliance on groundwater, and the number of wells in a basin or subbasin.

[2] CASGEM is the California Statewide Groundwater Elevation Monitoring program implemented under Water Code Part 2.11 Groundwater Monitoring and administered by DWR.

In 2018, DWR began a statewide process to revise the SGMA priority designations that it assigns to groundwater basins.[3] Through that process, DWR changed the designation for the Napa Valley Subbasin from medium priority to high priority (**Figure 2-1**). The increase in priority designation for the Napa Valley Subbasin in 2018 was due primarily to revised projections of future population for the Subbasin, an increased assessment of the total number of wells, and a revised approach to evaluating water quality in the Subbasin compared to the previous prioritization analysis performed in 2014. The change from medium priority to high priority does not affect current requirements for the Napa Valley Subbasin under SGMA. Information about DWR's prioritization process and results can be found on DWR's website: http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm

For most basins designated by DWR as medium priority or high priority, SGMA requires the designation of groundwater sustainability agencies (GSA) and the adoption of groundwater sustainability plans (GSP); or development of an alternative to a GSP, provided that the local entity (entities) can meet certain requirements. Under SGMA, Section 10733.6, a local entity (or entities) can pursue an alternative to a GSP provided that certain sustainability objectives are met. An alternative to a GSP may include "An analysis of basin conditions that demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years" (Section 10733.6(b)(3)). In response to SGMA, Napa County prepared a Basin Analysis Report for the Napa Valley Subbasin per the requirements of Water Code Section 10733.6 (b)(3). While the Basin Analysis Report analyzes areas outside the Subbasin to determine how those areas affect recharge and runoff in the Subbasin, the areas outside the Subbasin are not subject to SGMA. The Basin Analysis Report (LSCE, 2016c) was submitted to DWR on December 16, 2016 in compliance with SGMA.

In June 2018, DWR released draft SGMA basin reprioritization that also included a change for the Napa-Sonoma Lowlands Subbasin (Lowlands Subbasin), which occurs along the lower Napa River, including the Carneros Subarea and American Canyon, and includes areas within Solano County (**Figure 2-1**). The June 2018 draft reprioritization showed the Lowlands Subbasin designation increasing from very low priority to medium priority.

DWR is expected to release a revised draft priority designation for the Lowlands Subbasin in spring 2019. Another public comment period will follow, with final revised priority scheduled to be released in late spring 2019.[4] If the designation is increased to medium priority, the Lowlands Subbasin would become subject to additional requirements under SGMA, including the development of a GSP.

[3] The California Water Code (§10933 and §12924) requires DWR to prioritize California's groundwater basins and subbasins statewide. Details are available at http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm.

[4] More information on the DWR Basin Prioritization is available at this website: https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization

All other Napa County basins and subbasins continue to the designated as very low or low priority according to DWR's revised 2018 scoring.

During the past nine years, Napa County has made significant progress towards executing groundwater-related studies and implementing recommendations provided by those studies to improve local understanding of groundwater conditions. In conformance with SGMA, the GRAC, and the direction of the Napa County Board of Supervisors (April 2014), the Napa Valley Subbasin SGMA Sustainability Goal is:

> *To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply. The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and maintain groundwater sustainability indefinitely without causing undesirable results, including unacceptable economic, environmental, or social consequences.*

The Basin Analysis Report comprises a first step in the implementation of SGMA monitoring and reporting requirements. Consistent with the requirements of Section 356.2 of the GSP Regulations, this Report, *Napa County Groundwater Sustainability: Annual Report – Water Year 2018,* presents:

- An update on groundwater conditions both in the Napa Valley Subbasin and in other areas across the county (see **Section 5**),
- An update on water use in the Napa Valley Subbasin (see **Section 6**),
- An update on the implementation of management actions presented in the 2016 Basin Analysis Report and 2018 Basin Analysis Report Amendment developed to maintain groundwater sustainability (see **Section7**), and
- An update on planned near-term activities, consistent with the Basin Analysis Report management recommendations, to maintain or improve groundwater conditions and ensure overall water resources sustainability in the Napa Valley Subbasin (see **Section 8**).

SGMA implementation activities underway or completed in 2018, in addition to the monitoring efforts and analyses presented in this Report, include (**Figure 7-1**):

A. Designation of the Northeast Napa Management Area within the Napa Valley Subbasin,
B. Application of revised conditions of approval requiring additional monitoring and reporting of groundwater conditions and water use for discretionary projects,
C. Providing tools and training to Napa County well owners to support monitoring and awareness of groundwater conditions in wells that they own,
D. Development of datasets to support the expansion of the groundwater flow model developed for the Northeast Napa Management Area to the entire Napa Valley Subbasin,

E. Developing best available water use data to track water use in the Napa Valley Subbasin and in other areas across the county,

F. Expansion of the streamflow monitoring network and evaluation of water use by Groundwater Dependent Ecosystems in the Napa Valley Subbasin, and

G. Ongoing coordination with other water management and planning programs.

## ES 3 GROUNDWATER MONITORING NETWORK

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in water year 2018. These included 61 sites within the Napa Valley Subbasin (**Table ES-1)**. **Figure 4-1** shows the distribution of sites monitored in 2018 by data reporting entity. Out of the total 108 sites monitored in 2018, 97 were wells monitored by Napa County. Four were wells monitored by DWR. The remaining seven sites are regulated facilities with multiple wells with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Program.

**Table ES-1 Groundwater Level Monitoring Sites in the Napa Valley Subbasin and Napa County Groundwater Subareas**

| Groundwater Basin or Groundwater Subarea | Number of Monitored Sites, Fall 2015 | Number of Monitored Sites, Fall 2016 | Number of Monitored Sites, Fall 2017 | Number of Monitored Sites, Fall 2018 |
|---|---|---|---|---|
| Napa-Sonoma Valley – Napa Valley Subbasin | 56 | 57 | 61 | 61 |
| | | | | |
| Napa Valley Floor-Calistoga | 9 | 7 | 7 | 8 |
| Napa Valley Floor-MST | 27 | 26 | 25 | 24 |
| Napa Valley Floor-Napa | 20 | 21 | 21 | 21 |
| Napa Valley Floor-St. Helena | 14 | 14 | 14 | 14 |
| Napa Valley Floor-Yountville | 14 | 13 | 13 | 13 |
| Carneros | 12 | 12 | 12 | 12 |
| Jameson/American Canyon | 1 | 1 | 1 | 1 |
| Napa River Marshes | - | - | - | - |
| Angwin | 5 | 5 | 5 | 5 |
| Berryessa | 3 | 1 | 1 | 2 |
| Central Interior Valleys | 2 | 2 | 2 | 2 |
| Eastern Mountains | 4 | 3 | 3 | 3 |
| Knoxville | - | - | - | - |
| Livermore Ranch | - | - | - | - |
| Pope Valley | 1 | 1 | 1 | 1 |
| Southern Interior Valleys | - | - | - | - |
| Western Mountains | 1 | 2 | 2 | 2 |
| **Total Sites** | **113** | **108** | **107** | **108** |

The County added one new well to the monitoring network in 2018. The well, designated NapaCounty-230, is in the Calistoga subarea in a zone of transition between the alluvial deposits of the Napa Valley Subbasin and adjacent volcanic rock formations. Also, in 2018, DWR resumed monitoring efforts at four wells that had been suspended in response to multiple, large wildfires that burned in many areas around Napa Valley in October 2017. DWR monitored all four of those wells monthly for much of 2018.

## ES 4 SUMMARY AND RECOMMENDATIONS

### ES 4.1 Groundwater Conditions

Groundwater level trends in the alluvial aquifer system[5] of the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin are stable in the majority of wells with long-term groundwater level records (see **Sections 5.1.1 and 5.1.2**). Groundwater levels showed continued stable conditions in water year 2018.[6]

Water year 2018 was a Dry year (19.3 inches) at a representative precipitation gauge with the longest period of record in the Subbasin (see **Section 5**). Spring 2018 groundwater levels were generally somewhat lower compared to spring 2017, which was conversely a Very Wet year. Overall, despite the reduced recharge potential in 2018 due to Dry year conditions, groundwater levels in fall 2018 remained comparable to levels in recent years. Groundwater levels in spring and fall 2018 were also generally above levels recorded in 2014, the most recent water year with a similar annual precipitation total.

Through February 2019, water year 2019 precipitation has exceeded the entire water year 2018 total at the Napa State Hospital precipitation gauge and is above the long-term median total for all water years since 1950.

For the Napa Valley Subbasin, groundwater levels recorded in 2018 were above the minimum thresholds established as sustainability criteria in 19 of 20 SGMA Representative Wells with water level criteria (see **Section 5.1.3**). The reduction of groundwater levels below the minimum threshold at one of twenty SGMA Representative Wells, 08N06W10Q001M, is most likely the result of a localized groundwater condition, possibly influenced by the Dry water year. Two other wells in the vicinity, NapaCounty-224 and NapaCounty-225, did not experience similar groundwater level conditions in fall 2018. Subsequent monitoring has found that water levels in well 08N06W10Q001M increased throughout the winter of 2018-2019, including an increase of 14 feet even before substantial rainfall occurred. These observations indicate that the fall 2018 groundwater level measurement does not reflect a changed condition in the Napa Valley Subbasin. In response to the fall 2018 groundwater level in well

[5] The alluvial aquifer system of the Quaternary Alluvial Deposits is the principal aquifer supplying water to wells in the Napa Valley Subbasin (LSCE, 2016c).

[6] Consistent with the GSP Regulation, the term “water year” is used in this report to refer to the period from October 1 through the following September 30, with the year designated according to the calendar year in which it ends (i.e., water year 2018 spanned from October 1, 2017 through September 30, 2018).

08N06W10Q001M, the County is reviewing conditions in the vicinity of the well including water use and the location and operation of nearby wells.

Although designated as a groundwater subarea for local planning purposes, the majority of the Milliken-Sarco-Tulucay (MST) subarea is not part of a groundwater basin as mapped by DWR. Groundwater level declines observed in the MST Subarea as early as the 1960s and 1970s have stabilized since about 2009 (see **Section 5.2**). Groundwater level responses differ within the MST Subarea and even within the north, central, and southern sections of this subarea, indicating that localized conditions, whether geologic or anthropogenic in nature, might be the primary influence on groundwater level conditions in this local subarea. An expanding recycled water distribution system in the MST subarea, supplied by the Napa Sanitation District, delivered over 250 acre-feet of recycled water to users in the MST Subarea in water year 2018. Increased use of this new source of water along with continued land use permitting constraints are expected to aid in maintaining stable groundwater level conditions in the MST subarea in the future.

## ES 4.2 Napa Valley Subbasin Groundwater Storage Changes

In the principal aquifer system of the Napa Valley Subbasin, the volume of groundwater in storage decreased in spring 2018 (a dry year) relative to spring 2017 (a very wet year) (see **Section 5.1.4**). The volume of groundwater in storage declined in 2018 by 9,314 acre-feet to a total of 209,984 acre-feet. From 1988 through 2018, the cumulative annual storage changes were 4,388 acre-feet, reflecting a basin in balance and the absence of long-term depletions of groundwater storage within the Subbasin.

Maps of saturated thickness and groundwater storage changes in the principal aquifer system show decreases in saturated thickness and groundwater storage throughout most of the Subbasin between spring 2017 and spring 2018 (**Figures 5-9A and 5-9B**). These decreases are consistent with the reduction in precipitation between 2017 and 2018. Larger decreases in saturated thickness occurred along Dry Creek and in the vicinity of Oak Knoll Avenue. Notably, the reductions in groundwater storage were variable over that area. For example, near the dedicated monitoring well at Dry Creek near Highway 29 declines were much smaller than in the active supply well monitored to the west near the Subbasin margin. This latter observation highlights the value of dedicated monitoring wells.

Changes in saturated thickness of the primary aquifer and groundwater storage volume changes were also evaluated for the period from spring 2014 to spring 2018, for comparison with the most recent year with a similar precipitation total. Saturated thickness and groundwater storage were greater in spring 2018 than in spring 2014 (**Figures 5-10A and 5-10B**). Spring 2018 saturated thickness was generally 0 to 10 feet greater than the saturated thickness in spring 2014 (**Figure 5-10A**).

## ES 4.3 Napa Valley Subbasin Water Use

Total water use in the Napa Valley Subbasin, including groundwater extracted from the Subbasin, surface water from sources within the Napa River Watershed, and imported surface water delivered through the State Water Project, is estimated to have been 37,174 acre-feet in water year 2018 (**Table 6-6**). Total estimated groundwater use in the Subbasin was 17,889 acre-feet. Groundwater use for water

year 2018 is presented along with values for 1988 – 2017 developed previously (LSCE, 2016c and LSCE, 2018b) in **Figure 6-7**. The figure also includes calculated annual and cumulative changes in groundwater storage in the alluvial aquifer system of the Subbasin. As noted above, groundwater storage volume decreased in 2018, by 9,413 acre-feet. Cumulative changes in groundwater storage show a net increase of 4,388 acre-feet from 1988 – 2018 in the principal aquifer of Napa Valley Subbasin (**Table ES-2**).

Groundwater use in water year 2018 was comparable to amounts used in recent years dating back to 2004 (**Figure 6-7**). Over the full 30-year period, annual storage changes in the aquifer system have fluctuated between positive and negative values, generally in accordance with the water year type. Cumulative changes in groundwater storage have also fluctuated between positive and negative values, indicating long-term stable groundwater storage conditions, the absence of chronic depletions of groundwater storage, and an overall condition of a basin in balance. Groundwater use in the Subbasin in water year 2018 remained within the sustainable yield range of 17,000 to 20,000 acre-feet per year identified in the Basin Analysis Report (LSCE, 2016c). **Together, the findings presented in this report regarding groundwater conditions at representative monitoring sites, changes in groundwater storage, and groundwater use demonstrate that the Napa Valley Subbasin has continued to be managed sustainably through 2018.**

For water year 2018, an additional analysis of groundwater use by Groundwater Dependent Ecosystems (GDEs)[7] was conducted to improve the understanding of their groundwater use relative to other users in the Subbasin. Likely and potential GDEs depicted in the Basin Analysis Report were used for the analysis (**Figure 6-8**, see also LSCE, 2016c). Estimates of groundwater use by GDEs for water year 2018 were developed using spatial evapotranspiration datasets developed using LandSat imagery and processed according to the METRIC Evapotranspiration (ET) method.[8]

The GDE ET analysis found that total groundwater use by GDEs, as determined from evapotranspiration data, was between 3,632 acre-feet and 4,721 acre-feet during the months when groundwater would be the dominant source of water available to GDEs (**Table 6-7**). The result indicates that groundwater use by GDEs in water year 2018 was approximately 20% to 26% of the total groundwater use of 17,889 acre-feet by other uses and users in the Subbasin (**Table 6-6**). This analysis provides a numerical point of comparison that will be useful going forward, along with updated GDE mapping, to understand the distribution and health of GDEs over time.

[7] Groundwater Dependent Ecosystems were initially identified in the Basin Analysis Report based on a review of a draft dataset of potential groundwater dependent ecosystems under development by The Nature Conservancy, in collaboration with DWR and California Department of Fish and Wildlife (DFW), as the Basin Analysis Report was being developed. The Napa Valley Subbasin GDEs include a variety of wetland and vegetation communities that may rely on groundwater as a water supply.

[8] Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) is an analytical method that applies an energy balance method to calculate field-scale evapotranspiration using energy flux data collected by satellites, paired with data from ground reference points.

The results from the GDE ET analysis are not additive for the purposes of evaluating annual use of groundwater relative to the sustainable yield for the Subbasin, because the Basin Analysis Report (LSCE, 2016c) evaluated sustainable yield in the context of "withdrawals" from the Subbasin due to groundwater pumping and not outflows due to ET or subsurface outflows to the Lowland Subbasin, though the latter two components were explicitly addressed and the water budget analysis presented in the Basin Analysis Report. GDEs are among the beneficial users of groundwater in the Subbasin, but they are not a user that the County proposes to constrain. Instead, the use of Groundwater by GDEs represents one indication of the health of GDEs that the County is working to better understand, per recommendations in the Basin Analysis Report.

**Table ES-2 Napa Valley Subbasin Principal Aquifer Groundwater Storage Changes, Water Years 1988 - 2018**

| Water Year | Water Year Classification | Napa Valley Subbasin Alluvial Aquifer Storage (Acre-feet) | Annual Storage Change (Acre-feet) | Cumulative Storage Change (Acre-feet) |
|---|---|---|---|---|
| 1988 | Normal (below average) | 205,596 | - | - |
| 1989 | Normal (below average) | 198,305 | (7,290) | (7,290) |
| 1990 | Dry | 202,469 | 4,164 | (3,126) |
| 1991 | Dry | 192,046 | (10,424) | (13,550) |
| 1992 | Normal (below average) | 212,532 | 20,486 | 6,936 |
| 1993 | Wet | 215,486 | 2,953 | 9,890 |
| 1994 | Dry | 208,000 | (7,486) | 2,404 |
| 1995 | Very Wet | 215,361 | 7,361 | 9,765 |
| 1996 | Wet | 211,141 | (4,220) | 5,545 |
| 1997 | Wet | 216,835 | 5,695 | 11,239 |
| 1998 | Very Wet | 219,733 | 2,898 | 14,138 |
| 1999 | Normal (above average) | 219,981 | 247 | 14,385 |
| 2000 | Normal (above average) | 213,878 | (6,103) | 8,282 |
| 2001 | Dry | 210,997 | (2,881) | 5,401 |
| 2002 | Normal (above average) | 214,534 | 3,537 | 8,938 |
| 2003 | Wet | 208,394 | (6,140) | 2,798 |
| 2004 | Normal (below average) | 204,592 | (3,802) | (1,004) |
| 2005 | Wet | 217,650 | 13,058 | 12,054 |
| 2006 | Very Wet | 222,904 | 5,254 | 17,308 |
| 2007 | Very Dry | 200,359 | (22,545) | (5,237) |
| 2008 | Normal (below average) | 201,029 | 670 | (4,567) |
| 2009 | Normal (below average) | 205,160 | 4,132 | (436) |
| 2010 | Wet | 210,929 | 5,769 | 5,333 |
| 2011 | Wet | 214,705 | 3,776 | 9,109 |
| 2012 | Normal (below average) | 210,338 | (4,367) | 4,742 |
| 2013 | Normal (below average) | 201,193 | (9,145) | (4,403) |
| 2014 | Dry | 191,523 | (9,670) | (14,073) |
| 2015 | Normal (below average) | 208,771 | 17,248 | 3,175 |
| 2016 | Normal (below average) | 214,827 | 6,056 | 9,232 |
| 2017 | Very Wet | 219,298 | 4,470 | 13,702 |
| **2018** | **Dry** | **209,984** | **(9,314)** | **4,388** |
| | **Average (1988 – 2018)** | **209,631** | **146** | |
| | **Median (1988 – 2018)** | **210,929** | **1,784** | |

## ES 4.4 Recommendations for Continued SGMA Implementation[9]

The following paragraphs provide an update on planned near-term activities, consistent with management recommendations previously supported by the Napa County Board of Supervisors in the Basin Analysis Report (LSCE, 2016c) and Northeast Napa Management Area Report (LSCE, 2018a) to maintain or improve groundwater conditions and ensure overall water resources sustainability in the Napa Valley Subbasin.

### ES 4.4.1 Update the Napa County Groundwater Program Communication and Education Plan (SGMA Implementation Recommendation 5.1b and 5.2a)

Update and revise the 2012 Communications and Education Plan developed by the Groundwater Resources Advisory Committee to incorporate recent guidance from DWR regarding public outreach and stakeholder engagement consistent with the requirements of SGMA. As part of the review, the County will receive input from the WICC and others on way to improve communications and engagement related to SGMA implementation activities. The County will review and update the Outreach and Education Plan based on the input received from the WICC and others.

### ES 4.4.2 Data Gap Refinement (SGMA Implementation Recommendations 11, 13, and 14)

Outreach to well owners in Napa County will continue through the WICC, County website and groundwater list-serve, public presentations regarding groundwater conditions, and other means to solicit wells for voluntary inclusion in the County's monitoring network. Napa County will also review discretionary projects recently approved by the County with conditions of approval requiring that project wells be made available for inclusion in the County's monitoring network.

Coordination with other county departments and other agencies that collect or utilize groundwater data could also provide additional data in areas of interest. Several local agencies, including the Town of Yountville, City of St. Helena, and City of Napa, already monitor groundwater levels at locations around the county.

### ES 4.4.3 Ongoing Water Quality Sampling (SGMA Implementation Recommendation 15)

Groundwater quality sampling is recommended to continue at wells throughout the Napa Valley Subbasin and Napa-Sonoma Lowlands Subbasin in 2019. Additional water quality sampling for a reduced set of constituents, including nitrate and chloride, is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites. These sites were previously sampled in 2015 and 2018.

[9] The Basin Analysis Report for the Napa Valley Subbasin includes a comprehensive list of monitoring and management recommendations developed since 2011. Additional recommendations developed as part of the Basin Analysis Report and the Northeast Napa Management Area Report were added to the list in sequence, beginning at number 13. Recommendations 1 – 12 are referenced in this Section where applicable to ongoing activities.

### ES 4.4.4 Improve Data Collection and Evaluation from Discretionary Permittees Required to Monitor Groundwater Conditions and Groundwater Use (SGMA Implementation Recommendations 16 and 25)

Through coordination between the Napa County Public Works Department and Planning, Building, and Environmental Services Department, continue to improve procedures for receiving data reported by permittees required to report groundwater data and regularly incorporate those data into the Napa County Groundwater Data Management System.

### ES 4.4.5 Evaluate Strategic Recharge and Water Conservation Opportunities (SGMA Implementation Recommendations 8 and 19)

While additional data are being utilized to improve the understanding of water use by public water systems throughout the county, data gaps remain regarding water use on vineyards and other irrigated crops. As part of continued revisions to the water budget analysis for the Napa Valley Subbasin, it is recommended that the County hold workshops with agricultural industry representatives to develop a shared understanding of water use practices applied across the Subbasin, including irrigation, frost and heat protection, and tile drainage operations. In addition to providing shared information, the workshops would be held to further improve the calibration of the Napa Valley Subbasin groundwater model and the water budget analysis developed for the SGMA Basin Analysis Report revision.

### ES 4.4.6 Evaluate Distribution of Groundwater Dependent Ecosystems; Coordinate Evaluation with Guidance Developed by DWR, The Nature Conservancy, California Native Plant Society or Others (SGMA Implementation Recommendations 11 and 20)

In 2019 with technical assistance from the Napa County Resource Conservation District (Napa RCD), Napa County will continue to review guidance on evaluating GDEs recently released by The Nature Conservancy (2018), in order to refine the mapping and assessment of GDEs presented in the Basin Analysis Report. Part of this effort is planned to be expanded in order to allow data collection by volunteers using a custom-built website application that is currently under testing by Napa County, with data collection occurring at 13 sites. Through this approach, Napa County will be able to efficiently collect standardized information and photographs documenting streamflow conditions at priority sites multiple times throughout the year. This information will complement existing stream gaging station data collected by Napa County, the Napa RCD, and U.S. Geological Survey.[10]

### ES 4.4.7 Update the Napa County Groundwater Ordinance for the Northeast Napa Management Area (SGMA Implementation Recommendation 28)

On October 24, 2017, the Napa County Board of Supervisors directed County staff to update the Napa County Groundwater Ordinance to reflect the additional requirements for project-specific analysis and to incorporate water use criteria and water use reporting requirements for the Northeast Napa Management Area using an approach similar to what has already been implemented in the MST Subarea. In response, Napa County Public Works Department and Planning, Building, and Environmental

[10] see https://napa.onerain.com/home.php

Services Department staff are currently coordinating resources to develop an update to the Groundwater Ordinance. The Planning, Building, and Environmental Services Department has developed specific mapping data to assist and alert its land use planners when a project is located in the Northeast Napa Management Area. For discretionary projects in the Northeast Napa Management Area, additional project-specific analyses (Napa County Water Availability Analysis-Tier 2) will be required to ensure that the proposed project location or planned use of groundwater does not cause an undesirable result (e.g., locate proposed wells at appropriate distances from surface water [or consider well construction approaches that avoid streamflow effects] and avoid mutual well interference to neighboring wells) (Napa County, 2015).

### ES 4.4.8 Continue to Implement Improvements to Napa County's Data Management System (SGMA Implementation Recommendation 1.1b)

In 2017, Napa County developed a field data tool to assist staff in the collection and management of groundwater level data. A pilot, mobile application (Collector Application) was developed using ArcGIS Online and tested by County staff. In 2018, Napa County continued to test and improve the application's functionality and integration with the County's Data Management System (DMS), which now allows for improved well data management and spatial mapping. Continued improvements are recommended to integrate other data sources into the DMS, such as recently available water use data available through the State Water Resources Control Board.

### ES 4.4.9 Develop Well Testing Standards (SGMA Implementation Recommendation 30)

Consistent with the recommendation approved by the Board of Supervisors in the January 2018 Amendment to the Basin Analysis Report for the Napa Valley Subbasin, it is recommended that Napa County develop appropriate standards and require that pumping test data be collected when new production wells are constructed in areas where the distribution of hydraulic conductivities is less well known, including the Northeast Napa Management Area east of the Napa River and in deeper geologic units throughout the rest of the Napa Valley Subbasin. Because older and less productive geologic formations occur near ground surface in the northeast Napa Area east of the Napa River, it is likely that pump tests will need to be performed for all new production wells in that area (**Figure 2-1).** Test results will not only provide valuable information regarding aquifer properties; true pump testing will provide well owners with more meaningful information about well capacity than the typical tests of well yield reported on historical well completion reports. Similar pump testing will be required for non-domestic production wells, and for wells that are completed in deeper units below the Quaternary alluvium throughout the Napa Valley Subbasin.

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# 1 INTRODUCTION

## 1.1 Purpose

This Report, *Napa County Groundwater Sustainability: Annual Report – Water Year 2018* [11], presents an update on groundwater conditions and water use in the Napa Valley Subbasin (Subbasin), as required by Section 356.2 of the GSP Regulations. As in the past, the Report also includes an update on groundwater conditions elsewhere in the county. This Report also provides an update on the recommended SGMA implementation actions presented in the Basin Analysis Report and the Northeast Napa Management Area Report. **Table 1-1** provides a cross reference between the required Annual Report elements described in the GSP Regulations and the corresponding components included in this Report.

Groundwater and surface water are highly important natural resources in Napa County. Together, the County, municipalities, water districts, commercial and industrial operations, the agricultural community, and the public are stewards of available water resources. Everyone living and working in Napa County has a stake in protecting the county's groundwater resources, including groundwater supplies, quality, and associated watersheds (GRAC, 2014). Without sustainable groundwater resources, the character of the County would be significantly different in terms of its economy, communities, rural character, ecology, housing, and lifestyles.

Similar to other areas in California, businesses and residents of Napa County face many water-related challenges including:

- Sustaining the quality, availability, and reliability of local and imported water supplies;
- Meeting challenges that arise during drought and flood conditions;
- Avoiding adverse environmental effects due to water use; and
- Changes in long-term water availability due to climate change.

To address these challenges, long-term, systematic monitoring programs are essential to provide data and the scientific analyses that allow for improved evaluation of water resources conditions and to facilitate effective water resources planning and management. As early as 2009, Napa County embarked on a countywide project referred to as the "Comprehensive Groundwater Monitoring Program, Data Review, and Policy Recommendations for Napa County's Groundwater Resources" (Comprehensive Groundwater Monitoring Program), to meet action items identified in the 2008 General Plan update. The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for ongoing coordinated, integrated water resources planning and management.

On June 28, 2011, the Napa County Board of Supervisors adopted a resolution to establish a Groundwater Resources Advisory Committee (GRAC). On September 20, 2011, the Board of Supervisors

[11] Consistent with the GSP Regulation, the term "water year" is used in this report to refer to the period from October 1 through the following September 30, with the year designated according to the calendar year in which it ends (i.e., water year 2018 spanned from October 1, 2017 through September 30, 2018).

appointed 15 residents to the GRAC, which held its first organizational meeting on October 27, 2011. GRAC members represented diverse interests, including environmental, agricultural, development, and community interests.

The GRAC was created to assist County staff and technical consultants with recommendations regarding:

- Synthesis of existing information and identification of critical data needs;
- Development and implementation of an ongoing non-regulatory groundwater monitoring program;
- Development of revised well pump test protocols and related revisions to the County's groundwater ordinance;
- Conceptualization of hydrogeologic conditions in various areas of the County and an assessment of groundwater resources as data become available;
- Development of groundwater sustainability objectives that can be achieved through voluntary means and incentives; and
- Building community support for these activities and next steps.

From January 2012 until January 2013, the GRAC reviewed and provided feedback on the development of the *Napa County Groundwater Monitoring Plan 2013* (Plan) (LSCE, 2013a).

The Plan was prepared to formalize and augment groundwater monitoring efforts to better understand the groundwater resources of Napa County. The Plan aids in making the County eligible for public funds administered by the California Department of Water Resources (DWR) and establishes regular evaluation of trends to identify changes in levels and/or quality and factors related to those changes that warrant further examination to ensure sustainable groundwater resources over the long-term. The Plan included refinement of criteria used to identify priority monitoring areas, a proposed expanded monitoring network, and the annual reporting of groundwater conditions (the purpose of this report).

The Napa County groundwater monitoring program relies on both publicly-owned and volunteered private wells. To fulfill its mission and garner community interest and support, the GRAC developed a Communication and Education Plan, designed to implement the Plan through voluntary participation. This effort included the development of an outreach brochure and a series of fact sheets on specific topics.

Some of the many activities accomplished by the GRAC in 2011 to 2014 included:

- Provided updates to agriculture industry groups, environmental organizations and others;
- Led and supported outreach efforts to well owners for volunteer monitoring wells, which has been very successful in adding new wells to the Napa County groundwater monitoring program;
- Held a joint public outreach meeting of the GRAC and Watershed Information and Conservation Council (WICC) Board (July 25, 2013);

- Reviewed and recommended modifications to the Napa County Water Availability Analysis and Groundwater Ordinance; and
- Developed and approved Groundwater Sustainability Objectives (GRAC, 2014).

The Plan recommended annual reports on groundwater conditions and modifications to the countywide groundwater monitoring program as needed. To date, four Annual Reports have been prepared (LSCE, 2015, 2016a, 2017a, and 2018b). This is the second Annual Report prepared to also meet the annual reporting requirements of the Sustainable Groundwater Management Act (SGMA).

In December 2016, Napa County submitted the Napa Valley Subbasin Basin Analysis Report (LSCE, 2016c) as an alternative to a Groundwater Sustainability Plan (GSP) in accordance with the GSP Regulations developed by DWR. Development of a Basin Analysis Report was possible in part because of groundwater resources studies and management activities initiated in prior years, including many that were completed with assistance from the GRAC. As with any GSP, progress towards maintaining sustainable groundwater conditions in the Napa Valley Subbasin did not end with submittal of the Basin Analysis Report. Additional public outreach and scientific studies are underway to improve upon best-available datasets regarding groundwater conditions, water use, surface water-groundwater interactions, groundwater dependent ecosystems, and other priorities identified in the Basin Analysis Report.

**Table 1-1 Groundwater Sustainability Plan Regulations**
**Annual Reporting Requirements**

| GSP Regulations Reference | Required Component Summary | Corresponding Annual Report Contents |
|---|---|---|
| 356.2(a) | General Information, including an executive summary and location map depicting the basin covered by the report | Executive Summary, Figure 2-1 |
| 356.2(b)(1)(A) | Groundwater elevation contour maps for each principal aquifer in the basin | Section 5.1, Figures 5-5 and 5-6 |
| 356.2(b)(1)(B) | Hydrographs of groundwater elevations and water year type | Section 5.1, Table 5-1, Figure 5-1, Figure 5-7, Figure 5-8, Appendix B |
| 356.2(b)(2) | Groundwater extraction for the preceding water year | Section 6.1, Figure 6-5, Figure 6-6, Table 6-6 |
| 356.2(b)(3) | Surface water supply used or available for use for groundwater recharge or in-lieu use for the preceding water year | Section 6.2, Table 6-8 |
| 356.2(b)(4) | Total water use by water use sector | Section 6.1, Table 6-3, Table 6-4, Table 6-5, Table 6-6, Table 6-7 |
| 356.2(b)(5)(A) | Change in groundwater storage maps for each principal aquifer in the basin | Section 5.1.4, Figure 5-9B, Figure 5-10B |
| 356.2(b)(5)(B) | A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available | Section 6.1, Figure 6-7 |
| 356.2(c) | A description of progress towards implementing the Plan (Basin Analysis Report) | Section 5.1.3, Table 5-2, Section 7, Table 7-1, Figure 7-1 |

## 1.2 Organization of Report

This Report summarizes activities implemented to improve the understanding of groundwater resource conditions and availability and actions taken by the County to ensure groundwater sustainability.

The Report includes the following sections:

**Section 2: Hydrogeology of Napa County**

- DWR Basins/Subbasins and County Subareas
- Summary of Geology and Groundwater Resources
- Groundwater Studies and Programs: 2009 – 2018
- Recent Groundwater Reports

**Section 3: Groundwater Resources Goals and Management Objectives**

- Napa County Water Resources Goals and Policies
- Overarching Groundwater Monitoring Objectives

**Section 4: Groundwater Monitoring Network**

- Groundwater Level Monitoring
- Surface Water-Groundwater Monitoring
- Representative Monitoring Sites

**Section 5: Groundwater Level Trends and Flow Directions**

- Napa Valley Floor Subbasin
    - Napa Valley Subbasin – Calistoga and St. Helena Subareas
    - Napa Valley Subbasin – Yountville and Napa Subareas
    - Napa Valley Subbasin Sustainability Indicators
    - Napa Valley Subbasin Groundwater Level Change in Storage
- Milliken-Sarco-Tulucay (MST) Subarea
- Napa-Sonoma Lowlands Subbasin and Subareas South of the Napa Valley Floor
- Subareas East and West of the Napa Valley Floor
- Pope Valley Subbasin and Pope Valley Subarea
- Angwin Subarea
- Napa Valley Surface Water-Groundwater Monitoring

## Section 6: Napa Valley Subbasin Water Use and Surface Water Availability

- Water Use by Sector
- Surface Water Supply Available for Use for Groundwater Recharge or In-lieu Use

## Section 7: Implementation of the Basin Analysis Report for the Napa Valley Subbasin

- Expand the Capacity to Encourage Groundwater Stewardship
- Napa Valley Subbasin Groundwater Model Dataset Development
- Developing Best Available Water Use Data
- Evaluation of Groundwater Dependent Ecosystem Water Use
- Coordination with Other Water Management and Planning Programs
- Integrated Regional Water Management Plans
- Napa County Watershed Information and Conservation Council of Napa County
- Northeast Napa Management Area Designation
- Revised Conditions of Approval for Discretionary Permits

## Section 8: Summary and Recommendations

- Update the Napa County Groundwater Program Communication and Education Plan
- Data Gap Refinement
- Ongoing Water Quality Sampling
- Improve Data Collection and Evaluation from Discretionary Permittees Required to Monitor Groundwater Conditions and Groundwater Use
- Evaluate Strategic Recharge and Water Conservation Opportunities
- Evaluate Distribution of Groundwater Dependent Ecosystems; Coordinate Evaluation with Guidance from DWR, The Nature Conservancy, California Native Plant Society or Others
- Update the Napa County Groundwater Ordinance for the Northeast Napa Management Area
- Continue to Implement Improvements to Napa County's Data Management System
- Develop Well Testing Standards

# 2 HYDROGEOLOGY OF NAPA COUNTY

This section summarizes the countywide geologic and hydrologic setting and includes information about Department of Water Resources (DWR) groundwater basin/subbasin delineations and prioritizations, and a description of the Napa County groundwater monitoring subareas. Numerous studies that form the basis of the understanding of County hydrogeology are referenced, including the *Updated Hydrogeologic Conceptualization and Characterization of Conditions* (LSCE and MBK, 2013).

## 2.1 DWR Basins/Subbasins and County Subareas

DWR has identified the major groundwater basins and subbasins in and around Napa County. The basins include the Napa-Sonoma Valley (which in Napa County includes the Napa Valley and Napa-Sonoma Lowlands Subbasins), Berryessa Valley, Pope Valley, and a small part of the Suisun-Fairfield Valley Groundwater Basins (**Figure 2-1**). These basins and subbasins are generally defined based on boundaries to groundwater flow and the presence of water-bearing geologic units. These groundwater basins defined by DWR are not confined within county boundaries, and DWR-designated "basin" or "subbasin" designations do not cover all of Napa County.

Groundwater conditions outside of the DWR-designated basins and subbasins are also very important in Napa County. An example of such an area is the Milliken-Sarco-Tulucay (MST) area, a locally identified groundwater deficient area. For purposes of local planning, understanding, and studies, the County has been subdivided into a series of groundwater subareas (**Figure 2-2**). These subareas were delineated based on the main watersheds and the County's environmental resource planning areas, and with consideration of groundwater basins; these geographic subareas are not groundwater basins or subbasins. The subareas include the Knoxville, Livermore Ranch, Pope Valley, Berryessa, Angwin, Central Interior Valleys, Eastern Mountains, Southern Interior Valleys, Jameson/American Canyon, Napa River Marshes, Carneros, Western Mountains Subareas and five Napa Valley Floor Subareas (Calistoga, St. Helena, Yountville, Napa, and MST).[12]

Previously under the California Statewide Groundwater Elevation Monitoring Program (CASGEM)[13], DWR classified California's groundwater basins and subbasins as either high, medium, low, or very low priority.

In 2018, DWR began a statewide process to revise the groundwater basin priority designations that it previously published in 2014.[14] Through that process, DWR changed the designation for the Napa Valley

[12] The majority of the following Napa Valley Floor Subareas align with the Napa Valley Subbasin: Calistoga, St. Helena, Yountville, and Napa. Most of the Napa Valley Floor-MST Subarea is located outside of the Napa Valley Subbasin and other designated basins or subbasins in Napa County.

[13] CASGEM is the California Statewide Groundwater Elevation Monitoring program implemented under Water Code Part 2.11 Groundwater Monitoring and administered by DWR.

[14] The California Water Code (§10933 and §12924) requires DWR to prioritize California's groundwater basins and subbasins statewide. Details are available at http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm.

Subbasin from medium priority to high priority, according to criteria specified in California Water Code Part 2.11 Groundwater Monitoring. The priority designation method used by DWR primarily considers the population within a basin or subbasin, projected population growth, the density of wells, overlying irrigated agriculture, and the degree to which groundwater is used as a source of supply. The change from medium priority to high priority does not affect requirements for the Napa Valley Subbasin under SGMA.

The increase in priority designation for the Napa Valley Subbasin in 2018 was due primarily to revised projections of future population for the Subbasin, an increased assessment of the total number of wells, and a revised approach to evaluating water quality in the Subbasin compared to the previous prioritization analysis performed in 2014.

The 2018 draft SGMA basin reprioritization released in June also included a change for the Napa-Sonoma Lowlands Subbasin (Lowlands Subbasin), which occurs along the lower Napa River, including the Carneros Subarea and American Canyon, and includes areas within Solano County (**Figure 2-1**). DWR's June 2018 draft reprioritization showed the Lowlands Subbasin designation increasing from very low priority to medium priority. Napa County, Solano County, and Solano County Water Agency submitted comments providing updated technical information to demonstrate that the coarse-scale analysis conducted by DWR for the draft reprioritization resulted in an inaccurate designation change. DWR is expected to release a revised draft priority designation for the Lowlands Subbasin in spring 2019. A public comment period will follow, with final revised priority scheduled to be released in late spring 2019.[15] If the designation is increased to medium priority, the Lowlands Subbasin would become subject to additional requirements through SGMA, including the development of the Groundwater Sustainability Plan (GSP).

The timing of the final reprioritization for the Lowlands Subbasin was affected by a minor basin boundary modification request submitted by the Sonoma Valley Subbasin Groundwater Sustainability Agency. The basin boundary modification was submitted with the goal of aligning the boundary between the Sonoma Valley Subbasin and the Lowlands Subbasin to the Napa-Sonoma County boundary. Previously, the subbasin boundary deviated from the county boundary such that several hundred acres in Napa County were mapped within the Sonoma Valley Subbasin, and vice-versa. The basin boundary modification request was supported by Napa County and the Los Carneros Water District. DWR approved the boundary modification on February 11, 2019.

## 2.2 Summary of Geology and Groundwater Resources

### 2.2.1 Previous Studies

Previous hydrogeologic studies and mapping efforts in Napa County are divisible into geologic studies and groundwater studies. The more significant studies and mapping efforts are mentioned in this

[15] More information on the DWR Basin Prioritization is available at this website: https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization

section. **Table 2-1** shows the chronological sequence of these numerous efforts that span more than six decades. Weaver (1949) presented geologic maps which covered the southern portion of the county and provided a listing of older geologic studies. Kunkel and Upson (1960) examined the groundwater and geology of the northern portion of the Napa Valley. DWR (Bulletin 99, 1962) presented a reconnaissance report on the geology and water resources of the eastern area of the County; Koenig (1963) compiled a regional geologic map which encompasses Napa County. Fox and others (1973) and Sims and others (1973) presented more detailed geologic mapping of Napa County. Faye (1973) reported on the groundwater of the northern Napa Valley. Johnson (1977) examined the groundwater hydrology of the MST area.

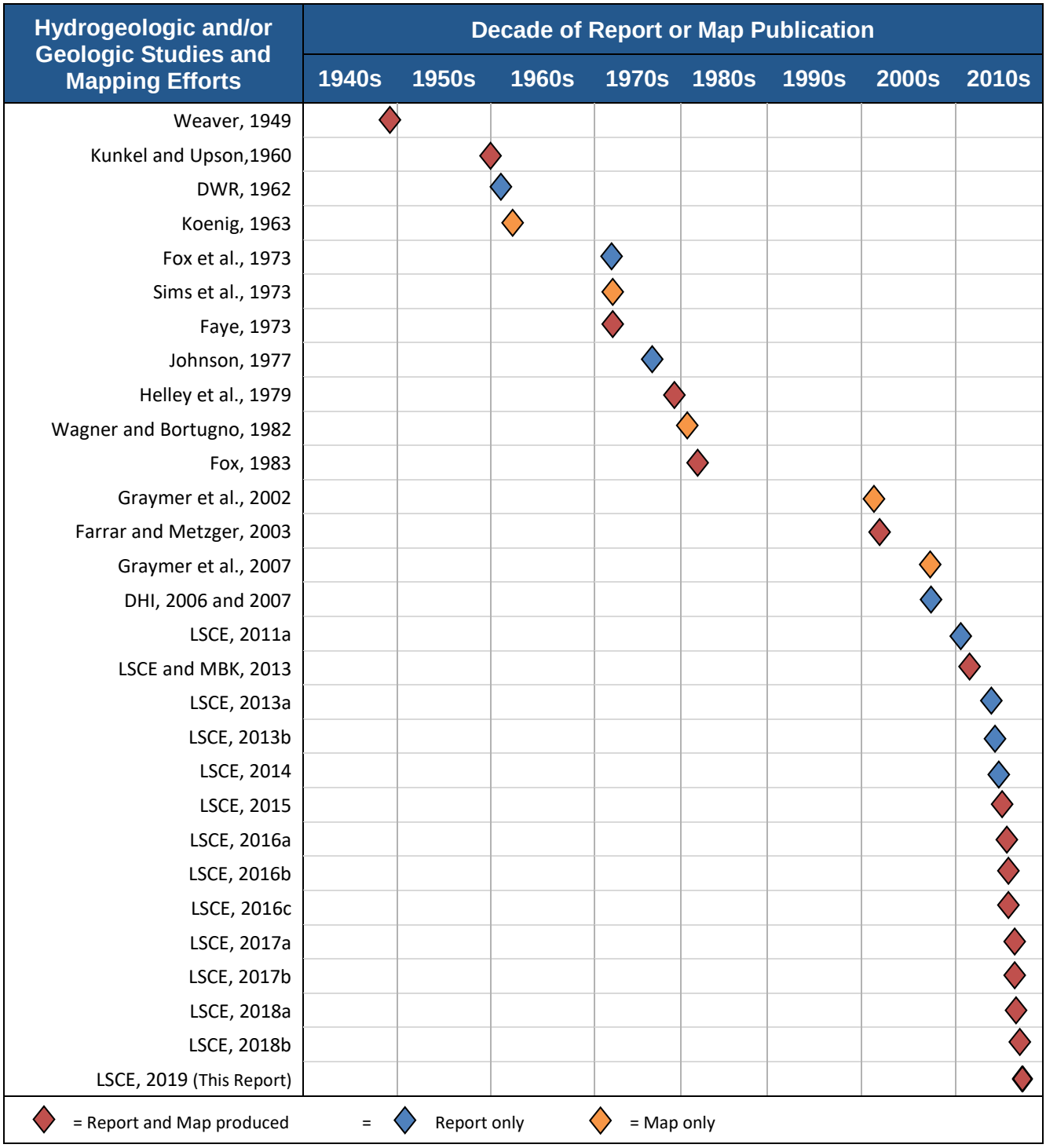
Helley and others (1979) summarized the flatland deposits of the San Francisco Bay Region, including those in Napa County. Fox (1983) examined the tectonic setting of Cenozoic rocks, including Napa County. Farrar and Metzger (2003) continued the study of groundwater conditions in the MST area.

Wagner and Bortugno (1982) compiled and revised the regional geologic map of Koenig (1963). Graymer and others (2002) presented detailed geologic mapping of the southern and portions of the eastern areas of the County, while Graymer and others (2007) compiled geologic mapping of the rest of Napa County.

In 2005 to 2007, DHI Water & Environment (DHI) contributed to the 2005 *Napa County Baseline Data Report* (DHI, 2006a and Jones & Stokes et al., 2005) which was part of the County's General Plan update (Napa County, 2008). A computer model was developed by DHI in conjunction with the Napa Valley and Lake Berryessa Surface Water models to simulate existing groundwater and surface water conditions on a regional basis primarily in the North Napa Valley and the MST and Carneros Subareas (DHI, 2006b). A 2007 technical memorandum, *Modeling Analysis in Support of Vineyard Development Scenarios Evaluation* (DHI, 2007), was prepared to document the groundwater model update which was used to evaluate various vineyard development scenarios.

Additional geologic maps, groundwater studies, and reports are listed in the references of the *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a). Additional work has been conducted to update the conceptualization and characterization of hydrogeologic conditions particularly for the Napa Valley Floor (LSCE and MBK, 2013 and LSCE, 2013b).

**Table 2-1 Summary and Chronology of Hydrogeologic and Geologic Studies and Mapping Efforts in Napa County**




Highlights of additional groundwater studies between 2009 and 2018 are provided in Section 2.3 followed by summaries of the recent reports in Section 2.4 including: 1) *Napa County*

*Groundwater/Surface Water Monitoring Facilities to Track Resource Interrelationships and Sustainability* (LSCE, 2016b)*, 2) Napa Valley Groundwater Sustainability: A Basin Analysis Report* (LSCE, 2016c), 3) *Northeast Napa Area: Special Groundwater Study* (LSCE, 2017b), and 4) *Napa Valley Groundwater Sustainability Northeast Napa Management Area: An Amendment to the 2016 Basin Analysis Report for the Napa Valley Subbasin* (LSCE, 2018a).

### 2.2.2 Precipitation Monitoring and Water Year Classifications

Infiltration of precipitation has been shown to provide significant groundwater recharge in Napa County, particularly in unconsolidated geologic settings (Kunkel and Upson 1960, LSCE and MBK 2013).

Precipitation records in Napa County date to 1906 at the longest continually operating gauge at the Napa State Hospital (GHCND: USC00046074). In a separate analysis, precipitation data from the Napa State Hospital gauge in Napa (elevation 35 feet) have been shown to have strong linear correlations (i.e., $R^2 \geq 0.90$) with monthly and annual precipitation totals from two other gauges in St. Helena (elevation 1,780 feet) and Angwin (elevation 1,815 feet) (2NDNature, 2014). Based on the strength of those correlations, the Napa State Hospital gauge has been recommended for use as an index gauge for the Napa River Watershed.

The water year classification presented in **Table 2-2** is revised from the version developed by 2NDNature (2014). The classification presented here accounts for gaps in the daily precipitation record at the Napa State Hospital gauge. Specifically, missing daily precipitation data in the Napa State Hospital gauge record from water years 1920 through 2015 were estimated based on daily data from the St. Helena precipitation gauge (GHCND: USC0004764) and Oakville precipitation gauge (elevation: 190 feet, CIMIS Station No. 77). These gauges show very strong linear correlations (i.e., $R^2 > 0.99$) for cumulative daily data from the Napa State Hospital gauge. Estimated daily precipitation values were calculated to fill gaps in the Napa State Hospital gauge record using observed values from either the Oakville or St. Helena gauges and the linear regression for cumulative daily precipitation between those gauges and the Napa State Hospital gauge.

A frequency analysis was used to define Very Dry, Dry, Normal, Wet, and Very Wet water year types according to exceedance probabilities calculated from the 96-year period of record for precipitation at the Napa State Hospital gauge from water years 1920 through 2015. Data from water years prior to 1920 were excluded from the frequency analysis due to large gaps in the Napa State Hospital gauge record prior to that year that were not able to be estimated using data from other gauges. Further information regarding precipitation in Napa County is included in **Section 5**.

**Table 2-2 Napa River Watershed Water Year Classification**

| Year Type | Water Year Precipitation Total | | Annual Precipitation Exceedance Probability (%) | Number of Years in Period of Record |
|---|---|---|---|---|
| | Lower Bound (inches) | Upper Bound (inches) | | |
| Very Dry | | 15.19 | ≥ 91 | 9 |
| Dry | 15.20 | 19.67 | ≥ 67 | 23 |
| Normal | 19.68 | 26.99 | ≥ 33 | 33 |
| Wet | 27.00 | 36.75 | ≥ 10 | 22 |
| Very Wet | 36.76 | | < 10 | 9 |
| Napa State Hospital (NSH) Average Annual Water Year Precipitation (1920 – 2015) = 24.86 inches<br>Period of record used for frequency analysis: 1920 – 2015 | | | | |

Direct infiltration of precipitation is a major component of recharge in the main Napa Valley Floor. Outside of the Napa Valley Floor, percolation of surface water appears to be the primary source of recharge. The rate of recharge within areas such as the MST Subarea has been shown to be significantly higher where streams and tributaries cross highly permeable outcrops (e.g., the tuffaceous member of the Sonoma Volcanics or shallow alluvium). Recharge outside of the Napa Valley Floor, throughout much of the county is generally limited by underlying shallow bedrock of low permeability. An additional component of groundwater recharge that is less understood is deep percolation through fractured rock and fault zones. This type of recharge can be very difficult to quantify due to the highly variable size and distribution of faults, fractures, and joints in a given area.

### *Groundwater Occurrence and Quality in the Sonoma Volcanics*

Groundwater occurs in the Sonoma Volcanics in Napa County and yields water to wells. Well yields are highly variable from less than 10 to several hundred gallons per minute (gpm). The most common yields are between 10 to 100 gpm. Faye (1973) reported well-test information which showed an average yield of 32 gpm and an average specific capacity of 0.6 gallons per minute per foot of drawdown. From the available well log data, the Tertiary marine sedimentary rocks are poor groundwater producers either for a lack of water or poor water quality (high salinity). At great depths, groundwater quality in the Tertiary marine sedimentary rocks is generally poor due to elevated chloride (salt) concentrations.

According to Kunkel and Upson (1960), groundwater in the Sonoma Volcanics is generally of good quality except in three areas. The first area with poor groundwater quality, the Tulucay Creek drainage basin, east of the City of Napa, contains groundwater with elevated iron, sulfate, and boron. The Suscol area, south of the City of Napa, is the second area where some wells exhibit poor quality groundwater

due to elevated chloride concentrations, possibly from leakage from salty water in the Napa River, alluvial material above, or the existence of zones of unusually saline connate water deep within the Sonoma Volcanics. The third area of poor groundwater quality, the Calistoga area in the northern end of the Napa Valley, contains isolated wells with naturally occurring elevated chloride, boron, and some trace metal concentrations.

Kunkel and Upson (1960) reported that the principal water yielding units of the Sonoma Volcanics are the tuffs, ash-type beds, and agglomerates. The lava flows were reported to be generally non-water bearing. However, it may be possible that fractured, fragmental, or weathered lava flows could yield water to wells. The hydrogeologic properties of the volcanic-sourced sedimentary deposits of the Sonoma Volcanics are complex and poorly understood.

#### *Groundwater Occurrence in Other Units and in the Quaternary Sedimentary Deposits*

Several hundred wells and test holes on record have been drilled into the exposed Huichica Formation. Well yields tend to be low to modest (< 10 gpm to tens of gpm). Only a few known wells on record are completed in the Clear Lake Volcanics near the northern County line. Three wells report high yields of 400 to 600 gpm. Much of the Clear Lake Volcanics to the south appear to be thinner, limited in extent, and in ridge-top locations where possible groundwater production appears to be less likely.

Groundwater production from Quaternary Alluvium Deposits is variable, with yields ranging from <10 gpm in the East and West mountainous areas to a high of 3,000 gpm along the Napa Valley Floor where the alluvium is thickest (>200 feet). According to Faye (1973), average yield of wells completed in the alluvium is 220 gpm. Many wells drilled in the alluvium within the last 30 years extend beyond the alluvium and into the underlying Cenozoic units. Kunkel and Upson (1960) report that groundwater in the alluvium is generally of good quality. The groundwater is somewhat hard and of the bicarbonate type, with small concentrations of sulfate, chloride, and total dissolved solids. A few isolated areas have increased chloride and boron concentrations. The Quaternary Alluvial Deposits comprise the principal aquifer system of the Napa Valley Subbasin (LSCE, 2016c).

## 2.3 Groundwater Studies and Programs: 2009 to 2018

This section summarizes the studies and initiatives recently completed by Napa County.

### 2.3.1 Napa County's Comprehensive Groundwater Monitoring Program

In 2009, Napa County implemented a Comprehensive Groundwater Monitoring Program to meet action items identified in Napa County's 2008 General Plan update (Napa County, 2008). The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for future coordinated, integrated water resources planning and dissemination of water resources information. The program covers the continuation and refinement of countywide groundwater level and quality monitoring efforts (including many basins, subbasins and/or subareas throughout the county) for the purpose of understanding groundwater conditions (i.e., seasonal and long-term groundwater level trends and also quality trends) and availability. This information is critical to enable integrated water

resources planning and the dissemination of water resources information to the public, state, and local decision-makers. Napa County's combined efforts through the Comprehensive Groundwater Monitoring Program along with the related AB 303 Public Outreach Project on groundwater (CCP, 2010) and the efforts of the Watershed Information and Conservation Council (WICC) of Napa County create a foundation for the County's continued efforts to increase public outreach and participation in water resources understanding, planning, and management.

Napa County's Comprehensive Groundwater Monitoring Program involved many tasks that led to the preparation of five technical memorandums and a report on *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a). That report and the other related documents are available on the WICC website (http://www.napawatersheds.org/groundwater). The report documents existing knowledge of countywide groundwater conditions and establishes a framework for the monitoring and reporting of groundwater levels and groundwater quality on a periodic basis. The report also summarizes priorities for groundwater level and quality monitoring for each of the county subareas.

The *Napa County Groundwater Monitoring Plan 2013* (Plan) (LSCE, 2013a) was prepared to formalize and augment groundwater monitoring efforts to better understand the groundwater resources of Napa County, aid in making the County eligible for public funds administered by DWR, and regularly evaluate trends to identify changes in levels and/or quality and factors related to those changes that warrant further examination to ensure sustainable water resources. The Plan included refinement of criteria used to identify priority monitoring areas and a proposed expanded monitoring network. During Plan implementation, the Groundwater Resources Advisory Committee (GRAC) led and supported outreach efforts to well owners for volunteer monitoring wells; the GRAC efforts were very successful in adding new wells to the Napa County groundwater monitoring program.

### 2.3.2 Napa County Statewide Groundwater Elevation Monitoring (CASGEM)

This section describes the DWR California Statewide Groundwater Elevation Monitoring (CASGEM) program.[16] The wells included by the County in the CASGEM program are a *subset* of the overall network of wells monitored in Napa County.

In November 2009, Senate Bill SBX7 – 6 mandated that the groundwater elevations in all basins and subbasins in California be regularly and systematically monitored with the goal of demonstrating seasonal and long-term trends in groundwater elevations. In accordance with the mandate, DWR developed the CASGEM program. DWR is facilitating the statewide program which began with the opportunity for local entities to apply to DWR to assume the function of regularly and systematically collecting and reporting groundwater level data for the above purpose. These entities are referred to as Monitoring Entities.

[16] More information on the CASGEM Program is available at this website: https://water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM

Wells designated for inclusion in the CASGEM program are for purposes of measuring groundwater levels on a semi-annual or more frequent basis that are representative of groundwater conditions in the state's groundwater basins and subbasins. A key aspect of the program is to make certain elements of the groundwater level information available to the public. On December 29, 2010, the County applied to DWR to become the local countywide Monitoring Entity responsible for designating wells as appropriate for monitoring and reporting groundwater elevations for purposes of the CASGEM program.

Some well owners whose wells are included in the County monitoring network have elected to be part of the CASGEM program. The wells in the CASGEM program are a *subset* of the overall wells monitored, i.e., the County has a much larger overall monitoring network. The County's participation in the CASGEM program complements pre-existing groundwater monitoring that has been ongoing in Napa County for several decades (the overall historical monitoring record began in 1920).

Following confirmation, the County, as the Monitoring Entity, proceeded to identify a *subset* of monitored wells to be included in the CASGEM network and to prepare a CASGEM Network Plan as required by DWR (LSCE, 2011b and LSCE, 2014). The initial CASGEM Network Plan submitted to DWR included a subset of fourteen wells. DWR formally designated Napa County as the Monitoring Entity for two basins in August 2014, specifically:

- Napa County was designated as the Monitoring Entity for the 2-2.01 Napa Valley Subbasin
- Napa County was designated as the Monitoring Entity for the 2-2.03 Napa-Sonoma Lowlands Subbasin in Napa County

The current CASGEM network wells, which includes 34 wells, are located primarily on the Napa Valley Floor, Carneros Subarea, and in the MST Subarea. Twenty of the CASGEM Network wells in Napa County are located in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (see **Section 4.1.2**). Some of these wells do not have sufficient construction details to define which portion of the aquifer system is represented by measured water levels. Additional data collection and surveying will be performed, with this information provided in future annual reports as it becomes available. Depending on the results of the County's evaluation, future actions may include removal and replacement of CASGEM wells with wells that are more representative of local groundwater conditions to better meet the objectives of the CASGEM program and the overall objectives of the County's Comprehensive Groundwater Monitoring Program.

In addition to the CASGEM well network described herein, the County is currently exploring the availability of additional monitoring wells in the Pope Valley Groundwater Basin[17]. There is a well monitored by the County in Pope Valley, however, it is not designated as a CASGEM well. Public outreach is underway through community organizations and other contacts. The Berryessa Valley

[17] The Overall Basin Ranking Score for the Pope Valley Groundwater Basin is "0.0"; the very low priority basin ranking range is 0 - 7. https://data.cnra.ca.gov/dataset/sgma-basin-prioritization-2018

Groundwater Basin has a very low priority designation and extremely small utilization of groundwater.[18] Per discussions with DWR, outreach will continue but no monitoring is planned in this groundwater basin at this time.

The Suisun-Fairfield Valley Basin has low priority designation. This basin is located mostly in Solano County, with a very small area (less than 0.3% of the total basin area) in Napa County (**Figure 2-1**). The Suisun-Fairfield Valley Basin is monitored by Solano County Water Agency as the CASGEM Monitoring Entity for Solano County.[19]

The Napa-Sonoma Lowlands Subbasin (Lowlands Subbasin), which includes portions of Napa County and Solano County (63% in Napa County, 37% in Solano County), is currently monitored within the Napa County portion of the subbasin. Monitoring in the Lowlands Subbasin has expanded since 2014. Napa County will continue to seek additional wells to monitor as necessary to ensure representative coverage in coordination with the Solano County Water Agency. As described in **Section 2.1**, the priority designation for the Lowlands Subbasin may be revised in 2019.

### 2.3.3 Updated Hydrogeologic Conceptualization and Characterization of Conditions

In 2012, activities were implemented to update the characterization and conceptualization of hydrogeologic conditions (LSCE and MBK, 2013). This work included:

1) Updated Napa Valley hydrogeologic conceptualization,
2) Linking well construction information to groundwater level monitoring data,
3) Groundwater recharge characterization and estimates, and
4) Evaluation of surface water/groundwater interrelationships.

#### *Updated Napa Valley Geologic Conceptualization*

As a part of the updated hydrogeologic conceptualization (LSCE and MBK, 2013), eight cross-valley geologic sections were constructed (**Figure 2-3**). About 1,300 water well drillers' reports were reviewed and located on topographic base maps; 191 of these were selected for use in the cross sections. Geologic correlations seen on the cross sections were extended between sections by available well control and surficial geologic maps. From the geologic cross-sections and correlations of other water well drillers' reports, the Quaternary alluvium was separated from underlying units, and an isopach (contours of equal thickness) map was constructed. Although many different geologic units underlie the

[18] The Overall Basin Ranking Score for the Berryessa Valley Groundwater Basin is "0.0"; the very low priority basin ranking range is 0 -7. https://data.cnra.ca.gov/dataset/sgma-basin-prioritization-2018

[19] The Overall Basin Ranking Score for the Suisun-Fairfield Valley Groundwater Basin is "11.5"; the low priority basin ranking range is 8 - 14. https://data.cnra.ca.gov/dataset/sgma-basin-prioritization-2018

Napa Valley Subbasin, the Quaternary alluvium unit forms the principal aquifer system for water supply purposes (LSCE, 2016c).

The alluvium was classified and mapped as three facies according to patterns detected in the lithologic record and used to delineate the depositional environment that formed them: fluvial, alluvial fan, and sedimentary basin (LSCE and MBK, 2013 and LSCE, 2013b). The fluvial facies consist of a thin narrow band of stream channel sands and gravels deposited by the Napa River. The sand and gravel beds tend to be thicker and/or more numerous in the fluvial facies area. They are interbedded with finer-grained clay beds of probable floodplain origin. Wells constructed in the fluvial facies tend to be moderately high yielding (for the valley, roughly 50 to 200 gallons per minute, or gpm). Local areas where thicker sand and gravel beds are reported, the well yields are the highest in the valley, ranging from about 200 to 2,000 gpm.

These areas with thick sand and gravel beds occur in the Yountville Narrows area, which extends about five miles from Oakville south to Ragatz Lane. Local areas of relatively lower well yield values of 200 to 500 gpm occur to the north and south. Hydraulic properties of these deposits are recorded during airlift testing, and drawdown values are generally not reported. Only a few well pump test results have been found, and these are in the high yielding area just north of the Yountville Narrows.

The alluvial fan facies of the Quaternary alluvium extends outward from the central fluvial facies and thins to zero thickness at the edge of the valley sides. These deposits appear to have been deposited as tributary streams and alluvial fans. These deposits appear to consist of interbedded sandy clays with thin beds (less than 10 feet thick) of sand and gravel. Wells constructed in the alluvial plain facies tend to be low yielding, ranging from a few gpm to a few tens of gpm. By at least 1970, most wells drilled on the alluvial plain facies were constructed to deeper depths into the underlying Sonoma Volcanics, although the proportion of groundwater that such wells derive from the Sonoma Volcanics is believed to be low.

The boundaries of certain alluvial facies (shown in **Figure 2-4**) coincide with areas of shallow groundwater levels. This suggests a relationship between shallow depths to groundwater and Quaternary Alluvial Fan (Qaa) and Quaternary Fluvial (Qaf) units. These areas represent somewhat more likely areas of connection between surface waters and groundwater.

At the northern end of the lower valley, the Quaternary alluvial fan transitions to the sedimentary basin facies. The sedimentary basin facies is characterized by fine-grained silt, sand, and clays with thin to scattered thicker beds of sand and gravel. The sedimentary basin facies is believed to be floodplain deposits that extend to the southern marshland/estuary deposits. As noted, the extent of this facies is poorly known due to lack of well control farther south. Limited information indicates low to moderate well yields of a few gpm to possibly up to 100 gpm. Again, the lack of well pump test information makes hydraulic properties of the deposits difficult to assess.

Portions of Napa Valley north of Lodi Lane were not characterized according to their Quaternary alluvial facies by LSCE and MBK (2013). However, depths to groundwater in the vicinity of monitored wells

indicate the potential for connection between surface water and groundwater in the vicinity of Garnett Creek and Cyrus Creek in and near Calistoga.

Beneath the alluvium is a complex sequence of Tertiary sedimentary deposits (Huichica Formation) and igneous deposits of the Sonoma Volcanics. These units are strongly deformed by folding and faulting and have complex stratigraphic relationships. A structure contour map (contours of elevation) of the top of these units and the subcrop[20] pattern was developed from the geologic cross-sections, lateral correlations informed by borehole lithologies between cross sections, and surficial geologic map relationships (LSCE and MBK, 2013). From north of the City of Napa near Oak Knoll Avenue extending southward through the City, these deposits are dominated by fine-grained basin fill deposits with few sand and gravels of floodplain or estuarine origin. North towards Yountville, sedimentary deposits of the Huichica Formation appear to overlie Sonoma Volcanics andesites and tuffs. Sonoma Volcanics and the older Mesozoic Great Valley sequence are exposed in a structural uplift area in the small hills in the Yountville area.

Further north, a Sonoma Volcanics andesite flow breccia appears to transition into a sedimentary conglomerate along the center of the valley. This unit is encountered in deep, high yielding wells also completed in the overlying alluvium fluvial facies, but it is not clear if this unit also is high yielding. Overlying the conglomerate/breccia on the east is the Tertiary sedimentary deposits sequence (Huichica Formation) of sandstones and mudstones. To the west of the unit occur older Sonoma Volcanics andesites, tuffs in the south, and possibly younger Sonoma Volcanics tuffs interbedded with Tertiary sedimentary deposits (Huichica Formation) of sand and gravels and clays. All of the Tertiary units beneath the Napa Valley Floor appear to be low to moderately water yielding with poor aquifer characteristics (LSCE and MBK, 2013).

### *Linking Well Construction Information to Groundwater Monitoring Data*

As part of the updated hydrogeologic characterization (LSCE and MBK, 2013), existing monitoring well construction data from all available public sources were reviewed to determine the distribution of aquifer-specific monitoring data in the Napa Valley. This effort addresses recommendations from the Comprehensive Groundwater Monitoring Program to identify and fill data gaps that will allow for analysis of groundwater occurrence and flow as a more robust understanding of the extent of groundwater resources in the county is developed. A major component of this work included identifying construction information for dozens of previously monitored wells in Napa Valley.

Groundwater level monitoring needs identified through the Comprehensive Groundwater Management Program include improved spatial distribution of groundwater level monitoring, additional characterization of subsurface geologic conditions in county subareas to identify aquifer characteristics, further examination of well construction information to define which portion of the aquifer system is represented by water levels measured in the currently monitored wells (and in many cases to link

[20] Occurrence of strata in contact with the undersurface of a stratigraphic unit, which in this case includes the strata beneath the alluvium.

construction information to the monitored wells), and improve the understanding of surface water/groundwater interactions and relationships.

### *Groundwater Recharge Characterization and Estimates*

Another important feature of the updated hydrogeologic investigation was the development of improved characterization of groundwater recharge in the areas of greatest groundwater development, with an emphasis on Napa Valley. Understanding the volume of and mechanisms driving groundwater recharge in the county are essential in determining where and how much groundwater can be produced without incurring negative impacts (LSCE, 2011a). The high permeability of the alluvial sediments in the Napa Valley permit precipitation and surface water to readily infiltrate and recharge groundwater throughout the majority of the valley floor.

Mass balance and streamflow infiltration methods were used to estimate regional and local recharge. Streamflow infiltration can be characterized by comparing the elevation of surface water to the shallowest adjacent groundwater. Detailed remotely sensed elevation data of the mainstem Napa River and several major tributaries were obtained for this purpose. LiDAR data were paired with previously collected groundwater level data and estimates of areas of greatest recharge potential to characterize the potential for direct hydraulic connections between surface water and groundwater and the potential for groundwater recharge through streambed infiltration.

In addition, mass balance recharge estimates have been developed for the Napa River watershed and major tributary watersheds using a range of available data (LSCE and MBK, 2013). Available records for streamflow, precipitation, land use, and vegetative cover throughout these watersheds have been used to develop spatially-distributed estimates of annual hydrologic inputs and outputs in order to solve for the volume of groundwater recharge at the watershed scale. Key components of this work included quantifying the distribution of precipitation across the land surface, quantifying the amount of water that returns to the atmosphere by evapotranspiration, and quantifying the hydraulic properties of soil and alluvial materials through which water must infiltrate to reach groundwater. Estimates developed through the mass balance approach have been evaluated using a sensitivity analysis to determine the degree to which any individual or set of inputs affects the recharge estimate.

Additional work has been conducted in the Napa Valley Subbasin to quantify recharge for water budget purposes (LSCE, 2016c); see also **Section 2.4.2**, below.

### *Groundwater-Surface Water Interrelationships: Depth to Groundwater Relative to Stream Thalweg*

The groundwater surface elevation and the estimated stream thalweg elevation data are important components for characterizing the groundwater/surface water relationship in the Napa Valley area. The spring 2010 contours of equal groundwater elevation were used to provide a snapshot representation of groundwater conditions with which to compare the vertical relationship between groundwater and surface water (LSCE and MBK, 2013 and LSCE, 2013b). This spatial relationship assisted in developing an understanding of the nature of water exchange between the groundwater and surface water systems.

*Other Areas of County*

Potential connections between surface water and groundwater in other areas of the county are less well known. Perennial and intermittent water courses have been mapped in Napa County as part of the U.S. Geological Survey National Hydrography Dataset[21] (**Figure 2-5**).

### 2.3.4 Annual Groundwater Reports

In 2015, Napa County began to submit Annual Reports to the County Board of Supervisors and the public that summarize activities implemented as part of the County's Comprehensive Groundwater Monitoring Program during the prior year to improve the understanding of groundwater resource conditions and availability. The Annual Reports for years since 2014 include summaries of current monitoring activities and additionally recommended groundwater monitoring needed to fill specific data gaps, and activities implemented since 2014 (LSCE, 2015; LSCE, 2016a; LSCE, 2017a; LSCE, 2018b). The Annual Reports also summarize the overarching groundwater level and quality monitoring objectives defined by the County and the GRAC. These objectives provide the framework necessary to ensure that the monitoring program and data collected from the countywide monitoring facilities can address these objectives. The 2017 Annual Report and this 2018 Annual Report present an update on both groundwater conditions and water use in the Napa Valley Subbasin as required for Annual Reports by Section 356.2 of the GSP Regulations developed by DWR.

The 2015 Annual Report (LSCE, 2016a) includes an update on groundwater quality data reported between 2009 and 2015. Those data were reviewed to provide an updated understanding of conditions and trends relative to the most recent countywide review of groundwater quality data published in the Napa County Groundwater Conditions and Groundwater Monitoring Recommendations Report (LSCE, 2011a). Between 2009 and 2015, groundwater quality data were available from a total of 81 sites. Groundwater quality data show generally good water quality with stable conditions in the Napa Valley Floor Subareas between 2009 and 2015 compared to the conditions reported previously based on data reported through 2008 (LSCE, 2011a); the 2015 Annual Report also presents groundwater quality information for other Subareas (LSCE, 2016a; see also LSCE, 2016c).

## 2.4 Recent Groundwater Reports

### 2.4.1 Napa County Groundwater/Surface Water Monitoring Facilities

In January of 2014, Napa County implemented a project to monitor interactions between groundwater and surface water resources in the Napa Valley Subbasin (LSCE, 2016b). Initial funding for the project was provided by DWR, through the Local Groundwater Assistance Grant Program, and the County. The project scope included monitoring facilities construction, data collection, and presentation of the results of initial data collection efforts. The project included construction of five dual-completion monitoring wells adjacent to the Napa River and Dry Creek in the Napa Valley Subbasin (**Figure 2-6**). Prior to

[21] In addition to the countywide dataset available from the U.S. Geological Survey (USGS), a dataset of stream alignments with attributes including perennial and intermittent flow designations, is available from the Napa RCD. The Napa RCD dataset is under review as part of ongoing efforts to characterize connections between surface water and groundwater.

construction of the monitoring facilities, hydrologic and geologic data were compiled and evaluated for each site to inform the monitoring well design. Monitoring well construction and development occurred in September and October of 2014. Data collection at the sites began in October of 2014 with manual groundwater level measurements followed by the installation of continuously recording pressure, temperature, and electrical conductivity transducers.

The following paragraphs summarize initial project implementation activities, as documented in the *Napa County groundwater/surface water monitoring facilities report (LSCE, 2016b).* Data were regularly downloaded from project transducers. The transducers were re-calibrated and serviced as needed. Project data were reviewed for quality control purposes and incorporated into the existing Napa County Data Management System (DMS). Data collection and analysis from these wells has continued, as described above, to track groundwater/surface water interactions. Project outreach continues through a variety of means, including presentations to the WICC, presentations to community groups around Napa Valley, and a field tours (i.e., such as one organized by the Sacramento-based Water Education Foundation).

The construction of dedicated monitoring facilities to track groundwater/surface water interactions in the Napa Valley Subbasin provides the County with an important source of data about these interconnected resources. Data collected in 2015 and 2016 show that shallow groundwater and surface waters were hydraulically connected throughout much of the winter and spring at the mainstem Napa River sites, and longer into summer in some locations. The direction of flow indicated by monitoring data varied between gaining stream (flow of groundwater into surface water) and losing stream (flow of surface water into the groundwater system) at most sites. Two sites maintained losing stream conditions (flow from surface water into groundwater) throughout 2015: Site 2 located on Dry Creek at Washington Street and Site 5 located on the Napa River at Pope Street. Water year 2015 marked the fourth year of California's statewide drought. Continued data collection in subsequent years has provided a more robust understanding of the range of conditions at these sites (see **Section 5.7**).

Implementation of groundwater/surface water monitoring in the Napa Valley Subbasin has already proven to be very valuable for improving the understanding of surface water and groundwater interactions. Similar facilities at additional locations would help further this understanding and aid in ongoing efforts to sustainably manage the Napa Valley Subbasin. Additional monitoring will also be key to the objective of maintaining or improving streamflow during drier years and/or seasons. As a result, it was recommended that the County, in coordination with the Napa RCD, the Napa County Flood Control and Water Conservation District and others, as appropriate (LSCE, 2016c; see also **Section 7** in this Report):

- Evaluate stream gaging network objectives, particularly with respect to the water budget requirements contained in the SGMA GSP Regulations and determine the need and feasibility of additional streamflow monitoring sites.
- Consider additional areas that may also benefit from nested groundwater monitoring wells located near the Napa River or its tributaries (similar to the facilities constructed as part of

the current project) to monitor groundwater/surface water interactions in areas where data are lacking or where geologic conditions indicate that conditions are not adequately represented by the current monitoring network.

- Continue efforts to integrate data collected at the groundwater/surface water monitoring sites with existing remote data acquisition systems in order to facilitate monitoring aquifer conditions in real-time.

### 2.4.2 Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin

In response to SGMA, Napa County prepared a Basin Analysis Report (LSCE, 2016c), an alternative submittal per the requirements of Water Code Section 10733.6 (b)(3). The report was submitted to DWR on December 16, 2016 and has been under review by DWR since its submittal. The Basin Analysis Report covers the entire Napa Valley Subbasin, which is subject to specific requirements under SGMA. The report includes an analysis of areas outside of the Subbasin to determine how those areas affect recharge and runoff in the Subbasin, although the areas outside of the Subbasin are not subject to SGMA.

During the past ten years, Napa County has made significant progress towards implementing groundwater-related studies and recommendations. In conformance with SGMA, the intent of the GRAC, and the direction of the Napa County Board of Supervisors (April 2014), the *Napa Valley Subbasin SGMA Sustainability Goal* is:

> *To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply. The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and maintain groundwater sustainability indefinitely without causing undesirable results, including unacceptable economic, environmental, or social consequences.*

As described in the Basin Analysis Report and this Annual Report (LSCE, 2019), groundwater conditions in the Napa Valley Subbasin have been, and continue to be, assessed using current and historical groundwater level and groundwater quality data. An extensive network of wells is used in these annual assessments. Groundwater level trends in the Napa Valley Subbasin are stable in a majority of wells having long-term groundwater level records.

The Napa River system is affected by a number of factors, groundwater being only one of them. The river system is influenced by variability in water year conditions from year-to-year and also drier periods within the year. Records dating back to the 1930s show the Napa River system has experienced these temporal and seasonal effects over many decades, particularly during the summer to fall period. As described above, the new groundwater monitoring wells and surface water monitoring facilities provide for the collection of continuous groundwater level and stream data to better assess the spatial and temporal interconnection of surface water and groundwater resources under changing climatic conditions. The timing and amount of precipitation and natural groundwater recharge events affect the

amount of groundwater baseflow discharged to the Napa River system. Heterogeneous (i.e., variable) subsurface conditions also affect the amount and location of recharge to groundwater and discharge to surface water.

While outflows from the Subbasin, including groundwater pumping, influence the surface water system, monitoring data and water budget analyses indicate that effects on the Napa River due to more or less groundwater pumping did not change during water years 1988-2015, the study period for the Napa Valley Subbasin Basin Analysis Report. Additionally, groundwater pumping is a relatively small outflow component compared to surface water stormflows and groundwater baseflow discharged to the River and ultimately to the San Pablo Bay, both of which are primarily driven by precipitation.[22] Flow and other aspects of the Napa River are affected by many factors beyond the County's control (e.g., precipitation and climate change), and some factors within the State's control (e.g., upstream damming or withdrawal of water from tributaries and historical removal of natural wetlands and floodplains). These are not under the purview of SGMA, though the Napa County Board of Supervisors is addressing many of them in other appropriate forums.

Groundwater and surface water supplies, including imported surface water supplies, in the Napa Valley Subbasin are dependent on population trends and land uses and their associated water demands. Long-term conditions in the Napa Valley Subbasin during the 1988 to 2015 base period (e.g., Basin Analysis Report study period) have been marked by relatively stable land uses and stable supplies of imported surface water. While most of the population in the Subbasin lives in the four incorporated municipalities (Cities of Napa, St. Helena, Calistoga, and Town of Yountville), the majority of the land is outside the municipalities and used primarily for agriculture. Municipal water use in the Subbasin ranged from a low of 14,700 acre-feet per year (AFY) in 2015 to a high of 20,400 AFY in 2002. Average annual municipal use in the Subbasin was 17,300 AFY over the 1988 to 2015 study period. The majority of this water is provided by reservoirs, increasing amounts of imported State Water Project water, and to a much smaller extent groundwater. Over the 28-year base period, water uses in the unincorporated part of the Subbasin have increased from about 4,000 AFY to about 5,000 AFY and are mostly supplied by groundwater.

Agricultural water supplies include groundwater pumped from the Subbasin, recycled water, surface water diverted from the Napa River system within the Subbasin, and surface water diverted from the Subbasin watershed (i.e., hillside areas). On average, the rate of total water use (surface water and groundwater) by agriculture within the Subbasin has decreased slightly from approximately 18,000 AFY between 1988 and 1991 to approximately 16,000 AFY between 2012 and 2015. With variations in the water supply mix on a year-to-year basis, surface water use has decreased by about 8,900 AFY, while groundwater utilization has increased by about 7,400 AFY over the same period. These changes are affected by a number of factors, including increases from new and expanded wineries and vineyards, balanced against greatly improved conservation practices and decreased residential population in the

[22] Average annual outflows from the Napa Valley Subbasin due to groundwater extraction were 7% of the average annual total Subbasin outflows during the 1988 to 2015 Basin Analysis Report base period.

unincorporated areas. The Basin Analysis Report also includes estimated additional groundwater needs for wineries and vineyards looking forward through 2025, based on proposals for new or modified land uses within the Subbasin from 2010 to 2015.

A combined surface water and groundwater watershed-scale water budget for the Subbasin was developed to assess inflows and outflows to the Subbasin and to determine the average annual change in groundwater storage over the 28-year base period (using a model with a monthly time step). The very large volumes of upland runoff and surface water outflows that move through and out of the Subbasin in most years are the predominant factors relating to change in storage as compared to the amounts of groundwater pumped from the Subbasin or flowing out of the Subbasin as subsurface outflow. Average annual changes in groundwater storage over the base period are positive, indicating that current groundwater pumping rates are within the sustainable yield for the Subbasin. The average annual increase in storage is estimated to be 5,900 AFY, which is consistent with stable to slightly above average cumulative precipitation inputs over the 28-year base period. A separate independent analysis of groundwater levels and corresponding spring-to-spring changes was also conducted to compute the change in groundwater storage; this analysis also shows positive average annual changes in groundwater storage for the 1988 to 2015 base period (LSCE, 2016c).

The analyses presented in the Napa Valley Subbasin Basin Analysis Report demonstrate that the basin has operated within its sustainable yield over a period of more than 20 years. Stable groundwater levels observed during recent drought conditions (from 2012 through 2015), along with absence of undesirable results, suggest that recent rates of groundwater pumping have not exceeded the sustainable yield of the Subbasin. The sustainable yield analysis establishes the maximum amount of water that can be withdrawn annually from the Subbasin groundwater supply without causing an undesirable result. The sustainable yield is within approximately 17,000 AFY to 20,000 AFY. By comparison, groundwater pumping averaged about 18,000 AFY during the 2012 to 2015 drought.

The Napa Valley Subbasin Basin Analysis Report and the County's annual reporting to DWR will implement legislative SGMA monitoring and reporting requirements and also provides additional recommendations to maintain or improve groundwater conditions and ensure overall water resources sustainability. It is critical that the County continue to invest in the Groundwater Program to expand the range of information and understanding of this complex water resources system. Where the County has discretionary authority, permit holders should be required to monitor their use, and data must be made available for analysis when needed. Abusive water use, when identified, must be corrected. Education and outreach should be made available to all users; only by collaborating as a community and sharing our understanding and stewardship responsibilities can the people living and working in Napa County collectively ensure that water resources are sustainable over the long-term.

### 2.4.3 Northeast Napa Area: Special Groundwater Study and Management Area Basin Analysis Report Amendment

On October 24, 2017, the Napa County Board of Supervisors received a report on groundwater conditions in a portion of the Napa Valley Subbasin, known as the northeast Napa Study Area (**Figure 2-**

**7**). The report, *Northeast Napa Area: Special Groundwater Study*, (Special Study Report) was initiated by Napa County to understand recent, historical changes in water level trends in a small portion of the Napa Valley Subbasin (LSCE, 2017b).

This northeast Napa Study Area, or Study Area, experienced historical groundwater level trends east of the Napa River that are different from and not representative of those that are typical of groundwater level trends for the overall Napa Valley Subbasin. The Study Area contains two wells that experienced historical groundwater level declines of between 20 feet and 30 feet[23], with groundwater levels in those same wells having stabilized since about 2009. Due to potential concerns relating to continued groundwater development in the area, and due to the complex hydrogeologic setting which includes mapped faults and the Napa River in relatively close proximity to the area of interest, the County authorized a study to better understand groundwater conditions and potential factors relating to historical groundwater levels in the northeast Napa Area. The study, conducted between 2016 and 2017, included evaluation of the potential effects from pumping in the overall Study Area, potential mutual well interference in an area of interest near Petra Drive, and potential streamflow effects.

The objectives of the Special Study were to:

1. Examine existing and future water use in the northeast Napa Area,
2. Identify sources of groundwater recharge, and
3. Evaluate the geologic setting to address questions regarding the potential for long-term effects on groundwater resources and streamflow.

As part of the Special Study, a transient numerical groundwater flow model was developed that incorporates the data collected for a base period of water years from 1988 to 2015 to analyze groundwater conditions in the Study Area and the area of interest near Petra Drive. The objectives of the groundwater flow model included:

1. Assessment of potential mutual well interference of wells located in the Petra Drive area;
2. Assessment of the potential streamflow effects from current and historical land uses;
3. Assessment of the potential influence of previously documented groundwater cones of depression in an area external to the Napa Valley Subbasin known as the MST Subarea to the east of the Study Area;
4. Assessment of the groundwater supply sufficiency to meet current and potential future groundwater demands for the Study Area; and
5. Assessment of whether potential groundwater management measures or controls (similar to those previously implemented in the MST) are warranted in the Study Area.

[23] Both of these wells are constructed in aquifer units with semi-confined characteristics. Groundwater level declines in these wells do not imply equivalent declines in the unconfined water table.

At their meeting on October 24, 2017, the Board of Supervisors chose to support the findings and recommendations of the Special Study Report and directed staff to develop documentation to formally establish the Northeast Napa Management Area covering approximately 1,960 acres within the 45,928-acre Napa Valley Subbasin (**Figure 2-7**). In response, Napa County developed, and submitted to DWR, the 2018 amendment to the Basin Analysis Report for the Napa Valley Subbasin (Northeast Napa Management Area Report) (LSCE, 2018a).

The 2018 amendment is a supplement to the Basin Analysis Report for the Napa Valley Subbasin, the purpose of which is to designate a management area within the Napa Valley Subbasin: the Northeast Napa Management Area. GSP Regulations adopted by the California Water Commission in 2016 define a management area as, "an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors" (Section 351).

The Basin Analysis Report Amendment was developed as a supplement to the Basin Analysis Report for the Napa Valley Subbasin. It does not change the findings of the 2016 Basin Analysis Report, rather it provides additional detail about conditions in the Northeast Napa Management Area and establishes sustainable management criteria at seven Representative Wells and presents management actions intended to support continued groundwater sustainability in the Napa Valley Subbasin.[24]

[24] Four of the representative wells designated for the Northeast Napa Management Area were previously designated as representative wells for the Napa Valley Subbasin, while three of the sites were newly designated as part of the Northeast Napa Management Area Report.

# 3 GROUNDWATER RESOURCES GOALS AND MANAGEMENT OBJECTIVES

## 3.1 Napa County Water Resources Goals and Policies

The County's 2008 General Plan update recognizes, "water is one of the most complex issues related to land use planning, development, and conservation; it is governed and affected by hundreds of federal, state, regional, and local mandates pertaining to pollution, land use, mineral resources, flood protection, soil erosion, reclamation, etc. Every year, the state legislature considers hundreds of bills relating to water issues, and in Napa County, more than two dozen agencies have some say in decisions and regulations affecting water quality and water use." As part of the 2008 General Plan update, and within the Conservation Element, six goals are set forth relating to the county's water resources, including surface water and groundwater. Complementing these goals are 28 policies and 10 water resources action items (one of which is "reserved" for later description). Napa County's six water resources goals are included below (the entire group of water resources goals, policies, and action items is included in LSCE, 2011a).

> **Goal CON-8:** Reduce or eliminate groundwater and surface water contamination from known sources (e.g., underground tanks, chemical spills, landfills, livestock grazing, and other dispersed sources such as septic systems).
>
> **Goal CON-9:** Control urban and rural storm water runoff and related non-point source pollutants, reducing to acceptable levels pollutant discharges from land-based activities throughout the county.
>
> **Goal CON-10:** Conserve, enhance and manage water resources on a sustainable basis to attempt to ensure that sufficient amounts of water will be available for the uses allowed by this General Plan, for the natural environment, and for future generations.
>
> **Goal CON-11:** Prioritize the use of available groundwater for agricultural and rural residential uses rather than for urbanized areas and ensure that land use decisions recognize the long-term availability and value of water resources in Napa County.
>
> **Goal CON-12:** Proactively collect information about the status of the County's surface and groundwater resources to provide for improved forecasting of future supplies and effective management of the resources in each of the County's watersheds.
>
> **Goal CON-13:** Promote the development of additional water resources to improve water supply reliability and sustainability in Napa County, including imported water supplies and recycled water projects.

Addressing the six water resources goals above, Napa County has produced specific General Plan Action Items related to the focus and objective of this Plan. Those action items include:

**Action Item CON WR-1:** Develop basin-level watershed management plans for each of the three major watersheds in Napa County (Napa River, Putah Creek, and Suisun Creek). Support each basin-level plan with focused sub-basin (drainage-level) or evaluation area-level implementation strategies, specifically adapted and scaled to address identified water resource problems and restoration opportunities. Plan development and implementation shall utilize a flexible watershed approach to manage surface water and groundwater quality and quantity. The watershed planning process should be an iterative, holistic, and collaborative approach, identifying specific drainage areas or watersheds, eliciting stakeholder involvement, and developing management actions supported by sound science that can be effectively implemented. [Implements Policies 42 and 44]

**Action Item CON WR-4:** Implement a countywide watershed monitoring program to assess the health of the County's watersheds and track the effectiveness of management activities and related restoration efforts. Information from the monitoring program should be used to inform the development of basin-level watershed management plans as well as focused sub-basin (drainage-level) implementation strategies intended to address targeted water resource problems and facilitate restoration opportunities. Over time, the monitoring data will be used to develop overall watershed health indicators and as a basis of employing adaptive watershed management planning. [Implements Policies 42, 44, 47, 49, 63, and 64]

**Action Item CON WR-6:** Establish and disseminate standards for well pump testing and reporting and include as a condition of discretionary projects that well owners provide to the County upon request information regarding the locations, depths, yields, drilling and well construction logs, soil data, water levels and general mineral quality of any new wells. [Implements Policy 52 and 55]

**Action Item CON WR-7:** The County, in cooperation with local municipalities and districts, shall perform surface water and groundwater resources studies and analyses and work toward the development and implementation of an integrated water resources management plan (IRWMP) that covers the entirety of Napa County and addresses local and state water resource goals, including the identification of surface water protection and restoration projects, establishment of countywide groundwater management objectives and programs for the purpose of meeting those objectives, funding, and implementation. [Implements Policy 42, 44, 61 and 63]

**Action Item CON WR-8:** The County shall monitor groundwater and interrelated surface water resources, using County-owned monitoring wells and stream and precipitation gauges, data obtained from private property owners on a voluntary basis, data obtained via conditions of approval associated with discretionary projects, data from the State Department of Water Resources, other agencies and organizations. Monitoring data shall be used to determine baseline water quality conditions, track groundwater levels, and identify where problems may exist. Where there is a demonstrated need for additional management actions to address groundwater problems, the County shall work collaboratively with property owners and other

stakeholders to prepare a plan for managing groundwater supplies pursuant to State Water Code Sections 10750-10755.4 or other applicable legal authorities. [Implements Policy 57, 63 and 64]

**Action Item CON WR-9.5:** The County shall work with the SWRCB[25], DWR, DPH, CalEPA, and applicable County and City agencies to seek and secure funding sources for the County to develop and expand its groundwater monitoring and assessment and undertake community-based planning efforts aimed at developing necessary management programs and enhancements.

Based on the GRAC's charge from the Napa County Board of Supervisors and a review of many definitions in published literature, the GRAC (2014) defined "groundwater sustainability[26]" as:

> *Groundwater sustainability depends on the development and use of groundwater in a manner that can be maintained indefinitely without causing unacceptable economic, environmental, or social consequences, while protecting economic, environmental, and social benefits.*

The GRAC concluded that groundwater sustainability is both a goal and a process; most importantly, it is a shared responsibility. Everyone living and working in the county has a stake in protecting groundwater resources, including groundwater supplies, groundwater quality, and the watersheds that support groundwater resources (GRAC, 2014). The GRAC further found that healthy communities, healthy agriculture and healthy environments exist together and not in isolation. Without sustainable groundwater resources, the character of the county would be significantly different in terms of its economy, communities, rural character, ecology, housing, and lifestyles. The GRAC also developed five major sustainability objectives that include: initiating and carrying out outreach and education efforts; optimizing existing water supplies and systems; continuing long-term monitoring and evaluation; improving the scientific understanding of groundwater recharge and groundwater/surface water interactions; and improving preparedness to address groundwater issues that might emerge (GRAC, 2014).

[25] SWRCB is the California State Water Resources Control Board. DPH is the California Department of Public Health, which has since been re-organized to place drinking water oversight and regulatory authority under the purview of the Division of Drinking Water within the SWRCB.

[26] The definition for Groundwater Sustainability developed by the GRAC is separate from the definition of Sustainable Groundwater Management applied in the 2014 Sustainable Groundwater Management Act, see **Section 3.1.1** of this Report for additional information.

### 3.1.1 Napa Valley Subbasin Sustainability Goal

SGMA requires that each agency shall establish a sustainability goal (Section 354.24). In conformance with SGMA and the intent of the GRAC (February 2014) and the direction of the County Board of Supervisors (April 2014), the Napa Valley Subbasin SGMA Sustainability Goal is (LSCE, 2016c):

> *To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply. The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and maintain groundwater sustainability indefinitely without causing undesirable results, including unacceptable economic, environmental, or social consequences.*

As described in the Napa Valley Subbasin Basin Analysis Report (LSCE, 2016c), the Napa Valley Subbasin has been operated within the sustainable yield for at least 20 years based on the current understanding of hydrogeologic conditions and management measures. The Napa Valley Subbasin is generally a full basin, benefitting from high precipitation, corresponding high potential for substantial amounts of recharge, and land use dominated by vineyards that have a comparatively low water requirement.

### 3.1.2 Napa Valley Subbasin Sustainability Criteria

SGMA establishes undesirable results for applicable sustainability indicators, including a description of the process and criteria used to define undesirable results for the Napa Valley Subbasin. A "sustainability indicator" (SGMA Article 2) refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are "caused by groundwater conditions occurring throughout the basin" (Section 354.26). Undesirable results include one or more of the following (SGMA Definitions):

i. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

ii. Significant and unreasonable reduction of groundwater storage.

iii. Significant and unreasonable seawater intrusion.

iv. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

v. Significant and unreasonable land subsidence that substantially interferes with surface land uses.

vi. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The Napa River system is considered to be the most sensitive sustainability indicator in the Napa Valley Subbasin, so the measurable objectives and minimum thresholds (i.e., metrics required by SGMA to track conditions relative to the sustainability indicators) were established in the Basin Analysis Report to ensure continued groundwater sustainability, or improve groundwater conditions, and provide ongoing management targets devised to address potential future effects on surface water.

SGMA defines "representative monitoring" as "a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin" (Section 351). This subset of the County's groundwater monitoring sites is for the purpose of monitoring groundwater conditions that are representative of the basin or an area of the basin (Section 354.36). For SGMA purposes for the Napa Valley Subbasin, these representative sites are where sustainability indicators are monitored, and minimum thresholds and measurable objectives are defined based on work conducted for the Basin Analysis Report (LSCE, 2016c) and the Northeast Napa Management Area Report (LSCE, 2018a). Many of the representative sites are monitored for more than one sustainability indicator. In the Napa Valley Subbasin, 21 Representative Monitoring Sites have been selected to monitor sustainability indicators and to set minimum thresholds and measurable objectives to alert stakeholders and ultimately avoid chronic lowering of groundwater levels, land subsidence, reduced groundwater storage, streamflow depletion, degraded groundwater quality, and seawater intrusion.

SGMA defines a "minimum threshold" as "a numeric value for each sustainability indicator used to define undesirable results" (Section 351). The Napa Valley Subbasin Basin Analysis Report discusses the preliminary minimum thresholds established to quantify groundwater conditions for each applicable sustainability indicator at representative monitoring sites. Justification is provided for the thresholds based on best available data, including groundwater levels, groundwater quality, and surface water flows.

SGMA defines "measurable objectives" as "specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions" (Section 351). Measurable objectives for each sustainability indicator are based on quantitative values using the same metrics and monitoring sites that are used to define the minimum thresholds. These objectives provide a reasonable margin of operational flexibility under adverse conditions where applicable and utilize components such as historical water budgets, seasonal and long-term trends, and periods of drought. See **Section 5.1.3** of this annual report for further discussion of the measurable objectives compared with 2018 monitoring results.

For representative monitoring sites where long-term periods of record are not available, as in the case of the dedicated monitoring facilities constructed in 2014 to monitor groundwater/surface water interactions, minimum thresholds and measurable objectives established in the Basin Analysis Report will be reviewed and reevaluated in future years as the collection of available data for each site expands to better reflect true long-term variability and representativeness of conditions at those sites.

This 2018 Annual Report summarizes groundwater conditions and compares them to the current minimum thresholds and the measurable objectives established in the Basin Analysis Report (LSCE, 2016c) and the Northeast Napa Management Area Report (LSCE, 2018a)).

## 3.2 Overarching Groundwater Monitoring Objectives

This section describes the water level and quality objectives established for the countywide Comprehensive Groundwater Monitoring Program[27] initially described in the *Napa County Groundwater Monitoring Plan 2013* (Plan) (LSCE, 2013a). The overarching groundwater monitoring objectives are linked to: 1) the County's General Plan goals and action items presented above, and 2) hydrogeologic conditions and potential areas of concern, including (but not limited to):

- Monitoring trends in groundwater levels and storage (e.g., groundwater balance) to assess and ensure long-term groundwater availability and reliability;
- Monitoring of groundwater/surface water interactions to ensure sufficient amounts of water are available to the natural environment and for future generations;
- Monitoring in significant recharge areas to assess factors (natural and human-influenced) that may affect groundwater recharge (including climate change) and also aid the identification of opportunities to enhance groundwater recharge and storage;
- Monitoring to establish baseline conditions in areas of potential saline water intrusion;
- Monitoring of general water quality to establish baseline conditions, trends, and protect and preserve water quality.
- Identify where data gaps occur in the key subareas and provide infill, replacement, and/or project-specific monitoring (e.g., such as may occur for planned projects or expansion of existing projects) as needed; and
- Coordinate with other entities on the collection, utilization, and incorporation of groundwater level data in the countywide DMS.

In addition to the countywide monitoring objectives summarized below, the Plan also includes subarea-level objectives for groundwater level and groundwater quality monitoring, based on the analysis of existing groundwater data and conditions described in the report *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a) and with input received from the GRAC.

### 3.2.1 Groundwater Level Monitoring Objectives

The countywide groundwater level monitoring program includes the following objectives:

- Expand groundwater level monitoring in priority County subareas to improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater

[27] These objectives were developed by the Napa County GRAC prior to passage of the 2014 Sustainable Groundwater Management Act. SGMA defines measurable objectives as quantitative means of evaluating the efficacy of groundwater basin management, which is different from the approach applied by the GRAC.

levels including seasonal and long-term trends; and identify vertical hydraulic head differences in the aquifer system and aquifer-specific groundwater conditions, especially in areas where short- and long-term development of groundwater resources are planned (this includes additional monitoring of the Tertiary formation aquifer in the area between the MST Subarea and the northeastern part of the Napa Subarea to determine whether groundwater water conditions in the MST Subarea are affecting other areas (LSCE and MBK, 2013);

- Detect the occurrence of, and factors attributable to, natural (e.g., direct infiltration of precipitation, surface water seepage to groundwater, groundwater discharge to streams) or induced factors (e.g., pumping, purposeful recharge/infiltration operations; application of recycled water) that affect groundwater levels and trends;
- Identify appropriate monitoring sites to further evaluate groundwater/surface water interaction and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; update analyses as additional data become available.

### 3.2.2 Groundwater Quality Monitoring Objectives

The primary objectives of the countywide groundwater quality monitoring program include (LSCE, 2013a):

- Evaluate groundwater quality conditions in the various county subareas and identify differences in water quality spatially between areas and vertically in the aquifer system within a subarea;
- Detect the occurrence of and factors attributable to natural (e.g., general minerals and trace metals) or other constituents of concern;
- Establish baseline conditions in areas of potential saltwater intrusion, including the extent and natural occurrence and/or causes of saltwater beneath the Carneros, Jameson/American Canyon and Napa River Marshes Subareas;
- Assess the changes and trends in groundwater quality; and
- Identify the natural and human factors that affect changes in water quality.

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# 4 GROUNDWATER MONITORING NETWORK

## 4.1 Groundwater Level Monitoring

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in water year 2018 (**Table 4-1)**. **Figure 4-1** shows the distribution of sites monitored in 2018 by data reporting entity.

**Table 4-1 Current Groundwater Level Monitoring Sites in Napa County by Reporting Entity**

| Reporting Entity / Monitoring Network | Number of Monitored Wells, Fall 2017 | Number of Monitored Wells, Fall 2018 |
|---|---|---|
| **NAPA COUNTY** | | |
| **CASGEM** | | |
| *Surface Water-Groundwater Monitoring Wells* | *10* | *10* |
| *Domestic and Irrigation Wells* | *23* | *24* |
| **CASGEM Subtotal** | 33 | 34 |
| **State Water Data Library / CASGEM (Voluntary)** | 16 | 16 |
| **County Volunteer Groundwater Monitoring Network** | 47 | 47 |
| **Napa County Subtotal** | **96** | **97** |
| **CALIFORNIA DEPARTMENT OF WATER RESOURCES** | | |
| **State Water Data Library / CASGEM (Voluntary)** | **4** | **4** |
| **STATE WATER RESOURCES CONTROL BOARD** | | |
| **Geotracker Regulated Facilities** | **7** | **7** |
| **Total Sites, All Entities** | **107** | **108** |

Out of the total 108 sites monitored in 2018, 97 wells were monitored by Napa County. Four wells were wells monitored by DWR. The remaining seven sites are regulated facilities with multiple wells with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Regulated Facilities Program (**Table 4-1**).

The County added one new well to the monitoring network 2018 (**Table 4-2**). The well, designated NapaCounty-230, is in the Calistoga subarea in a zone of transition between the alluvial deposits of the Napa Valley Subbasin and adjacent volcanic rock formations. Also, in 2018, DWR resumed monitoring efforts at four wells that had been suspended in response to multiple, large wildfires that burned in many areas around Napa Valley in October 2017.

**Table 4-2 Napa County Monitoring Network Status Changes and Updates Through October 2018**

| Well ID | Status Change | Groundwater Subarea |
|---|---|---|
| NapaCounty-230 | Added to network at owner's request | Western Mountains |

Wells monitored in 2018 were distributed across 13 of 18 groundwater subareas (**Table 4-3**). As in previous years, most monitored wells were in the five Napa Valley Floor groundwater subareas and the Carneros Subarea. Groundwater levels were monitored at 61 sites distributed throughout the Napa Valley Subbasin.

Additional summary information for currently monitored sites is provided in **Appendix A**.

### 4.1.1 Napa County Monitoring Network

In 2018, Napa County monitored groundwater levels at 97 wells. Eight wells were monitored by Napa County at a monthly interval, to address temporal data gaps identified in the 2014 Annual Monitoring Report (LSCE, 2015). Ten wells were monitored using continuously recording instrumentation at dedicated monitoring wells constructed as part of the County's Surface Water–Groundwater Monitoring Project.

**Table 4-3 Groundwater Level Monitoring Sites in the Napa Valley Subbasin and Napa County Groundwater Subareas**

| Groundwater Basin or Groundwater Subarea | Number of Monitored Sites, Fall 2015 | Number of Monitored Sites, Fall 2016 | Number of Monitored Sites, Fall 2017 | Number of Monitored Sites, Fall 2018 |
|---|---|---|---|---|
| Napa-Sonoma Valley – Napa Valley Subbasin | 56 | 57 | 61 | 61 |
| | | | | |
| Napa Valley Floor-Calistoga | 9 | 7 | 7 | 8 |
| Napa Valley Floor-MST | 27 | 26 | 25 | 24 |
| Napa Valley Floor-Napa | 20 | 21 | 21 | 21 |
| Napa Valley Floor-St. Helena | 14 | 14 | 14 | 14 |
| Napa Valley Floor-Yountville | 14 | 13 | 13 | 13 |
| Carneros | 12 | 12 | 12 | 12 |
| Jameson/American Canyon | 1 | 1 | 1 | 1 |
| Napa River Marshes | - | - | - | - |
| Angwin | 5 | 5 | 5 | 5 |
| Berryessa | 3 | 1 | 1 | 2 |
| Central Interior Valleys | 2 | 2 | 2 | 2 |
| Eastern Mountains | 4 | 3 | 3 | 3 |
| Knoxville | - | - | - | - |
| Livermore Ranch | - | - | - | - |
| Pope Valley | 1 | 1 | 1 | 1 |
| Southern Interior Valleys | - | - | - | - |
| Western Mountains | 1 | 2 | 2 | 2 |
| **Total Sites** | **113** | **108** | **107** | **108** |

### 4.1.2 CASGEM Monitoring Network

The CASGEM Monitoring Network is a subset of the total wells in the Napa County monitoring program. Well owners voluntarily choose whether to participate in the State's CASGEM Program. As of fall 2018 the Napa County CASGEM Network included 24 privately-owned wells monitored by Napa County and 10 dedicated monitoring wells from the Surface Water-Groundwater Monitoring Project (**Figure 2-6**). Wells in the CASGEM Network are distributed across all five Napa Valley Floor Subareas (Calistoga, St. Helena, Yountville, Napa, and MST) as well as the Carneros, Angwin, and Western Mountains Subareas (**Table 4-4 and Figure 4-2**). Twenty of the CASGEM Network wells in Napa County are located in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (**Table 4-5**). In addition, six CASGEM Network wells are located in the Napa-Sonoma Lowlands Subbasin of the Napa-Sonoma Valley, while eight are not located in any groundwater basin or subbasin.

**Table 4-4 Current CASGEM Network Sites in Napa County by Groundwater Subarea**

| Groundwater Subarea | Number of Monitored Sites, Fall 2018 |
|---|---|
| Napa Valley Floor-Calistoga | 2 |
| Napa Valley Floor-MST | 5 |
| Napa Valley Floor-Napa | 9 |
| Napa Valley Floor-St. Helena | 5 |
| Napa Valley Floor-Yountville | 5 |
| Carneros | 6 |
| Jameson/American Canyon | - |
| Napa River Marshes | - |
| Angwin | 1 |
| Berryessa | - |
| Central Interior Valleys | - |
| Eastern Mountains | - |
| Knoxville | - |
| Livermore Ranch | - |
| Pope Valley | - |
| Southern Interior Valleys | - |
| Western Mountains | 1 |
| **Total Sites** | **34** |

**Table 4-5 Current CASGEM Network Sites in Napa County by Groundwater Basin**

| Basin/Subbasin Number | Basin Name | Subbasin Name | Number of Monitored Sites, Fall 2018 |
|---|---|---|---|
| 2-2.01 | Napa-Sonoma Valley | Napa Valley | 20 |
| 2-2.03 | Napa-Sonoma Valley | Napa-Sonoma Lowlands | 6 |
| 5-20 | Berryessa Valley | - | - |
| 5-68 | Pope Valley | - | - |
| 2-3 | Suisun-Fairfield Valley | - | - |
| - | Non-basin Areas | - | 8 |
| | | **Total Sites** | **34** |

### 4.1.3 DWR Monitoring Network

DWR currently monitors four wells in Napa County as part of its voluntary groundwater monitoring efforts (**Table 4-1**). In 2018, all four of these wells were monitored at monthly intervals. These wells are distributed across the Napa Valley Subbasin. As noted in **Section 4.1**, DWR previously suspended monitoring at all four wells over the summer of 2017, in response to multiple, large wildfires that burned in many areas around Napa Valley in October 2017.

### 4.1.4 State Water Resources Control Board Geotracker Network

The State Water Resources Control Board (SWRCB) stores environmental data for regulated facilities in California in their Geotracker database, including groundwater levels and groundwater quality. Data from these regulated facilities usually include manual measurements and samples from groundwater monitoring wells (typically shallow wells) at each site. Groundwater level data are available for seven Geotracker sites located throughout Napa County in 2018 (**Table 4-1**). The groundwater level monitoring frequency is typically semi-annual or quarterly, although more frequent measurements are sometimes recorded. Geotracker sites with data reported in 2018 are located in the Napa Valley Floor-Napa, Napa Valley Floor-MST, Berryessa, and Central Interior Valleys Subareas (**Figure 4-1**). Four of the sites are located within the Napa Valley Subbasin, while the other three are not within any designated groundwater basin.

## 4.2 Surface Water-Groundwater Monitoring

Funding from the DWR 2012 Local Groundwater Assistance Grant Program enabled Napa County to construct 10 monitoring wells at five sites in the Napa Valley Subbasin in September 2014. These wells comprise the groundwater monitoring facilities for the Napa County Surface Water-Groundwater Monitoring Project. In addition to grant funding from DWR, Napa County provided matching funds to cover a portion of the monitoring well construction and instrumentation costs (LSCE, 2016b).

### 4.2.1 Surface Water-Groundwater Monitoring Network

Four of the current surface water-groundwater sites are located along the Napa River while one is adjacent to Dry Creek (**Figure 2-6**). The five sites are within the Napa, Yountville, and St. Helena Subareas of the Napa Valley Floor.

Each of the five sites includes a dual-completion monitoring well to enable monitoring of groundwater conditions at specific depth intervals. These dual-completion wells consist of two separate casings in a single borehole. Each casing is independent of the other with distinct total depths and screen intervals. The construction details for each casing were developed based on site-specific hydrogeologic and surface water channel considerations.

In general, groundwater monitoring facilities at each site consist of one shallow casing constructed to represent groundwater conditions at the water table surface and at elevations similar to the adjacent surface water channel. The second casing at each site is constructed to a deeper depth with screen intervals coinciding with aquifer materials and depths likely to be accessed by production wells in the vicinity. Paired casings are separated within the borehole by intermediate seals designed to provide a

physical separation such that groundwater conditions reflected by each casing are not influenced by conditions in other portions of the groundwater system.

## 4.3 SGMA Representative Monitoring Sites

Groundwater level conditions are currently monitored at 61 sites distributed throughout the Subbasin (**Table 4-3** and **Figure 4-3**). These sites include 20 wells identified as groundwater level representative wells in the Basin Analysis Report and the Northeast Napa Management Area Report (**Table 4-6**).[28] SGMA defines "representative monitoring" as "a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin" (Section 351). This subset of representative monitoring sites is established for the purpose of monitoring groundwater conditions that are representative of the basin or an area of the basin (Section 354.36). For SGMA purposes for the Napa Valley Subbasin, these sites are where sustainability indicators are monitored, and minimum thresholds and measurable objectives are defined.

Napa County has used the term "representative" in reference to hydrographs presented in previous reports (LSCE, 2011a; 2015; 2016a). Specific representative monitoring sites that typify conditions in the Subbasin are designated in the Basin Analysis Report and Northeast Napa Management Area Report, to align ongoing monitoring efforts with SGMA (LSCE, 2016c). Seven of the SGMA representative wells were selected because of their long historical groundwater level record and their prior use in Napa County groundwater-related reports as "representative" wells with hydrographs that typify groundwater conditions and trends in the Subbasin. Ten relatively new wells in the surface water-groundwater monitoring network were selected because of their construction and location, for the specific purpose of assessing surface water and groundwater interaction. One other well, 5N4W-15E1, was selected because of its location in the southern part of the Subbasin, moderate historical groundwater level record, likely construction in unconfined part of the groundwater system, and for the purpose of tracking groundwater trends and gradients near the adjoining subbasin. Well 5N4W-15E1 is currently only associated with minimum thresholds and measurable objectives for groundwater quality.[29] As part of its ongoing efforts to refine the understanding of how groundwater conditions in individual wells relate to different aquifer zones in the Subbasin, Napa County will continue to review new information on well construction and other information that may provide additional insights on the interpretation of well-specific data in relation to the hydrogeologic conceptual model for the Subbasin. One example of such review is NapaCounty-135, which is understood to be in an area where alluvial deposits are relatively thin. Analysis conducted for the water year 2017 Annual Report showed that the

[28] Well 5N/4W-15E1 is currently the only representative monitoring site designated for groundwater quality criteria, but not groundwater level criteria. Therefore, a total of 21 representative monitoring sites are established for the Napa Valley Subbasin, twenty of which have groundwater level criteria.

[29] Groundwater quality monitoring also occurs at the 10 dedicated monitoring wells owned by Napa County at surface water-groundwater monitoring sites and three additional production wells monitored by DWR in the Napa Valley Subbasin. In addition, groundwater quality monitoring is planned to occur at up to 16 wells in the Napa County voluntary monitoring network.

well likely has the majority of its screened interval in formations of the Tertiary Sonoma Volcanics, below the alluvium.

**Table 4-6 Napa Valley Subbasin Representative Monitoring Sites**

| Well ID | Data Source | Aquifer Designation[1] | Subarea | Well Depth (ft) | Basis for Selection |
|---|---|---|---|---|---|
| 06N04W17A001M | DWR | Qa | Yountville | 250 | Long record |
| 06N04W27L002M | DWR | Qa | Napa | 120 | Long record |
| 07N05W09Q002M | DWR | ND | St. Helena | 232 | Long record |
| 08N06W10Q001M | DWR | ND | Calistoga | 200 | Long record |
| 5N/4W-15E1 | DWR | Qa | Napa | 158 | Moderate record [2] |
| NapaCounty-76 | Napa County | Tsv | Napa | 405 | Aquifer-specific construction, Moderate record |
| NapaCounty-122 | Napa County | Tss | MST | 210 | Aquifer-specific construction, Moderate record |
| NapaCounty-229 | Napa County | Tss | MST | 350 | Aquifer-specific construction, Moderate record |
| NapaCounty-128 | Napa County | Qa | Calistoga | 50 | Long record |
| NapaCounty-133 | Napa County | Qa | Yountville | 120 | Long record |
| NapaCounty-135 | Napa County | Qa, Tsv | Yountville | 125 | Long record |
| NapaCounty-214s-swgw1 | Napa County | Qa | Napa | 53 | Designated SW/GW facility [3] |
| NapaCounty-215d-swgw1 | Napa County | Qa | Napa | 98 | Designated SW/GW facility |
| NapaCounty-216s-swgw2 | Napa County | Qa | Yountville | 50 | Designated SW/GW facility |
| NapaCounty-217d-swgw2 | Napa County | Qa | Yountville | 86 | Designated SW/GW facility |
| NapaCounty-218s-swgw3 | Napa County | Qa | Napa | 40 | Designated SW/GW facility |
| NapaCounty-219d-swgw3 | Napa County | Qa | Napa | 93 | Designated SW/GW facility |
| NapaCounty-220s-swgw4 | Napa County | Qa | Yountville | 45 | Designated SW/GW facility |
| NapaCounty-221d-swgw4 | Napa County | Qa | Yountville | 85 | Designated SW/GW facility |
| NapaCounty-222s-swgw5 | Napa County | Qa | St. Helena | 40 | Designated SW/GW facility |
| NapaCounty-223d-swgw5 | Napa County | Qa | St. Helena | 100 | Designated SW/GW facility |

1 Aquifer Designations: Qa = Quaternary Alluvium, Tsv = Tertiary Sonoma Volcanic Rocks, Tss = Tertiary Sedimentary Rocks, ND = Not Determined

2 Well 5N4W-15E1 is currently designated as a representative site for groundwater quality criteria only.

3 Designated SW/GW facility refers to surface water and groundwater monitoring facilities installed as part of the DWR Local Groundwater Assistance Program grant awarded to Napa County for purposes of evaluating the connectivity between groundwater and surface water.

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# 5 GROUNDWATER LEVEL CONDITIONS AND TRENDS

Groundwater data availability in Napa County varies widely between local subareas. The bulk of sites with historical and current groundwater level and quality data are located in the Napa Valley Floor Subareas (e.g., the Calistoga, St. Helena, Yountville, Napa, and MST Subareas) with less abundant records available in other Napa County subareas. Except for the MST Subarea, the Napa Valley Floor subareas generally coincide with the Napa Valley Subbasin delineated by DWR. This section presents a discussion of groundwater levels, with a focus on groundwater level characteristics by local subarea.

Precipitation records in Napa County date back to 1906 at the longest continually operating gauge at the Napa State Hospital (GHCND: USC00046074). In a separate analysis, precipitation data from the Napa State Hospital gauge in Napa (elevation 35 feet) have been shown to have strong linear correlations (i.e., $R^2 \geq 0.90$) with monthly and annual precipitation totals from two other gauges in St. Helena (elevation 1,780 feet) and Angwin (elevation 1,815 feet) (2NDNature, 2014). Based on the strength of those correlations, the Napa State Hospital gauge has been recommended for use as an index gauge for the Napa River Watershed.

Napa County received below average precipitation at the Napa State Hospital gauge during water years 2012, 2013, 2014, 2015, and 2016. Water year 2014 registered as a Dry year on the five-stage rating system of Very Dry, Dry, Normal, Wet and Very Wet water year types (**Table 5-1**). Since 1949 when most long-term groundwater monitoring records begin, comparable multi-water year periods with below average precipitation occurred in 1990-1991 (both Dry), 1976-1977 (both Very Dry), and 1959-1962 (all Dry), and 1954-1955 (both Dry).

**Figure 5-1** depicts both the annual water year precipitation recorded at the Napa State Hospital gauge along with the cumulative departure from the mean water year precipitation value for water years 1950 through 2018. A cumulative departure from mean curve is often used to identify trends in historical climatic conditions, such as periods of dry, average, or wet conditions. To develop a cumulative departure curve, the long-term mean (average) of a set of climatic data is calculated and compared to each annual amount, to determine the amount of annual departures from the mean. The cumulative departure curve is then compiled by progressively accumulating these annual departure amounts, from the first year through the last year of the historical period. The cumulative departure curve always begins and ends at zero, because the values are a measure of deviation from an arithmetic mean across the complete dataset on which the mean is calculated. Downward trends through time are indicative of a period of overall dry conditions, upward trends indicate a period of overall wet climatic conditions, and level sections of the curve indicate a period of overall average conditions. This cumulative departure curve was developed for the Napa Valley Subbasin to identify precipitation trends over time.

**Table 5-1 Recent Napa State Hospital Annual Precipitation Totals and Napa River Watershed Water Year Types**

| Water Year | Annual Precipitation (in) (updated values from LSCE) | Water Year Type |
|---|---|---|
| 2009 | 21.31 | Normal (below average) |
| 2010 | 28.85 | Wet |
| 2011 | 36.62 | Wet |
| 2012 | 21.75 | Normal (below average) |
| 2013 | 20.26 | Normal (below average) |
| 2014 | 19.67 | Dry |
| 2015 | 20.72 | Normal (below average) |
| 2016 | 24.42 | Normal (below average) |
| 2017 | 45.50 | Very Wet |
| **2018** | **19.30** | **Dry** |

The cumulative departure values calculated for **Figure 5-1** provide a tally of precipitation received relative to the mean value over time. Beginning in water year 1988, the first year of the study period used for the Basin Analysis Report, three different periods are evident. From 1988 to 1994, the Subbasin received below average precipitation in six of seven years. From 1995 to 2006, the Subbasin received above average precipitation in nine of twelve years, resulting in a broadly positive trend in the cumulative departure curve. From 2007 to 2016, the Subbasin received below average precipitation in eight of ten years.

Notably, the eight-year span from 1987 through 1994, with only one year of above average precipitation, resulted in a net cumulative departure deficit[30] of 48.24 inches (**Figure 5-1**). This protracted period contrasts with the Very Dry years of 1976 and 1977, which although more acute, produced a less severe net cumulative departure deficit of 28.55 inches. Groundwater level records from the Napa Valley Subbasin that include both of these time periods generally show the lowest spring groundwater levels in 1977, as compared to the 1987 to 1994 period. This indicates that the Subbasin experienced sufficient recharge relative to outflows allowing it to maintain relatively stable spring groundwater levels over an eight-year period when precipitation totals were below average on the whole.

[30] The progressive accumulation or deficit of precipitation (i.e., cumulative annual departure relative to the mean) can have important effects on hydrologic relationships (e.g., streamflow) that are directly related to precipitation.

The five-year span from 2012 through 2016 produced a net cumulative departure deficit of 32.53 inches. Despite the decline in the cumulative departure curve of precipitation in Napa Valley, groundwater levels in the Napa Valley Subbasin have remained stable since 2012 at the Subbasin scale. Groundwater levels in the Quaternary alluvial formations that comprise the principal aquifer system of the Napa Valley Subbasin continued to experience groundwater recharge and corresponding rises in groundwater levels from fall to spring during this time.

Water year 2017 was the single wettest year since 1983 in the Subbasin. It was followed by a Dry year in 2018, with an annual total (19.30 inches) similar to that of 2014 (19.67 inches). The annual total precipitation at the Napa State Hospital in 2018 was 15% below the median annual total of 22.84 inches for years since 1950.

Depths to water in the Subbasin in spring 2018 ranged from 4.9 feet to 40.74 feet below ground surface (**Table 5-3**). Spring 2018 depths to groundwater in the alluvial aquifer are shown in **Figure 5-2** using an interpolation of measured depths to water in wells throughout the Subbasin. The pattern or distribution of depths to water in the alluvial aquifer in spring 2018 is similar to observations in prior years. However, depths to groundwater were generally greater in spring 2018 compared to spring 2017, consistent with the limited precipitation received in water year 2018.

Overall, the depth to the groundwater table in the alluvial aquifer of the Subbasin is quite shallow; the depth to groundwater in the main part of the Napa Valley Floor in the spring 2018 was between 4.9 and 41.74 feet. While agricultural land use, especially vineyards, have covered much of the Napa Valley Floor for decades, the water requirements for this type of agricultural land use are significantly lower than agricultural commodities grown elsewhere in California, such as the Central Valley (LSCE, 2016c). **As a result, due to high recharge potential in most years, low water requirements and a hydrogeologic setting conducive to recharge, the Napa Valley Subbasin remains full overall.**

Underlying geologic setting and differences in aquifer zones within a subarea or groundwater subbasin are additional considerations relevant to the interpretation of groundwater levels, particularly for wells constructed entirely or partially within the alluvium in Napa Valley. **Figure 5-3** depicts three wells located relatively near each other at the land surface that exhibit distinct groundwater levels due in part to having been constructed within different aquifer zones. Well 07N05W09Q2 has a total depth of 232 feet and is located near the center of Napa Valley, where the alluvium extends to approximately 200 feet below ground surface (LSCE and MBK, 2013). NapaCounty-138 has a total depth of 321 feet and is located closer to the western edge of Napa Valley in an area where the alluvium extends only about 50 feet below ground surface. NapaCounty-177 has a total depth of 123 feet and is located closer to the center of Napa Valley where the alluvium extends to depths of about 130 feet. The lower static water levels measured in the fall at NapaCounty-138 indicate that the well draws water from a geologic formation below the alluvium and is therefore not interpreted to provide accurate representation of static groundwater level conditions in the alluvial aquifer system in fall when water levels in the well are most impacted by groundwater pumping that has occurred over the dry season. **Knowledge of the**

**geologic setting and construction details for a given well are very important considerations when interpreting groundwater level data.**

**Figure 5-4** depicts another example of the influence that aquifer zones can have on water levels in wells located in the same area. In this case, the well located east of the Napa River is constructed in the Sonoma Volcanics, while the wells west of the Napa River are constructed within alluvial sediments. Additional discussion of these wells is provided in **Section 5.1.2**.

The groundwater elevation contours described below are derived from available depth to water measurements made in wells. Prior to interpolating groundwater elevations across the valley, depth to water values were converted to groundwater elevation values by subtracting the measured depth to water from the reference point elevation at each monitored well. In this way, the depth to water measurements were related to the North American Vertical Datum 1988 (NAVD88) as a standard point of reference. The resulting groundwater elevation values at each well were used to interpolate groundwater elevation contours for the alluvial aquifer system of the Napa Valley Floor and in the aquifer system of the volcanic sediments and volcanic rock formations in the MST area. A contour line represents a line of equal elevation of the water surface similar to the way a topographic map contour line shows a line of equal elevation of ground surface. The direction of groundwater flow is perpendicular to the contour lines.

## 5.1 Napa Valley Subbasin

The Napa Valley Floor Subarea is subdivided into five smaller subareas. From north to south these areas are Calistoga, St. Helena, Yountville, Napa, and the MST. The groundwater level conditions in each of these areas are described below.

Over the length of the Napa Valley, groundwater is contained in and moves primarily through the older and younger Quaternary alluvial formations from Calistoga to San Pablo Bay. These alluvial formations comprise the principal aquifer system of the Napa Valley Subbasin (LSCE, 2016c). For the purposes of contouring groundwater data on a regional basis, wells with measurements representing and/or primarily representing these formations were used for contouring. Groundwater levels that were determined to represent a non-alluvial part of the aquifer system were excluded from the contouring dataset. Monitoring conducted since 2014 at dedicated monitoring wells along the Napa River and Dry Creek within Napa Valley and data from other wells show that within the Napa Valley alluvial formations groundwater conditions range from unconfined to semi-confined throughout the Valley Floor and Napa Valley Subbasin. The degree of confinement in groundwater results from variations in the nature of geologic materials, with more areally extensive and thicker areas of fine-grained, low-permeability materials leading to semi-confined conditions in underlying aquifer materials that can result in groundwater levels in deeper portions of the alluvium being offset from groundwater levels in shallower portions of the alluvium. These differences in groundwater levels are an indication of physical resistance to vertical groundwater flow between unconfined to semi-confined areas. Data from wells constructed in semi-confined portions of the Subbasin are included in the development of groundwater level contour

maps for spring only if spring groundwater levels measured at those locations are consistent with groundwater levels in other wells in the vicinity.

Interpreted groundwater elevation contours for spring and fall 2018 are shown in **Figures 5-5** and **5-6,** respectively. Groundwater elevation contours for Napa Valley in spring 2018 are similar to those developed for prior years dating back to spring 2010 (LSCE, 2013b; LSCE, 2015; LSCE, 2016a; LSCE, 2017a). Contours across these time periods show a generally southeasterly to east-southeasterly groundwater gradient paralleling the valley axis from Calistoga to Yountville with similar groundwater elevation ranges. In the southern portion of the valley, near the City of Napa, contours indicate a more eastward flow direction, consistent with the spring contours dating back to 2014. Through the valley, groundwater elevations in spring 2018 ranged from 369 feet near Calistoga to 6 feet along the Napa River near First Street in Napa.

### 5.1.1 Napa Valley Subbasin – Calistoga and St. Helena Subareas

The hydrographs for the representative wells illustrated on **Figure 5-7** show groundwater elevations and corresponding depth to groundwater from 1970 to present, as available.[31] Groundwater levels have been generally stable over time in the Calistoga Subarea and northern portion of the St. Helena Subarea. Groundwater levels in the representative wells are frequently very shallow at less than 10 feet below the ground surface in the spring. Minor seasonal groundwater level variations of about 10 feet occur between spring and fall in the Calistoga Subarea. Groundwater levels in well 08N06W10Q1 have been lower in the late September to December timeframe in seven years since 2001. However, in every year since 1970 and including 2018, groundwater levels returned to within 10 feet of the ground surface the following spring.

Elsewhere in the St. Helena Subarea, groundwater levels exhibit greater seasonal declines of about 20 feet. Groundwater levels at well 07N05W09Q2 have remained relatively stable although somewhat susceptible to dry years. An example of this occurred in 1976 and 1977, two Very Dry years in the Napa River Watershed. In 1976, the spring groundwater level measurement was 18.8 feet below ground surface, which is lower by more than 10 feet from the prior spring. In 1977, the spring groundwater level measurement was 26.7 feet below ground surface, down almost 8 feet from the spring 1976 measurement. Spring water levels in the same well in 2014 and 2015 were 18.1 feet and 12.7 feet below ground surface, respectively; the spring 2014 and 2015 levels are above the levels measured in 1976 and 1977. In 2017, the spring groundwater level was measured as high as 9.2 feet below ground surface. Fall water levels in 07N05W09Q2 remained about 5 feet above levels recorded at similar times of year from 2013 to 2015. Consistent with the reduction in precipitation and available groundwater recharge in 2018, the spring water level in this well was measured to be 16.1 feet below ground surface.

[31] Hydrographs contained in Figures 5-7, 5-8, 5-13, and 5-14 include only data that are not designated with questionable measurement flags, which are used to indicate when a measurement is likely to not accurately represent a static water level. Hydrographs for the same wells are included in Appendix B with all available data points plotted.

NapaCounty-132 was noted in the 2014 Annual Monitoring Report for possible signs of declining water levels. This well is recorded as having a total depth of 265 feet, screened from 25 feet to 265 feet, in an area where the thickness of alluvial deposits is likely less than 100 feet. The driller's log for the well indicates extensive clay (or fine grained, low permeability) layers were encountered, particularly in the upper 100 feet of the boring. In spring 2015, a depth to groundwater of 16.1 feet was measured at this well, which is more comparable to levels seen prior to 2014. A site visit to this well conducted in 2015 showed that much of the surrounding acreage is planted in young vines. A subsequent review of aerial photography showed that a large-scale vineyard replanting took place in 2007. Given these observations it is possible that changing irrigation demands have been a factor in this area since 2007. In spring 2018, the depth to groundwater at NapaCounty-132 was 19.43 feet below ground surface, compared to a depth of 24.95 feet in spring 2014 (**Appendix B**).

### 5.1.2 Napa Valley Subbasin – Yountville and Napa Subareas

The representative hydrographs shown in **Figure 5-8** show groundwater elevations and corresponding depths to water in the Yountville and Napa Subareas. Long-term groundwater elevations have remained stable in most of the representative wells in the Yountville Subarea. In the Yountville Subarea, the depth to groundwater in the spring is generally less than 10 to 20 feet under non-drought conditions, similar in nature to the Calistoga and St. Helena Subareas to the north. Seasonal fluctuations vary by proximity to the center of the valley. Along the western and eastern edges of the subarea, levels are more subject to larger seasonal fluctuations. Groundwater elevations in the center of the valley fluctuate seasonally approximately 10 to 25 feet, and near the edge of the valley fluctuate approximately 25 to 35 feet.

In the Napa Subarea, depth to water ranges from about 20 to 30 feet below ground surface during the spring in most years. Seasonal groundwater elevations in this subarea generally fluctuate from 10 to 40 feet. Long-term trends have been generally stable with the exception of the northeastern area at NapaCounty-76 where groundwater levels have locally declined by about 20 to 30 feet over the past 15 years (**Appendix B**).

NapaCounty-76 is located east of the Napa River and East Napa Fault and west of Soda Creek Fault. The well is completed below the alluvium in the Sonoma Volcanics formation. The Sonoma Volcanics are also present in the MST Subarea to the east, where previous monitoring has shown several pumping depressions (LSCE, 2011a). Analyses conducted with the groundwater flow model developed for the Northeast Napa Special Groundwater Study found a trend of decreasing subsurface inflow into the Napa Valley Subbasin from portions of the MST Subarea east of the Soda Creek Fault resulting from the influence of the cones of depression east of the Soda Creek Fault outside of the Subbasin (**Figure 2-7**) (LSCE, 2017b).

Three monitored wells located west of the Napa River and nearest to NapaCounty-76 (i.e., 06N04W27L002M, NapaCounty-218s, and NapaCounty-219d) are constructed to depths of 120 feet or less and are completed in the alluvium. These three wells have shown stable groundwater level trends. Well 06N04W27L002M, in particular, has shown stable water levels since the 1960s. It appears that the

extent of the pumping depression beyond the MST Subarea is limited to the northeastern Napa Subarea east of the Napa River.

As part of increased attention on the northeast portion of the Napa Subarea, three additional wells, NapaCounty-182, NapaCounty-228, and NapaCounty-229, have been added to the County's monitoring networks in this area in recent years (**Appendix B**).

In the southwestern part of the Yountville Subarea and at the Napa Valley margin, groundwater levels in NapaCounty-135 have exhibited increasing seasonal variation from spring to fall, since the first measurements were recorded in the late 1970s and early 1980s. The well also experienced very limited water level recovery in spring 2014, with a measurement of 76 feet below ground surface (**Figure 5-8**). In response to these observations Napa County began monitoring this well at monthly intervals in fall 2015. Water levels measured at NapaCounty-135 recovered to 23.8 feet below ground surface and in 2016 and 21.3 feet in 2017, indicating that groundwater levels observed during the preceding years were primarily the result of reductions in groundwater recharge during drier years. With the return to dry conditions in 2018, the depth to groundwater in NapaCounty-135 increased compared to 2016 and 2017 but remained more than 35 feet above the depth to groundwater measured in spring 2014.

Regarding the increasing seasonal variation observed at NapaCounty-135, monthly data collected at this well in the fall of 2015 and 2016 show monthly variations between October and November of 7 and 23 feet, respectively. Spring measurements recorded in March and April 2017 differed by more than 6 feet. These variations indicate the potential variability that semi-annual data collection at this well from 1979 through 2014 did not capture.

Very little construction information is available for NapaCounty-135. It is known to have a total depth of 125 feet and is located in an area where the total thickness of the alluvium is likely less than 50 feet, based on contours of alluvium thickness developed as part of the report *Updated Hydrogeologic Conceptualization and Characterization of Conditions Report* (LSCE and MBK Engineers, 2013). As at NapaCounty-132, the construction information and alluvium thickness data for the area around the well suggest that a substantial portion of the well screen is likely exposed to geologic formations below the alluvium, as a result conditions in this well in the fall are reflective of conditions in older, semi-consolidated formations below the primary alluvial aquifer of the Napa Valley Subbasin.

### 5.1.3 Napa Valley Subbasin Sustainability Indicators

As described in **Section 2.4.2**, the Basin Analysis Report for the Napa Valley Subbasin provides an updated sustainability goal for the Subbasin based on the requirements of SGMA (LSCE, 2016c). The Basin Analysis Report meets the functionally equivalent standard for alternatives to a Groundwater Sustainability Plan (GSP) in part by updating sustainability criteria for the Napa Valley Subbasin in conformance to the definitions provided in SGMA. To evaluate the condition of the Subbasin in relation to the sustainability goal, the sustainability criteria include measurable objectives and minimum thresholds developed to avoid the six undesirable results identified in SGMA (LSCE, 2016c and LSCE, 2018a). Sustainability criteria are established for 20 wells identified as groundwater level representative

wells in the Basin Analysis Report and the Northeast Napa Management Area Report (see **Section 4.3**) For SGMA purposes, "measurable objectives" are "specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions" (Section 351). SGMA additionally defines a "minimum threshold" as "a numeric value for each sustainability indicator used to define undesirable results" (Section 351).

At 19 of 20 SGMA Representative Wells, the lowest recorded groundwater elevation for fall 2018 was greater than the minimum threshold established for the well (**Table 5-2**).[32] The reduction of groundwater levels below the minimum threshold at one of twenty SGMA Representative Wells, 08N06W10Q001M, is most likely the result of a localized groundwater condition, possibly influenced by the Dry water year. Two other wells in the vicinity, NapaCounty-224 and NapaCounty-225, did not experience similar groundwater level reductions in fall 2018, compared to prior years. The subsequent measurement at well 08N06W10Q001M, in November 2018 before substantial rainfall occurred, found that the water level had recovered by 14 feet four weeks after the fall measurement occurred. Further monitoring found that water levels in well 08N06W10Q001M continued to increase during the winter of 2018-2019, reaching levels similar to prior years in the same well. These observations indicate that the fall 2018 groundwater level measurement does not reflect a changed condition in the Napa Valley Subbasin. In response to the fall 2018 groundwater level in well 08N06W10Q001M, the County is reviewing conditions in the vicinity of the well including water use and the location and operation of nearby wells.

The measurable objectives established in the Basin Analysis Report for the Napa Valley Subbasin provide a reasonable margin of operational flexibility under adverse conditions where applicable and utilize components such as historical water budgets, seasonal and long-term trends, and periods of drought. Groundwater elevations serve as the proxy for multiple sustainability indicators where reasonable. For representative monitoring sites where, long-term periods of record are not available, as in the case of the dedicated monitoring wells constructed in 2014, which were developed specifically to monitor groundwater/surface water interactions, measurable objectives established at these facilities will be reviewed and reevaluated as appropriate, as the collection of available data for each site expands to better reflect true long-term variability at those locations.

As noted earlier in this Report, the Napa River system is considered to be the most sensitive sustainability indicator in the Napa Valley Subbasin (also see **Section 3**). Measurable objectives and minimum thresholds were established to ensure continued groundwater sustainability, or improve groundwater conditions, and provide ongoing management targets devised to address potential future effects on surface water.

[32] Data reviewed were from 10/1/2018 to 11/15/2018. DWR monitored well 06N04W17A001M monthly beginning in the summer of 2018 and recorded a lower GWL in September than in October. That result is not included as it is outside of the traditional fall monitoring period and represents a data point that is not consistent with the temporal data that were evaluated to establish minimum thresholds (i.e., historical fall semi-annual monitoring performed in October).

Based on the analyses of surface water and groundwater interconnections, measurable objectives and minimum thresholds for streamflow depletion are set at 16 SGMA-related representative wells in the Subbasin (**Table 5-2**) (LSCE, 2016c). The measurable objectives represent the mean fall groundwater level elevations that occurred historically. The minimum thresholds represent the lowest static groundwater level elevation that has occurred historically in the fall and an elevation below which additional streamflow depletion is likely to occur, i.e., expand the duration of annual no flow days in some reaches of the Napa River. The minimum thresholds also represent the lowest static groundwater elevation to which groundwater levels may reasonably be lowered at the end of a dry season without exacerbating streamflow depletion. These levels are not acceptable on a continuous basis as this would contribute to a worsening of existing conditions. Taken together, the measurable objectives and minimum thresholds represent the fall groundwater elevations within which groundwater elevations are reasonably likely to fluctuate during fall (including fall periods for all water year types) without exacerbating streamflow depletion.

Measurable objectives and minimum thresholds for the avoidance of chronic groundwater level decline, land subsidence, and a reduction in groundwater storage are based on fall groundwater levels at representative wells that use the fall groundwater elevations for avoidance of streamflow depletion as the proxy (**Table 5-2**). One additional well NapaCounty-135, located away from the Napa River, is an additional representative well used for these sustainability indicators.

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**Table 5-2 Sustainability Indicators: Groundwater Levels**

| Representative Monitoring Sites Well ID | Date Monitored | Measured Minimum 2018 Fall Groundwater Elevation (GWE) (Feet)[1] | Chronic Lowering of GWLs | | Reduced GW Storage | | Land Subsidence | | Streamflow Depletion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Minimum Threshold (Fall GWE, Feet) | Measurable Objective (Fall GWE, Feet) | Minimum Threshold (Fall GWE, Feet) | Measurable Objective (Fall GWE, Feet) | Minimum Threshold (Fall GWE, Feet) | Measurable Objective (Fall GWE, Feet) | Minimum Threshold (Fall GWE, Feet) | Measurable Objective (Fall GWE, Feet) |
| 06N04W17A001M[2] | 10/10/2018 | 43 | 37 | 50 | 37 | 50 | 37 | 50 | 37 | 50 |
| 06N04W27L002M | 11/7/2018 | 8 | -2 | 12 | -2 | 12 | -2 | 12 | -2 | 12 |
| 07N05W09Q002M | 11/7/2018 | 132 | 127 | 135 | 127 | 135 | 127 | 135 | 127 | 135 |
| 08N06W10Q001M | 10/10/2018 | **251** | 269 | 281 | 269 | 281 | 269 | 281 | 269 | 281 |
| NapaCounty-76 | 11/16/2018 | -12 | -30 | 20 | -30 | 20 | - | - | - | - |
| NapaCounty-122 | 11/19/2018 | -34 | -45 | -26 | -45 | -26 | -45 | -26 | - | - |
| NapaCounty-128 | 10/17/2018 | 331 | 320 | 331 | 320 | 331 | 320 | 331 | 320 | 331 |
| NapaCounty-133 | 10/29/2018 | 75 | 72 | 76 | 72 | 76 | 72 | 76 | 72 | 76 |
| NapaCounty-135 | 11/19/2018 | 34 | 20 | 60 | 20 | 60 | 20 | 60 | - | - |
| NapaCounty-214s-swgw1 | 10/25/2018 | 3 | 2 | 4 | 2 | 4 | - | - | 2 | 4 |
| NapaCounty-215d-swgw1 | 10/25/2018 | 3 | 2 | 4 | 2 | 4 | - | - | 2 | 4 |
| NapaCounty-216s-swgw2 | 10/25/2018 | 72 | 61 | 76 | 61 | 76 | - | - | 61 | 76 |
| NapaCounty-217d-swgw2 | 10/25/2018 | 62 | 61 | 76 | 61 | 76 | - | - | 61 | 76 |
| NapaCounty-218s-swgw3 | 10/25/2018 | 30 | 29 | 32 | 29 | 32 | - | - | 29 | 32 |
| NapaCounty-219d-swgw3 | 10/25/2018 | 30 | 29 | 32 | 29 | 32 | - | - | 29 | 32 |
| NapaCounty-220s-swgw4 | 10/2/2018 | 76 | 75 | 77 | 75 | 77 | - | - | 75 | 77 |
| NapaCounty-221d-swgw4 | 10/2/2018 | 76 | 75 | 77 | 75 | 77 | - | - | 75 | 77 |
| NapaCounty-222s-swgw5 | 10/25/2018 | 187 | 185 | 190 | 185 | 190 | - | - | 185 | 190 |
| NapaCounty-223d-swgw5 | 10/25/2018 | 171 | 164 | 175 | 164 | 175 | - | - | 164 | 175 |
| NapaCounty-229 | 11/19/2018 | -65 | -69 | -51 | -69 | -51 | -69 | -51 | - | - |

1. Values below a minimum threshold shown in bold.

GWE = Groundwater Elevation

NapaCounty-214s-swgw1, NapaCounty-215d-swgw1, NapaCounty-218s-swgw3, NapaCounty-219d-swgw3, NapaCounty-76, NapaCounty-122, and NapaCounty-229 are all designated as representative wells for the Northeast Napa Management Area as part of the Napa Valley Subbasin.

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### 5.1.4 Napa Valley Subbasin Groundwater Level Change in Storage

Additional analysis of groundwater levels in the Napa Valley Subbasin was conducted for this Report to evaluate changes in groundwater in storage in the principal aquifer, the alluvial aquifer system, in accordance with the requirement of the GSP Regulations (Section 356.2(b)(5)). This analysis builds on a similar analysis performed as part of the Basin Analysis Report (LSCE, 2016c). The objective of the analysis provided in this Report is to continue tracking changes in groundwater storage for the alluvial aquifer system over time and identify any chronic storage depletions, if any.

The analysis relies on water level measurements from 27 wells located throughout the Napa Valley Subbasin (**Table 5-3**). Two wells located at the northern and southern ends of the Subbasin were duplicated as "Auxiliary" wells for the analysis to achieve a result inclusive of the entire Subbasin.[33] Use of these auxiliary wells in the analysis assumes a consistent water level condition between the true well and the auxiliary well. This approach is consistent with the method used for the earlier analysis described in the Basin Analysis Report (LSCE, 2016c). However, the 27 wells used for this analysis is reduced from 32 wells used in the earlier analysis, in order to omit deeper wells that have greater exposure to deeper water-bearing formations, which are less likely to represent the local condition in the principal aquifer, the alluvial aquifer system.

Depths of the wells included in the analysis range from 40 feet to 321 feet. Water levels in these wells are expected to represent local groundwater levels in the principal aquifer, namely the Quaternary alluvial aquifer. As noted earlier in this Report, some of these wells occur in areas of relatively thin alluvial deposits and may draw water from deeper formations, particularly later during the dry season. Since this analysis is conducted using spring water levels, when static water levels in the wells are within the alluvial zone, it is assumed that any vertical gradients between the shallow alluvium and deeper formations are negligible.

For each year, a continuous surface representing the groundwater table of the alluvial aquifer was created by interpolating available water level measurements, using the Inverse Distance Weighting interpolation method in ArcGIS software. The saturated thickness of the alluvium throughout the Subbasin was calculated by subtracting the depth to groundwater table from the previously mapped alluvium thickness dataset (LSCE and MBK Engineers, 2013). The total saturated volume of alluvium was calculated from the summation of saturated alluvium thickness throughout the Subbasin. Finally, the volume of groundwater that occurs in the alluvium was calculated by multiplying the saturated volume of alluvium by 0.06, the bulk specific yield of the aquifer (LSCE, 2016c). This procedure is consistent with the method used for the earlier analysis described in the Basin Analysis Report (LSCE, 2016c).

[33] Due to a questionable measurement in spring 2018 at NapaCounty-127, the Auxiliary well, the value assigned to NapaCounty-127-AUX is the average of spring 2018 measured values at two nearby wells, NapaCounty-128 and NapaCounty-129.

**Table 5-3 Spring Depths to Groundwater, 2014, 2017, and 2018**

| Well ID | RPE[2] | Depth[3] | 2014 Depth to Water (feet below ground surface) | 2017 Depth to Water (feet below ground surface) | 2018 Depth to Water (feet below ground surface) |
|---|---|---|---|---|---|
| NapaCounty-127-AUX [1] | 392.5 | 149 | 10.6 | 6.1 | 5.9 [4] |
| NapaCounty-127 | 392.5 | 149 | 10.6 | 6.1 | - |
| NapaCounty-128 | 343.7 | 50 | 5.3 | 5.6 | 4.9 |
| NapaCounty-129 | 338.7 | 253 | 8.7 | 3.9 | 6.7 |
| 08N06W10Q001M | 293.4 | 200 | 10.6 | 5.4 | 6.4 |
| NapaCounty-222s-swgw5 | 217.1 | 40 | - | 18.6 | 19.8 |
| 07N05W09Q002M | 158.2 | 232 | 31.4 | 9.2 | 17.9 |
| NapaCounty-132 | 142.7 | 265 | 25 | 8.6 | 20.2 |
| NapaCounty-131 | 173.5 | 221 | 20.7 | 11 | 17.4 |
| NapaCounty-138 | 195.1 | 321 | 7.2 | 7.5 | 6.9 |
| NapaCounty-204 | 141.7 | 220 | - | 16.7 | 24.2 |
| NapaCounty-177 | 149.3 | 123 | 8.4 | 7.1 | 7.6 |
| NapaCounty-220s-swgw4 | 98.2 | 45 | - | 10.5 | 15.9 |
| NapaCounty-133 | 94.7 | 120 | 16 | 5.5 | 9.4 |
| NapaCounty-179 | 74.3 | 150 | 17.9 | 5.8 | 12.2 |
| 06N04W17A001M | 70.3 | 250 | 22.7 | 2.4 | 17.9 |
| NapaCounty-218s-swgw3 | 56.1 | 40 | - | 13.3 | 22.1 |
| NapaCounty-216s-swgw2 | 103.1 | 50 | - | 15.4 | 17.2 |
| NapaCounty-139 | 85.8 | 120 | 17.9 | 7.2 | 13.8 |
| NapaCounty-135 | 129.2 | 125 | 76.3 | 21.3 | 40.74 |
| NapaCounty-185 | 83.0 | 260 | 21.6 | 10.2 | 24.5 |
| 06N04W27L002M | 53.6 | 120 | 40 | 18.8 | 29.2 |
| NapaCounty-152 | 78.3 | - | 9.8 | 6.7 | 7.4 |
| NapaCounty-136 | 53.2 | 120 | 23.3 | 14.2 | 20.9 |
| NapaCounty-214s-swgw1 | 20.1 | 53 | - | 13.8 | 14.7 |
| SL0605536682MW-1 | 31.63 | 24 | 8.5 | 6.6 | 7.9 |
| T0605514064MW1 | 14 | 21 | 3 | 2 | 5.1 |
| NapaCounty-18 | 124.372 | 189 | 20.8 | 19.6 | 20.29 |
| NapaCounty-18-AUX [1] | 124.3 | 189 | 20.8 | 19.6 | 20.29 |

1. Auxiliary data point to achieve water level interpolation covering entire Subbasin
2. Reference Point Elevation (ft, NAVD88)
3. Total depth of the well (ft)
4. Due to a questionable measurement at NapaCounty-127 in spring 2018, the value assigned to NapaCounty-127-AUX is the average of spring 2018 measured values at NapaCounty-128 and NapaCounty-129.

Results of the groundwater storage analysis are summarized in **Table 5-4**. Consistent with the Dry water year condition, the volume of groundwater in storage declined in 2018 by 9,314 acre-feet to a total of 209,984 acre-feet. From 1988 through 2018 the cumulative annual storage changes were 4,388 acre-feet, reflecting the absence of long-term depletions of groundwater storage in the Subbasin (**Table 5-4**). The spring 2018 storage volume of 209,984 acre-feet was similar to the 1988 to 2018 average and median storage volumes of 209,631 acre-feet and 210,929 acre-feet, respectively.

The change in alluvial aquifer saturated thickness from spring 2017 to spring 2018 is depicted in **Figure 5-9A**. Saturated thickness decreased between 0 and 10 feet throughout most of the Subbasin. Larger decreases occurred along Dry Creek and in the vicinity of Oak Knoll Avenue. Notably, the reductions in saturated thickness were variable over that area. For example, near the dedicated monitoring well at Dry Creek near Highway 29 the decline was only 2 feet.

Saturated thickness of the alluvial aquifer in spring 2018 was also greater than conditions in spring 2014, the most recent year with similar precipitation conditions. Spring 2018 saturated thickness was generally 0 to 10 feet greater than the saturated thickness in spring 2014 (**Figure 5-10A**). The largest difference in saturated thickness is shown near Dry Creek at the western margin of the Subbasin, where the saturated thickness in spring 2018 was up to 20 feet above the spring 2014 condition.

Areas within the Subbasin with no value shown for change in saturated thickness represent areas where the interpolated groundwater surface was below the bottom of the Quaternary alluvial deposits.

Changes in groundwater storage in the principal aquifer system of the Subbasin are shown in **Figures 5-9B and 5-10B**. As noted above, areas within the Subbasin with no value shown for change in groundwater storage represent areas where the interpolated groundwater surface was below the bottom of the Quaternary alluvial deposits. Volumetric changes depicted in these figures are similar to the changes in saturated thickness shown in **Figures 5-9A and 5-10A**.

Reductions in groundwater storage between spring 2017 and spring 2018 were largest along Oak Knoll Avenue and along the Napa River from Dry Creek downstream to above Trancas Street (**Figure 5-9B**). Throughout this area reductions in storage were between 1 acre-foot per acre and 0.5 acre-foot per acre.

Groundwater storage changes between spring 2014 and spring 2018 were positive in most areas of the Subbasin (**Figure 5-10B**), consistent with the overall increase in groundwater storage volume between those years (**Table 5-4**) and the generally higher groundwater levels in spring 2018 compared to spring 2014. The reductions in saturated thickness and groundwater storage volumes between 2014 and 2018 north of Oakville Cross Road are not consistent with the increases in saturated thickness labeled in surrounding wells in **Figure 5-10A**. It is likely that the reductions mapped in that area are due to an anomaly in the interpolated groundwater surface. Similar reductions in storage were not mapped in this area between 2015 and 2017 (LSCE, 2018b).

**Table 5-4 Napa Valley Subbasin Principal Aquifer Groundwater Storage Changes, Water Years 1988 - 2018**

| Water Year | Water Year Classification | Napa Valley Subbasin Alluvial Aquifer Storage (Acre-feet) | Annual Storage Change (Acre-feet) | Cumulative Storage Change (Acre-feet) |
|---|---|---|---|---|
| 1988 | Normal (below average) | 205,596 | - | - |
| 1989 | Normal (below average) | 198,305 | (7,290) | (7,290) |
| 1990 | Dry | 202,469 | 4,164 | (3,126) |
| 1991 | Dry | 192,046 | (10,424) | (13,550) |
| 1992 | Normal (below average) | 212,532 | 20,486 | 6,936 |
| 1993 | Wet | 215,486 | 2,953 | 9,890 |
| 1994 | Dry | 208,000 | (7,486) | 2,404 |
| 1995 | Very Wet | 215,361 | 7,361 | 9,765 |
| 1996 | Wet | 211,141 | (4,220) | 5,545 |
| 1997 | Wet | 216,835 | 5,695 | 11,239 |
| 1998 | Very Wet | 219,733 | 2,898 | 14,138 |
| 1999 | Normal (above average) | 219,981 | 247 | 14,385 |
| 2000 | Normal (above average) | 213,878 | (6,103) | 8,282 |
| 2001 | Dry | 210,997 | (2,881) | 5,401 |
| 2002 | Normal (above average) | 214,534 | 3,537 | 8,938 |
| 2003 | Wet | 208,394 | (6,140) | 2,798 |
| 2004 | Normal (below average) | 204,592 | (3,802) | (1,004) |
| 2005 | Wet | 217,650 | 13,058 | 12,054 |
| 2006 | Very Wet | 222,904 | 5,254 | 17,308 |
| 2007 | Very Dry | 200,359 | (22,545) | (5,237) |
| 2008 | Normal (below average) | 201,029 | 670 | (4,567) |
| 2009 | Normal (below average) | 205,160 | 4,132 | (436) |
| 2010 | Wet | 210,929 | 5,769 | 5,333 |
| 2011 | Wet | 214,705 | 3,776 | 9,109 |
| 2012 | Normal (below average) | 210,338 | (4,367) | 4,742 |
| 2013 | Normal (below average) | 201,193 | (9,145) | (4,403) |
| 2014 | Dry | 191,523 | (9,670) | (14,073) |
| 2015 | Normal (below average) | 208,771 | 17,248 | 3,175 |
| 2016 | Normal (below average) | 214,827 | 6,056 | 9,232 |
| 2017 | Very Wet | 219,298 | 4,470 | 13,702 |
| **2018** | **Dry** | **209,984** | **(9,314)** | **4,388** |
| | **Average (1988 – 2018)** | **209,631** | **146** | |
| | **Median (1988 – 2018)** | **210,929** | **1,784** | |

## 5.2 Milliken-Sarco-Tulucay (MST) Subarea

Although designated as a groundwater subarea for local planning purposes, the majority of the MST is not part of a groundwater basin as mapped by DWR. In the MST, the aquifer system is composed primarily of the Sonoma Volcanics and associated Tertiary sedimentary deposits. These aquifer materials have different hydraulic properties than the Napa Valley Subbasin alluvial deposits and the level of communication and connectivity between the two areas is believed to be more limited. Groundwater levels used for contour mapping in the MST Subarea generally represent conditions of a composite aquifer system of those Sonoma Volcanics and Tertiary sediments as previously described by Farrar and Metzger (2003).

Historically, groundwater flow directions in the MST Subarea were generally from the Coast Range Mountains that include Mt. George[34] along the eastern border of the MST Subarea toward the Napa River to the west. Beginning in the 1970s, investigators have identified pumping depressions in the northern, central, and southern parts of the MST (Johnson 1975, Farrar and Metzger 2003). The current coverage of wells does not extend to the former location of the central (and deepest) pumping depression and; therefore, flow directions cannot be visualized and evaluated. However, the coverage does extend to the former locations of the northern and southern depressions, and they are shown in the spring and fall 2018 groundwater level contour maps (**Figure 5-11** and **5-12**).

In the northern MST, the highest groundwater elevations of 36 feet and 35 feet occurred between Monticello Road along the lower one mile of Sarco Creek. Groundwater flow directions were to the east and north of this area. Groundwater elevation gradients were steepest to the east and were towards an area of -49 feet groundwater elevations (NAVD88) east of Vichy Avenue. A less steep northerly gradient to the north was toward Milliken Creek where monitored wells recorded spring groundwater elevations ranging from -5 feet to -18 feet.

In the southern MST, groundwater flow continues to be generally northwest (unchanged direction since 2009) in the spring and fall 2017 with a minimum spring groundwater elevation of about -57 feet (NAVD88). However, the western portion of this area has no coverage of wells with water level data, which limits the ability to define the extent of the pumping depression.

Representative hydrographs for the MST illustrated on **Figures 5-13 and 5-14** show groundwater elevations and corresponding depths to groundwater since 1970 in the northern (**Figure 5-13**) and central/southern parts of the MST (**Figure 5-14**). In the northern MST, groundwater levels were stable throughout the late seventies until the mid-1980s (1986), at which time a decline of about 10 to 40 feet occurred. Following this decline, groundwater levels stabilized until the late 1990s to early 2000s. After that time, groundwater levels experienced a gradual decline of about 10 to 30 feet until approximately 2009. After 2009, groundwater levels have shown signs of stabilizing in three of four currently monitored wells in the northern MST (NapaCounty-2, NapaCounty-43, and NapaCounty-122), while

[34] This range if referenced as the Howell Mountains by Farrar and Metzger (2003). However, that name does not appear in the USGS Geographic Names Information System as of 2018.

NapaCounty-98 has shown continued declines, possibly resulting from recent dry years. Depths to groundwater in the northern part of the MST Subarea currently range from about 60 to 200 feet.

An important geologic feature within the northern part of the MST is the Soda Creek Fault that several previous investigators have described as an occasional barrier to groundwater flow. It is described by Weaver (1949) as a normal fault with more than 700 feet vertical displacement downward on the western side. Johnson (1977) and Farrar and Metzger (2003) describe groundwater elevations were about 10 feet higher on the eastern side of the fault during their respective study periods.

In **Figure 5-14**, groundwater elevations in the central and southern portion of the MST have stabilized since about 2009. The groundwater elevations in the central portion of the MST began to decline in the 1950s and currently have declined up to 250 feet in some locations. The central portion of the MST also corresponds to an area in which the main water bearing rocks of the Sonoma Volcanics utilized elsewhere in the subarea, the tuffaceous member of that unit, is not present. Based on the groundwater level trends and local geologic conditions, some of these trends may be the result of variations in geologic conditions or increasing levels of development relative to conditions 40 to 50 years ago. However, the stability of water levels over the past nine years indicates that rate of groundwater extraction is being balanced by rates of groundwater recharge.

An expanding recycled water distribution system in the MST subarea, supplied by the Napa Sanitation District, delivered over 200 acre-feet of recycled water to users in the MST Subarea in 2018. Increased use of this new source of water along with continued land use permitting constraints are expected to aid in maintaining stable groundwater level conditions in the MST subarea in the future.

## 5.3 Napa-Sonoma Lowlands Subbasin and Subareas South of the Napa Valley Floor

In 2018, twelve groundwater level monitoring sites were located in the Carneros Subarea (**Table 4-3**). The longest period of record among them extended back to October 2011 (NapaCounty-150, **Appendix A**). All monitored wells are located in the southern half of the subarea at land surface elevations between 100 feet and 15 feet (NAVD88). Patterns of groundwater level fluctuations in these wells have shown annual variations of approximately 5 feet from spring to fall (**Appendix B**). Groundwater elevations range from about 30 feet, relative to mean sea level, to -5 feet, relative to mean sea level. Depths to groundwater below ground surface have varied more widely from 5 feet to 100 feet. Groundwater levels have been stable to increasing in 10 of 12 currently monitored wells. In 2018, groundwater levels were above levels measured in 2014 and 2015 in the two wells that showed groundwater level declines since monitoring began in 2011 (NapaCounty-150) and 2012 (NapaCounty-153).

In the Jameson/American Canyon Subarea, the only current groundwater level data are from one well recently volunteered for monitoring. Spring and fall measurements recorded in that well between 2014 and 2018 show shallow depths to groundwater ranging from 3 feet in the spring to 14 feet in the fall.

## 5.4 Subareas East and West of the Napa Valley Floor

The Eastern Mountains and Western Mountains Subareas flank the Napa Valley Floor Subareas and comprise the uplands of the Napa River Watershed. The geology of these large subareas is complex and highly variable. Recent efforts to expand the Napa County monitoring network have resulted in five wells volunteered for monitoring between the two subareas (**Table 4-3**).

Groundwater level monitoring data for these wells are limited to three years of semi-annual measurements. The depths to groundwater in these wells ranged from 36 feet to 247 feet.

## 5.5 Pope Valley Basin and Pope Valley Subarea

The only current groundwater level monitoring site in Pope Valley is a single well in the Pope Valley Basin with data available from 2014 to 2018 (**Table 4-3**). Depths to water have ranged from 3 to 16 feet below ground surface over that time.

## 5.6 Angwin Subarea

In 2018, groundwater level monitoring in the Angwin Subarea was performed at five wells by Napa County, Howell Mountain Mutual Water Company, and Pacific Union College at recently volunteered wells (**Table 4-3**).

Groundwater level monitoring data for the Angwin Subarea wells are available from 2014 to 2018. Depths to groundwater in these wells ranged from 95 feet to 233 feet.

## 5.7 Napa Valley Surface Water-Groundwater Monitoring

Napa County has a network of five sites with dedicated monitoring wells near the Napa River and Dry Creek to enable monitoring of distinct depth intervals within the alluvial deposits of the Napa Valley Subbasin (see **Section 4.2**). Across four years of monitoring, with highly variable water year types during that time, groundwater levels have remained stable at all five sites demonstrating the relatively full condition of the Subbasin. Data from Sites 1 (**Figure 5-15**), 3 (**Figure 5-17**), and 4 (**Figure 5-18**) show that groundwater levels were above or very near the riverbed at these sites throughout 2018, indicating connectivity between groundwater and the nearby surface water. Site 2 (**Figure 5-16**) and Site 5 (**Figure 5-19**) recorded groundwater levels in the uppermost part of the aquifer system at or above the streambed for a portion of the year in 2018. Groundwater levels in the deeper monitoring well at Site 5 (NapaCounty-223d-swgw5) were recorded to be within two feet of the elevation of the adjacent Napa River streambed in March and April 2018, while water levels in the deeper monitoring well at Site 2 (NapaCounty-217d-swgw2) remained well below the streambed throughout the year.

Site 1 is located within the City of Napa and is the farthest downstream along the Napa River (**Figure 2-6**). The river is perennially wetted and tidally-influenced at this site with a 5-foot to 7-foot tidal range observed during the period of record. Data from Site 1 show that groundwater levels were above the elevation of the riverbed and near to or slightly above the elevation of water in the river channel, indicating a connection between groundwater and surface water. However, the fine-grained nature of the riverbed in the vicinity of Site 1 and the distinct and stable differences in electrical conductivity

concentrations between the river and both monitoring wells suggest a limited degree of flow between groundwater and surface water at this site (LSCE, 2016b).

Data from Sites 3 and 4 along the Napa River showed groundwater elevations reaching 5 to 8 feet above the adjacent streambed in spring 2018, gradually declining over summer to a level equal to the adjacent streambed by late September 2018 (**Figure 5-17** and **Figure 5-18**). This pattern is more similar to groundwater levels observed at these sites in 2015, particularly in the somewhat lower spring groundwater levels relative to 2016 and 2017. The similarity between spring 2015 and spring 2018 conditions is consistent with the reduced precipitation and stormflows in those years relative to 2016 and 2017. However, as noted above, groundwater levels have remained stable across all four years.

At both Site 2 (**Figure 5-14**) and Site 5 (**Figure 5-17**) the direction of groundwater flow was predominantly away from the streambed and into the subsurface in 2018, as in the three prior years. At both sites, the streams are mapped by the USGS as intermittent in the reaches adjacent to the monitoring sites (**Figure 2-6**). The seasonal disconnection between shallow groundwater and the streambed observed at these sites, even after a very wet precipitation year in 2017, indicates that these are perennially losing reaches where surface water infiltrates along the streambed to recharge the alluvial aquifer of the Napa Valley Subbasin.

At Site 2, located along Dry Creek, a pattern similar to Site 5 occurred in 2018, such that unconfined groundwater levels were at or above the streambed during the winter and spring while stormflows provided recharge. Unlike at Site 5, however, the deeper, semi-confined portion of the aquifer system at Site 2 did not see groundwater levels equilibrate with the shallow, unconfined part of the aquifer system between 2015 and 2018. At both Sites 2 and 5, groundwater levels in the shallow, unconfined part of the aquifer system were consistently below the streambed elevation in the summer and part of the fall of 2017, indicating that groundwater was disconnected from the stream, although recharge to the groundwater system likely occurred for a portion of that period while water flowed in the streambed.

Site 2 also showed groundwater level differences between the shallow and deep casings of at least 8 feet for most or all of 2018. Given that most groundwater withdrawals in Napa Valley occur from depths greater than 50 feet, these water level differences show how the groundwater system's response to pumping from deeper aquifer units does not necessarily lead to an equivalent reduction in shallow groundwater levels, even at times of the year when the streambed is dry and groundwater recharge is not occurring along the stream.

Although the period of record at these sites is short compared to many wells monitored by Napa County, **Figure 5-20** demonstrates how the range of groundwater elevations monitored at a Surface Water – Groundwater Network site are comparable to a well constructed in a similar part of the aquifer system nearby. NapaCounty-133 is located approximately 0.5 miles south from Site 4 and a similar distance from the Napa River (**Figure 4-2**). Data from NapaCounty-133 from 1978 through 2018 show a similar range and stable trend in groundwater elevations from spring to fall across the full period of record, including 2018.

In August 2018, groundwater quality samples were collected at all five surface water groundwater sites (**Table 5-5**). This sampling was the second round of sampling conducted at these sites, with the first samples collected in June 2015. Nitrate concentrations in August 2018 were stable or reduced compared to results from June 2015 in all monitoring. Chloride concentrations were below the secondary drinking water MCL of 250 mg/L in 9 of 10 monitoring wells. Chloride concentrations increased in three of 10 monitoring wells between June 2015 and August 2018 and were stable or reduced relative to results from June 2015 in the other 7 wells.

**Table 5-5 Water Quality Sample Results: Surface Water-Groundwater Monitoring Sites**

| Site | Sample ID | Sample Collection June 2015 | Sample Collection August 2018 | Sample Collection June 2015 | Sample Collection August 2018 |
|---|---|---|---|---|---|
| | | Nitrate mg/L as N EPA 300.0 | Nitrate mg/L as N EPA 300.0 | Chloride mg/L EPA 300.0 | Chloride mg/L EPA 300.0 |
| Site 1 | NapaCounty-214s | 7.3 | 1.1 | 28 | 18 |
| Site 1 | NapaCounty-215d | <0.1 | <0.1 | 177 | 350 |
| Site 1 | NapaCounty-swgw_SW1 | 12.6 | 4.5 | 4699 | 8700 |
| Site 2 | NapaCounty-216s | 5.4 | 3.8 | 15 | 12 |
| Site 2 | NapaCounty-217d | <0.1 | <0.1 | 5 | 4 |
| Site 2 | NapaCounty-swgw_SW2 | 0.5 | Dry | 12 | Dry |
| Site 3 | NapaCounty-218s | 1.8 | 0.9 | 19 | 21 |
| Site 3 | NapaCounty-219d | <0.1 | <0.1 | 73 | 59 |
| Site 3 | NapaCounty-swgw_SW3 | <0.1 | <0.1 | 27 | 26 |
| Site 4 | NapaCounty-220s | 0.7 | 0.6 | 7 | 4.2 |
| Site 4 | NapaCounty-221d | <0.1 | <0.1 | 6 | 4.8 |
| Site 4 | NapaCounty-swgw_SW4 | <0.1 | <0.1 | 18 | 23 |
| Site 5 | NapaCounty-222s | <0.1 | <0.1 | 32 | 40 |
| Site 5 | NapaCounty-223d | 0.3 | <0.1 | 16 | 16 |
| Site 5 | NapaCounty-swgw_SW5 | <0.1 | Dry | 34 | Dry |

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# 6 NAPA VALLEY SUBBASIN WATER USE AND SURFACE WATER AVAILABILITY

Groundwater Sustainability Plan (GSP) Regulations require reporting of best available information for water use by water use sector, groundwater extraction, and surface water used or available for groundwater recharge or in-lieu use[35] (Section 356.2(b)(2-4)). The following sections are included to meet the requirements for SGMA reporting and align with the format of water use information presented in the Basin Analysis Report updated with water use data and estimates for water year 2018. An additional analysis of groundwater use by Groundwater Dependent Ecosystems (GDEs) was conducted for water year 2018 and is presented in **Section 6.1.4**.

## 6.1 Subbasin Water Use by Sector

### 6.1.1 Agricultural Water Use

Water supplies available to agricultural land uses (specifically for crop production, rather than related activities such as winery operations; which are discussed in **Section 6.1.3** below) in the Subbasin include groundwater pumped from the Subbasin, recycled water, surface water diverted from the Napa River system within the Subbasin, and to a lesser extent surface water diverted outside the Subbasin from the adjacent watershed into Lake Hennessey. Diversions of surface water from the Subbasin watersheds are a minor source of supply to agriculture within the Subbasin, although the Cities of Napa and St. Helena have reported some sales of water totaling a few hundred acre-feet in most years.

Data from DWR land use maps for 1987 and 2011 notwithstanding, as in many areas of the state, there is no comprehensive data collection effort in the Subbasin to monitor groundwater use by agriculture. Limited data on surface water diversions are available from the State Water Resources Control Board (SWRCB) Electronic Water Rights Information Management System (eWRIMS). In response to the lack of comprehensive data, a root zone water balance model was developed for the Basin Analysis Report to more accurately quantify rates of water application to meet evapotranspiration demands by crops or other irrigated vegetation over the based period from 1988 to 2015 (LSCE, 2016c). The Root Zone Model accounts for applications of groundwater, surface water, and recycled water to meet crop water demands. Estimates of water use for crop production since 2015 were developed for the prior Annual Report and this Report based on linear relationships between monthly irrigation demand and environmental variables (i.e., precipitation and reference evapotranspiration (ETo).

Monthly values of each variable were used to determine a relationship that might be used to predict water usage (from groundwater and surface water) for years without simulated or measured values using data based on monthly simulated quantities from the Root Zone Model from water years 2011 to 2025.[36] On average, most groundwater pumping and surface water use occur in May, June, July, August,

[35] SGMA defines in-lieu use as "groundwater use by persons who could otherwise extract groundwater in order to leave groundwater in the basin" (Section 10721(m)).

[36] Although simulated Root Zone Model data including groundwater pumping and surface water use for various categories of water use are available from water year 1988 to 2025, the land use coverage from 2011 was selected

and September. A collection of plots that illustrate the linear and non-linear relationships between total groundwater pumping, vineyard groundwater pumping, other agricultural groundwater pumping, total surface water use, vineyard surface water use, other agricultural surface water use, and either ETo or precipitation is included in **Appendix D**.

Relationships with a coefficient of determination ($R^2$) value of greater than 0.75 were initially selected for consideration for interpolating water budget components for 2018 using precipitation data and evapotranspiration data from the Oakville station in the California Irrigation Management Information System (CIMIS) Network. The table below summarizes the $R^2$ values for each relationship described above (**Table 6-1**). Not all months with $R^2$ values greater than 0.75 for either ETo of precipitation were used to develop monthly use estimates. For example, coefficients of determination values are high between precipitation and five out six water use categories in June (**Table 6-1**); however, the strength of those correlations is greatly influenced by a very small number of data pairs where high precipitation totals occur. Since the dataset for 2018 included no precipitation in June, using the calculated linear correlation produces high estimates for water use relative to the water year type classifications for those years (**Table 5-1**), in response to this observation Method 4 was used to estimate total groundwater water use in June.

Four interpolation methods were employed to estimate monthly pumping and surface water use amounts:

> **Method 1:** Linear interpolation using linear relationships between measured ETo or precipitation for water use categories with an $R^2$ value of greater than 0.75;
>
> **Method 2:** Average monthly proportions of groundwater pumping for each category ("Other Agricultural Pumping", "Vineyard Groundwater Pumping", "Semi-Agricultural Pumping", and "Urban Groundwater Pumping") were estimated based on estimates of total groundwater pumping and Root Zone Model simulated values. Average monthly proportions of surface water use were also estimated for each surface water use category ("Other Agricultural Surface Water Use", "Vineyard Surface Water Use", "Semi-Agricultural Surface Water Use", and "Urban Surface Water Use") based on estimates of total surface water use and Root Zone Model simulated values (**Figure 6-1**).
>
> **Method 3:** For months with no acceptable linear correlation (e.g., February, March, July, August, and December) to use for interpolation, average monthly proportions of annual totals of groundwater pumping and surface water use values were used from Root Zone Model output (from water years 2011-2025) (**Figure 6-2**).
>
> **Method 4:** For months in which the only interpolated values are for total groundwater pumping or total surface water use, the monthly average proportion of total groundwater to total surface

to represent current conditions and only simulated water use data from 2011 on was used for this interpolating exercise.

water use is employed to estimate the other total water use category (either total groundwater pumping or total surface water use) (**Figure 6-3**).

These four methods employed together provide monthly estimates for each category of water use for groundwater pumping and surface water for water years 2016 and 2017, putting the most confidence in the linearly interpolated values (from Method 1). Certain monthly category values estimated using Method 2 above had to be slightly adjusted in order to agree with the linearly interpolated total groundwater pumping or total surface water use amount when one or more groundwater or surface water categories (e.g., "Other Agricultural Pumping", "Vineyard Surface Water Use", etc.) are interpolated from the linear interpolation method (these months were September and October). Adjustments were minor, indicating that the linearly interpolated total groundwater/surface water amount agrees well with the proportion of the other linearly interpolated water use category for that particular month.[37] Interpolated and estimated monthly water use values are presented in **Table 6-2** for water year 2018.

The estimated agricultural water uses for water year 2018, along with data from years since 2013, are summarized in **Table 6-3**. Groundwater use comprised 80% of agricultural water use in 2018. Surface water use, supplied primarily by diversions occurring within the Subbasin, comprised 17% of agricultural water use in water year 2018. Recycled water use comprised 3% of agricultural water use in 2018. Accuracy data are not available for the water year 2018 estimates of agricultural water use in the Subbasin. Additional study and data collection are planned to occur regarding water use and water conservation practices (see **Sections 8.1.4 and 8.1.5**). The planned efforts will provide a basis for evaluating the accuracy of unincorporated area water use estimates.

[37] Adjustments to the groundwater pumping components totaled 130 acre-feet for the water year. Adjustments to the surface water use components totaled 60 acre-feet for the water year.

**Table 6-1 Coefficient of Determination ($R^2$) Values for Napa Valley Subbasin Agricultural Water Use and Evapotranspiration and Precipitation**

| Month | Evapotranspiration | | | | | |
|---|---|---|---|---|---|---|
| | Total GW Pumping | Vineyard GW Pumping | Other Ag GW Pumping | Total SW Use | Vineyard SW Use | Other Ag SW Use |
| January | 0.67 | N/A | **0.77** | 0.52 | N/A | **0.77** |
| February | 0.06 | N/A | 0.06 | 0.06 | N/A | N/A |
| March | 0.07 | N/A | 0.05 | 0.09 | N/A | 0.09 |
| April | 0.56 | 0.22 | 0.36 | 0.63 | 0.10 | 0.12 |
| May | 0.44 | 0.46 | 0.21 | 0.23 | 0.49 | 0.38 |
| June | 0.60 | 0.60 | 0.52 | 0.60 | 0.65 | 0.69 |
| July | 0.06 | 0.04 | 0.32 | 0.24 | 0.05 | 0.21 |
| August | 0.05 | 0.08 | 0.03 | 0.04 | 0.03 | 0.01 |
| September | **0.84** | **0.86** | 0.51 | 0.62 | **0.84** | 0.47 |
| October | **0.96** | N/A | **0.95** | **0.96** | N/A | **0.93** |
| November | **0.82** | N/A | **0.76** | **0.79** | N/A | **0.81** |
| December | 0.04 | N/A | 0.01 | 0.22 | N/A | 0.01 |
| **Month** | **Precipitation** | | | | | |
| | Total GW Pumping | Vineyard GW Pumping | Other Ag GW Pumping | Total SW Use | Vineyard SW Use | Other Ag SW Use |
| January | 0.13 | N/A | 0.09 | 0.17 | N/A | 0.09 |
| February | 0.19 | N/A | 0.12 | 0.18 | N/A | N/A |
| March | 0.33 | N/A | 0.22 | 0.33 | N/A | 0.05 |
| April | **0.75** | 0.26 | 0.34 | **0.83** | 0.13 | 0.12 |
| May | 0.28 | 0.21 | 0.58 | **0.76** | 0.17 | 0.29 |
| June | **0.89** | **0.87** | **0.96** | **0.89** | **0.75** | 0.72 |
| July | 0.03 | 0.02 | 0.08 | 0.08 | 0.04 | 0.08 |
| August | 0.41 | 0.47 | 0.09 | 0.06 | 0.35 | 0.11 |
| September | **0.98** | **0.98** | **0.75** | **0.84** | **0.97** | 0.72 |
| October | **0.95** | N/A | **0.93** | **0.96** | N/A | **0.91** |
| November | 0.41 | N/A | 0.33 | 0.49 | N/A | 0.39 |
| December | 0.25 | N/A | 0.12 | 0.34 | N/A | 0.13 |

**Table 6-2 Interpolated and Estimated Values of Water Use Components for 2018**

| Month | Year | Groundwater Pumping Components (Acre-Feet) | | | | | Surface Water Use Components (Acre-Feet) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Other Agricultural Pumping | Vineyard Groundwater Pumping | Semi-Agricultural Pumping | Urban Groundwater Pumping | Total Groundwater Pumping | Other Agricultural Surface Water Use | Vineyard Surface Water Use | Semi-Agricultural Surface Water Use | Urban Surface Water Use | Total Surface Water Use |
| **October** | **2017** | 31.4 | 0.0 | 27.2 | 198.7 | 253.3 | 12.6 | 0.0 | *5.4* | *791.7* | 807.4 |
| **November** | **2017** | 5.9 | 0.0 | 1.6 | *10.3* | 17.9 | 3.2 | 0.0 | 0.3 | *92.5* | 96.1 |
| **December** | **2017** | 0.3 | 0.0 | 0.3 | 3.8 | 4.4 | 0.3 | 0.0 | 0.1 | 28.7 | 29.0 |
| **January** | **2018** | 0.8 | 0.0 | 0.6 | 9.3 | 10.7 | 0.4 | 0.0 | 0.1 | 50.3 | 50.8 |
| **February** | **2018** | 0.0 | 0.0 | 0.5 | 5.5 | 6.0 | 0.0 | 0.0 | 0.1 | 30.5 | 30.6 |
| **March** | **2018** | 0.5 | 0.0 | 6.7 | 39.2 | 46.5 | 0.0 | 0.0 | 1.1 | 129.9 | 131.0 |
| **April** | **2018** | 2.2 | 3.3 | 9.0 | 59.8 | 74.2 | 0.0 | 0.8 | 1.6 | 212.7 | 215.0 |
| **May** | **2018** | 76.5 | 768.6 | 97.0 | 583.1 | 1,525.2 | 8.7 | 139.8 | 13.2 | 1,583.3 | 1,745.0 |
| **June** | **2018** | 133.9 | 3,131.4 | 113.8 | 674.7 | 4,053.7 | 46.0 | 629.6 | 19.2 | 1,894.4 | 2,589.1 |
| **July** | **2018** | 119.2 | 3,594.9 | 96.5 | 573.4 | 4,384.1 | 68.4 | 746.0 | 22.7 | 2,093.3 | 2,930.4 |
| **August** | **2018** | 85.9 | 3,366.0 | 73.8 | 447.5 | 3,973.1 | 44.6 | 698.4 | 17.8 | 1,809.8 | 2,570.7 |
| **September** | **2018** | 54.6 | 1,268.8 | *13.3* | *393.1* | 1,729.8 | 22.5 | 245.1 | *13.5* | *1,272.5* | 1,553.6 |

Explanation:

Method 1 – Linearly interpolated values estimated using relationships between actual measured monthly ET or precipitation.
Method 2 – Estimated values based on monthly average proportions of each water use category.
Method 3 – Estimated values based on monthly proportions of annual groundwater and surface water totals from the previous year.
Method 4 – Estimated values based on monthly surface water to groundwater total proportions.

*italic* Italic values indicate a slight adjustment was made to water use category values in order to match the interpolated total groundwater or surface water values. Adjustments to the Semi-Agricultural and Urban groundwater pumping components totaled 130 acre-feet. Adjustments to the Semi-Agricultural and Urban surface water use components totaled 60 acre-feet.

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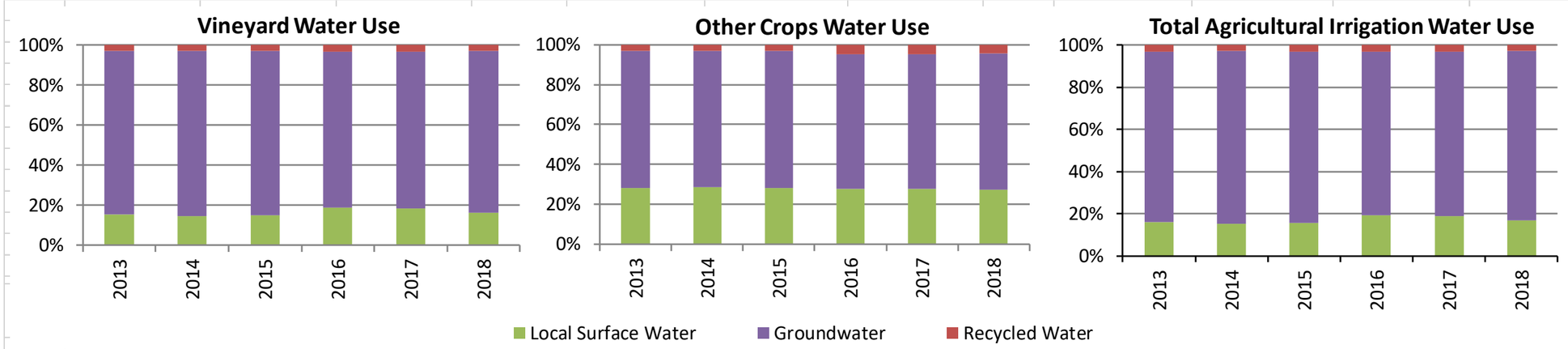
## Table 6-3 Napa Valley Subbasin Agricultural Water Use

| Year | Vineyards | | | | All Other Crops | | | | All Agricultural Irrigation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Local Supply* | | | Total [AF] | *Local Supply* | | | Total [AF] | *Local Supply* | | | Total [AF] |
| | Surface Water (Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | | Surface Water (Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | | Surface Water (Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | |
| **2013** | 2,373 | 12,447 | 458 | **15,278** | 181 | 445 | 21 | **647** | 2,554 | 12,892 | 479 | **15,925** |
| **2014** | 2,058 | 11,499 | 378 | **13,935** | 200 | 474 | 20 | **694** | 2,258 | 11,973 | 398 | **14,629** |
| **2015** | 2,479 | 13,412 | 479 | **16,370** | 191 | 465 | 21 | **677** | 2,670 | 13,877 | 500 | **17,047** |
| **2016** | 2,461 | 10,225 | 407 | **13,093** | 191 | 459 | 33 | **683** | 2,652 | 10,684 | 440 | **13,776** |
| **2017** | 2,461 | 10,386 | 407 | **13,254** | 193 | 467 | 33 | **693** | 2,654 | 10,853 | 440 | **13,947** |
| **2018** | 2,459 | 12,133 | 407 | **14,999** | 206 | 516 | 33 | **755** | 2,665 | 12,649 | 440 | **15,754** |




NOTES:

All data are estimates calculated from relationships between precipitation and reference evapotranspiration measured in the Subbasin in water year 2018 and outputs from the Napa Valley Subbasin Rootzone Model published in the 2016 Basin Analysis Report for the Napa Valley Subbasin.

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### 6.1.2 Municipal Water Use

Four municipalities overlie parts of the Napa Valley Subbasin: Calistoga, St. Helena, Yountville, and Napa (**Figure 2-1**). Municipal sector water use data for water year 2018 were provided for this Report by the City of Napa, City of St. Helena, and City of Calistoga. Annual calendar year reports of diversion and water use were available through 2017 from Rector Reservoir through the State Water Resources Control Board (water right application number: A010456). Available data are summarized in **Table 6-4**. Water supplied from Rector Reservoir to users other than the Town of Yountville are estimated for water year 2018 based on the average of water supplied from 2012 through 2017.

The sources of supply for municipal water suppliers in the Napa Valley Subbasin remained consistent in water year 2018 as in the latter years of the Basin Analysis Report 1988 – 2015 study period. Surface water, from local sources and the State Water Project, comprised the majority of water supplied by municipalities in the Subbasin. State Water Project water supplies, delivered from reservoirs outside of Napa County via the North Bay Aqueduct, comprised 52% of municipal water use in water year 2018. Local reservoirs, located outside the Subbasin but within the Subbasin watershed, supplied 40% of municipal water use in water year 2018. Groundwater pumped from the Subbasin accounted for 2% of the municipal water use in both years. Recycled water comprised 6% of municipal water use in water year 2018.

All four municipalities in the Napa Valley Subbasin currently re-use wastewater, at varying treatment levels. The Cities of Calistoga and St. Helena produce recycled water, which is used to irrigate city-owned properties. The Town of Yountville has a tertiary treatment facility and produces recycled water, some of which is used for the irrigation of some Town properties and some of which is sold to local vineyards for use as irrigation water.

The Napa Sanitation District (NSD) provides recycled water along two main pipelines to the southeast and north of the Soscol Water Recycling Facility, including a branch that now extends to the MST Subarea adjacent to the Napa Valley Subbasin. The NSD is working with water users throughout southern Napa County to identify areas where recycled water could replace the use of potable water, surface water or groundwater. The pipeline serving the MST Subarea was put into service in 2016 and is designed to initially deliver up to 700 acre-feet per year (230 million gallons), with the potential to deliver up to 2,000 acre-feet per year (650 million gallons). In water year 2018, NSD delivered over 250 acre-feet of recycled water to users in the MST Subarea.

The 2015 City of Napa Urban Water Management Plan reports an estimated accuracy of 2% for water meters used to track the supply used from sources owned by the City, local reservoirs in the Subbasin watershed. The same 2% accuracy estimate pertains to the State Water Project deliveries to Calistoga, St. Helena, and Yountville reported in **Table 6-4**.

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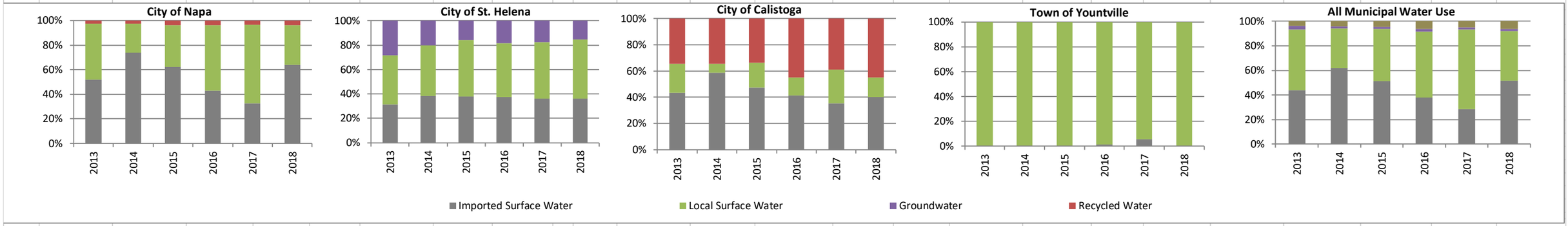
**Table 6-4 Napa Valley Subbasin Municipal Water Use**

| Year | City of Napa | | | | | City of St. Helena | | | | City of Calistoga | | | | | Town of Yountville | | | State of CA | All Municipal Suppliers | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Imported Supply* | *Local Supply* | | | | *Imported Supply* | *Local Supply* | | | *Imported Supply* | *Local Supply* | | | | *Imported Supply* | *Local Supply* | | *Local Supply* | *Imported Supply* | *Local Supply* | | | |
| | State Water Project [AF] | Lake Hennessey [AF] | Milliken Reservoir [AF] | Recycled Water [AF] | Total [AF] | State Water Project /City of Napa Purchase [AF] | Bell Canyon [AF] | Groundwater [AF] | Total [AF] | State Water Project [AF] | Kimball Reservoir [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] | State Water Project [AF] | Rector Reservoir [AF] | Total [AF] | Rector Reservoir [AF] | State Water Project [AF] | Surface Water, Local Reservoirs [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] |
| **2013** | 6,992 | 5,903 | 191 | 330 | **13,416** | 583 | 737 | 526 | **1,846** | 505 | 263 | 0 | 402 | **1,170** | 0 | 630 | **630** | 1,421 | 8,080 | 9,144 | 526 | 732 | **18,483** |
| **2014** | 8,854 | 2,331 | 508 | 318 | **12,012** | 593 | 646 | 317 | **1,555** | 580 | 71 | 0 | 341 | **992** | 0 | 560 | **560** | 1,028 | 10,027 | 5,143 | 317 | 659 | **16,146** |
| **2015** | 6,539 | 2,921 | 660 | 393 | **10,513** | 582 | 713 | 244 | **1,540** | 439 | 176 | 0 | 311 | **927** | 0 | 492 | **492** | 1,258 | 7,560 | 6,220 | 244 | 704 | **14,729** |
| **2016** | 4,612 | 5,683 | 39 | 428 | **10,763** | 574 | 670 | 285 | **1,529** | 503 | 162 | 0 | 548 | **1,213** | 6 | 481 | **486** | 944 | 5,695 | 7,980 | 285 | 976 | **14,935** |
| **2017** | 3,565 | 6,841 | 157 | 364 | **10,926** | 607 | 769 | 293 | **1,670** | 409 | 302 | 0 | 453 | **1,164** | 27 | 444 | **471** | 1,886 | 4,607 | 10,399 | 293 | 816 | **16,116** |
| **2018** | 7,199 | 3,526 | 62 | 436 | **11,223** | 634 | 846 | 267 | **1,748** | 542 | 199 | 0 | 606 | **1,347** | 0 | *521* | **521** | *1,323* | 8,375 | 6,478 | 267 | 1,042 | **16,162** |




NOTES:

average of data reported from 2013 to 2017, and Water Year 2018 total supplies from Rector Reservoir, which is shown here as average of reported data from 2013 to 2017.

City of Napa uses shown, excepting recycled water uses, are 89.9% of the total amount reflecting the estimated proportion of the City of Napa Population within the Napa Valley Subbasin as of the 2010 census.

Recycled water use by City of Napa reflects use by those customers located within the Napa Valley Subbasin, as reported by City of Napa staff.

The City of Napa 2015 Urban Water Management Plan Update estimates the accuracy of metered use by source is +/- 2%.

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### 6.1.3 Unincorporated Area Water Use

Water use in unincorporated areas of the Subbasin has been estimated and is summarized in **Table 6-5**. The sources of supply are consistent with information presented in the Basin Analysis Report (LSCE, 2016c). The estimate of indoor residential water use is projected based on a per capita daily demand of 60.3 gallons and estimated for the entire unincorporated Subbasin based on the projected population. Water use for landscape irrigation in unincorporated areas is based on the linear correlation analysis described in Section 6.1.1, using data from the Root Zone Model and precipitation and evapotranspiration data from 2018.

Water use by wineries in the Subbasin was updated for water year 2018 using the same estimation method developed for the Basin Analysis Report, which estimates water use based on the details of approved winery permits in the Subbasin (outside of municipal boundaries). The water year 2018 estimate is updated to reflect wineries permits, including new permits and modifications of existing permits, approved in 2018 (**Figure 6-4**). In 2018 Napa County approved three new permits for wineries, one of which is located in the Napa Valley Subbasin. Also, in 2018, Napa County approved 10 discretionary permits for modifications to previously permitted wineries, three of which are located in the Napa Valley Subbasin.

As in the Basin Analysis Report, the estimates of winery water use assume that all use is supplied by groundwater and that all wineries are operating at their full, permitted capacity.

Overall, 95% of water use in unincorporated areas of the Subbasin, excluding water used for crop production, is estimated to have been supplied by groundwater in water year 2018 (**Table 6-5**). The remaining amounts are estimated to have been supplied by diversions of surface water from within the Subbasin. Accuracy data are not available for the water year 2018 estimates of water use in unincorporated areas of the Subbasin. Additional study and data collection are planned to occur regarding water use and water conservation practices (see **Sections 8.1.4 and 8.1.5**). The planned efforts will provide a basis for evaluating the accuracy of unincorporated area water use estimates.

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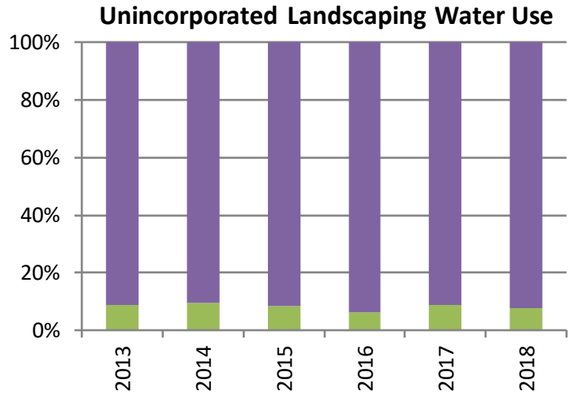
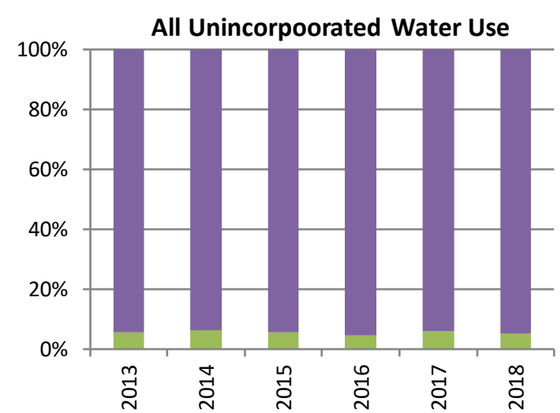
## Table 6-5 Napa Valley Subbasin Unincorporated Water Use

| Year | Unincorporated Domestic (Indoor) | | Unincorporated Landscaping Irrigation | | | | Unincorporated Wineries | | All Unincorpoorated | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Local Supply* | | *Local Supply* | | | | *Local Supply* | | *Local Supply* | | | |
| | Groundwater [AF] | Total [AF] | Surface Water [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] | Groundwater [AF] | Total [AF] | Surface Water [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] |
| **2013** | 372 | **372** | 277 | 2,928 | 0 | **3,205** | 1,222 | **1,222** | 277 | 4,522 | - | **4,799** |
| **2014** | 369 | **369** | 317 | 2,958 | 0 | **3,275** | 1,222 | **1,222** | 317 | 4,549 | - | **4,866** |
| **2015** | 367 | **367** | 291 | 3,202 | 0 | **3,493** | 1,222 | **1,222** | 291 | 4,791 | - | **5,082** |
| **2016** | 366 | **366** | 291 | 4,497 | 0 | **4,788** | 1,207 | **1,207** | 291 | 6,070 | - | **6,361** |
| **2017** | 363 | **363** | 294 | 3,109 | 0 | **3,403** | 1,213 | **1,213** | 294 | 4,685 | - | **4,979** |
| **2018** | 360 | **360** | 286 | 3,384 | 0 | **3,669** | 1,229 | **1,229** | 286 | 4,973 | - | **5,258** |




Local Surface Water  Groundwater  Recycled Water

NOTES:

Unincorporated Domestic Indoor use data are estimates calculated based on a per household demand of 161 gallons per day for indoor uses (Aquacraft, 2011) and annual unincorporated Subbasin population and average household size based on population projections based on U.S. Census data for 2000 and 2010.

Unincorporated Landscape Irrigation use data are estimates calculated from relationships between precipitation and reference evapotranspiration measured in the Subbasin in Water Year 2018 and outputs from the Napa Valley Subbasin Root Zone Model published in the 2016 Basin Analysis Report for the Napa Valley Subbasin.

Unicorporated Winerie water use data are estimates calculated based on Napa County Planning, Building, and Environmental Services Dept. records of permitted wineries, including uses for winemaking, visitation, events, and employees with average per unit water demands applied as described in the Napa County Water Availability Analysis Guidance Document (Napa County, 2015).

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### 6.1.4 Water Use Summary

Total water use in the Napa Valley Subbasin, including groundwater extracted from the Subbasin, surface water from sources within the Napa River Watershed, and imported surface water delivered through the State Water Project, is estimated to have been 37,174 acre-feet in water year 2018 (**Table 6-6**). State Water Project supplies provided 23% of water used in 2018 across the Subbasin. Reservoirs located in the Subbasin watershed provided 25% of water used in 2018. Groundwater pumped in the Subbasin provided 48% of water used in 2018. Recycled water supplied 4% of total water used during the water year.

Total estimated groundwater use in the Subbasin was 17,889 acre-feet in water year 2018. **Figure 6-5** shows the distribution of water supply wells according to the designated use provided on Well Completion Reports, to demonstrate the variability in groundwater well densities across the Subbasin. The mapped densities apply to the entire section, not only the portion within the Subbasin, based on the total number of wells by type as provided in the DWR Well Completion Report Web Map Application. The two most common well types, domestic and irrigation wells, are found throughout the Subbasin, with the exception of some sections in the vicinity of Napa and near the southern boundary of the Subbasin. Domestic wells are most concentrated near the head of Napa Valley in the vicinity of Calistoga. High concentrations of domestic wells are also found in the sections that overlie portions of the narrow, eastward extension of the Subbasin, although it is not clear how many of the wells in those sections are located within the extent of the Quaternary alluvium that is the basis for the Subbasin boundary. Irrigation wells are distributed more evenly throughout the Subbasin, with a slightly higher concentration to the south of St. Helena.

The distribution of groundwater extraction in water year 2018 is shown **Figure 6-6** based on the sum of outputs from the Root Zone Model[38], census estimates for population in the unincorporated areas, groundwater use reported by municipalities, and winery water use estimates.

Groundwater use for water year 2018 is presented along with values for 1988 – 2017 developed previously (LSCE, 2016c and LSCE, 2018b) in **Figure 6-7**. The figure also includes calculated annual and cumulative changes in groundwater storage in the alluvial aquifer system of the Subbasin. Water year types are indicated by labels along the bottom axis of the figure. The “Variable” label is used when both above and below average years occurred over time. “Dry” and “Wet” labels are used when a series of years of the same type occurred or when particularly notable single years occurred. As described in **Section 5.1.4**, groundwater storage volume decreased in 2018, by 9,413 acre-feet. Cumulative changes in groundwater storage show a net increase of 4,388 acre-feet from water year 1988 – 2018 (**Table 5-4**).

[38] Since estimates of groundwater use for irrigation were derived from Root Zone Model outputs developed for the Basin Analysis Report, the distribution of irrigation demand included in these figures is based on scaled Root Zone Model outputs for comparable years. Root Zone Model the output for 2015 was scaled to match the total irrigation demand estimated for 2018.

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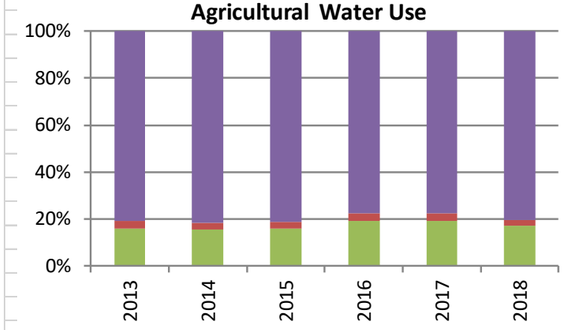
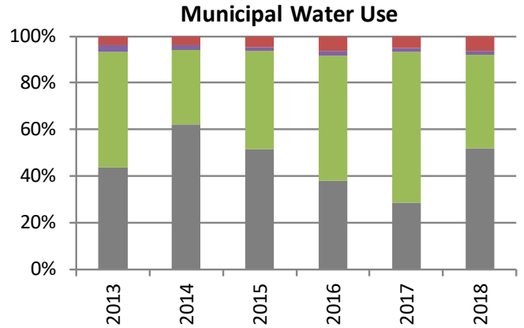
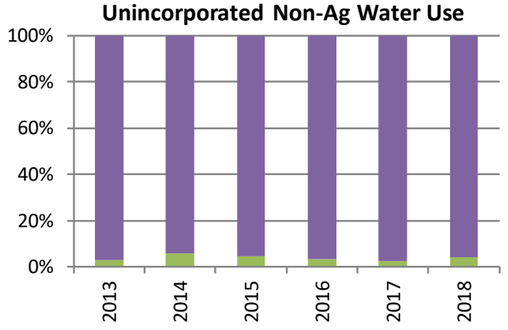
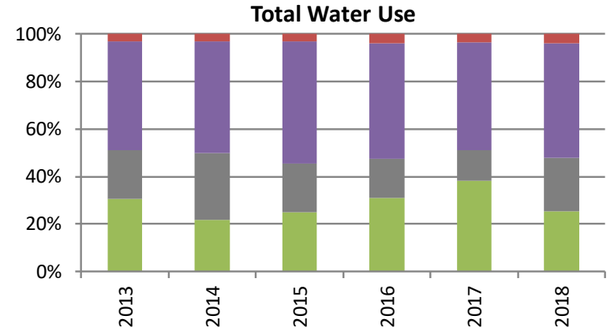
**Table 6-6 Napa Valley Subbasin Total Water Use**

| Year | Agricultural Irrigation Uses | | | | Municpal Uses | | | | | Unincorporated, Non-Agricultural Uses | | | | Total Water Use | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Local Supply* | | | | *Imported Supply* | *Local Supply* | | | | *Local Supply* | | | | *Imported Supply* | *Local Supply* | | | |
| | Surface Water (Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] | State Water Project [AF] | Surface Water, Local Reservoirs [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] | Surface Water (Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] | State Water Project [AF] | Surface Water (Local Reservoirs and Diversions Within Subbasin) [AF] | Groundwater [AF] | Recycled Water [AF] | Total [AF] |
| **2013** | 2,554 | 12,892 | 479 | **15,925** | 8,080 | 9,144 | 526 | 732 | **18,483** | 277 | 4,522 | 0 | **4,799** | 8,080 | 11,975 | 17,940 | 1,211 | **31,127** |
| **2014** | 2,258 | 11,973 | 398 | **14,629** | 10,027 | 5,143 | 317 | 659 | **16,146** | 317 | 4,549 | 0 | **4,866** | 10,027 | 7,718 | 16,839 | 1,057 | **25,614** |
| **2015** | 2,670 | 13,877 | 500 | **17,047** | 7,560 | 6,220 | 244 | 704 | **14,729** | 291 | 4,791 | 0 | **5,082** | 7,560 | 9,181 | 18,912 | 1,204 | **29,298** |
| **2016** | 2,652 | 10,684 | 440 | **13,776** | 5,695 | 7,980 | 285 | 976 | **14,935** | 291 | 6,070 | 0 | **6,361** | 5,695 | 10,923 | 17,039 | 1,416 | **35,072** |
| **2017** | 2,654 | 10,853 | 440 | **13,947** | 4,607 | 10,399 | 293 | 816 | **16,116** | 294 | 4,685 | 0 | **4,979** | 4,607 | 13,347 | 15,831 | 1,256 | **35,042** |
| **2018** | 2,665 | 12,649 | 440 | **15,754** | 8,375 | 6,478 | 267 | 1,042 | **16,162** | 286 | 4,973 | 0 | **5,258** | 8,375 | 9,428 | 17,889 | 1,482 | **37,174** |



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Groundwater use in water year 2018 was comparable to amounts used in recent years dating back to 2004 (**Figure 6-7**). Over the full 30-year period, annual storage changes in the aquifer system have fluctuated between positive and negative values, generally in accordance with the water year type. Cumulative changes in groundwater storage have also fluctuated between positive and negative values, indicating long-term stable groundwater storage conditions, the absence of chronic depletions of groundwater storage, and an overall condition of a basin in balance. Groundwater use in the Subbasin in water year 2018 remained within the sustainable yield range of 17,000 to 20,000 acre-feet per year identified in the Basin Analysis Report (LSCE, 2016c).

For water year 2018, an additional analysis of groundwater use by Groundwater Dependent Ecosystems (GDEs)[39] was conducted to improve the understanding of their groundwater use relative to other users in the Subbasin. Likely and potential GDEs depicted in the Basin Analysis Report were used for the analysis (**Figure 6-8**, see also LSCE, 2016c). Estimates of groundwater use by GDEs for water year 2018 were developed using spatial evapotranspiration datasets developed using LandSat imagery and processed according to the METRIC Evapotranspiration (ET) method.[40]

The specific datasets acquired for the analysis were daily EToF (fraction of grass reference ET) raster datasets at 30-meter resolution, available through Google Earth Engine.[41] EToF datasets were converted to ET using daily ETo (grass reference ET) data from the Oakville CIMIS station, according to the method described in the METRIC ET Google Earth Engine application website. The time period of the analysis was from June 1 through September 30, to coincide with the period of the water year when reliance on groundwater by GDEs is most significant. Eleven raster datasets covering the Subbasin were available for the period of analysis, at periods ranging from 8 to 16 days. These were interpolated to produce daily rasters for June 1 through September 30. EToF values for areas mapped as likely or potential GDEs were then compiled and actual ET volumes calculated based on daily ETo values from Oakville.

The GDE ET analysis found that total groundwater use by GDEs, as determined from evapotranspiration, was between 3,632 acre-feet and 4,721 acre-feet during the months when groundwater would be the dominant source of water available to GDEs (**Table 6-7**). This result quantifies water use in unirrigated areas where vegetation mapping has identified likely or potentially groundwater-dependent vegetation. The result indicates that groundwater use by GDEs in water year 2018 was approximately 20% to 26% of the total groundwater use of 17,889 acre-feet by other uses and users in the Subbasin (**Table 6-6**). This

[39] Groundwater Dependent Ecosystems were initially identified in the Basin Analysis Report based on a review of a draft dataset of potential groundwater dependent ecosystems under development by The Nature Conservancy, in collaboration with DWR and California Department of Fish and Wildlife (DFW), as the Basin Analysis Report was being developed. The Napa Valley Subbasin GDEs include a variety of wetland and vegetation communities that may rely on groundwater as a water supply.

[40] Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) is an analytical method that applies an energy balance method to calculate field-scale evapotranspiration using energy flux data collected by satellites, paired with data from ground reference points.

[41] http://eeflux-level1.appspot.com/

analysis provides a numerical point of comparison that will be useful going forward, along with updated GDE mapping, to understand the distribution and health of GDEs over time.

The results from the GDE ET analysis are not additive for the purposes of evaluating annual use of groundwater relative to the sustainable yield for the Subbasin, because the Basin Analysis Report (LSCE, 2016c) evaluated sustainable yield in the context of "withdrawals" from the Subbasin due to groundwater pumping and not outflows due to ET or subsurface outflows to the Lowland Subbasin, though the latter two components were explicitly addressed and the water budget analysis presented in the Basin Analysis Report. GDEs are among the beneficial users of groundwater in the Subbasin, but they are not a user that the County proposes to constrain. Instead, the use of Groundwater by GDEs represents one indication of the health of GDEs that the County is working to better understand, per recommendations in the Basin Analysis Report.

**Table 6-7 Napa Valley Subbasin Groundwater Dependent Ecosystems 2018 Estimated Groundwater Use**

| | Total ET (ft) | GDE Area (acres) | Total ET (AF) |
|---|---|---|---|
| **Likely GDEs** | 24.78 | 1,759.08 | 3,632 |
| **Potential GDEs** | 23.93 | 546.09 | 1,089 |
| **Total** | 24.58 | 2,305.17 | 4,721 |

AF = acre-feet

## 6.2 Surface Water Supply Available for Use for Groundwater Recharge or In-lieu Use

GSP Regulations call for annual reporting on the supply of surface water available for use for groundwater recharge or in-lieu use to offset groundwater pumping. **Table 6-8** presents estimates based on a method developed by DWR (DWR, 2017). The DWR method is one approach for estimating the availability of surface water available for recharge (WAFR) based on historical gauged streamflow, monthly simulated outflows from the Water Evaluation and Planning (WEAP) model, and information on existing water rights and water diversions in each gauged watershed. This method results in estimates of water that may be available to divert for groundwater recharge projects while allowing for minimum streamflow requirements and the capacity of existing, approved diversions.

The DWR WAFR method provides a way to estimate the amount of surface water available for recharge based on the proportion of average annual gauged outflow that could potentially be diverted by a conceptual replenishment project, referred to as the WAFR Fraction. A range of conceptual replenishment projects is envisioned, resulting in a range of WAFR Fractions for a given gauged watershed. The so-called Best Estimate WAFR Fraction replicates the capacity of the single largest existing diversion in the gauged watershed. Additional bounds for the WAFR estimate are provided by calculating a WAFR Fraction based on one-half of the single largest existing diversion capacity, the Lower

Uncertainty WAFR Fraction, and doubling the single largest existing diversion capacity, the Upper Uncertainty WAFR Fraction.

Instream flow requirements are also taken into account as part of the conceptual replenishment projects. The WAFR Fractions calculated based on the conceptual project capacities described above are also subject to instream flow requirements that limit the potential for surface water diversions. Existing instream flow requirements, whether established for the watershed as a whole or the largest existing diversion, were used as applicable. If neither are applicable, an instream flow requirement was determined by the Tennant method (Tennant, 1975). Instream flow requirements are assumed to be applied constantly throughout the year. The DWR method varies the instream flow requirement for the Lower Uncertainty WAFR Fraction estimate to account for the potential for additional constraints on diversions. The Lower Uncertainty WAFR Fraction uses a doubled instream flow requirement relative to the existing requirement, while the Upper Uncertainty WAFR Fraction and the Best Estimate WAFR Fractions apply the existing instream flow requirement.

As described above, the DWR method allows for uncertainty by including a range of WAFR fractions for each gauged watershed. In addition to the Lower and Upper Uncertainty WAFR Fractions, DWR allows for a maximum project estimate with an unlimited diversion capacity. **Table 6-8** omits the maximum project estimate for the Napa River because the WAFR fraction used by DWR, 95.59%, represents a level of diversion that is not practical for the Napa Valley Subbasin.

Estimates for the surface water supply from the Napa River that could have been available for groundwater recharge or in-lieu use range from 900 acre-feet to 3,300 acre-feet in 2018, a substantial reduction from amounts calculated for 2017 that ranged from 11,400 acre-feet to 43,200 acre-feet. The higher amounts estimated for 2017 are a direct result of the larger stream discharge measured at the USGS Napa River near Napa stream gauge in 2017, during a Very Wet water year. Streamflow in the Napa River was much less overall in 2018, as a result of the Dry water year. These estimates are understood to be preliminary, pending confirmation of actual surface water diversions in the watershed and the timing of storm flows relative to restrictions on diversions that were implemented as part of the 1976 Permanent Injunction 31785 and any subsequent limitations imposed by the DWR Watermaster or the State Water Resources Control Board.

**Table 6-8 Napa Valley Subbasin Surface Water Supply Used or Available for Use for Groundwater Recharge or In-Lieu Use**

| Water Year | USGS Napa River near Napa Gauge Outflow (TAF) | Low Uncertainty, 3.03% (TAF) | Best Estimate, 6.52% (TAF) | Upper Uncertainty, 11.46% (TAF) |
|---|---|---|---|---|
| 2016 | 111.8 | 3.39 | 7.29 | 12.8 |
| 2017 | 376.2 | 11.4 | 24.5 | 43.2 |
| 2018 | 28.6 | 0.9 | 1.9 | 3.3 |

TAF = Thousand Acre-Feet

Other sources of water for groundwater recharge and in-lieu use in the Napa Valley Subbasin include recycled water and conservation. Additional study is planned to better understand the benefits, both existing benefits and potential future benefits, of water conservation by grape growers in the Subbasin. Recycled water is currently used in the Subbasin to offset groundwater use. It is estimated that 440 acre-feet of recycled water was used for crop production in the Subbasin in water year 2018 (**Table 6-3**). These amounts are based on the areas where recycled water has been identified as a source of irrigation supply in DWR land use maps and other information described in the 2016 Basin Analysis Report (LSCE, 2016c) (**Figure 6-9**). This assumes that crops irrigated by recycled water would otherwise be irrigated by groundwater, if recycled water were unavailable. Additional recycled water use in the Subbasin occurs by customers of the City of Calistoga and the City of Napa/Napa Sanitation District. However, neither Calistoga nor Napa currently supplies groundwater from the Subbasin to their customers, so the production of recycled water by those systems is not likely to offset groundwater use that would otherwise occur in the Subbasin. Recycled water is also not currently known to be used for groundwater recharge purposes in the Subbasin.

# 7 IMPLEMENTATION OF THE BASIN ANALYSIS REPORT FOR THE NAPA VALLEY SUBBASIN [42]

In December 2016, Napa County submitted the Napa Valley Subbasin Basin Analysis Report (LSCE, 2016c) as an alternative to a Groundwater Sustainability Plan (GSP) in accordance with the GSP Regulations developed by DWR. Development of a Basin Analysis Report was possible because of groundwater resources studies and management activities initiated in prior years, including many that were completed with assistance from the GRAC. As with any GSP, progress towards maintaining sustainable groundwater conditions in the Napa Valley Subbasin did not end with submittal of the Basin Analysis Report. Annual reporting, additional public outreach and further scientific studies are underway to improve upon best-available datasets regarding groundwater conditions, water use, surface water-groundwater interactions, groundwater dependent ecosystems, and other priorities identified in the Basin Analysis Report. **Figure 7-1** illustrates the implementation activities conducted in 2017, 2018, and occurring to date in 2019.

The Basin Analysis Report (LSCE, 2016c) includes a discussion of groundwater management policies and projects currently implemented in the Napa Valley Subbasin. They include Napa County General Plan policies, Napa County's Groundwater Ordinance, Napa County's Water Availability Analysis procedure for discretionary proposed permits, water conservation outreach and education, collaboration with other water management planning programs, and ongoing water resources monitoring efforts. In addition, the Basin Analysis Report summarizes groundwater management recommendations developed by the County since 2011 and records the status or anticipated completion of those recommendations. Thirteen of those recommendations were newly developed for the Basin Analysis Report. Those recommendations are included in **Table 7-1** (Items 13 – 25) below with updated notations regarding status, as appropriate.

**Table 7-1** also includes five management recommendations (Items 26 – 30) developed as part of the Northeast Napa Special Groundwater Study (see **Section 2.4.3**). These management actions complement the management actions described in the Basin Analysis Report in that they are intended to maintain groundwater sustainability for the Napa Valley Subbasin. The management recommendations developed as part of the Northeast Napa Special Groundwater Study were presented to the Napa County Board of Supervisors on October 24, 2017, as part of the Special Study Report. The Board of Supervisors indicated its support for the new management recommendations, and they were subsequently included in an amendment to the Basin Analysis Report establishing the Northeast Napa Management Area (LSCE, 2018a). Napa County will lead implementation of these management actions,

[42] The Basin Analysis Report for the Napa Valley Subbasin includes a comprehensive list of monitoring and management recommendations developed since 2011. Additional recommendations developed as part of the Basin Analysis Report and the Northeast Napa Management Area Report were added to the list in sequence, beginning at number 13. Recommendations 1 – 12 are referenced in this Section where applicable to ongoing activities.

with outreach to users of groundwater and other stakeholders as described in the Basin Analysis Report (LSCE, 2016c).

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| **Napa County Groundwater Conditions and Groundwater Monitoring Recommendations (2011)** | | | | |
| 1.1a | Entry of archived data not previously available, link WellMA table information, add well construction data from wells the County monitors, add recent surface water delivery information, add municipal pumping data, and other information along with development and implementation of quality control protocols for inputting new data and reviewing existing data discrepancies | **Near to Long Term** | **1** | **Complete** |
| 1.1b | Establishment of a map-interface with the DMS to enhance the use of the database by non-database users | **Near Term to Mid Term** | **1** | **2019** |
| 2.1a | Input CASGEM groundwater level data into the DMS | **Ongoing** | **1** | **Complete** |
| 2.1b | Establish data format to meet DWR guidelines for electronic data transfer | **Near Term** | **1** | **Complete** |
| 2.1c | Optimize CASGEM monitoring well network per DWR guidelines by filling in data gaps where identified | **Mid to Long Term** | **3** | **Complete** |
| 3.1a | Update County field procedures for measuring groundwater levels | **Near Term** | **1** | **Complete** |
| 3.1b | Develop and/or expand aquifer-specific groundwater monitoring network in Napa Valley Floor, Pope Valley and Carneros Subareas by identifying existing wells with well construction data and constructing new aquifer-specific monitoring wells as needed where data gaps may exist | **Near to Mid Term** | **2** | **Ongoing** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 3.1c | Develop aquifer-specific groundwater monitoring network in other Subareas by identifying existing monitored wells with well construction data and constructing new wells where data gaps may exist | **Mid to Long Term** | **3** | **Ongoing** |
| 4.1a | Update geologic cross sections for the Napa Valley Floor and Carneros Subareas (previous ones were 50 years old) | **Near to Mid Term** | **2** | **Complete** |
| 4.1b | Develop new geologic cross sections in those areas with the greatest short- and long-term growth and/or land use potential | **Near to Long Term** | **2** | **2019** |
| 4.1c | Investigate groundwater/surface water interactions and the effect of recharge and pumping on groundwater levels in the Napa Valley Floor Subareas, along with the Carneros Subarea to assess the sustainability of groundwater resources. May include groundwater modeling, as needed. | **Near to Mid Term** | **1** | **Complete/ Ongoing** |
| 5.1a | Prepare workplan for the purposes of preparing a Groundwater Sustainability Plan; workplan includes steps to implement County Monitoring Program and CASGEM Program | **Near Term** | **1** | **Complete (Basin Analysis Report; Monitoring Program and CASGEM Plan)** |
| 5.1b | Utilize the Watershed Information & Conservation Council (WICC) Board for various public outreach components related to groundwater sustainability planning | **Near Term** | **2** | **Ongoing** |
| 5.1c | Develop objectives for public outreach, including information sharing and education about the County's groundwater resources | **Near to Mid Term** | **2** | **Complete** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 5.1d | Preparation of a Groundwater Sustainability Plan for Napa County | **Near to Mid Term** | **2** | **Complete (Basin Analysis Report)** |
| 5.2a | Public outreach, including information sharing and education about the County's groundwater resources | **Ongoing** | **3** | **Ongoing** |
| 6.1a | Updating of Ordinances 13.04, 13.12, and 13.15 | **Mid Term** | **2** | **Complete** |
| 6.1b | Update Groundwater Permitting Process | **Mid Term** | **3** | **Complete** |
| **Groundwater Resources Advisory Committee (February 2014)** | | | | |
| 7 | Develop and widely distribute public outreach programs and materials; educate people about opportunities for taking action | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 8 | Support landowners in implementing best sustainable practices; Solicit information on, and widely share best practices with regard to water use in vineyards, wineries, and other agricultural/commercial applications | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 9 | Enhance the water supply system and infrastructure to improve water supply reliability (regional and local) | **Near Term (evaluate and rank opportunities); Long Term – seek funding for high value projects** | **2** | **Ongoing** |
| 10 | Share groundwater conditions data and results; updates through BOS/WICC/Other | **Near Term/ Ongoing** | **1** | **Ongoing** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 11 | Continue to improve scientific understanding of groundwater recharge and groundwater- surface water interactions | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 12 | Improve preparedness for responding to long-term trends and evolving issues; improve preparedness for responding to acute crises, such as water supply disruptions and multiyear drought conditions | **Long Term** | **3** | **2020** |
| **Basin Analysis Report for the Napa Valley Subbasin (2016)** | | | | |
| 13 | Address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the alluvial aquifer | **Near Term** | **1** | **Ongoing** |
| 14 | Evaluate and address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the semi-confined to confined portions of the aquifer system | **Near Term** | **1** | **Ongoing** |
| 15 | Implement Napa County groundwater quality monitoring program; includes water quality monitoring in a subset of current monitoring network wells | **Near Term** | **1** | **Ongoing** |
| 16 | Coordinate with existing discretionary permit applicants (e.g., wineries and others) regarding existing groundwater level and/or water quality information) | **Near Term** | **1** | **Ongoing** |
| 17 | Coordinate with RCD and others regarding current stream gaging and supplemental needs for SGMA purposes; consider areas that may also benefit from nearby shallow nested groundwater monitoring wells (similar to LGA SW/GW facilities) | **Near- to Mid Term** | **2** | **2019** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 18 | Install test hole(s) and multiple completion monitoring wells at south end of Napa Valley Subbasin/Napa Sonoma Lowlands Subbasin for improved understanding of freshwater/salt water interface | **Mid Term** | **2** | **2020** |
| 19 | Evaluate strategic recharge opportunities, particularly along Subbasin margin and in consideration of hydrogeologic factors and O'Geen (2015) mapping. Evaluate approaches for retaining and using stormwater and/or tile drain water to increase water conservation, examining opportunities to reduce pumping and streamflow diversions, potentially lessening streamflow effects during drier years or drier periods of the year, and creating additional climate resiliency through targeted recharge strategies | **Near- to Mid Term** | **2** | **2019** |
| 20 | Evaluate distribution of Groundwater Dependent Ecosystems and relationships to depth to groundwater; coordinate evaluation with BMPs or guidance developed by DWR, Nature Conservancy, California Native Plant Society or others | **Near Term** | **1** | **Underway/ 2019** |
| 21 | Review of and coordination with BMPs published on DWR's web site (DWR is due to post BMPS by January 1, 2017) | **Near Term** | **1** | **Ongoing** |
| 22 | Evaluate and address uncertainties in historical water budgets to improve calibration of budget components and reduce uncertainty of projected future water budgets. | **Near- to Mid Term** | **1-2** | **2020** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 23 | Revise the standard Conditions of Approval used by Napa County for discretionary projects to include, for all future projects, groundwater monitoring and water use monitoring, reporting data to the County when requested, and use of project wells for monitoring when requested and needed to support this plan, and provisions for permit modification based on monitoring results | **Near Term** | **2** | **Complete** |
| 24 | Expand the capacity to encourage groundwater stewardship/groups through education, facilitation, and equipment | **Near- to Mid Term** | **2** | **Ongoing** |
| 25 | Develop an improved understanding of surface water and groundwater uses in unincorporated areas in the County and trends in those uses | **Near Term** | **1** | **Underway/ 2019** |
| **Northeast Napa Management Area Report - An Amendment to the 2016 Basin Analysis Report for the Napa Valley Subbasin (2018)** | | | | |
| 26 | Expand and improve the groundwater flow model developed for the Northeast Napa Special Groundwater Study (LSCE, 2017b) to facilitate further regional groundwater analyses and assessment of streamflow depletion required for continued SGMA implementation. | **Near- to Mid Term** | **1** | **2021** |
| 27 | Expand the existing network of dedicated surface water/groundwater monitoring facilities and construct shallow nested groundwater monitoring wells east of the Napa River in the vicinity of Petra Drive. | **Mid Term** | **1** | **2020** |

**Table 7-1 Napa Valley Subbasin Summary of Recommended SGMA Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 28 | For discretionary projects in the Northeast Napa Management Area, additional project-specific analyses (Napa County Water Availability Analysis-Tier 2) will be conducted to ensure that the proposed project location or planned use of groundwater does not cause an undesirable result. In addition, the Napa County Board of Supervisors has directed staff to update the Napa County Groundwater Ordinance to reflect the additional requirements for project-specific analysis and to incorporate water use criteria and water use reporting requirements for the Management Area using an approach similar to what has already been implemented in the MST Subarea. | **Near Term** | **1** | **Initiation in 2018, then ongoing** |
| 29 | As a precautionary measure, Napa County will track new non-discretionary groundwater wells constructed in the Northeast Napa Management Area, including their planned usage and location. | **Near Term** | **2** | **Initiation in 2019, then ongoing** |
| 30 | Develop appropriate standards and require that pumping test data be collected when new production wells are constructed in areas where the distribution of hydraulic conductivities is less known, including the Northeast Napa Management Area east of the Napa River and in deeper geologic units throughout the rest of the Napa Valley Subbasin. | **Mid Term** | **1** | **Initial standards developed by 2019, then ongoing** |

[1] Implementation schedule reflects relative multi-year time frames for completing or conducting the task. Near, Mid, and Long Terms are reflective of 3, 5, and 10-year periods.

[2] Priority ranking is on a scale of 1 to 3 with 1 being the highest priority and 3 being the lowest.

## 7.1 Expand the Capacity to Encourage Groundwater Stewardship (SGMA Implementation Recommendation 24)

Since 2016, Napa County has expanded its efforts to empower County residents to monitor and understand groundwater conditions in wells that they own through the Do It Yourself (DIY) Groundwater Level Monitoring Program.[43,44] The County maintains an acoustic groundwater level sounder and makes it available to residents as a short-term free rental. In addition to providing the acoustic sounder, County staff also provide training to residents who use the sounder to ensure that they collect accurate data. To date, the program has assisted ten well owners in measuring ten wells within the county. The program has been advertised in the Napa County Resource Conservation District (Napa RCD) and Napa County Farm Bureau newsletters, direct emails through the Napa Valley Grapegrowers Association and Napa Valley Vintners, promoted on the County's social media channels, and hosted on the County and WICC websites. Expanded promotion of the Do It Yourself (DIY) Groundwater Level Monitoring Program (during community events, meetings and lectures) is planned for 2019 to increase awareness and participation.

In July 2017, Napa County published the *Well Owners Guide, A Guide for Private Well Owners in Napa County* (Guide) (Napa County, 2017).[45] This 23-page document communicates important concepts, including state and local standards for well construction, well permitting requirements, the importance of regular well maintenance, and land use practices to limit risks to groundwater quality. The Guide also answers frequently asked questions about the County's Voluntary Groundwater Monitoring Program and provides information on the County's Do It Yourself (DIY) Groundwater Level Monitoring Program. The Guide is available on the WICC website and on the County groundwater webpage.[46,47]

## 7.2 Napa Valley Subbasin Groundwater Model Dataset Development (SGMA Implementation Recommendation 25)

In 2017, Napa County began development of spatial datasets to expand on work conducted Northeast Napa Special Groundwater Study and Basin Analysis Report to provide several important datasets needed to develop a numerical groundwater flow model for the Napa Valley Subbasin. These datasets include spatially (aerial and vertical) distributed groundwater pumping data and surface water diversion data necessary to characterize water uses within the Subbasin at the parcel scale to facilitate Subbasin groundwater management efforts.

In 2018, additional work has been performed to improve the characterization of hydrogeologic conditions in the Napa-Sonoma Lowlands Subbasin. This work supports an expansion of the conceptual model of the Napa Valley and Lowlands Subbasins to better understand how groundwater moves

[43] https://www.napawatersheds.org/files/managed/Document/7964/DIYmonitoring_flyer.pdf

[44] https://www.napawatersheds.org/DIY-monitoring-program

[45] https://www.napawatersheds.org/files/managed/Document/8773/20170720_Well_Owners_Guide_Final.pdf

[46] https://www.napawatersheds.org/groundwater

[47] https://www.countyofnapa.org/1230/Groundwater

between the subbasins and the conditions that influence interactions with San Pablo Bay and the tidal reaches of streams in the Lowlands Subbasin. As part of the effort conducted in 2018, an existing digital geologic dataset, including lithologic data for 185 wells developed by the USGS was expanded based on a review and location determination of 66 high-quality well completion reports and surficial geologic maps to define the thickness of alluvial deposits in the Lowlands Subbasin and the extent of pre-alluvial formations below the surficial deposits.

Also in 2018, the Napa RCD expanded its existing stream monitoring network to include two new stream gauges: on Soda Creek and near the mouth of the Napa River. Both of these sites will provide data useful to development of the Napa Valley Subbasin groundwater model, which is planned to include integrated surface water and groundwater simulation capabilities.

## 7.3 Developing Best Available Water Use Data (SGMA Implementation Recommendation 25)

In 2018, Napa County acquired water use data from the State Water Resources Control Board and the DWR Watermaster for the Napa River to improve the understanding of water use across the county. Data obtained from the SWRCB include reported production of water by public water systems (ranging from large community water systems to transient non-community water systems that may only serve 25 people per day for at least 60 days per year) for calendar years 2016 and 2017. These data, particularly data reported by smaller water systems, provide a much broader dataset of water production than has been available in the past. Previously, only large community water systems were required to report production data. Going forward, these data will provide useful information to inform water budget calculations required under SGMA.

Additional data on surface water diversions were obtained from the SWRCB (reported diversions of surface water for calendar year 2017) and the DWR Napa River Watermaster (spring 2018 diversion from the Napa River by a subset of diverters participating in the Watermaster Program). These datasets will continue to be compiled in future years to account for reported diversions and to inform refinements to the Napa Valley Subbasin water budget planned for the 2021 update to the Basin Analysis Report.

Also, in 2018, Napa County evaluated land use data to assess water use in the Napa-Sonoma Lowlands Subbasin. This work, conducted as part of the review of DWR's draft reprioritization of the Lowlands Subbasin, used best available land use data from 2011 and 2014, to develop an updated baseline understanding of the surface water, groundwater, and recycled water use in the Subbasin.

## 7.4 Evaluation of Groundwater Dependent Ecosystem Water Use

As described in **Section 6.1.4**, an analysis of groundwater use by Groundwater Dependent Ecosystems (GDEs) was conducted for water year 2018 to improve the understanding of their groundwater use relative to other users in the Subbasin. That analysis used remote-sensing data derived from LandSat satellite data on evaporation rates to quantify the volume of evaporation and transpiration occurring when groundwater is the primary source of supply to native vegetation. This method will continue to be

evaluated in future years. It may also be expanded to provide estimates of water use across the Napa Valley Subbasin during the irrigation season, to provide a cross-check or validation of irrigation water use calculated by other means.

During 2018, in cooperation with the WICC and the Napa RCD, Napa County continued to collect observations about streamflow conditions within the Napa Valley Subbasin. Throughout the water year, over 180 observations were recorded at 13 sites by trained volunteers. These observations provide a useful complement to traditional stream gauge sites in the Subbasin, by providing an understanding of streamflow conditions as they change throughout the year over a broad area. Knowledge of when wetted channels appear and recede is important in understanding baseflow influences on GDEs, including fish and other aquatic species.

## 7.5 Coordination with Other Water Management and Planning Programs

### 7.5.1 Integrated Regional Water Management Plans

Integrated Regional Water Management (IRWM) is defined by DWR as "a collaborative effort to identify and implement water management solutions on a regional scale that increase self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives" (DWR, 2015a).

*Napa County's Participation in San Francisco Bay Area and Westside Sacramento IRWMPs*

In 2005, the County formed the Napa County regional water management group (RWMG), a working group of local water agencies, where the Napa County Flood Control and Water Conservation District served as the lead agency. The County RWMG worked together to draft the Napa-Berryessa Integrated Regional Water Management Plan (IRWMP) Functional Equivalent (Napa-Berryessa Regional Water Management Group, 2005).

In 2009, DWR established IRWM regions that have been accepted through the Regional Acceptance Process (DWR, 2009). Currently, there are two formally accepted regions that include Napa County; these regions are: 1) the San Francisco Bay Area Region (which covers the generally southern part of Napa County and focuses on the Napa River and Suisun Creek watersheds), and 2) the Westside Sacramento Region (which covers the generally northern part of Napa County and focuses on the Putah Creek/Lake Berryessa watershed; the Westside Region also covers parts of Yolo, Solano, Lake, and Colusa Counties).

The County is contributing to two larger regional IRWMPs. The County collaborates with the San Francisco Bay and Westside RWMGs to update the IRWMP for the San Francisco Bay[48] (Kennedy Jenks et al., 2013) and to develop a new IRWMP for the Westside Sacramento Region[49] (Kennedy Jenks, 2013; Kennedy Jenks, 2019). The County's representation and participation in both the San Francisco Bay and

[48] http://bayareairwmp.org/

[49] http://www.westsideirwm.com

Westside IRWMPs enables further coordination and sharing of information on water resources management planning programs and projects (particularly those that are a high priority for the County) and other information for IRWMP grant funding and implementation.

### 7.5.2 Watershed Information and Conservation Council (WICC) of Napa County (SGMA Implementation Recommendations 5.1b, 5.2a, 7, and 25)

The WICC[50] was established in 2002 to serve as an advisory committee to Napa County Board of Supervisors – assisting with the Board's decision making and serving as a conduit for citizen input by gathering, analyzing, and recommending options related to the management of watershed resources (WICC, 2015). The WICC has achieved significant accomplishments in its 16-year history – both alone and in partnership with nonprofits, public agencies, and private landowners.

The WICC Mission is: improving the health of Napa County's watersheds by informing, engaging and fostering partnerships within the community.

The 2015 WICC Strategic Plan outlines five goals, including (WICC, 2015):

- Goal 1: Coordinate and facilitate watershed planning, research, and monitoring efforts among Napa County organizations, agencies, landowners and citizens.
- Goal 2: Strengthen and expand community understanding, connections and involvement to improve the health of Napa County's watersheds.
- Goal 3: Support informed decision-making on topics that affect the health of Napa County's watersheds.
- Goal 4: Improve WICC Board efficiency and effectiveness.
- Goal 5: Explore additional funding opportunities to support the goals of the WICC.

Additionally, Subgoal 1B to Goal 1 includes the WICC serving as the local clearinghouse for groundwater resource data, mapping, and monitoring (Implements: Napa County General Plan Action Item CON WR-4). As part of developing education and outreach for the community regarding groundwater conditions, the WICC is expanding groundwater information on the WICC website by offering an online groundwater information portal: www.napawatersheds.org/groundwater. This portal provides groundwater summary data and graphs for the County's groundwater basins and/or subareas that are delineated on the website's interactive maps. Data are displayed at the watershed scale and are not project or parcel specific. Information includes:

- Updates on groundwater resource issues locally and throughout California,
- Articles explaining key technical issues related to groundwater,
- Updates on groundwater mapping and monitoring in Napa County,

[50] Prior to 2015 this organization was named the Watershed Information Center and Conservancy.

- Educational materials and resources on groundwater recharge areas and ways to improve these areas,
- Report on the Napa County Voluntary Groundwater Level Monitoring Program, and
- Educational guides, resources and videos.

Napa County conducted public outreach regarding the status of SGMA implementation and groundwater conditions in several ways in 2018. An annual groundwater conditions presentation was provided to the Board of Supervisors in March 2018 and again to the WICC in July 2018. In October 2017, the Northeast Napa Special Study Report was presented to the Board of Supervisors. Then in January 2018, the Northeast Napa Special Study Report was presented to the WICC to further inform the public about the results of the Special Study and the Board of Supervisors support for establishing the Northeast Napa Management Area. An additional outreach presentation regarding the Northeast Napa Special Study was made in August 2018 to the Napa Engineers Society.

The WICC has supported continued efforts to refine the groundwater monitoring network in Napa County by publicizing outreach maps at public meetings. **Figure 7-2** depicts six areas of interest for monitoring network expansion and refinement, previously presented to the WICC. The areas of interest were identified through an ongoing review of currently monitored wells, including the distribution of wells and their exposure to different aquifer zones and geologic formations. WICC members and Napa County staff have worked to recruit new wells to the voluntary monitoring network within the areas of interest through individual outreach and publication in WICC email newsletters. As a result of outreach efforts, in 2017 and 2018 Napa County reviewed six wells for potential inclusion in the monitoring network. These included a well owned by the City of Napa and a well that is part of an existing groundwater quality monitoring network of the Department of Water Resources.

The County posted documents and other resources pertaining to the Basin Analysis Report, 2017 Annual Report, and Northeast Napa Special Study Report to its groundwater information webpage with copies posted to the WICC website, along with additional resources. These resources included copies of presentation slides, a frequently asked questions document, and the state's GSP Regulations. Links to pertinent state websites were also posted to the two County websites.

Throughout 2018, the County continued to provide notifications of new document availability and public meetings through the WICC's automated weekly news digest, distributed by email on the Thursday mornings. The County also communicated with stakeholders and the public regarding SGMA implementation, including updates on the DWR public comment period following submittal of the Basin Analysis Report, using a groundwater list-serve. Eight SGMA-specific email announcements were sent to an average of 116 recipients on the list-serve during the 2018 water year announcing public meetings and new reports.

In June 2017, Napa County published and promoted an update to its Groundwater Outreach Brochure that describes the County's monitoring efforts and available resources. In July 2017, Napa County published the *Well Owners Guide, A Guide for Private Well Owners in Napa County* (Guide) (Napa County, 2017). This 23-page document communicates important concepts including state and local

standards for well construction, well permitting requirements, the importance of regular well maintenance, and land use practices to limit risks to groundwater quality. The Guide also answers frequently asked questions about the County's Voluntary Groundwater Monitoring Program and provides information on the County's Do It Yourself (DIY) Groundwater Level Monitoring Program. The Guide is featured on the WICC website homepage and is available to for download.[51]. In July 2017, the County also released a video on local social media channels promoting the Voluntary Groundwater Monitoring Program.[52] The video is available via links on both the WICC and County websites.

## 7.6 Northeast Napa Management Area Designation

Following completion of the Basin Analysis Report, Napa County undertook the Northeast Napa Special Groundwater Study (Special Study) to refine the understanding of groundwater conditions in a 6,090-acre study area within the Napa Valley Subbasin. The Special Study was referenced as a planned implementation activity in the Basin Analysis Report.

At their meeting on October 24, 2017, the Board of Supervisors chose to support the findings and recommendations of the Special Study Report and directed staff to develop documentation to formally establish the Northeast Napa Management Area covering approximately 4% or 1,960 acres within the 45,928-acre Napa Valley Subbasin (**Figure 2-7**). In response, Napa County developed an Amendment to the Basin Analysis Report for the Napa Valley Subbasin (the Northeast Napa Management Area Report) (LSCE, 2018a). The Amendment was presented to the Board of Supervisors on March 20, 2018.

The Amendment is a supplement to the Basin Analysis Report for the Napa Valley Subbasin, the purpose of which is to designate a management area within the Napa Valley Subbasin: The Northeast Napa Management Area. GSP Regulations adopted by the California Water Commission in 2016 define a management area as, "an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors" (Section 351).

The Basin Analysis Report Amendment was developed as a supplement to the Basin Analysis Report for the Napa Valley Subbasin, demonstrating Napa County's active commitment to ensuring the sustainability of the Subbasin. The Amendment does not change the findings of the 2016 Basin Analysis Report, rather it provides additional detail about conditions in the Northeast Napa Management Area and establishes additional sustainable management criteria and management actions intended to support continued groundwater sustainability in the Napa Valley Subbasin.

[51] https://www.napawatersheds.org/files/managed/Document/8773/20170720_Well_Owners_Guide_Final.pdf

[52] https://www.youtube.com/watch?v=yyGHAWyegK0

The Basin Analysis Report Amendment includes refined definitions for undesirable results[53] in the Napa Valley Subbasin by considering the possibility of future localized conditions that could create significant and unreasonable effects in the Northeast Napa Management Area that may not be experienced throughout the Subbasin due to local geologic conditions. By refining the definitions for undesirable results in this manner, this Amendment intends to be protective of conditions within the Management Area to an even greater degree than would occur if the Management Area were not designated.

The Amendment designates seven representative monitoring sites as a subset of monitoring sites in the area for the purpose of monitoring groundwater conditions that are representative of the basin or an area of the basin (Section 354.36). For SGMA purposes for the Napa Valley Subbasin, these seven sites are where sustainability indicators are monitored, and minimum thresholds and measurable objectives are defined. Many sites are monitored for more than one sustainability indicator. Four of the representative sites designated for the Northeast Napa Management Area were previously designated as representative sites for the Napa Valley Subbasin. The sustainability criteria established for those sites in the 2016 Basin Analysis Report are incorporated here for tracking conditions in the Management Area.

The Amendment presents Northeast Napa Management Area minimum thresholds for all six undesirable results described in SGMA. Minimum thresholds are set (in feet above mean sea level) to avoid chronic lowering of groundwater levels and reduced groundwater storage for seven representative monitoring sites. Minimum thresholds for surface water depletion due to groundwater extraction and use in the Subbasin are provided for two representative sites; for one representative monitoring site to avoid degraded groundwater quality (e.g., for nitrate); for one representative monitoring site (for chloride concentrations) to avoid seawater intrusion; and for two representative monitoring sites to avoid land subsidence.

Northeast Napa Management Area measurable objectives, or specific quantifiable goals for maintaining or improving groundwater conditions, are provided with respect to avoidance of chronic lowering of groundwater levels and groundwater storage depletion for seven representative monitoring sites. Measurable objectives for surface water due to groundwater extraction and use in the Subbasin are provided in this Amendment for two representative monitoring sites. The measurable objective to maintain or improve groundwater quality is set for one representative monitoring site; for one representative monitoring site to avoid seawater intrusion; and for two representative monitoring sites to avoid land subsidence.

[53] According to SGMA definitions, Undesirable Results include: chronic lowering of groundwater levels (overdraft); significant and unreasonable reduction of groundwater storage; significant and unreasonable seawater intrusion; significant and unreasonable land subsidence that substantially interferes with surface land uses and; depletions of interconnected surface water due to groundwater extraction and use in the Subbasin that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

## 7.7 Revised Conditions of Approval for Discretionary Permits (SGMA Implementation Recommendation 23)

In 2017 Napa County staff revised the standard Conditions of Approval (CoA) used by the Planning, Building, and Environmental Services Department when recommending County approval of discretionary projects proposing to use groundwater as a source of supply. The revised CoA requires that permittees monitor groundwater levels in project wells and record amounts of groundwater pumped at regular intervals. In addition, permittees are required to report those data to the County and make project wells available as part of the County's groundwater monitoring program, subject to certain conditions. The revised CoA language is excerpted below.

> ***GROUND WATER MANAGEMENT – WELLS***
>
> *This condition is implemented jointly by the Public Works and PBES Departments:*
>
> *The permittee shall be required (at the permittee's expense) to record well monitoring data (specifically, static water level no less than quarterly, and the volume of water withdrawn no less than monthly). Such data will be provided to the County, if the Director of Planning, Building, and Environmental Services (PBES Director) determines that substantial evidence [1] indicates that water usage at the project is affecting, or would potentially affect, groundwater supplies or nearby wells. If data indicates the need for additional monitoring, and if the applicant is unable to secure monitoring access to neighboring wells, onsite monitoring wells may need to be established to gauge potential impacts on the groundwater resource utilized for the project. Water usage shall be minimized by use of best available control technology and best water management conservation practices.*
>
> *In order to support the County's groundwater monitoring program, well monitoring data as discussed above will be provided to the County if the Director of Public Works determines that such data could be useful in supporting the County's groundwater monitoring program. The project well will be made available for inclusion in the groundwater monitoring network if the Director of Public Works determines that the well could be useful in supporting the program.*
>
> *In the event that changed circumstances or significant new information provide substantial evidence [1] that the groundwater system referenced in this use permit would significantly affect the groundwater basin, the PBES Director shall be authorized to recommend additional reasonable conditions on the permittee, or revocation of this permit, as necessary to meet the requirements of the County Code and to protect public health, safety, and welfare.*
>
> *1. Substantial evidence is defined by case law as evidence that is of ponderable legal significance, reasonable in nature, credible and of solid value. The following constitute substantial evidence: facts, reasonable assumptions predicated on facts; and expert opinions supported by facts. Argument, speculation, unsubstantiated opinion or narrative, or clearly inaccurate or erroneous information do not constitute substantial evidence.*

# 8 SUMMARY AND RECOMMENDATIONS

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in 2018, including 61 wells within the Napa Valley Subbasin (**Table 4-1** and **Table 4-3)**. The number and distribution of wells monitored in 2018 was generally consistent with monitoring conducted since 2014, when the County initiated annual reporting as part of the ongoing Groundwater Monitoring Program.

Groundwater level trends in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin are stable in the majority of wells with long-term groundwater level records (see **Sections 5.1.1 and 5.1.2**).

Water year 2018 was a Dry year (19.3 inches) at a representative precipitation gauge with the longest period of record in the Subbasin (see **Section 5**). Spring 2018 groundwater levels were generally somewhat lower compared to spring 2017, which was a Very Wet year. Overall, despite the reduced recharge potential in 2018, due to dry year conditions, groundwater levels in fall 2018 remained comparable to levels in recent years. Groundwater levels in spring and fall 2018 were also generally above levels recorded in 2014, the most recent water year with a similar annual precipitation total.

Through February 2019, water year 2019 precipitation has exceeded the entire water year 2018 total at the Napa State Hospital precipitation gauge and is above the long-term median total for all water years since 1950.

Although designated as a groundwater subarea for local planning purposes, the majority of the Milliken-Sarco-Tulucay (MST) subarea is not part of a groundwater basin as mapped by DWR. Groundwater level declines observed in the MST Subarea as early as the 1960s and 1970s have stabilized since about 2009 (see **Section 5.2**). Groundwater level responses differ within the MST Subarea and even within the north, central, and southern sections of this subarea, indicating that localized conditions, whether geologic or anthropogenic in nature, might be the primary influence on groundwater level conditions in this local subarea. An expanding recycled water distribution system in the MST subarea, supplied by the Napa Sanitation District, delivered over 250 acre-feet of recycled water to users in the MST Subarea in water year 2018. Increased use of this new source of water along with continued land use permitting constraints are expected to aid in maintaining stable groundwater level conditions in the MST subarea in the future.

For the Napa Valley Subbasin, groundwater levels recorded in 2018 were above the minimum thresholds established as sustainability criteria in 19 of 20 SGMA Representative Wells with water level criteria (see **Section 5.1.3**). The reduction of groundwater levels below the minimum threshold at one of twenty SGMA Representative Wells, 08N06W10Q001M, is most likely the result of a localized groundwater condition, possibly influenced by the Dry water year. Two other wells in the vicinity, NapaCounty-224 and NapaCounty-225, did not experience similar groundwater level conditions in fall 2018. Subsequent monitoring has found that water levels in well 08N06W10Q001M increased throughout the winter of 2018-2019, including an increase of 14 feet even before substantial rainfall occurred. These observations indicate that the fall 2018 groundwater level measurement does not reflect a changed

condition in the Napa Valley Subbasin. In response to the fall 2018 groundwater level in well 08N06W10Q001M, the County is reviewing conditions in the vicinity of the well including water use and the location and operation of nearby wells.

Consistent with the Dry water year condition, the volume of groundwater in storage in the principal aquifer system of the Napa Valley Subbasin decreased in spring 2018 relative to spring 2017 (see **Section 5.1.4**). The volume of groundwater in storage declined in 2018 by 9,314 acre-feet to a total of 209,984 acre-feet. From 1988 through 2018, the cumulative annual storage changes were 4,388 acre-feet, reflecting a basin in balance and the absence of long-term depletions of groundwater storage within the Subbasin.

Maps of saturated thickness and groundwater storage changes in the principal aquifer system show decreases in saturated thickness and groundwater storage throughout most of the Subbasin between spring 2017 and spring 2018 (**Figures 5-9A and 5-9B**). These decreases are consistent with the reduction in precipitation between 2017 and 2018. Larger decreases in saturated thickness occurred along Dry Creek and in the vicinity of Oak Knoll Avenue. Notably, the reductions in groundwater storage were variable over that area. For example, near the dedicated monitoring well at Dry Creek near Highway 29 declines were much smaller than in the active supply well monitored to the west near the Subbasin margin. This latter observation highlights the value of dedicated monitoring wells.

Changes in saturated thickness of the primary aquifer and groundwater storage volume changes were also evaluated for the period from spring 2014 to spring 2018, for comparison with the most recent year with a similar precipitation total. Saturated thickness and groundwater storage were greater in spring 2018 than in spring 2014 (**Figures 5-10A and 5-10B**). Spring 2018 saturated thickness was generally 0 to 10 feet greater than the saturated thickness in spring 2014 (**Figure 5-10A**).

Total water use in the Napa Valley Subbasin, including groundwater extracted from the Subbasin, surface water from sources within the Napa River Watershed, and imported surface water delivered through the State Water Project, is estimated to have been 37,174 acre-feet in water year 2018 (**Table 6-6**). Total estimated groundwater use in the Subbasin was 17,889 acre-feet. Groundwater use for water year 2018 is presented along with values for 1988 – 2017 developed previously (LSCE, 2016c and LSCE, 2018b) in **Figure 6-7**. The figure also includes calculated annual and cumulative changes in groundwater storage in the alluvial aquifer system of the Subbasin. As noted above, groundwater storage volume decreased in 2018, by 9,413 acre-feet. Cumulative changes in groundwater storage show a net increase of 4,388 acre-feet from 1988 – 2018 in the principal aquifer of Napa Valley Subbasin (**Table 5-4**).

Groundwater use in water year 2018 was comparable to amounts used in recent years dating back to 2004 (**Figure 6-7**). Over the full 30-year period, annual storage changes in the aquifer system have fluctuated between positive and negative values, generally in accordance with the water year type. Cumulative changes in groundwater storage have also fluctuated between positive and negative values, indicating long-term stable groundwater storage conditions, the absence of chronic depletions of groundwater storage, and an overall condition of a basin in balance. Groundwater use in the Subbasin in water year 2018 remained within the sustainable yield range of 17,000 to 20,000 acre-feet per year

identified in the Basin Analysis Report (LSCE, 2016c). **Together, the findings presented in this report regarding groundwater conditions at representative monitoring sites, changes in groundwater storage, and groundwater use demonstrate that the Napa Valley Subbasin has continued to be managed sustainably through 2018.**

For water year 2018, an additional analysis of groundwater use by Groundwater Dependent Ecosystems (GDEs)[54] was conducted to improve the understanding of their groundwater use relative to other users in the Subbasin. Likely and potential GDEs depicted in the Basin Analysis Report were used for the analysis (**Figure 6-8**, see also LSCE, 2016c). Estimates of groundwater use by GDEs for water year 2018 were developed using spatial evapotranspiration datasets developed using LandSat imagery and processed according to the METRIC Evapotranspiration (ET) method.[55]

The GDE ET analysis found that total groundwater use by GDEs, as determined from evapotranspiration data, was between 3,632 acre-feet and 4,721 acre-feet during the months when groundwater would be the dominant source of water available to GDEs (**Table 6-7**). The result indicates that groundwater use by GDEs in water year 2018 was approximately 20% to 26% of the total groundwater use of 17,889 acre-feet by other uses and users in the Subbasin (**Table 6-6**). This analysis provides a numerical point of comparison that will be useful going forward, along with updated GDE mapping, to understand the distribution and health of GDEs over time.

The results from the GDE ET analysis are not additive for the purposes of evaluating annual use of groundwater relative to the sustainable yield for the Subbasin, because the Basin Analysis Report (LSCE, 2016c) evaluated sustainable yield in the context of "withdrawals" from the Subbasin due to groundwater pumping and not outflows due to ET or subsurface outflows to the Lowland Subbasin, though the latter two components were explicitly addressed and the water budget analysis presented in the Basin Analysis Report. GDEs are among the beneficial users of groundwater in the Subbasin, but they are not a user that the County proposes to constrain. Instead, the use of Groundwater by GDEs represents one indication of the health of GDEs that the County is working to better understand, per recommendations in the Basin Analysis Report.

[54] Groundwater Dependent Ecosystems were initially identified in the Basin Analysis Report based on a review of a draft dataset of potential groundwater dependent ecosystems under development by The Nature Conservancy, in collaboration with DWR and California Department of Fish and Wildlife (DFW), as the Basin Analysis Report was being developed. The Napa Valley Subbasin GDEs include a variety of wetland and vegetation communities that may rely on groundwater as a water supply.

[55] Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) is an analytical method that applies an energy balance method to calculate field-scale evapotranspiration using energy flux data collected by satellites, paired with data from ground reference points.

## 8.1 Recommendations for Continued SGMA Implementation [56]

The following paragraphs provide an update on planned near-term activities, consistent with management recommendations previously supported by the Napa County Board of Supervisors in the Basin Analysis Report (LSCE, 2016c) and Northeast Napa Management Area Report (LSCE, 2018a) to maintain or improve groundwater conditions and ensure overall water resources sustainability in the Napa Valley Subbasin.

### 8.1.1 Update the Napa County Groundwater Program Communication and Education Plan (SGMA Implementation Recommendation 5.1b and 5.2a)

Update and revise the 2012 Communications and Education Plan developed by the Groundwater Resources Advisory Committee to incorporate recent guidance from DWR regarding public outreach and stakeholder engagement consistent with the requirements of SGMA. As part of the review, the County will receive input from the WICC and others on way to improve communications and engagement related to SGMA implementation activities. The County will review and update the Outreach and Education Plan based on the input received from the WICC and others.

### 8.1.2 Data Gap Refinement (SGMA Implementation Recommendations 11, 13, and 14)

Outreach to well owners in Napa County will continue through the WICC, County website and groundwater list-serve, public presentations regarding groundwater conditions, and other means to solicit wells for voluntary inclusion in the County's monitoring network. Napa County will also review discretionary projects recently approved by the County with conditions of approval requiring that project wells be made available for inclusion in the County's monitoring network.

Coordination with other county departments and other agencies that collect or utilize groundwater data could also provide additional data in areas of interest. Several local agencies, including the Town of Yountville, City of St. Helena, and City of Napa, already monitor groundwater levels at locations around the county.

### 8.1.3 Ongoing Water Quality Sampling (SGMA Implementation Recommendation 15)

Groundwater quality sampling is recommended to continue at select wells throughout the Napa Valley Subbasin and Napa-Sonoma Lowlands Subbasin in 2019. Additional water quality sampling for a reduced set of constituents, including nitrate and chloride, is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites. Prior sampling at these sites occurred 2015 and 2018. Continued sampling of these wells is recommended in the Basin Analysis Report.

[56] The Basin Analysis Report for the Napa Valley Subbasin includes a comprehensive list of monitoring and management recommendations developed since 2011. Additional recommendations developed as part of the Basin Analysis Report and the Northeast Napa Management Area Report were added to the list in sequence, beginning at number 13. Recommendations 1 – 12 are referenced in this Section where applicable to ongoing activities.

### 8.1.4 Improve Data Collection and Evaluation from Discretionary Permittees Required to Monitor Groundwater Conditions and Groundwater Use (SGMA Implementation Recommendations 16 and 25)

Through coordination between the Napa County Public Works Department and Planning, Building, and Environmental Services Department, continue to improve procedures for receiving data reported by permittees required to report groundwater data and regularly incorporate those data into the Napa County Groundwater Data Management System.

### 8.1.5 Evaluate Strategic Recharge and Water Conservation Opportunities (SGMA Implementation Recommendations 8 and 19)

While additional data are being utilized to improve the understanding of water use by public water systems throughout the county, data gaps remain regarding water use on vineyards and other irrigated crops. As part of continued revisions to the water budget analysis for the Napa Valley Subbasin, it is recommended that the County hold workshops with agricultural industry representatives to develop a shared understanding of water use practices applied across the Subbasin, including irrigation, frost and heat protection, and tile drainage operations. In addition to providing shared information, the workshops would be held to further improve the calibration of the Napa Valley Subbasin groundwater model and the water budget analysis developed for the SGMA Basin Analysis Report revision.

### 8.1.6 Evaluate Distribution of Groundwater Dependent Ecosystems; Coordinate Evaluation with Guidance Developed by DWR, Nature Conservancy, California Native Plant Society or Others (SGMA Implementation Recommendations 11 and 20)

In 2019 with technical assistance from the Napa County Resource Conservation District (Napa RCD), Napa County will continue to review guidance on evaluating GDEs recently released by The Nature Conservancy (2018), in order to refine the mapping and assessment of GDEs presented in the Basin Analysis Report. Part of this effort is planned to be expanded in order to allow data collection by volunteers using a custom-built website application that is currently under testing by Napa County, with data collection occurring at 13 sites. Through this approach, Napa County will be able to efficiently collect standardized information and photographs documenting streamflow conditions at priority sites multiple times throughout the year. This information will complement existing stream gaging station data collected by Napa County, the Napa RCD, and U.S. Geological Survey.[57]

### 8.1.7 Update the Napa County Groundwater Ordinance for the Northeast Napa Management Area (SGMA Implementation Recommendation 28)

On October 24, 2017, the Napa County Board of Supervisors directed County staff to update the Napa County Groundwater Ordinance to reflect the additional requirements for project-specific analysis and to incorporate water use criteria and water use reporting requirements for the Northeast Napa Management Area using an approach similar to what has already been implemented in the MST Subarea. In response, Napa County Public Works Department and Planning, Building, and Environmental

[57] see https://napa.onerain.com/home.php

Services Department staff are currently coordinating resources to develop an update to the Groundwater Ordinance. The Planning, Building, and Environmental Services Department has developed specific mapping data to assist and alert its land use planners when a project is located in the Northeast Napa Management Area. For discretionary projects in the Northeast Napa Management Area, additional project-specific analyses (Napa County Water Availability Analysis-Tier 2) will be required to ensure that the proposed project location or planned use of groundwater does not cause an undesirable result (e.g., locate proposed wells at appropriate distances from surface water [or consider well construction approaches that avoid streamflow effects] and avoid mutual well interference to neighboring wells) (Napa County, 2015).

### 8.1.8 Continue to Implement Improvements to Napa County's Data Management System (SGMA Implementation Recommendation 1.1b)

In 2017, Napa County developed a field data tool to assist staff in the collection and management of groundwater level data. A pilot, mobile application (Collector Application) was developed using ArcGIS Online and tested by County staff. In 2018, Napa County continued to test and improve the application's functionality and integration with the County's Data Management System (DMS), which now allows for improved well data management and spatial mapping. Continued improvements are recommended to integrate other data sources into the DMS, such as recently available water use data available through the State Water Resources Control Board.

### 8.1.9 Develop Well Testing Standards (SGMA Implementation Recommendation 30)

Consistent with the recommendation approved by the Board of Supervisors in the January 2018 Amendment to the Basin Analysis Report for the Napa Valley Subbasin, it is recommended that Napa County develop appropriate standards and require that pumping test data be collected when new production wells are constructed in areas where the distribution of hydraulic conductivities is less well known, including the Northeast Napa Management Area east of the Napa River and in deeper geologic units throughout the rest of the Napa Valley Subbasin. Because older and less productive geologic formations occur near ground surface in the northeast Napa Area east of the Napa River, it is likely that pump tests will need to be performed for all new production wells in that area (**Figure 2-1).** Test results will not only provide valuable information regarding aquifer properties; true pump testing will provide well owners with more meaningful information about well capacity than the typical tests of well yield reported on historical well completion reports. Similar pump testing will be required for non-domestic production wells, and for wells that are completed in deeper units below the Quaternary alluvium throughout the Napa Valley Subbasin.

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# FIGURES

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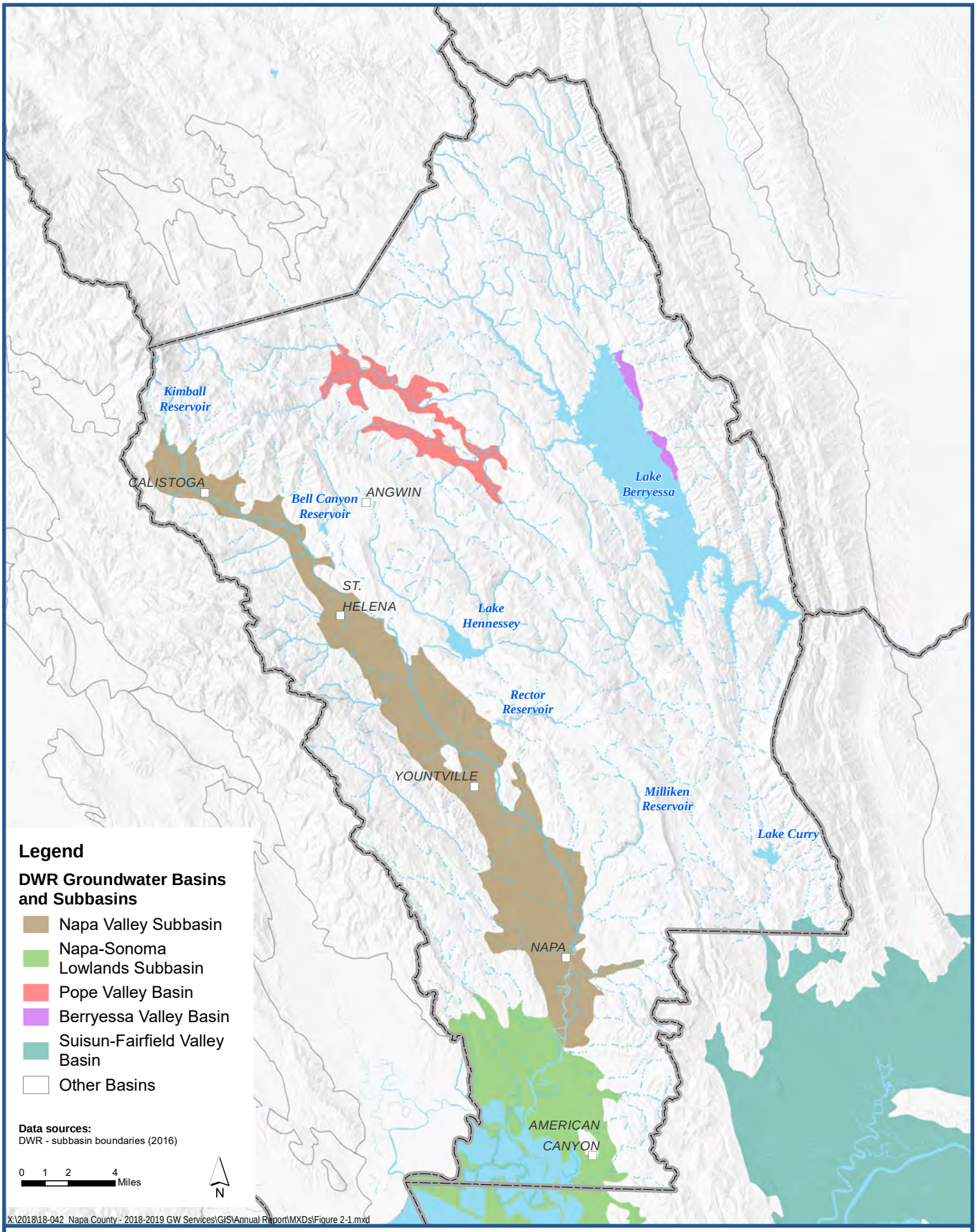


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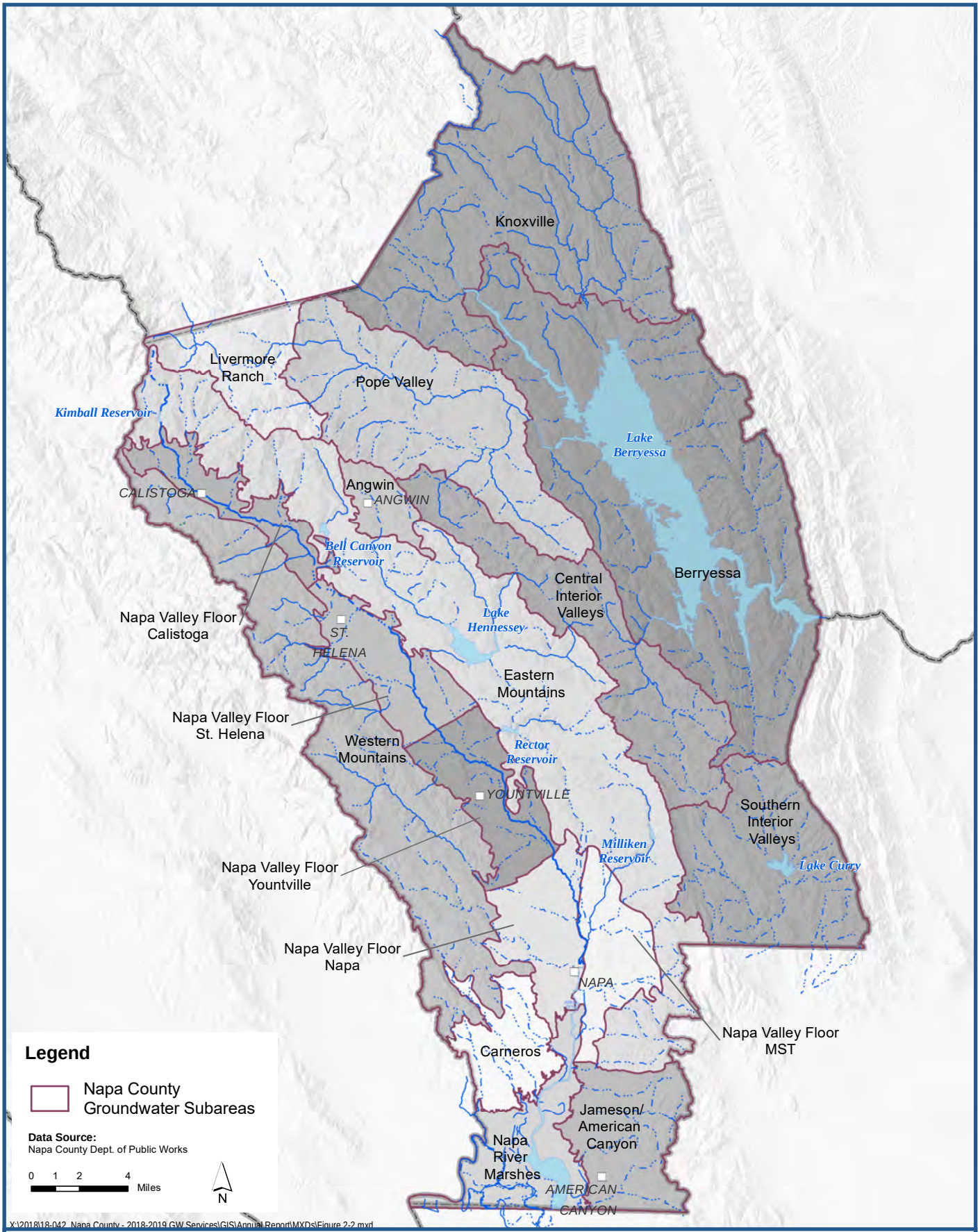
**Groundwater Basins in Napa County**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 2-1**

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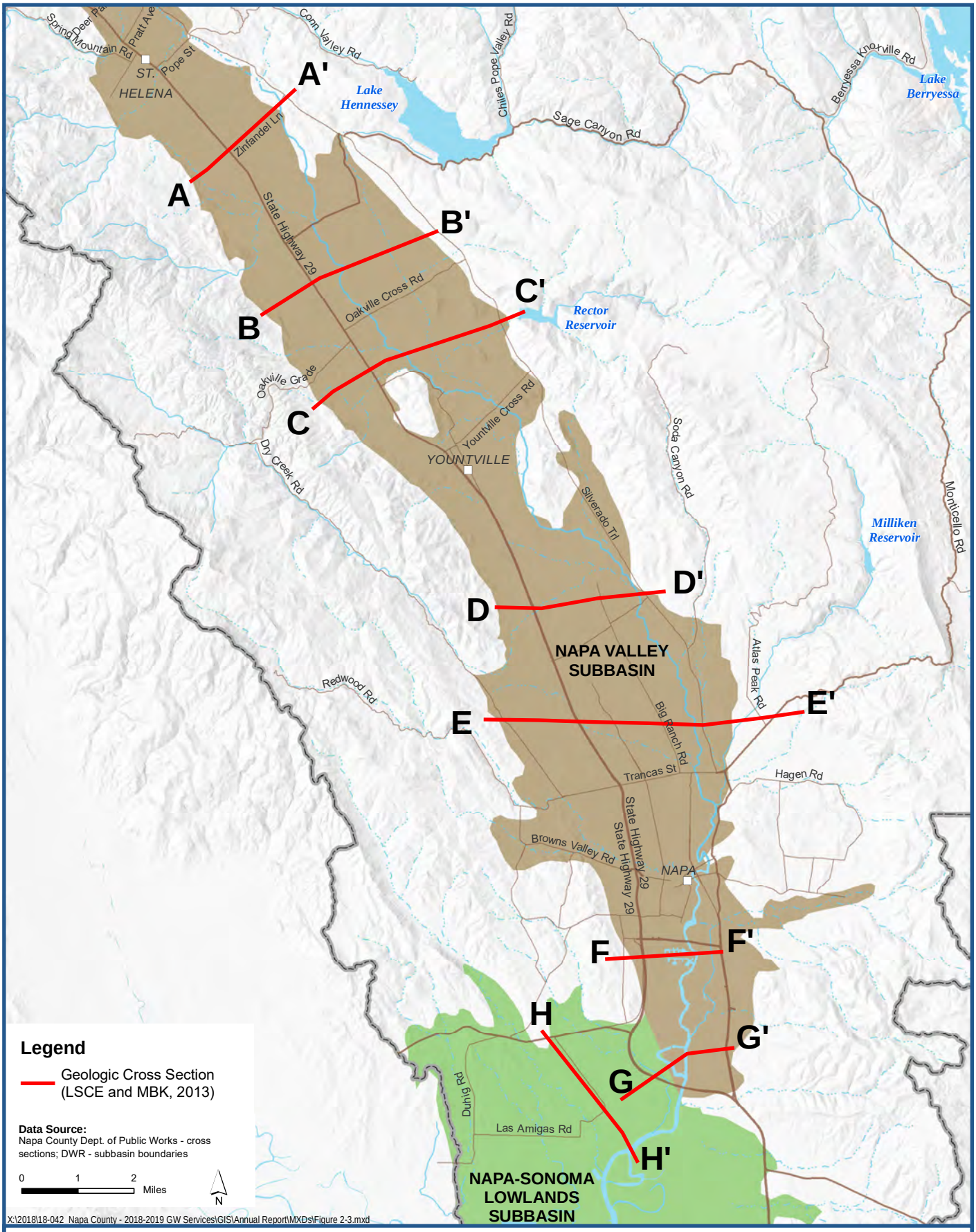
**Napa County Groundwater Subareas**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 2-2**

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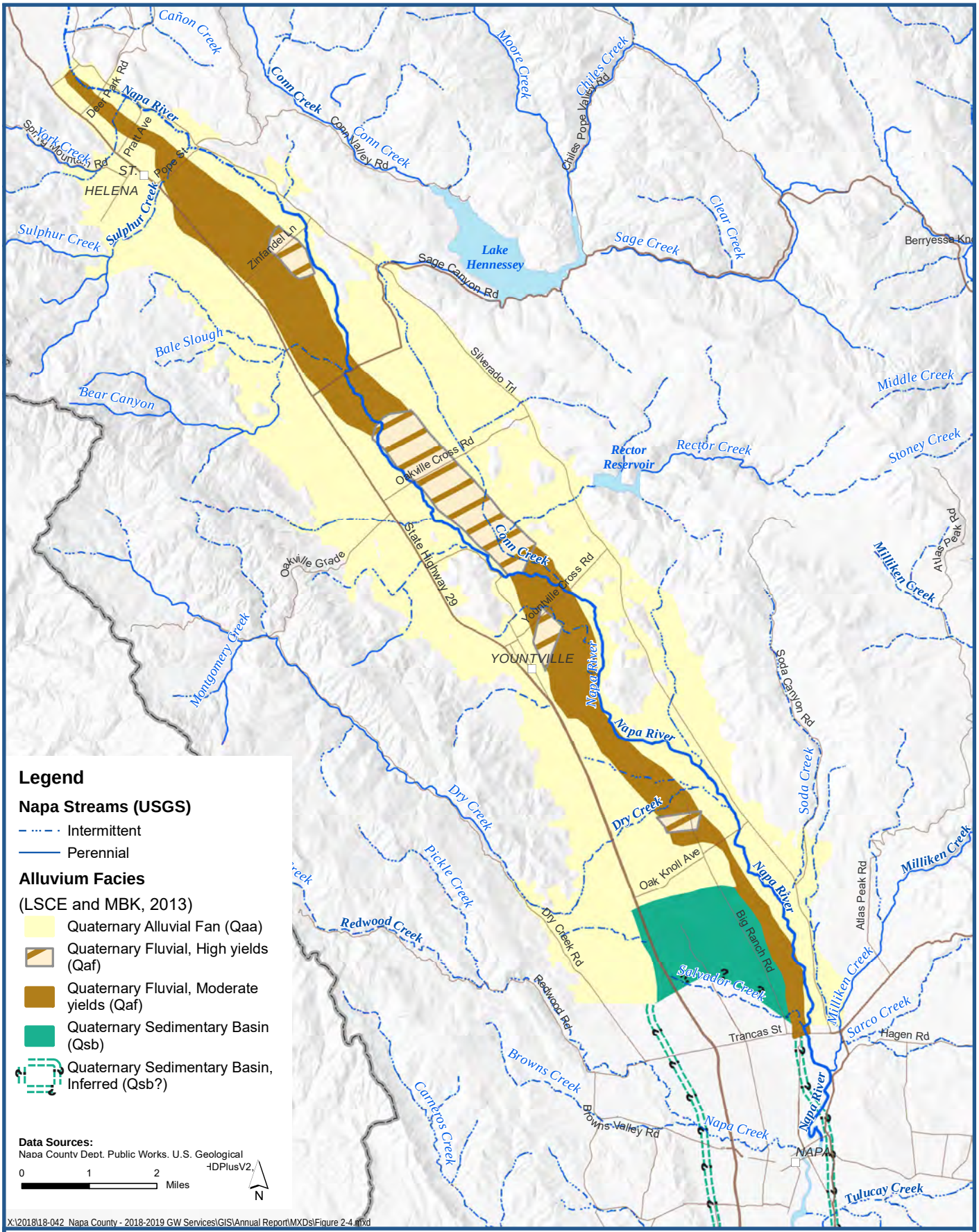
**Updated Hydrogeologic Conceptualization**
**Geologic Cross Section Locations**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 2-3**

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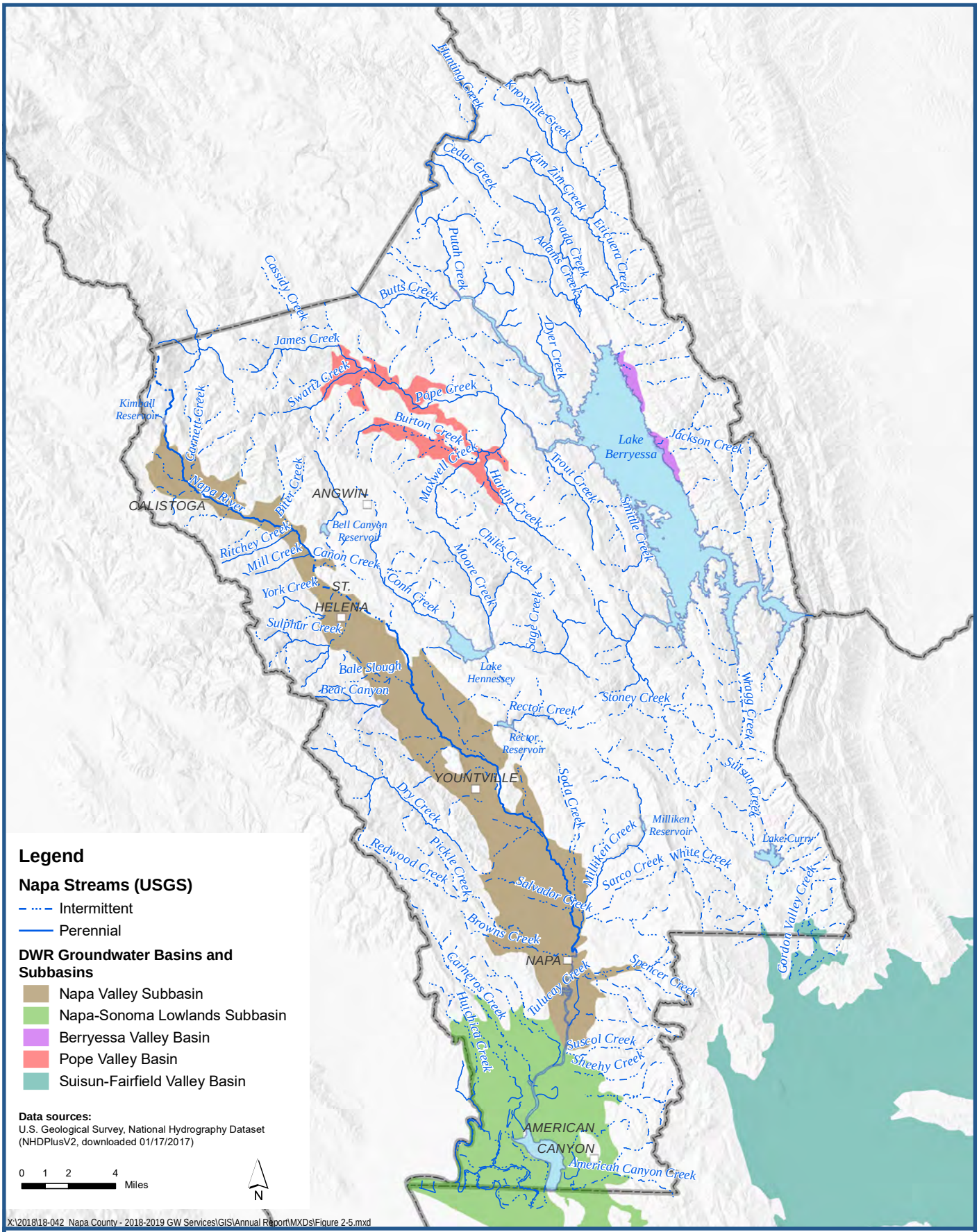
**Streams and Alluvium Facies, Napa Valley Floor**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 2-4**

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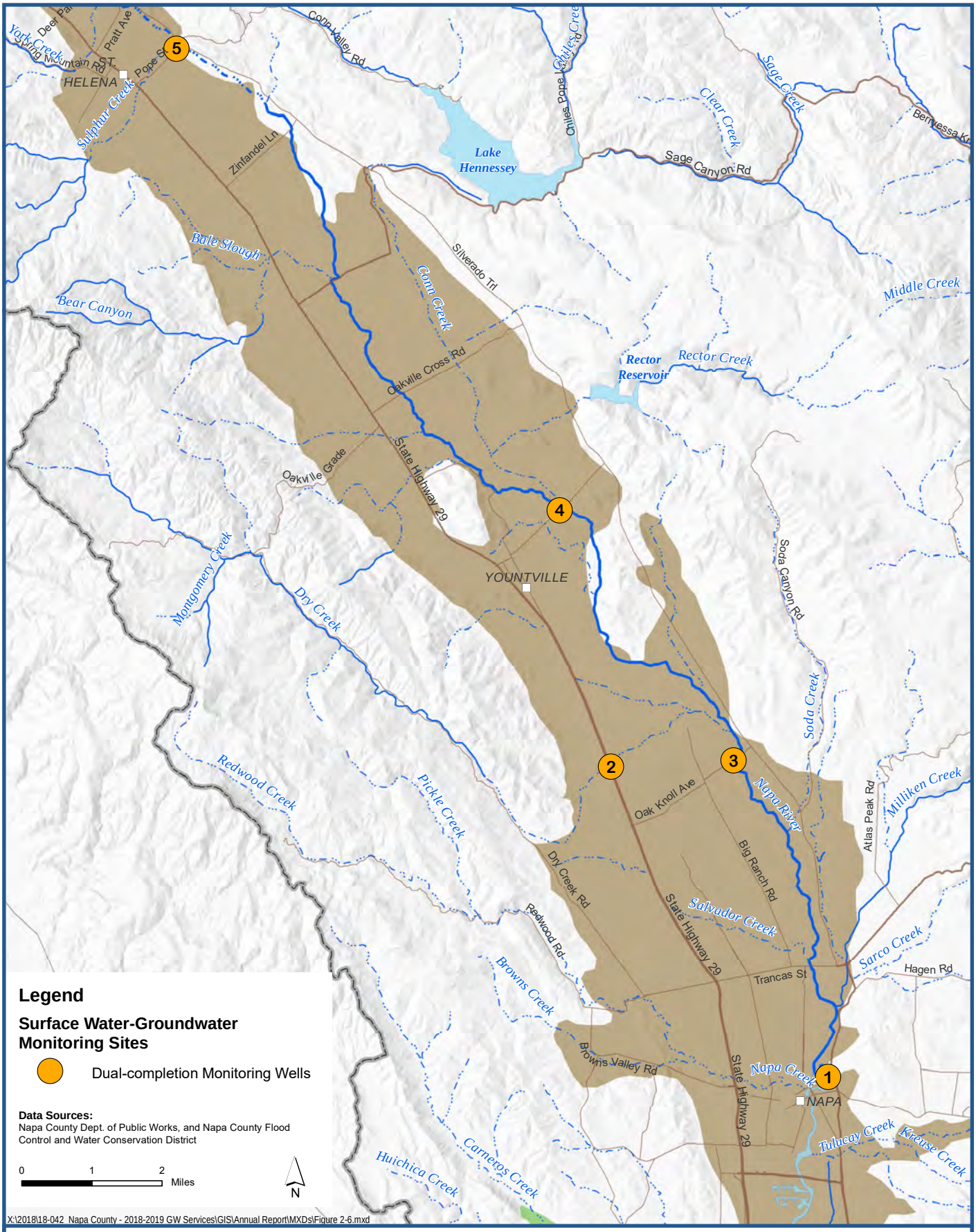
**Perennial Streams and Intermittent Streams, Napa County**

**Figure 2-5**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

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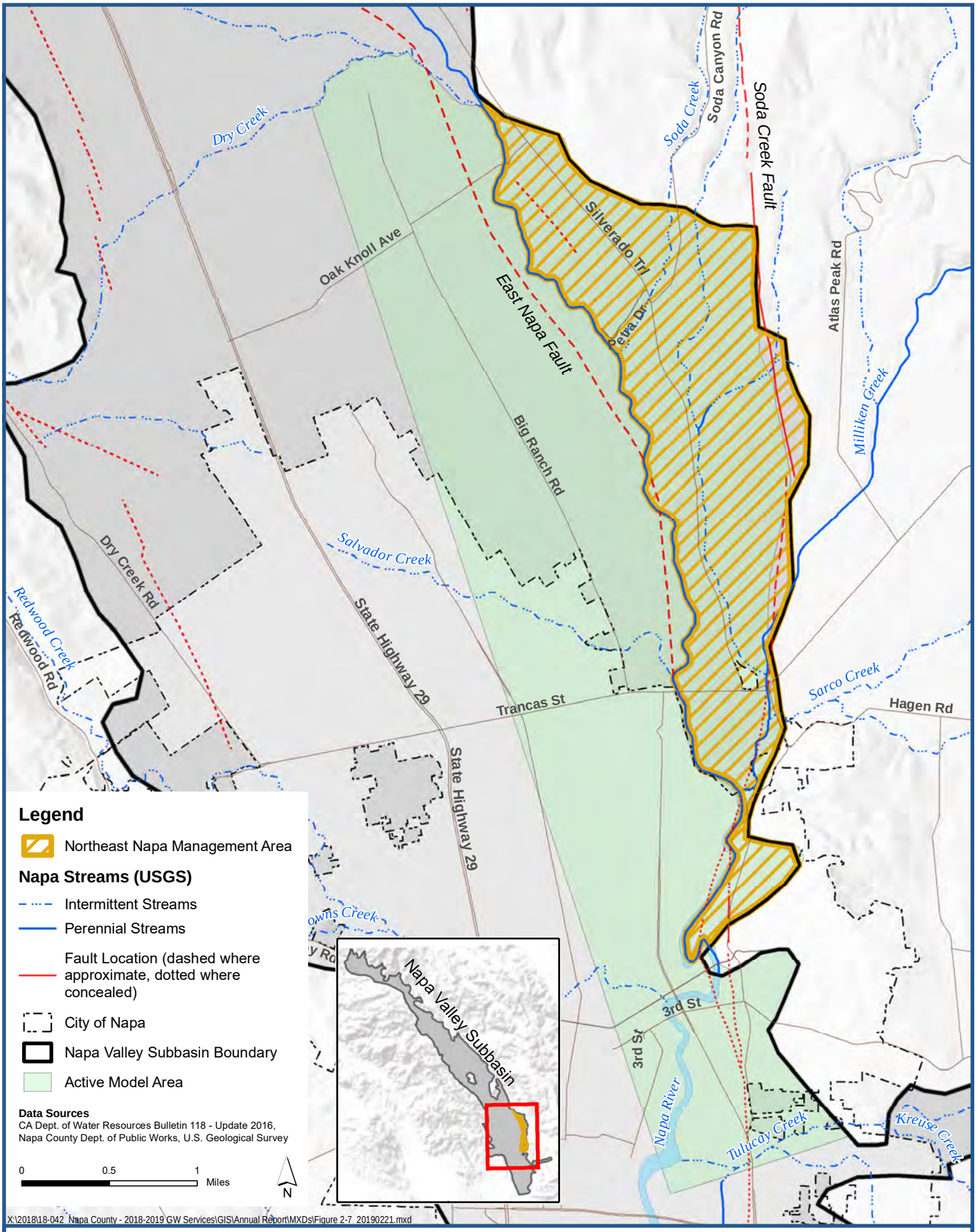
**Napa County Surface Water-Groundwater**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 2-6**

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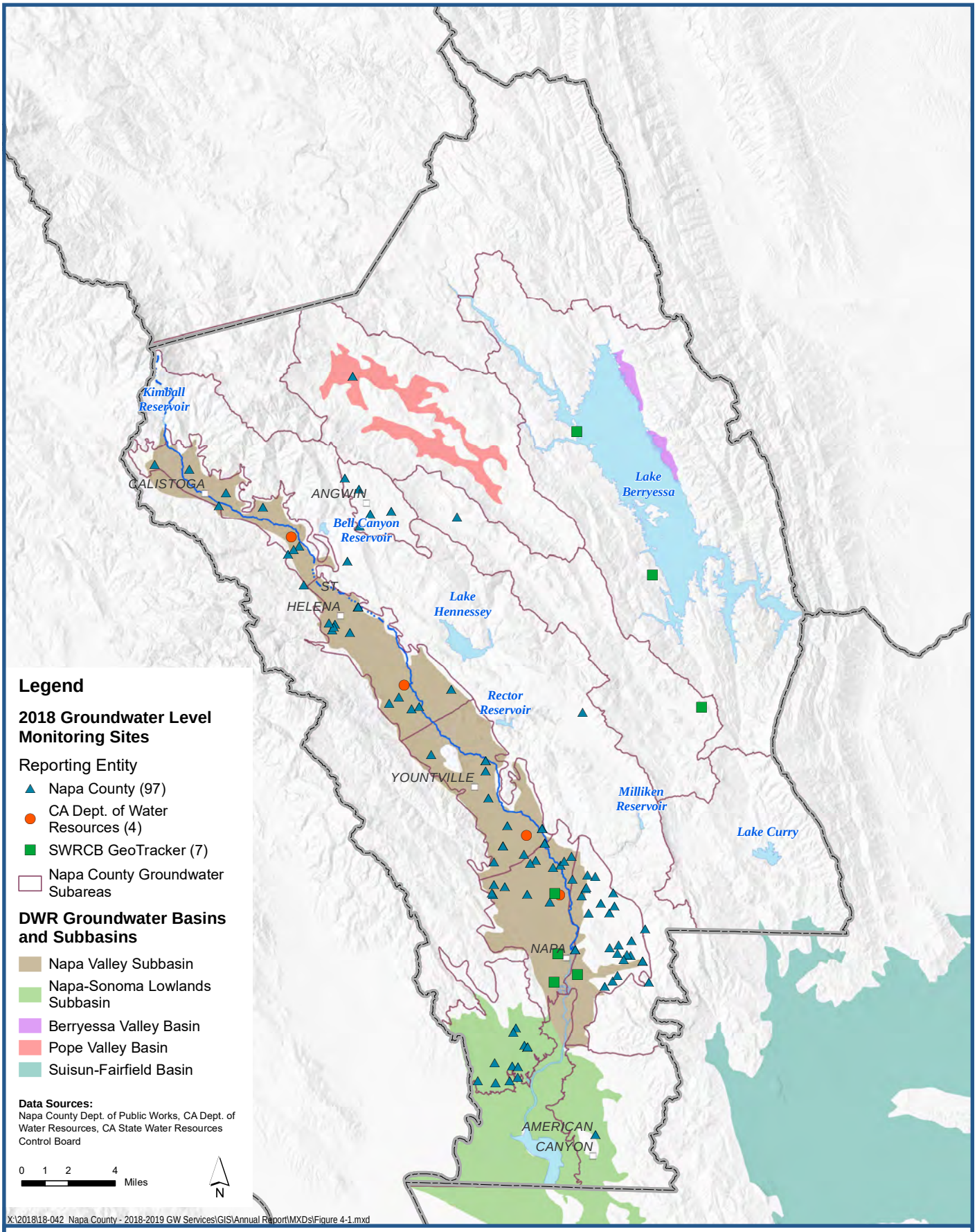
**Napa Valley Subbasin: Northeast Napa Management Area**

**Figure 2-7**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

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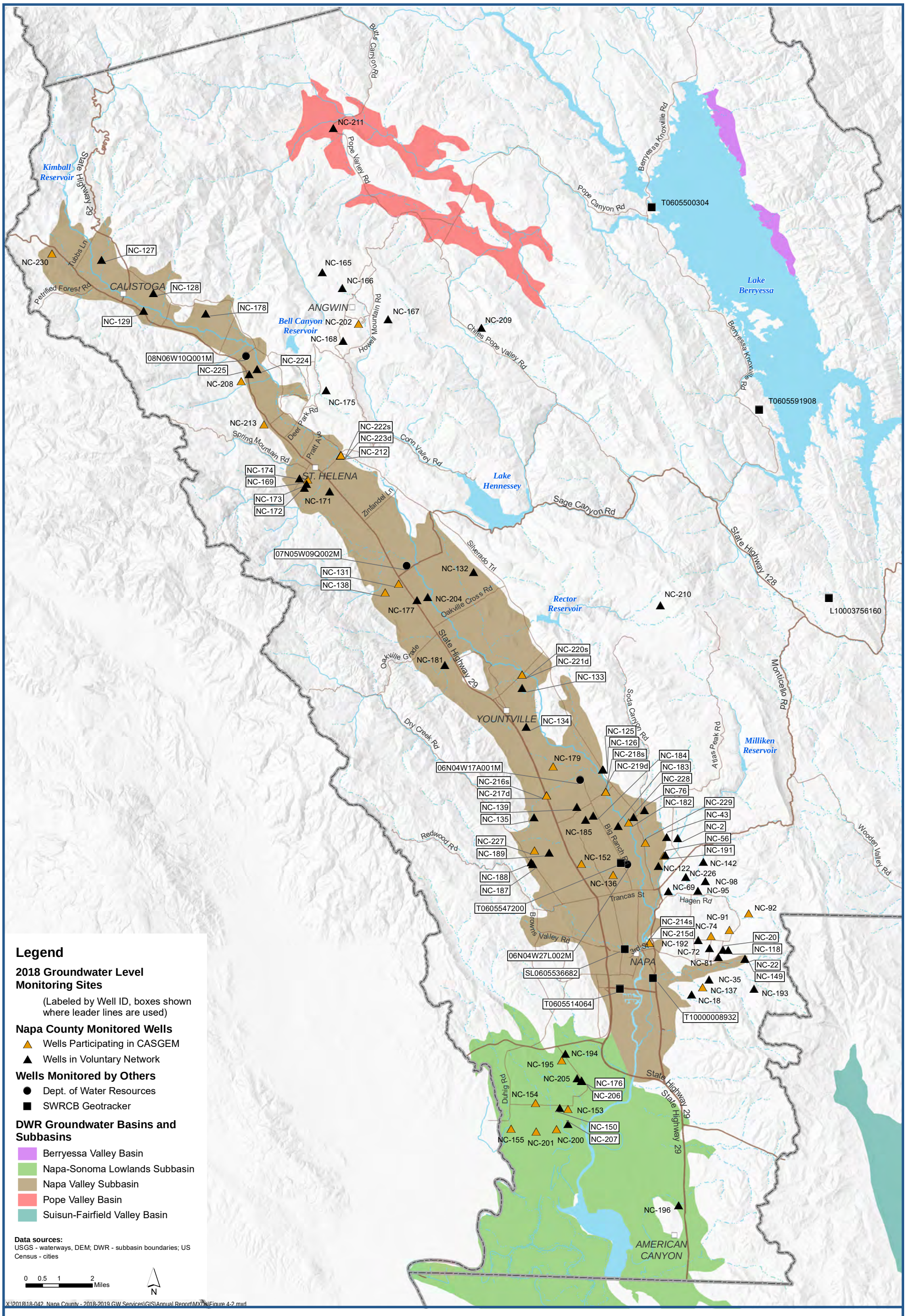
**Current Groundwater Level Monitoring Sites by Reporting Entity**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 4-1**




## Legend

### 2018 Groundwater Level Monitoring Sites

(Labeled by Well ID, boxes shown where leader lines are used)

### Napa County Monitored Wells

- Wells Participating in CASGEM
- Wells in Voluntary Network

### Wells Monitored by Others

- Dept. of Water Resources
- SWRCB Geotracker

### DWR Groundwater Basins and Subbasins

- Berryessa Valley Basin
- Napa-Sonoma Lowlands Subbasin
- Napa Valley Subbasin
- Pope Valley Basin
- Suisun-Fairfield Valley Basin

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries; US Census - cities

0 0.5 1 2 Miles

N

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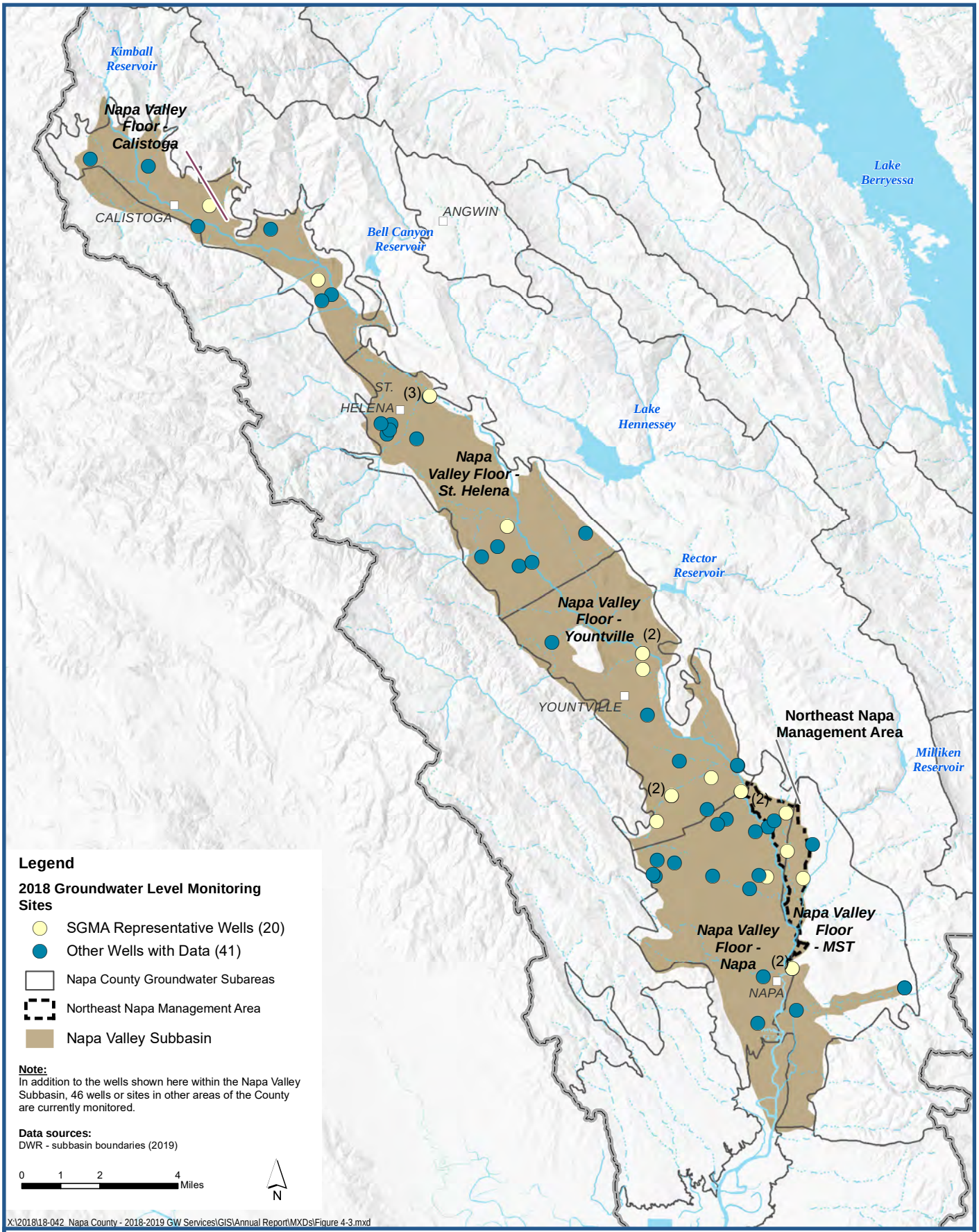
**Current Groundwater Level Monitoring Network and CASGEM Sites, Napa County, CA**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 4-2**

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**Representative Wells and Wells Utilized for Analyses in the Napa Valley Subbasin**

**Figure 4-3**

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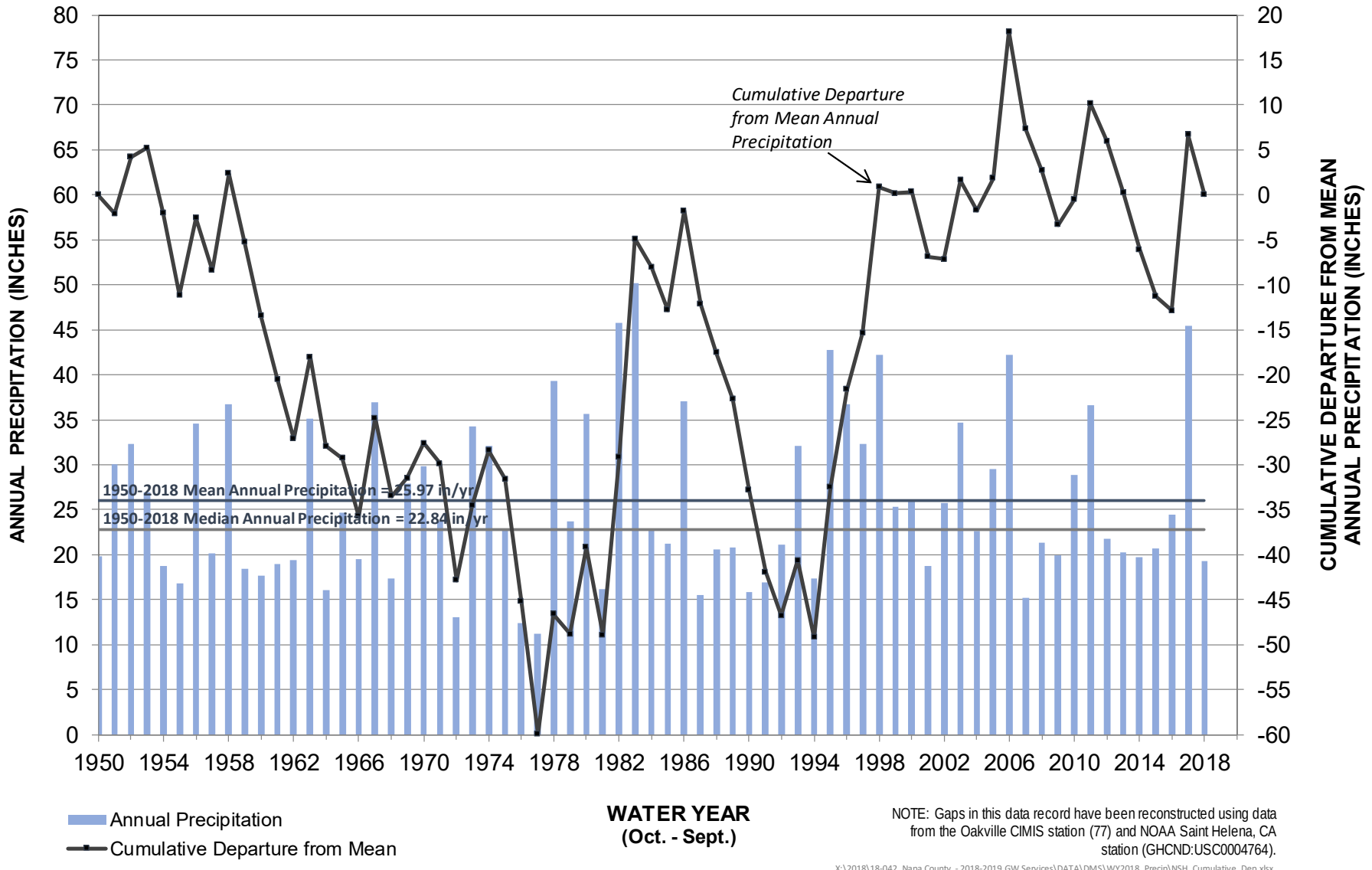


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**Napa State Hospital Water Year Precipitation and Cumulative Departure, Water Years 1950 - 2018**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 5-1**

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Kimball Reservoir
Garnett Creek
Swartz Creek
Horns Creek
Blossom Creek
Tubbs Ln
Petrified Forest Rd
CALISTOGA
Biter Creek
Pope Valley Rd
Burton Creek
Pope Canyon Rd
Lake Berryessa
Howell Mountain Rd
ANGWIN
Maxwell Creek
Chiles Pope Valley Rd
Hardin Creek
Trout Creek
Berryessa Knoxville Rd
Bell Canyon Reservoir
Deer Park Rd
Nash Creek
Lakmead Ln
Blue Ln
Ritchey Creek
Sanitarium Rd
Mill Creek
Canon Creek
Moore Creek
Chiles Creek
York Creek
Spring Mountain Rd
Pratt Ave
Pope St
ST. HELENA
Conn Valley Rd
Clear Creek
Lake Hennessey
Sage Creek
Sage Canyon Rd
Sulphur Creek
Zinfandel Ln
Napa River
Silverado Trl
Bale Slough
State Highway 29
Bear Canyon
Oakville Cross Rd
Conn Creek
Middle Creek
Stoney Creek
Rector Reservoir
Rector Creek
Oakville Grade
Yountville Cross Rd
YOUNTVILLE
Soda Canyon Rd
Atlas Peak Rd
Soda Creek
Milliken Reservoir
Redwood Creek
Pickle Creek
Dry Creek
Oak Knoll Ave
Big Ranch Rd
Milliken Creek
Sarco Creek
Dry Creek Rd
Salvador Creek
Redwood Rd
Trancas St
Hagen Rd
Browns Creek
Browns Valley Rd
Napa Creek
3rd St
Kreuse Creek
Huichica Creek
Carneros Creek
Dunig Rd
Las Amigas Rd
Suscol Creek
Sheehy Creek
Napa Slough

5 7 6 20 18 17 7 24 8 20 16 9 12 18 17 14 22 41 24 7 29 21 15 8 5 20

## Legend

**Wells with Groundwater Level Measurement**

- Labeled with Depth to Groundwater (ft)
- Napa Valley Subbasin

**Depth to Groundwater (ft), Spring 2018**

- 2 to 10
- 10 to 20
- 20 to 30
- 30 to 41

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries; US Census - cities

0 0.5 1 2 Miles

N

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**Napa Valley Subbasin Spring 2018**
**Interpolated Depth to Groundwater**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-2**

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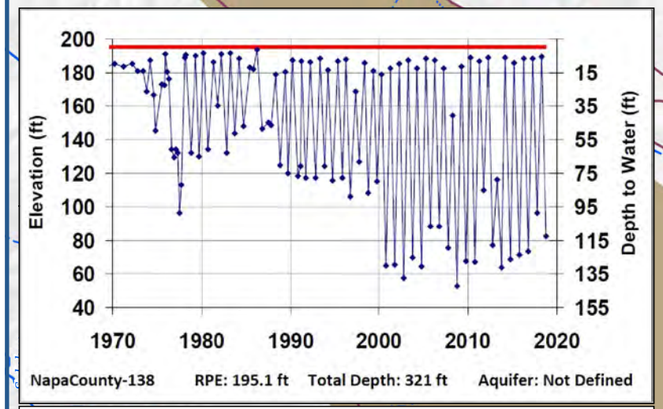
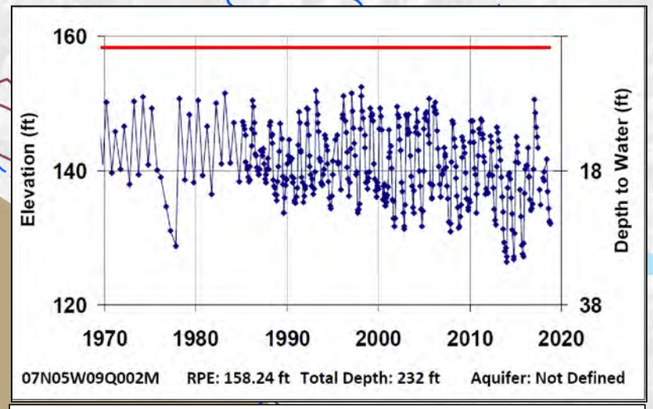
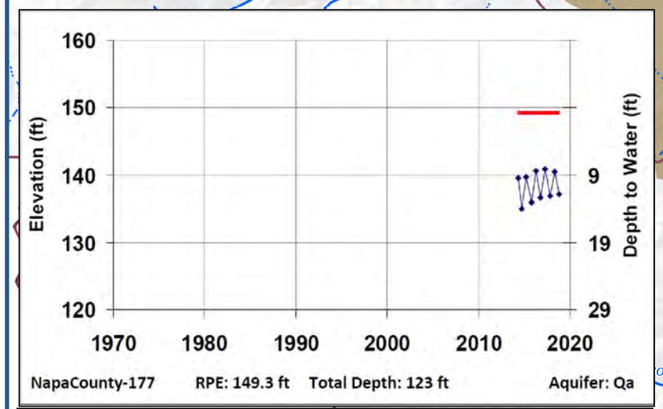


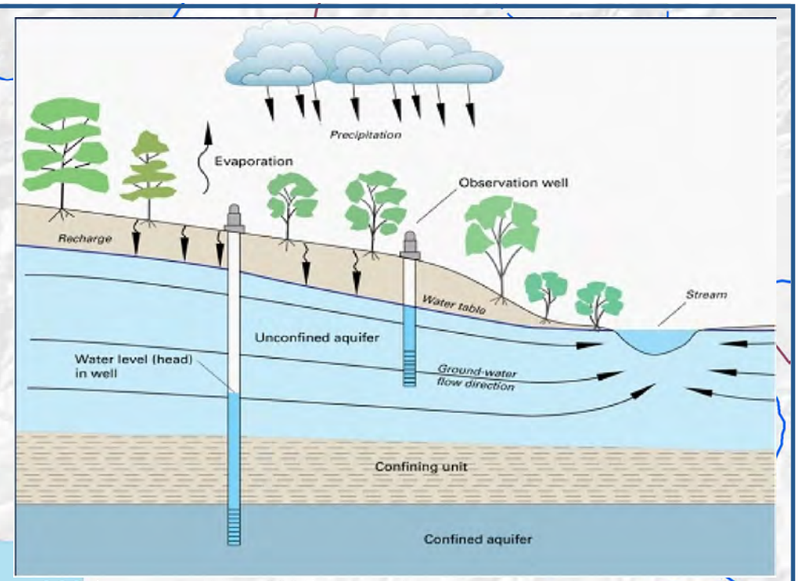

NapaCounty-138 has a total depth of 321 ft and is located nearer to the Napa Valley margin in an area where alluvial sediments extend only approximately 50 feet below ground surface (LSCE and MBK, 2013). Static groundwater levels in this well indicate increasing contributions from geologic formations below the alluvium, although spring season groundwater levels have remained stable.




Well 07N05W09Q2 is constructed in an area where alluvial sediments extend to approximately 200 feet below ground surface (LSCE and MBK, 2013). Static groundwater levels in this well typically vary by about 20 ft from spring to fall and have remained well above the bottom of alluvium, indicating significant contributions from the alluvial aquifer system.




Similar to 07N05W09Q2, NapaCounty-177 is constructed in an area where alluvial sediments extend to approximately 200 feet below ground surface (LSCE and MBK, 2013). However, NapaCounty-177 is a more shallow well, with a total depth of 123 feet. Water levels at this well have been much less variable than in the other two wells, one likely reason for this is that the well is constructed within the upper portion of the alluvial aquifer system where groundwater experiences unconfined conditions.




USGS (Taylor and Alley, 2001) schematic showing a relatively shallower well completed in (i.e., witth screened intervals intersecting) an unconfined upper aquifer zone and a relatively deeper well completed below a confining unit in a deeper aquifer zone. The groundwater levels in these wells are illustrated as being different due to the influence of the distinct aquifer zones.



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**Southern St. Helena Subarea Aquifer Zone Schematic and Illustrative Hydrographs**

**Figure 5-3**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

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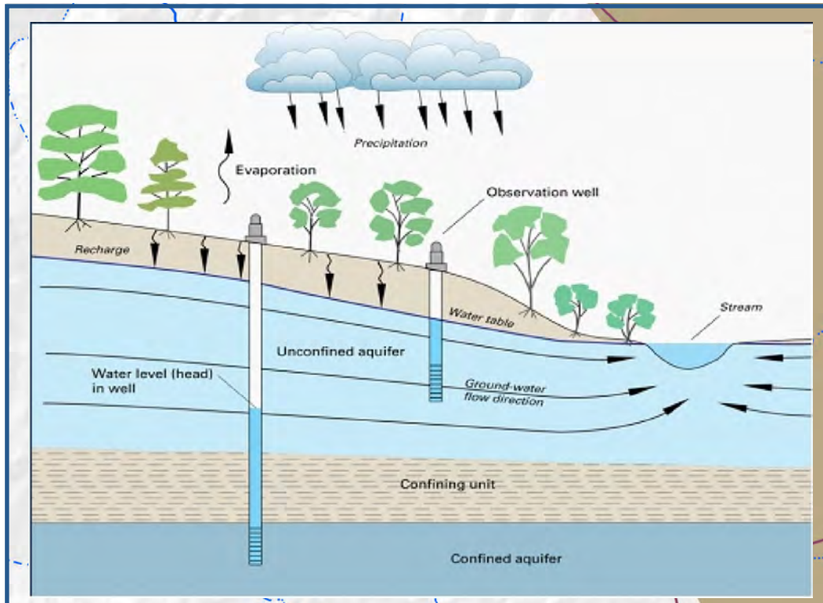
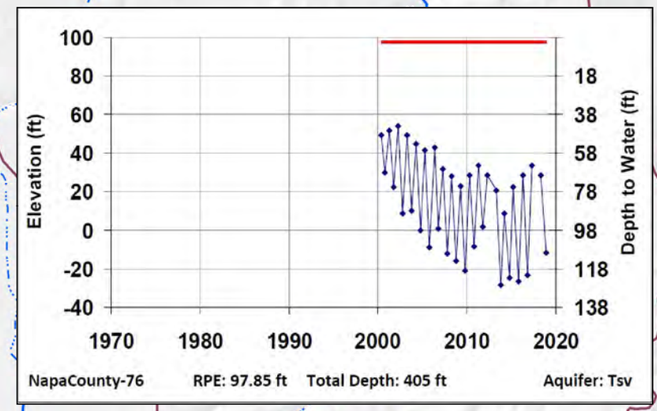
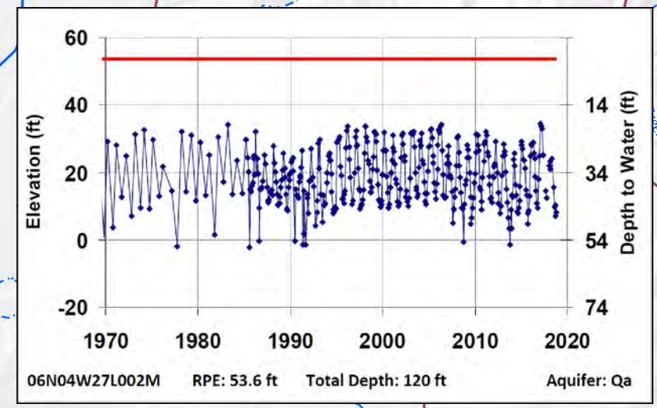



USGS (Taylor and Alley, 2001) schematic showing a relatively shallower well completed in (i.e., witth screened intervals intersecting) an unconfined upper aquifer zone and a relatively deeper well completed below a confining unit in a deeper aquifer zone. The groundwater levels in these wells are illustrated as being different due to the influence of the distinct aquifer zones.



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**Northeast Napa Subarea Aquifer Zone Schematic and Illustrative Hydrographs**

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*Annual Report - Water Year 2018*

**Figure 5-4**

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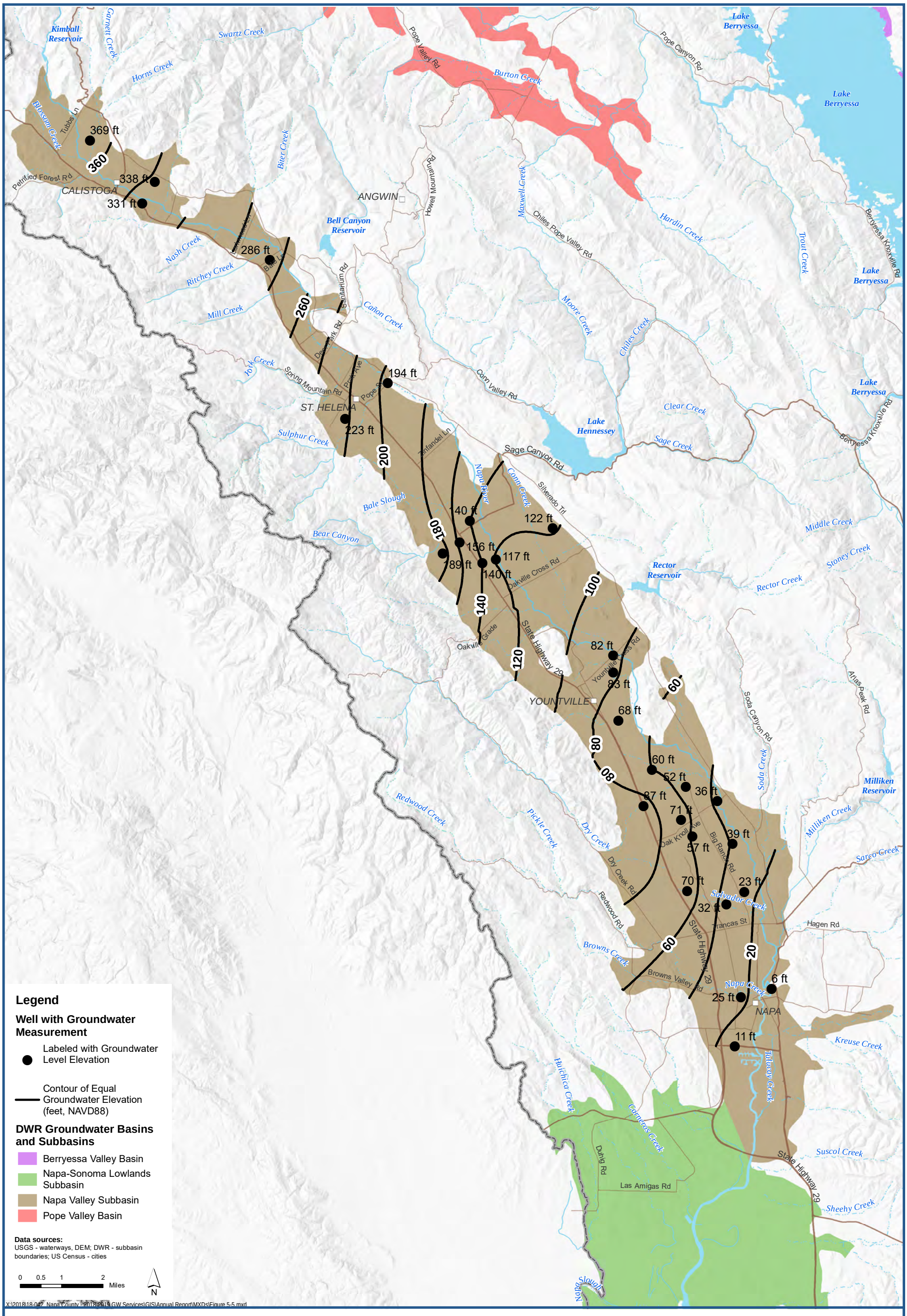


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**Contours of Equal Groundwater Elevation, Spring 2018**
**Napa Valley Subbasin, Napa County, CA**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-5**

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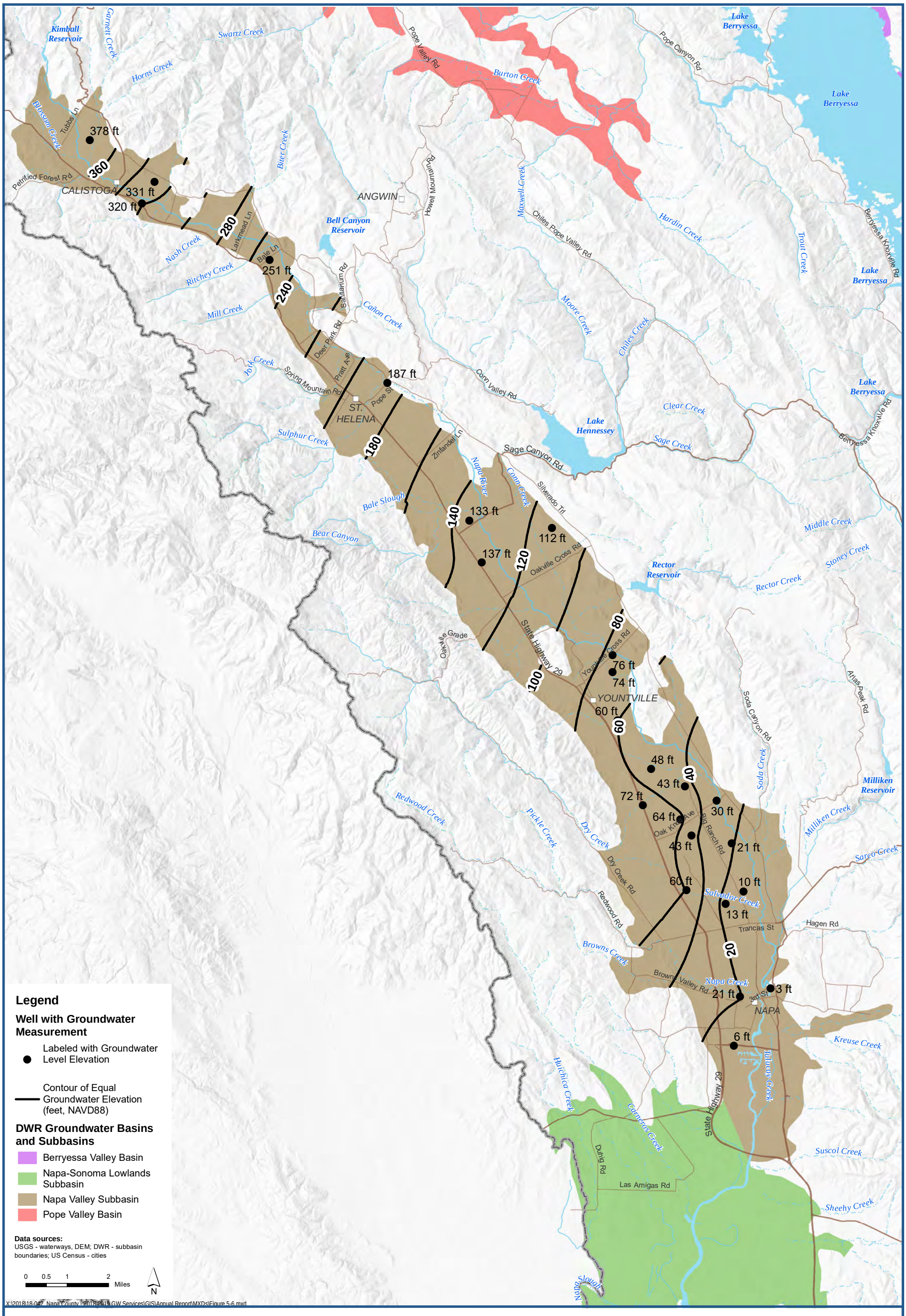


**Legend**

**Well with Groundwater Measurement**

- Labeled with Groundwater Level Elevation

- Contour of Equal Groundwater Elevation (feet, NAVD88)

**DWR Groundwater Basins and Subbasins**

- Berryessa Valley Basin
- Napa-Sonoma Lowlands Subbasin
- Napa Valley Subbasin
- Pope Valley Basin

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries; US Census - cities

0 0.5 1 2 Miles

N

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**Contours of Equal Groundwater Elevation, Fall 2018**
**Napa Valley Subbasin, Napa County, CA**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-6**

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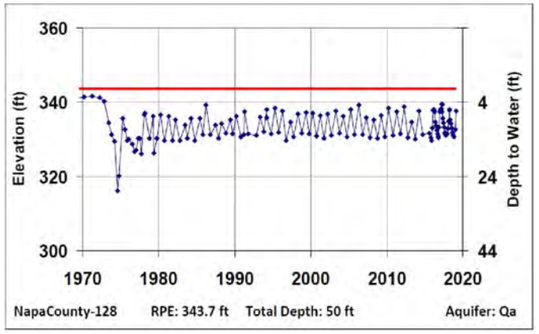


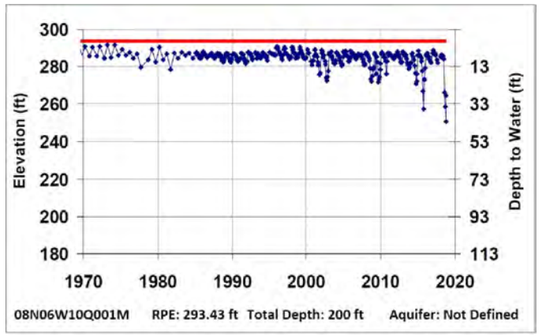


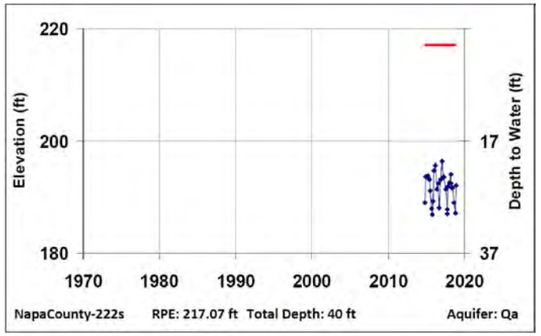


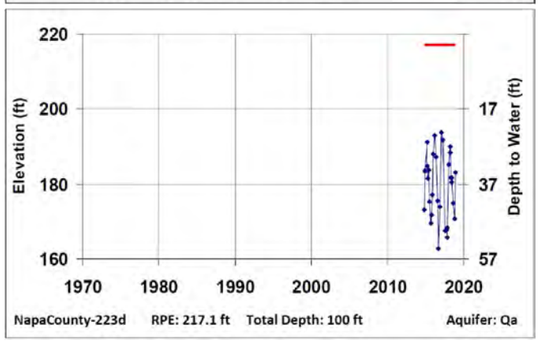


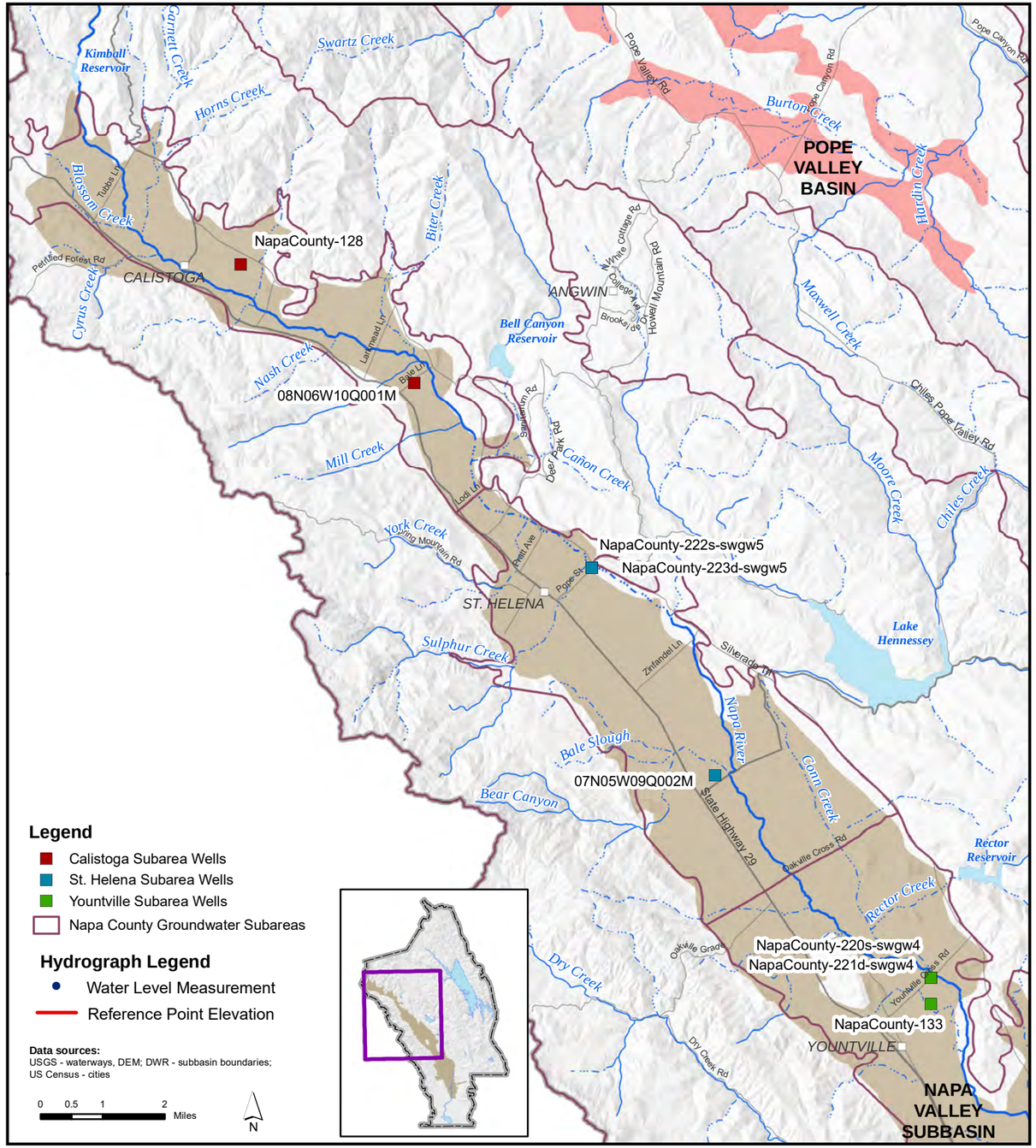


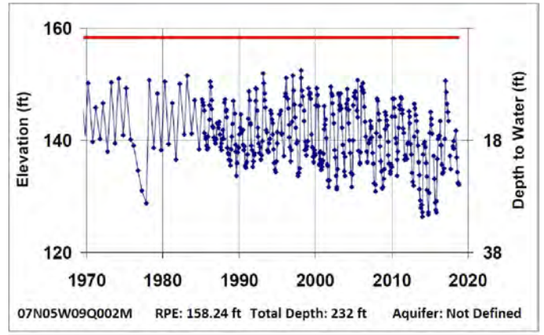


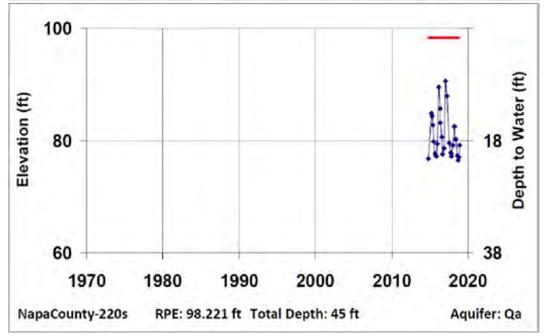


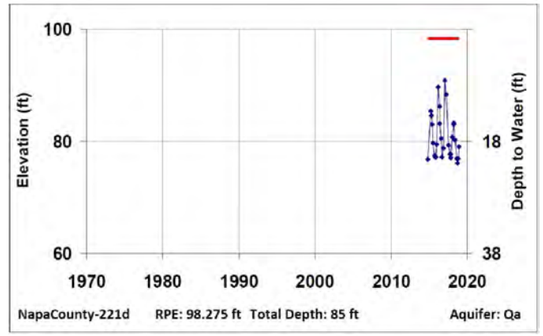


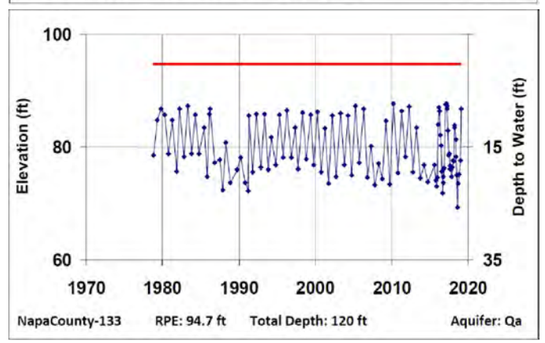


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**Sustainable Groundwater Management Act Representative Groundwater Hydrographs, Northern Napa Valley Subbasin**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 5-7**

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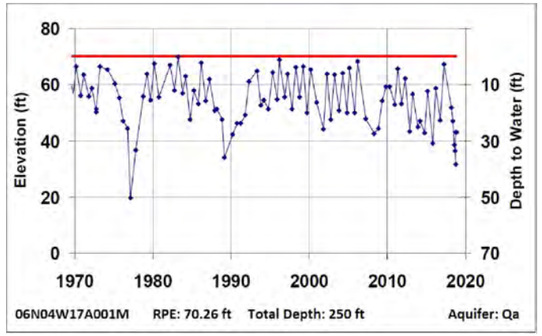


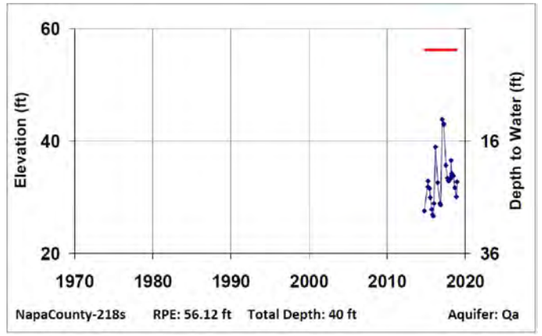


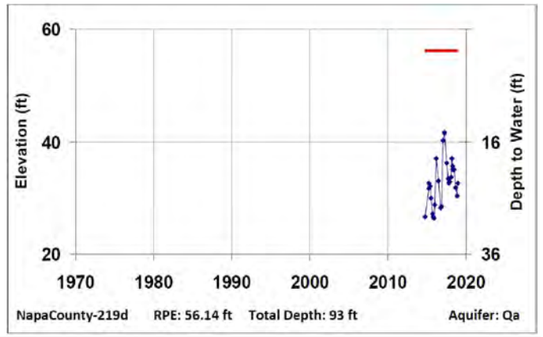


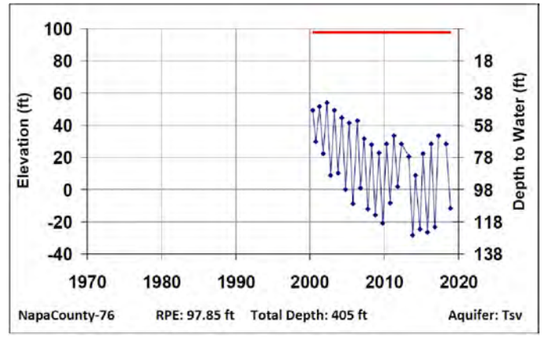


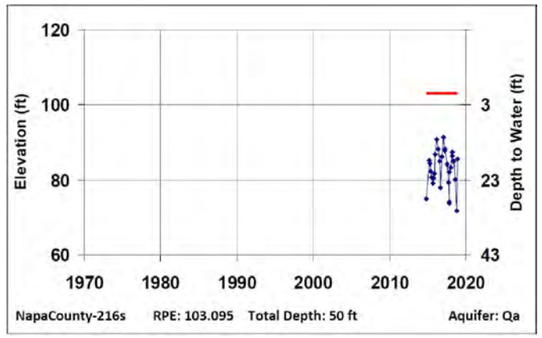


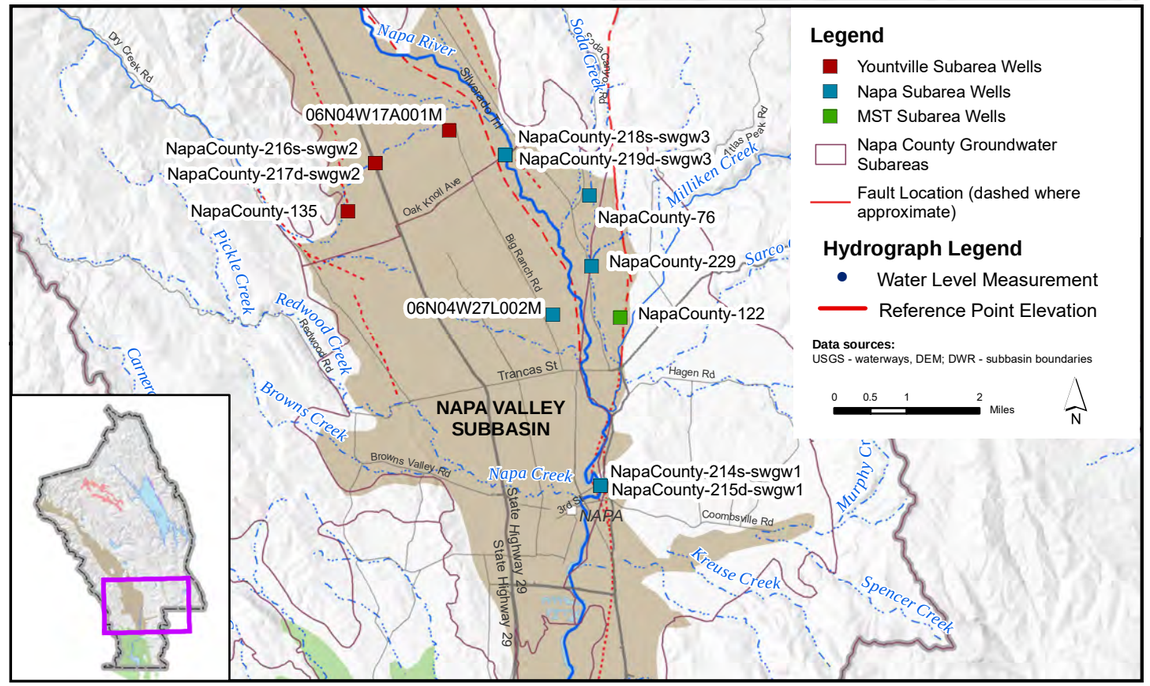


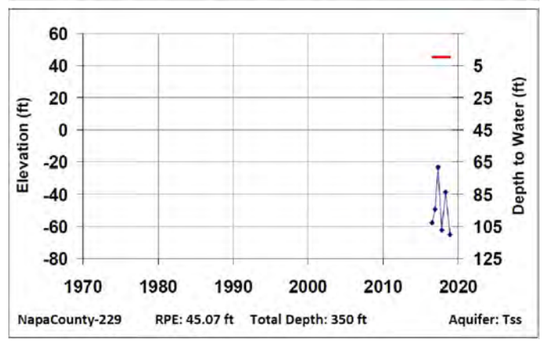


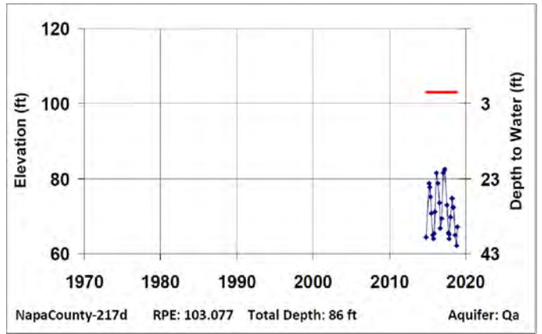


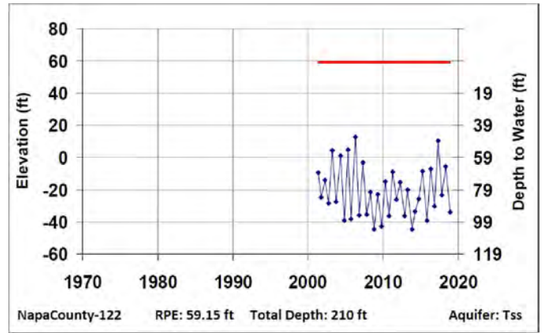


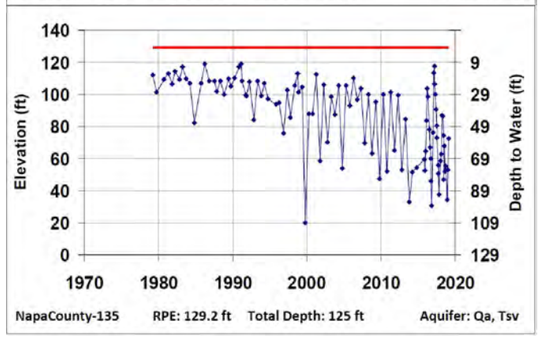


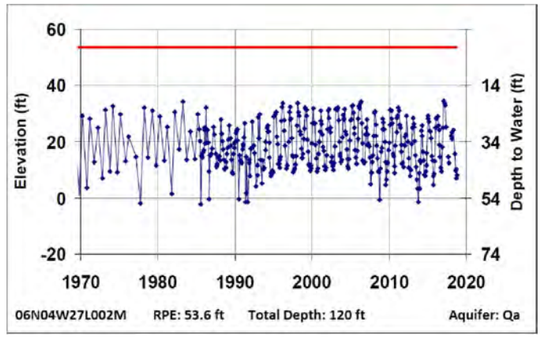


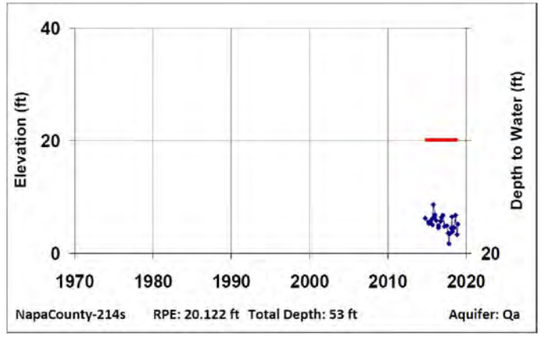


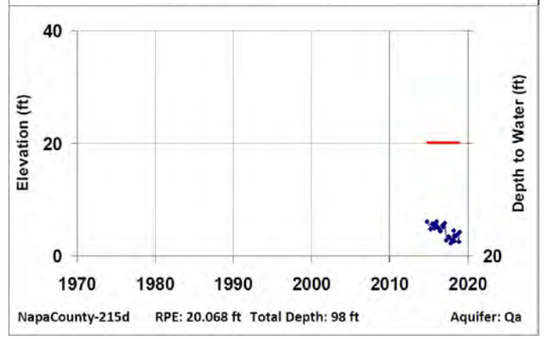


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Luhdorff & Scalmanini Consulting Engineers

**Sustainable Groundwater Management Act Representative Groundwater Hydrographs, Southern Napa Valley Subbasin**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 5-8**

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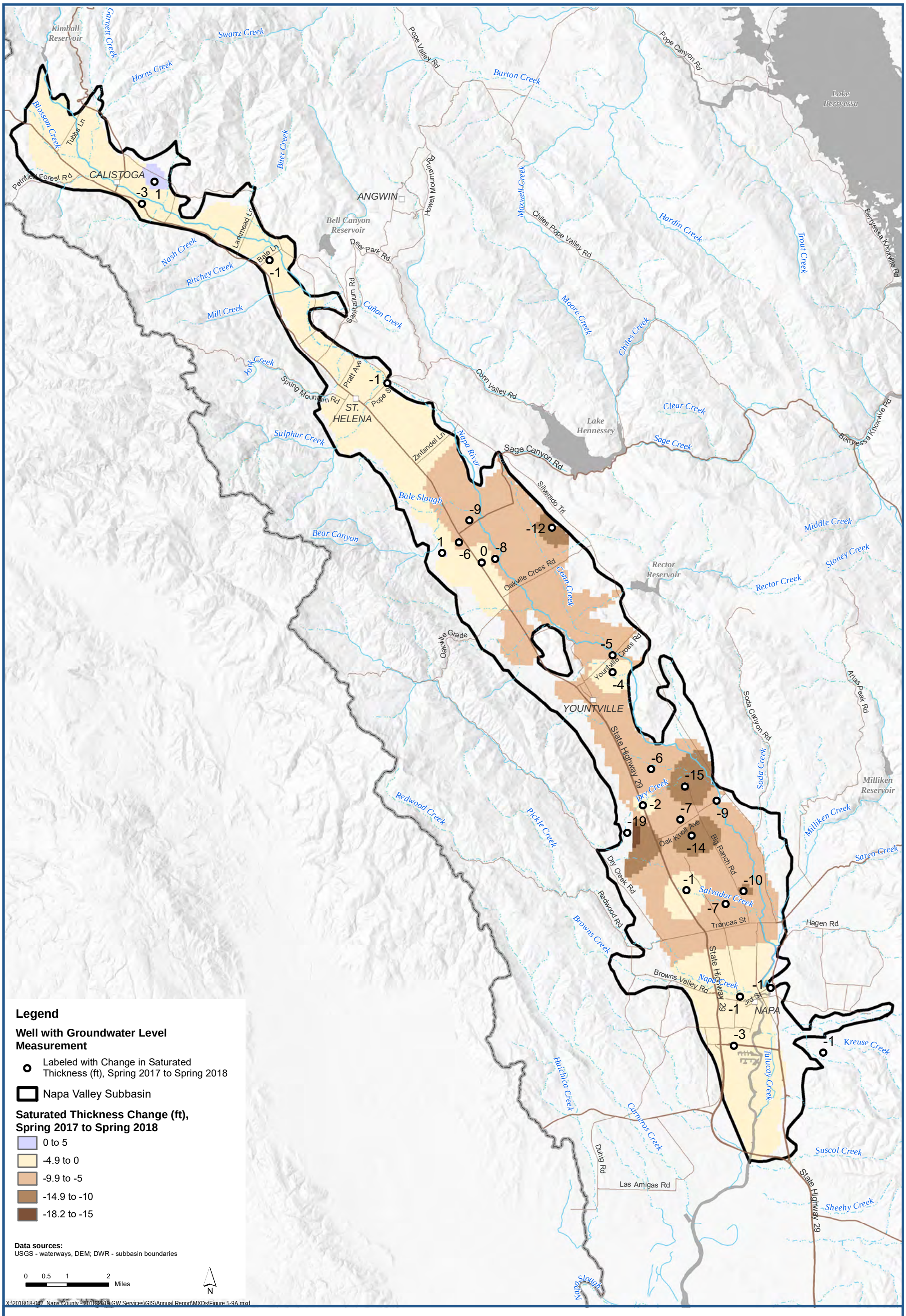


## Legend

**Well with Groundwater Level Measurement**

- Labeled with Change in Saturated Thickness (ft), Spring 2017 to Spring 2018
- Napa Valley Subbasin

**Saturated Thickness Change (ft), Spring 2017 to Spring 2018**

- 0 to 5
- -4.9 to 0
- -9.9 to -5
- -14.9 to -10
- -18.2 to -15

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries

0 0.5 1 2 Miles

N

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**Napa Valley Subbasin Principal Aquifer**
**Change in Saturated Thickness, Spring 2017 to Spring 2018**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-9A**

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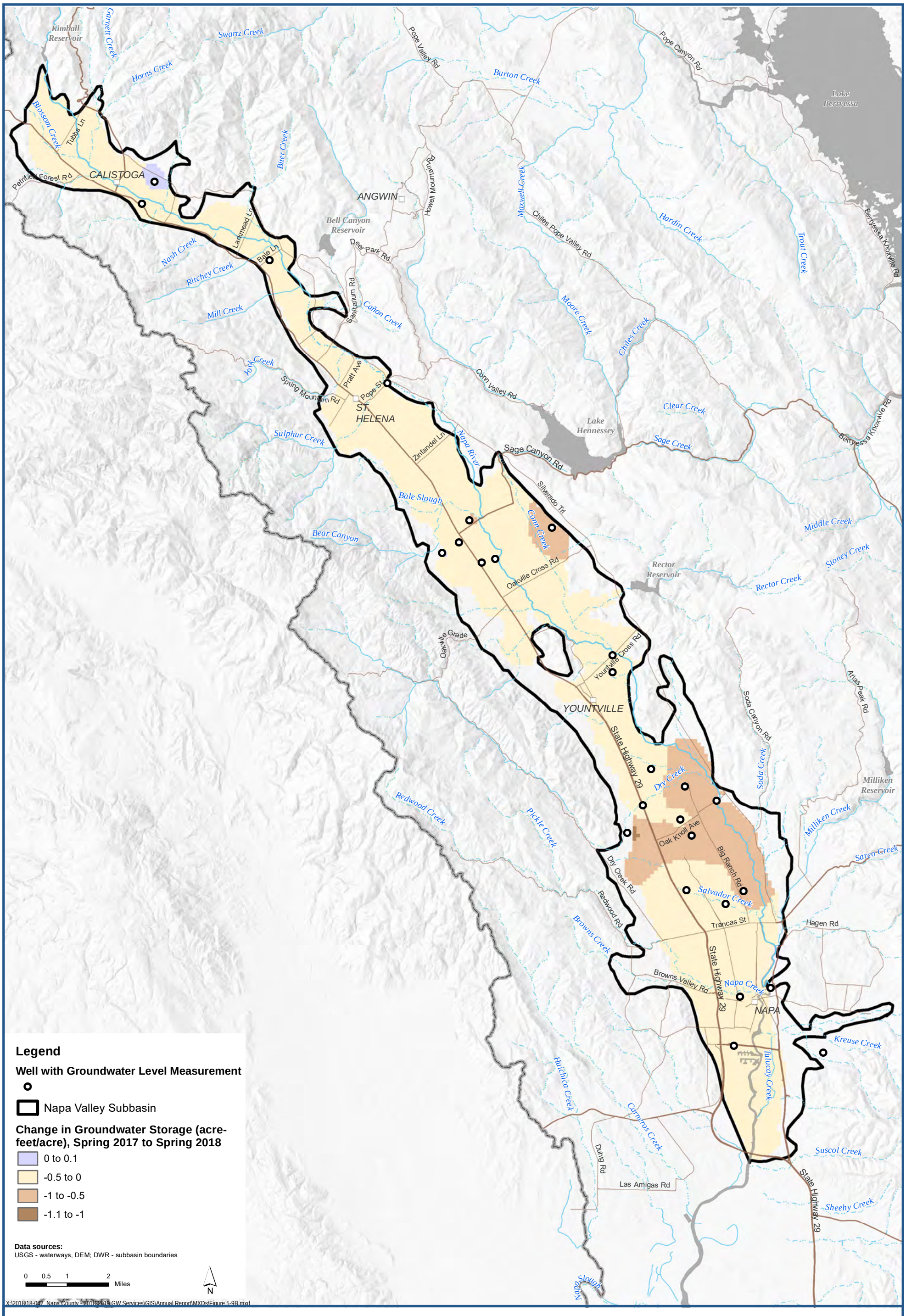


## Legend

**Well with Groundwater Level Measurement**

Napa Valley Subbasin

**Change in Groundwater Storage (acre-feet/acre), Spring 2017 to Spring 2018**

- 0 to 0.1
- -0.5 to 0
- -1 to -0.5
- -1.1 to -1

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries

0 0.5 1 2 Miles

N

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**Napa Valley Subbasin Principal Aquifer**
**Change in Groundwater Storage, Spring 2017 to Spring 2018**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-9B**

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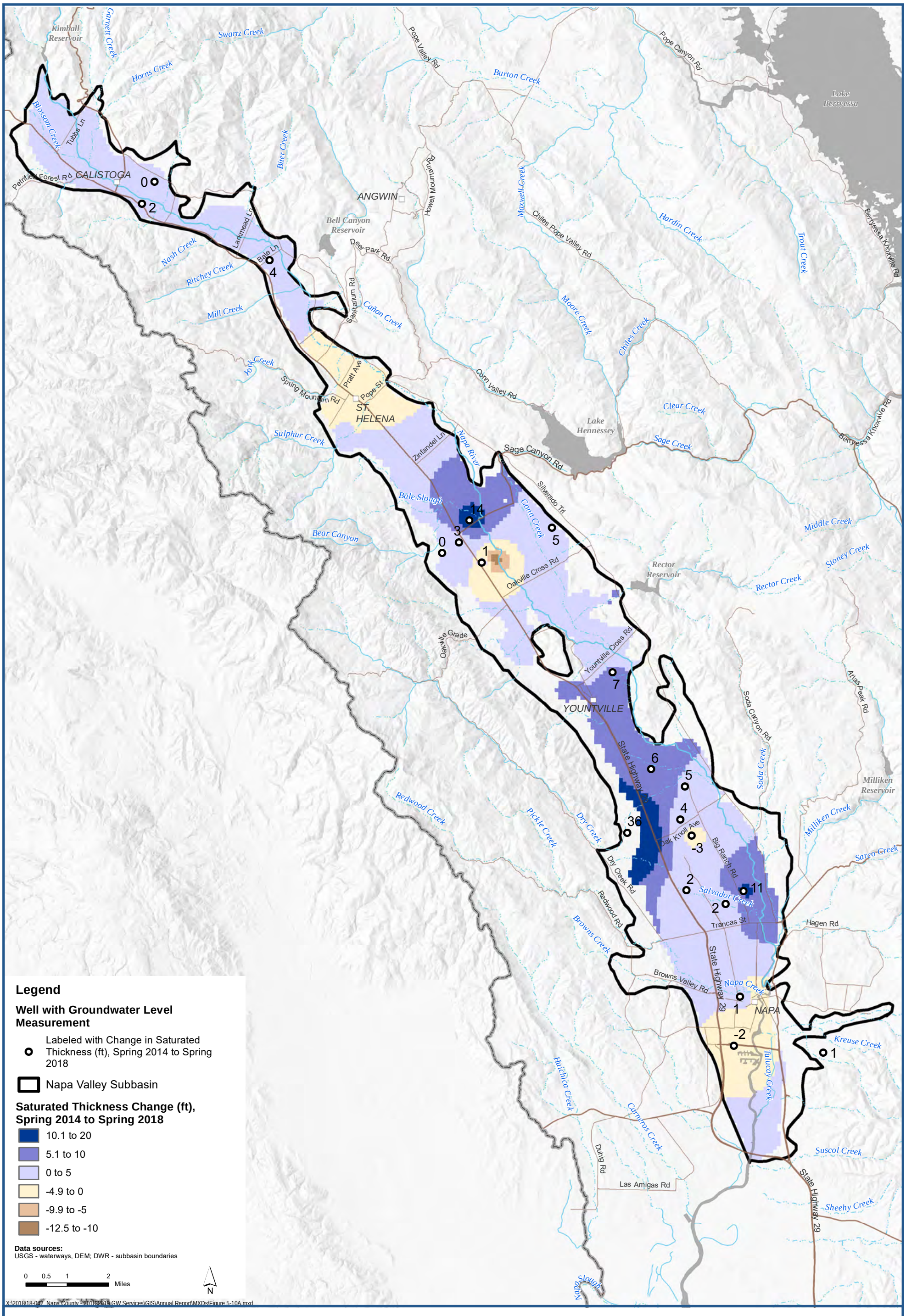


## Legend

**Well with Groundwater Level Measurement**

- Labeled with Change in Saturated Thickness (ft), Spring 2014 to Spring 2018

Napa Valley Subbasin

**Saturated Thickness Change (ft), Spring 2014 to Spring 2018**

- 10.1 to 20
- 5.1 to 10
- 0 to 5
- -4.9 to 0
- -9.9 to -5
- -12.5 to -10

**Data sources:**
USGS - waterways, DEM; DWR - subbasin boundaries

0 0.5 1 2 Miles

N

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**Napa Valley Subbasin Principal Aquifer**
**Change in Saturated Thickness, Spring 2014 to Spring 2018**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-10A**

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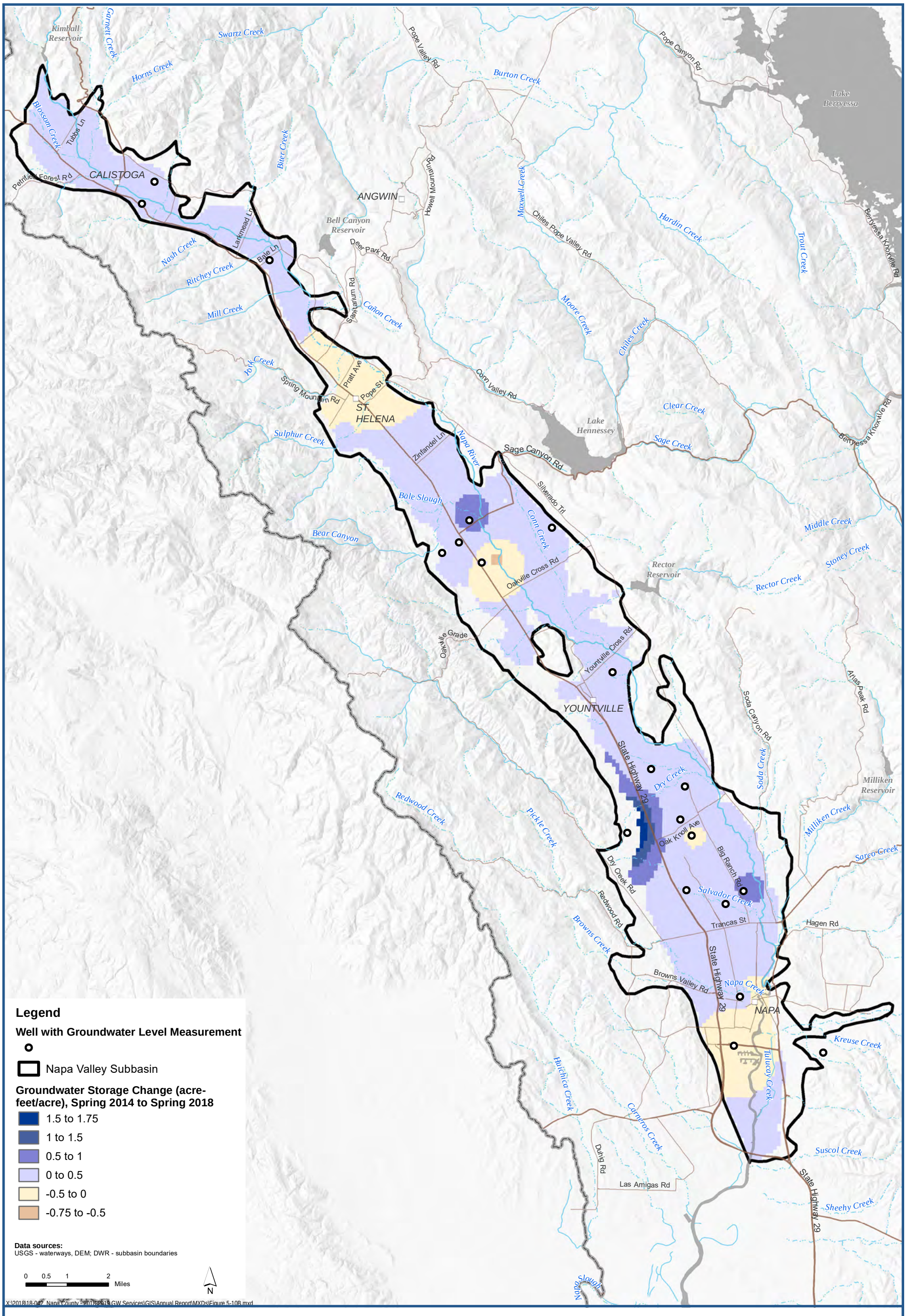


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**Napa Valley Subbasin Principal Aquifer**
**Change in Groundwater Storage, Spring 2014 to Spring 2018**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-10B**

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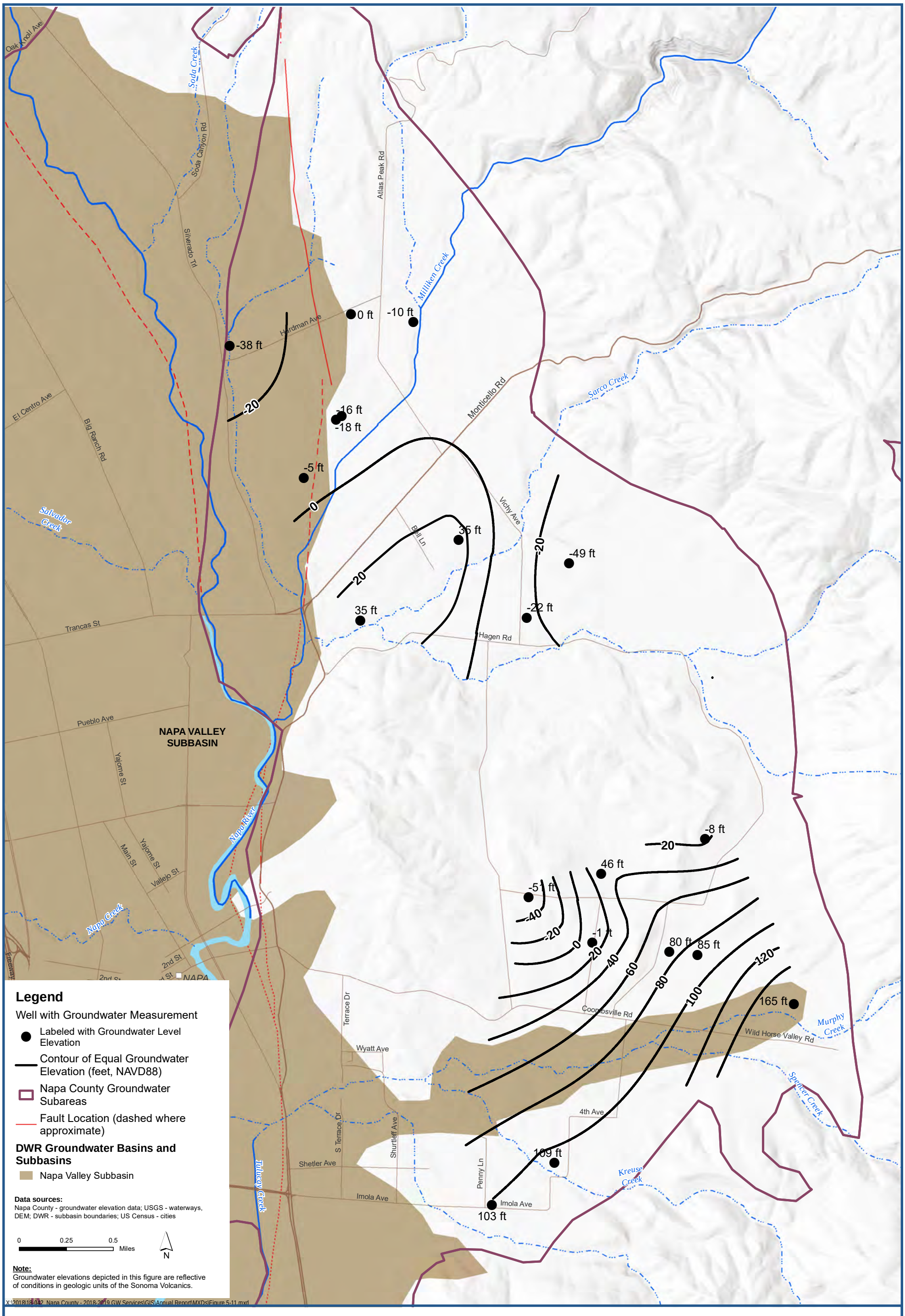


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**Contours of Equal Groundwater Elevation, Spring 2018**
**MST Subarea, Napa County, CA**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-11**

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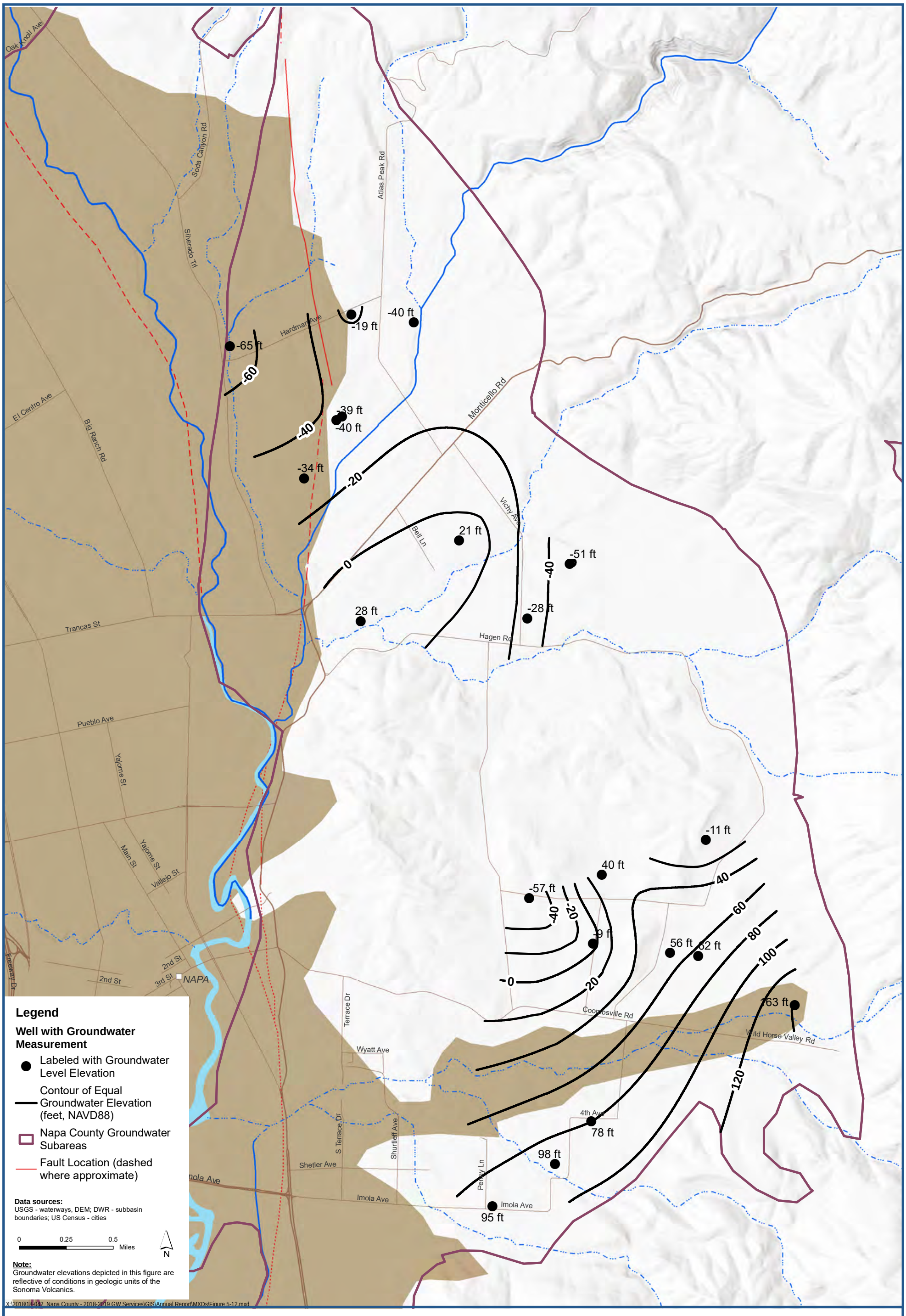


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**Contours of Equal Groundwater Elevation, Fall 2018**
**MST Subarea, Napa County, CA**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 5-12**

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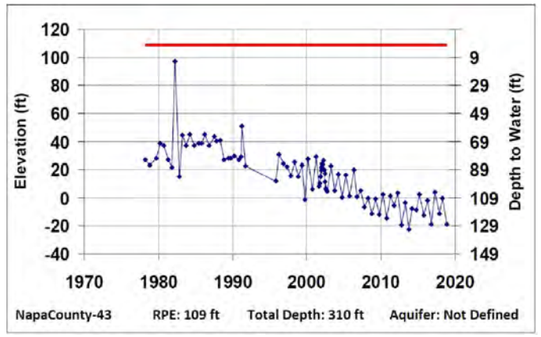


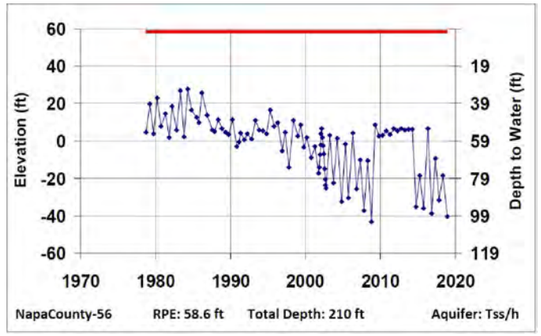


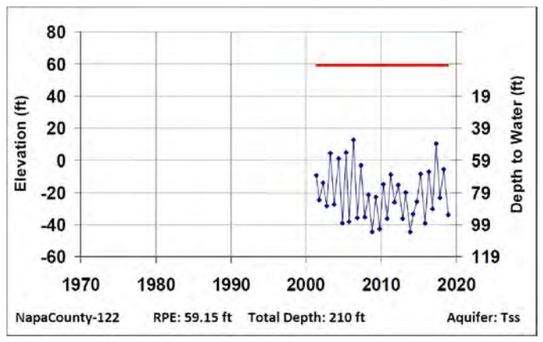


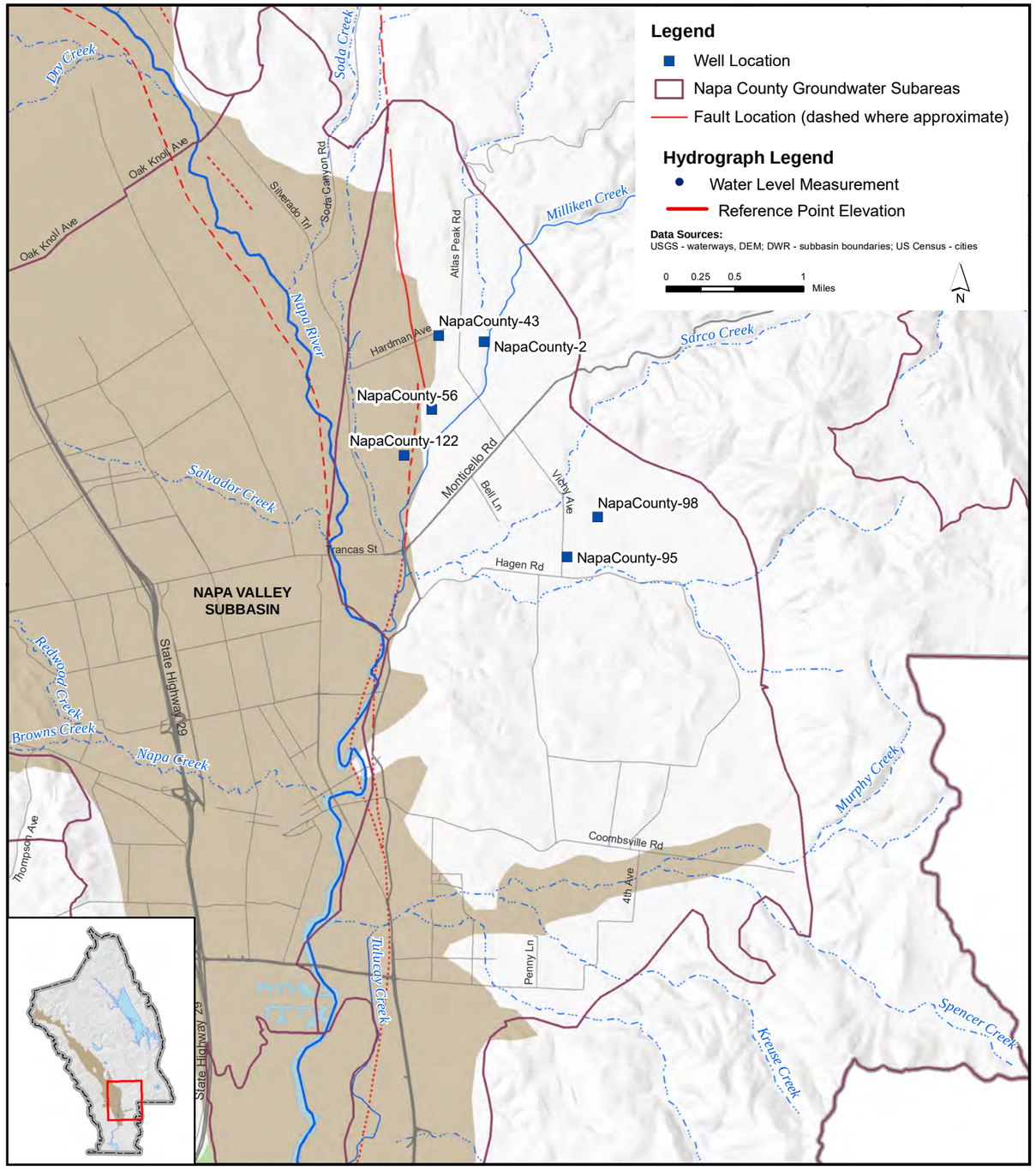


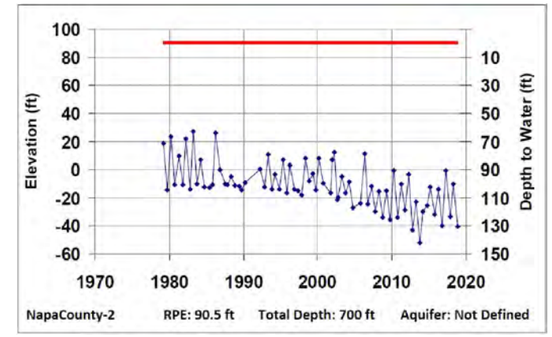


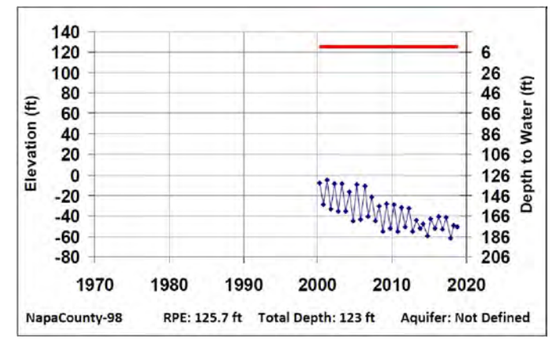


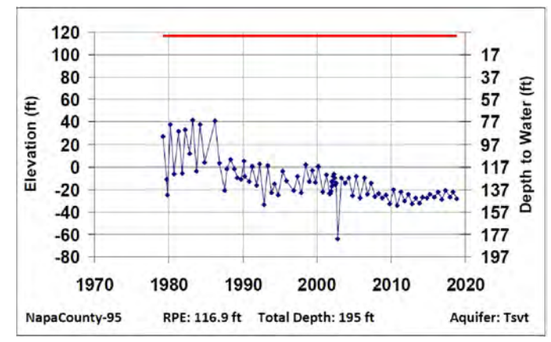


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**Representative Groundwater Hydrographs, Northern MST Subarea**

**Figure 5-13**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

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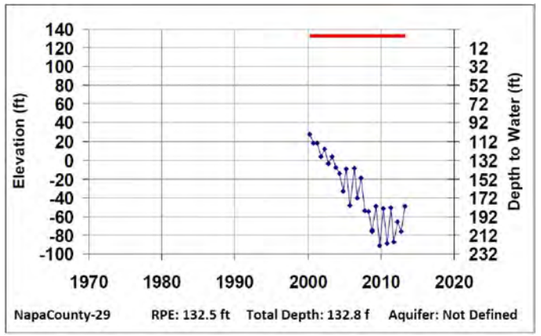


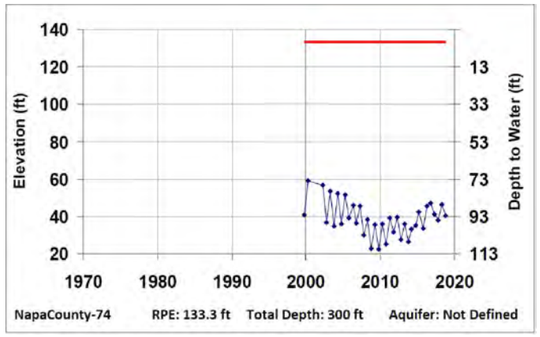


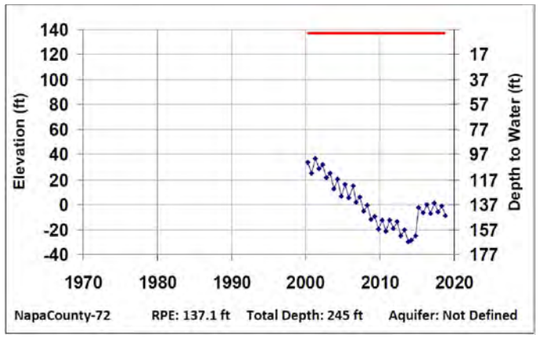


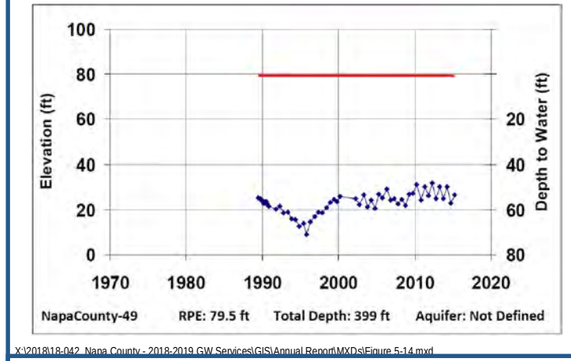


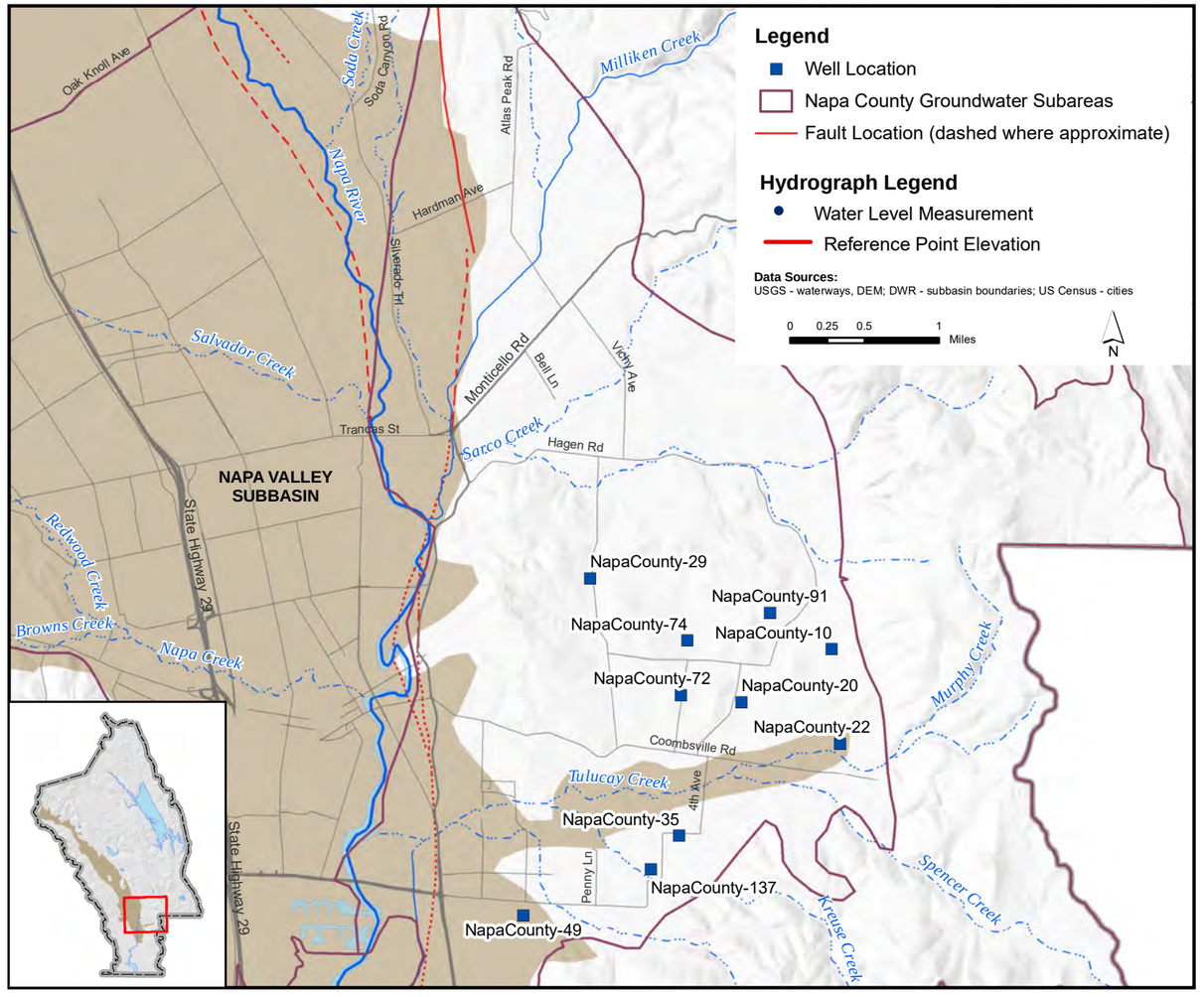


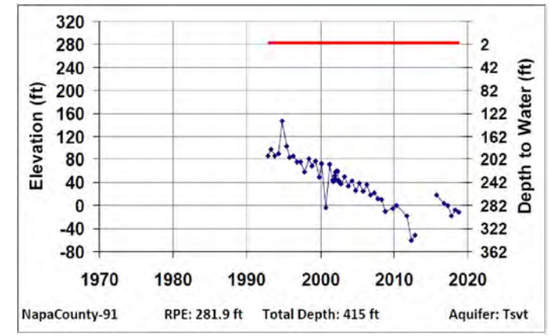


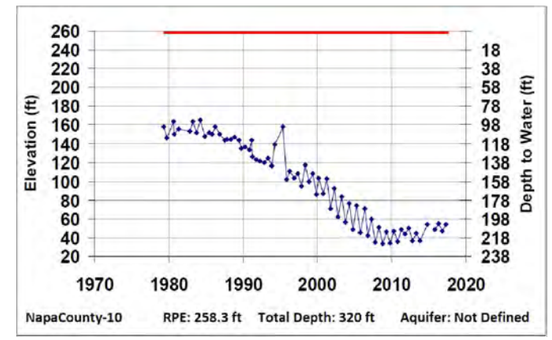


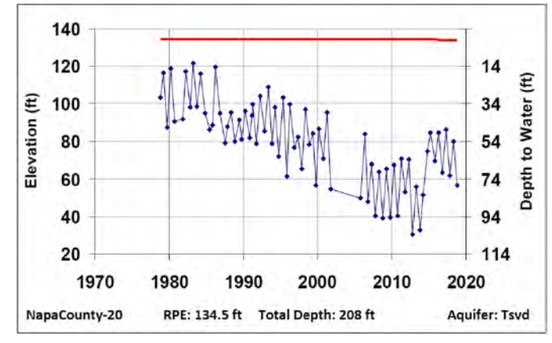


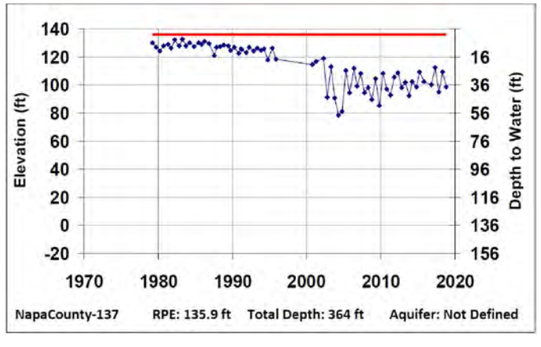


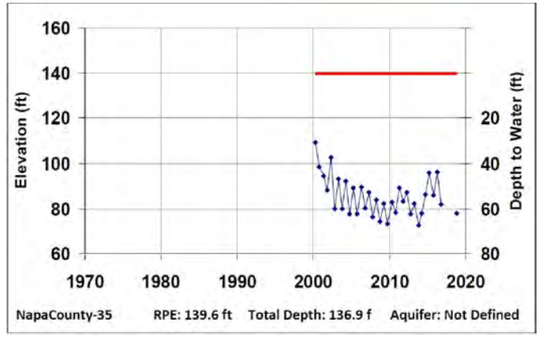


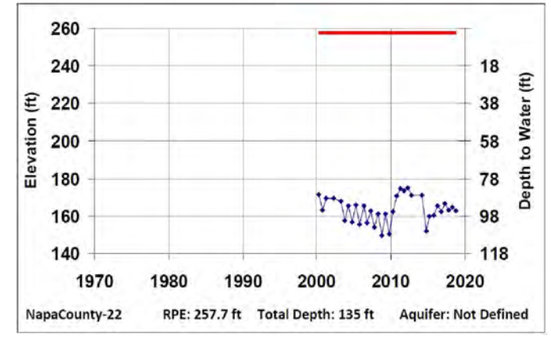


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**Representative Groundwater Hydrographs, Southern MST Subarea**

**Figure 5-14**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

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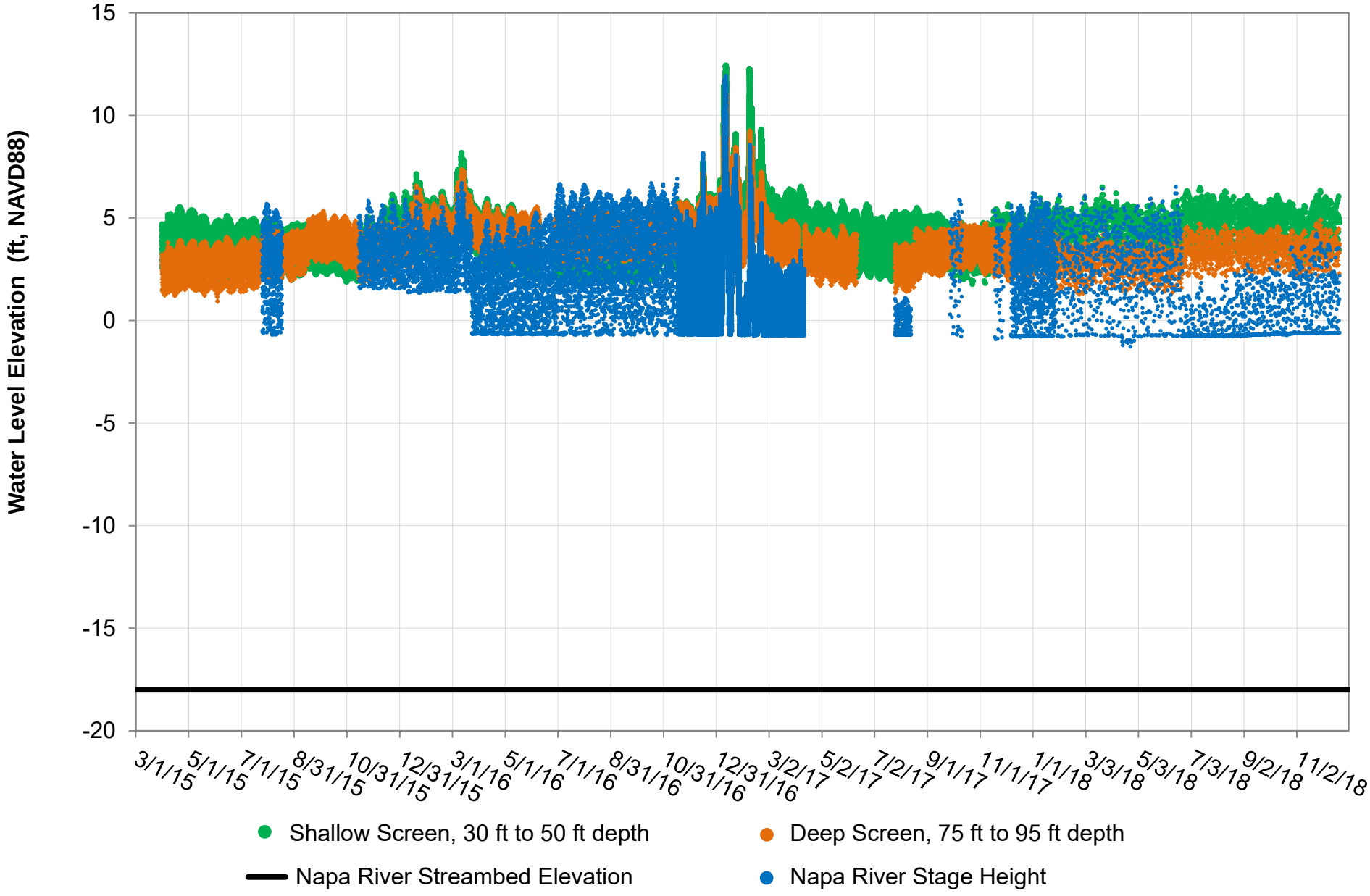


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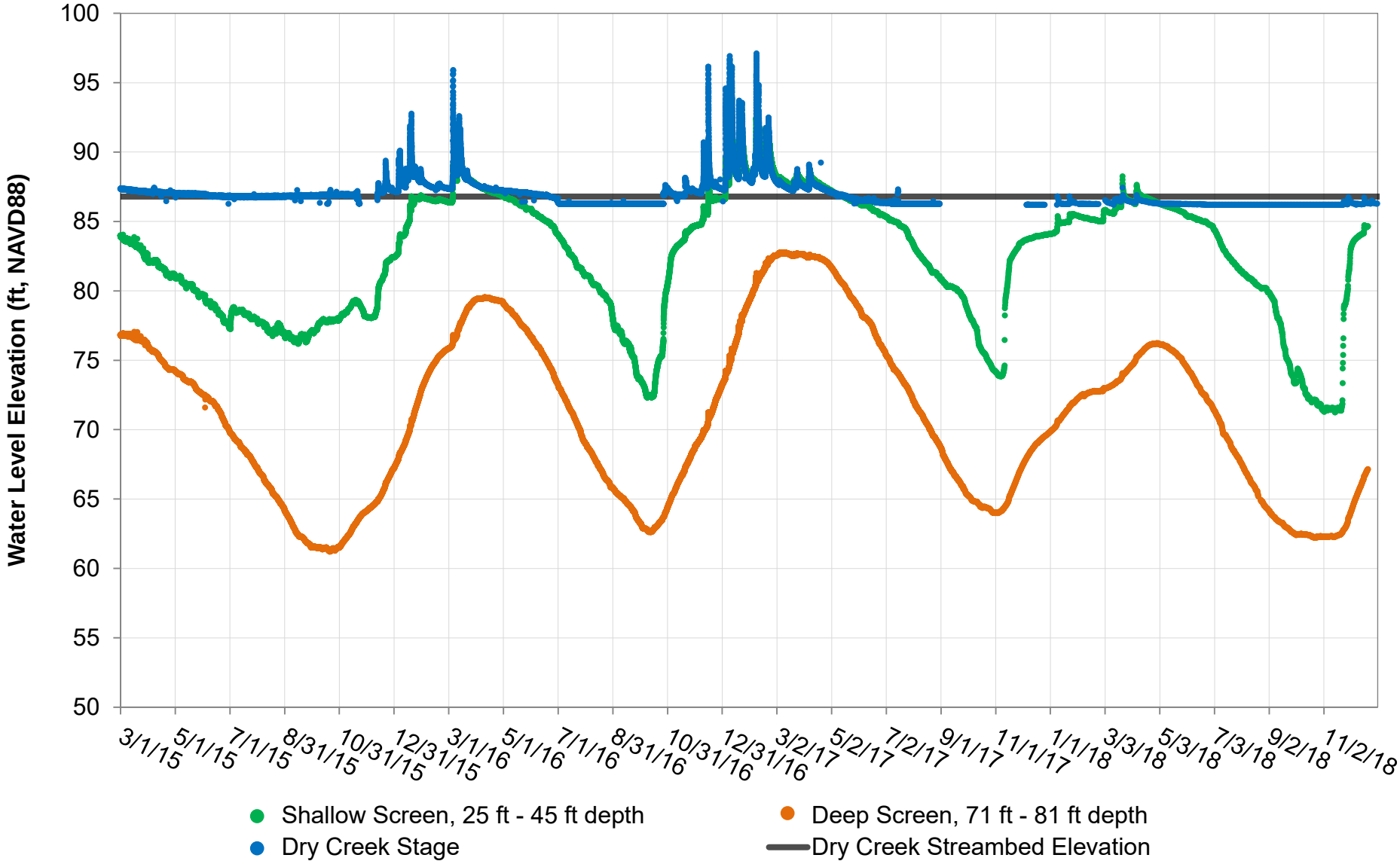
**FIGURE 5-15**
**Surface Water-Groundwater Hydrograph**
**Site 1: Napa River at First Street**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*




*Note: Creek stage values below the streambed elevation reflect conditions where water is present in the channel in a pool or depression at the gauge but not above the surveyed thalweg elevation.*

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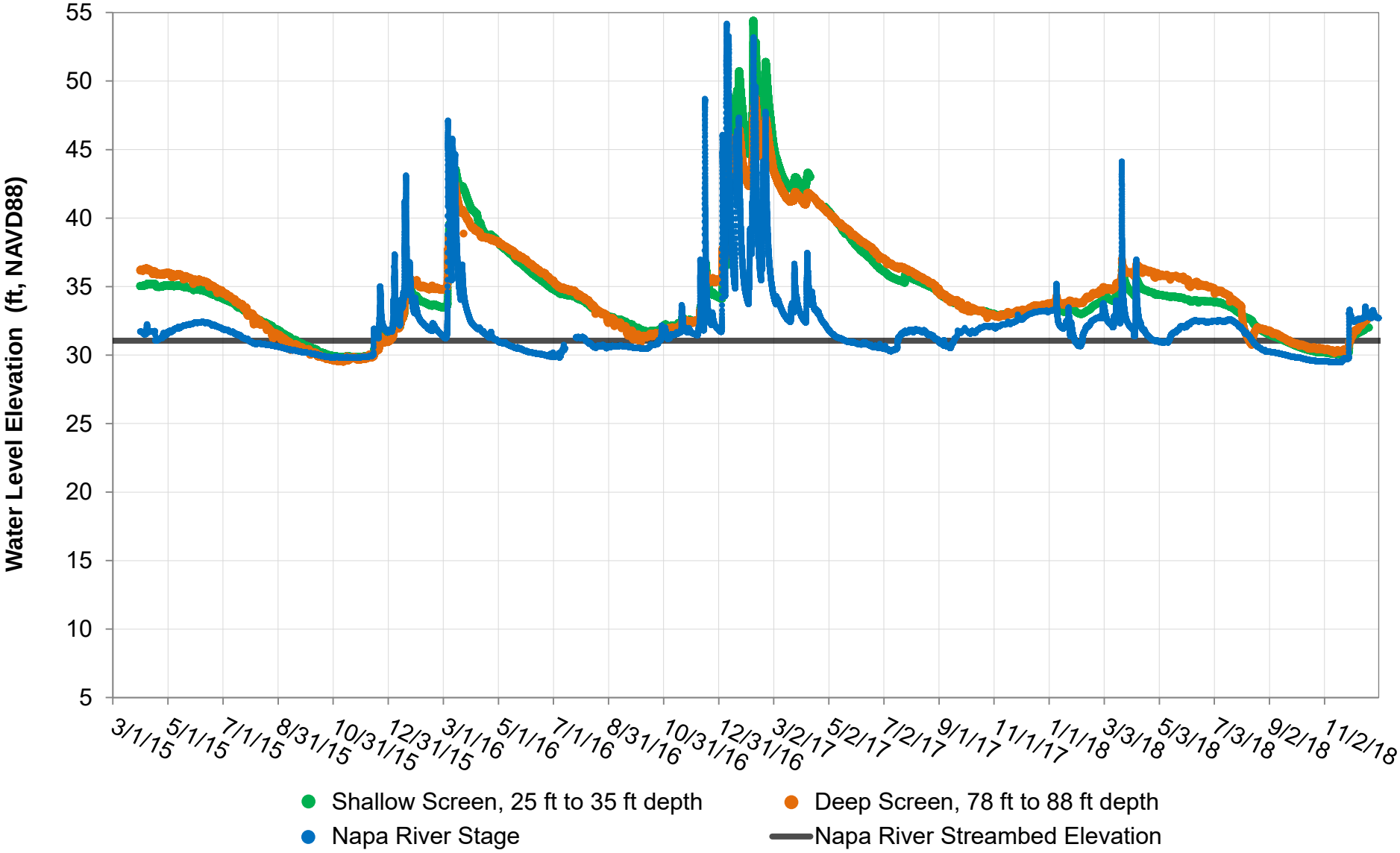
**FIGURE 5-16**
**Surface Water-Groundwater Hydrograph**
**Site 2: Dry Creek at Washington Street**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*




*Note: Creek stage values below the streambed elevation reflect conditions where water is present in the channel in a pool or depression at the gauge but not above the surveyed thalweg elevation.*

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**FIGURE 5-17**
**Surface Water-Groundwater Hydrograph**
**Site 3: Napa River at Oak Knoll Avenue**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*

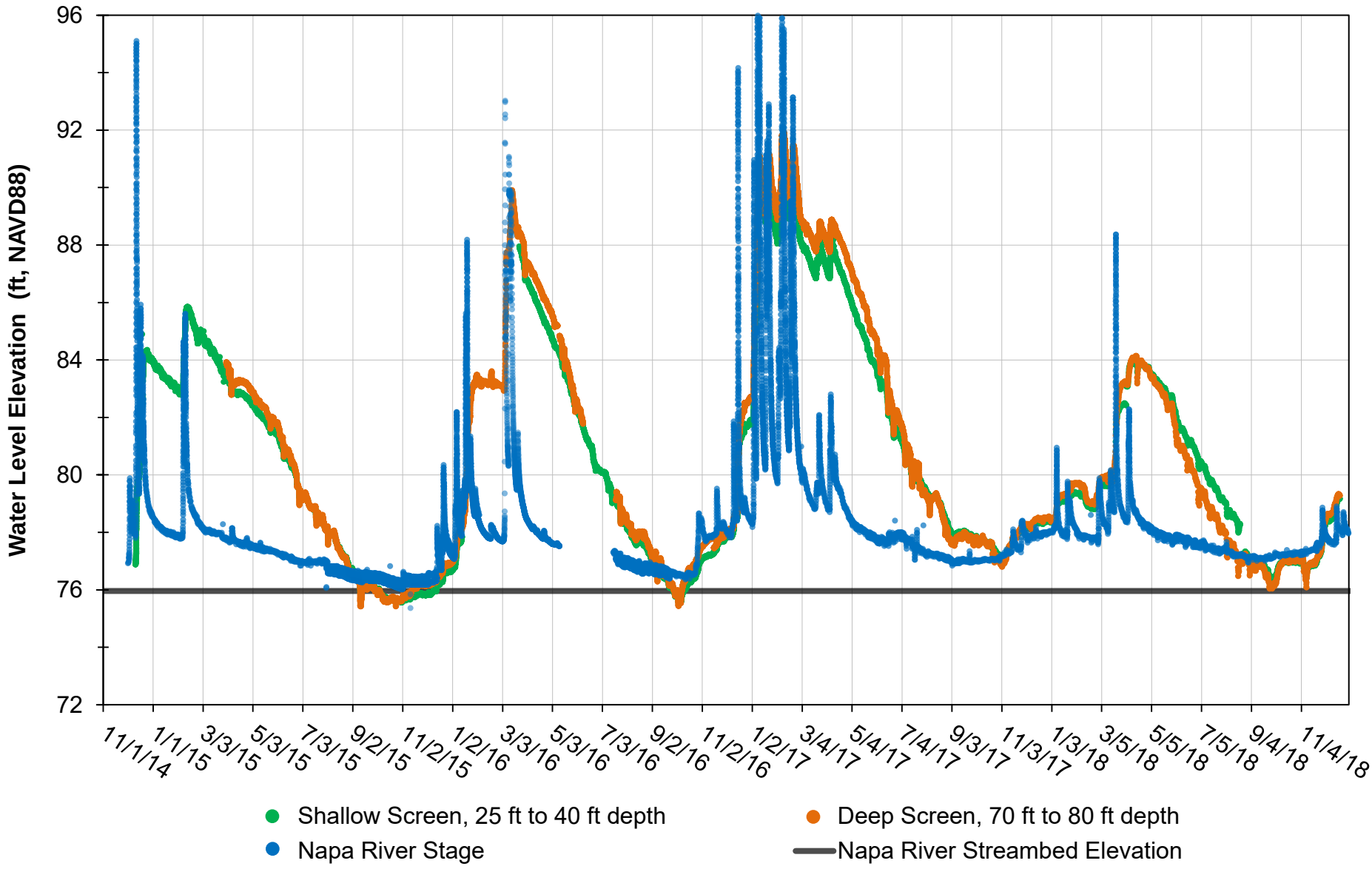


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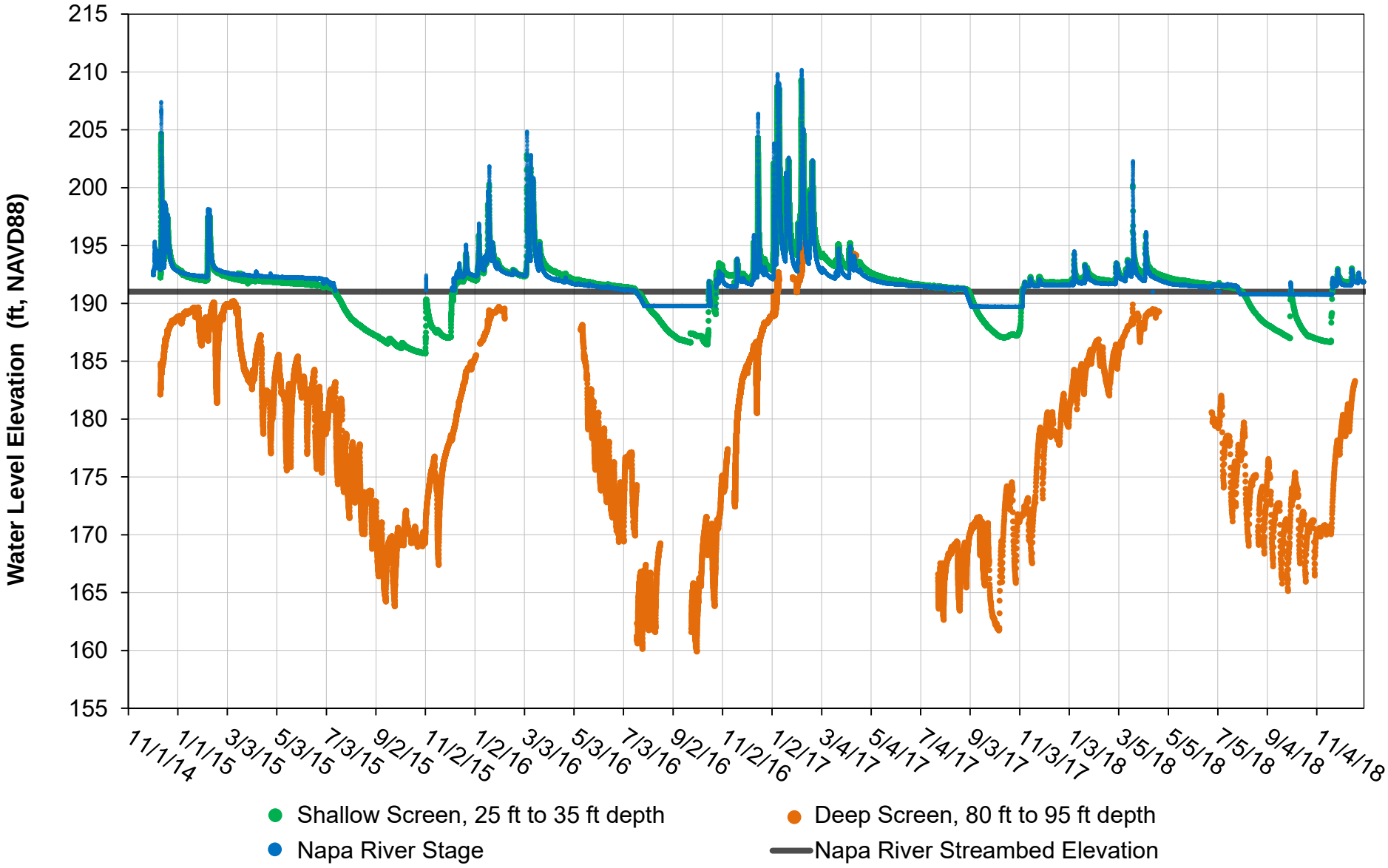
**FIGURE 5-18**
**Surface Water-Groundwater Hydrograph**
**Site 4: Napa River at Yountville Cross Road**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*




*Note: Creek stage values below the streambed elevation reflect conditions where water is present in the channel in a pool or depression at the gauge but not above the surveyed thalweg elevation.*

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**FIGURE 5-19**
**Surface Water-Groundwater Hydrograph**
**Site 5: Napa River at Pope Street**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*

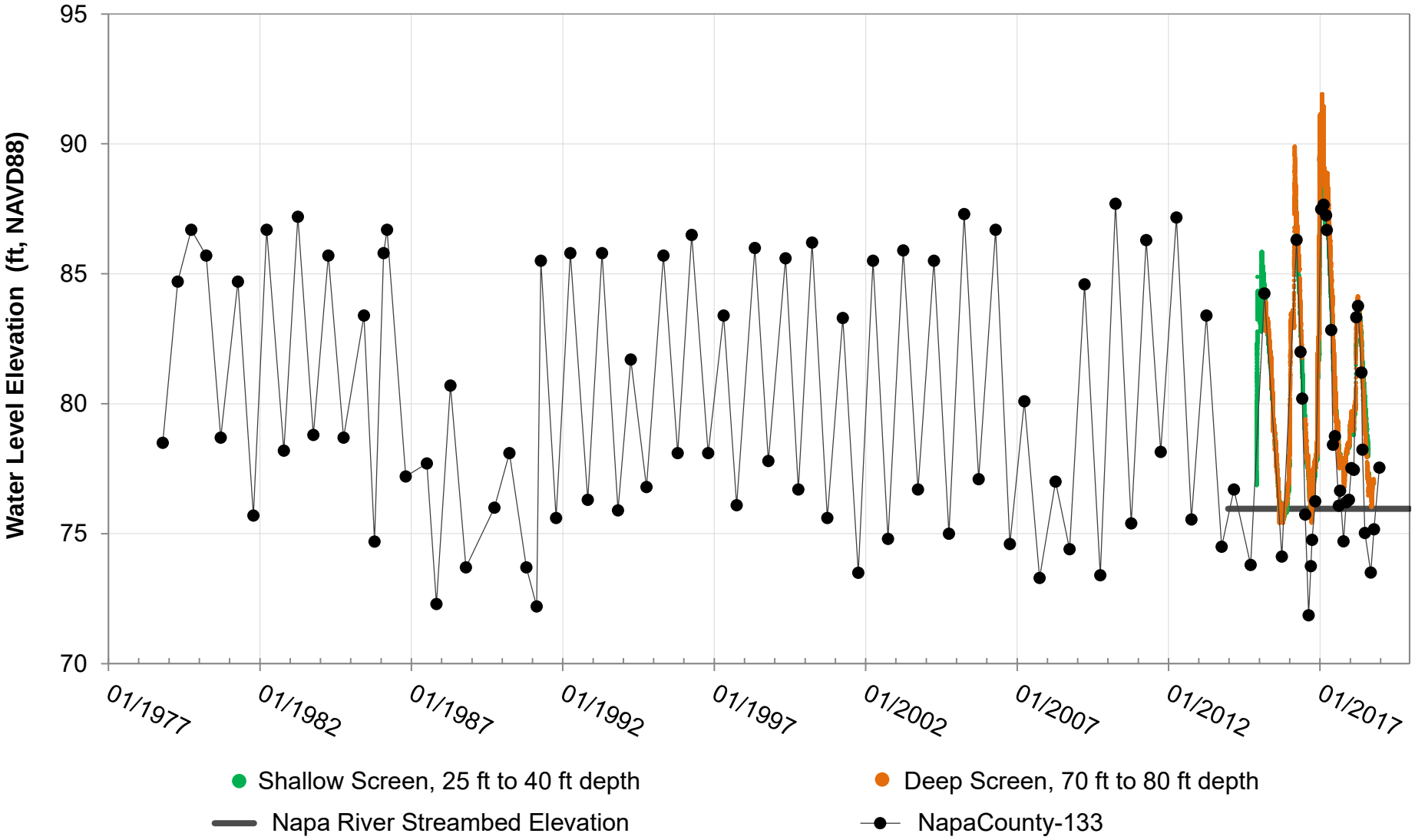


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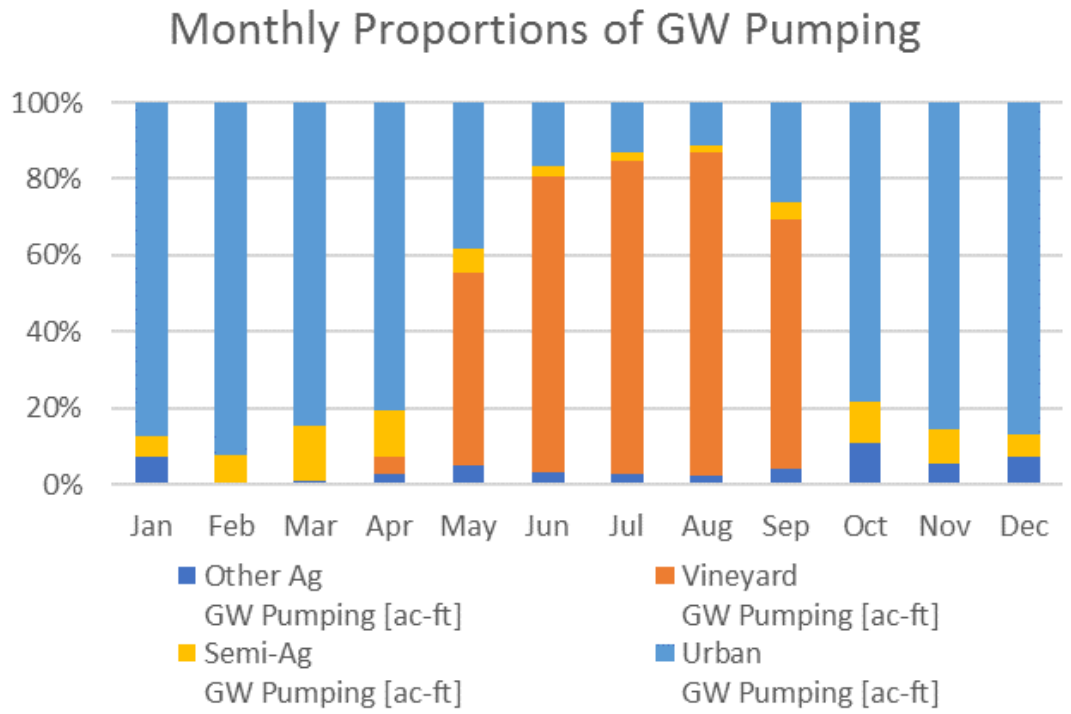
**FIGURE 5-20**
**Surface Water-Groundwater Network Historical Hydrograph**
**Site 4: Napa River at Yountville Cross Road**



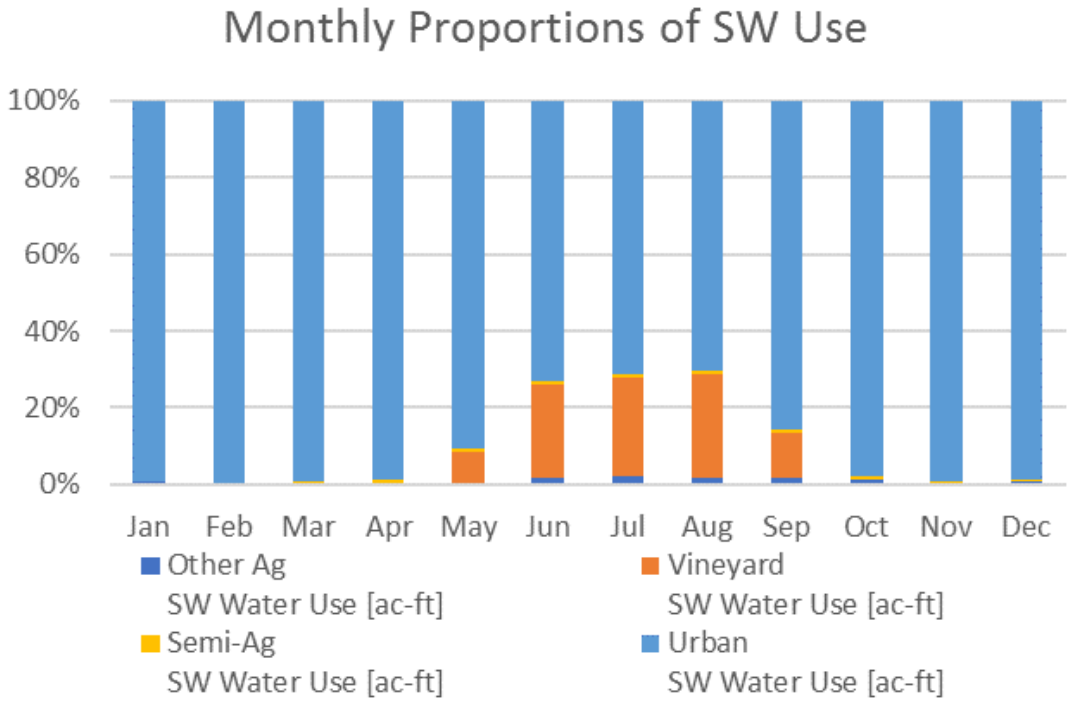




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**FIGURE 6-1**
**Monthly Proportions of Groundwater and Surface Water Use for Irrigation**

*Napa County Groundwater Sustainability: Annual Report – Water Year 2018*

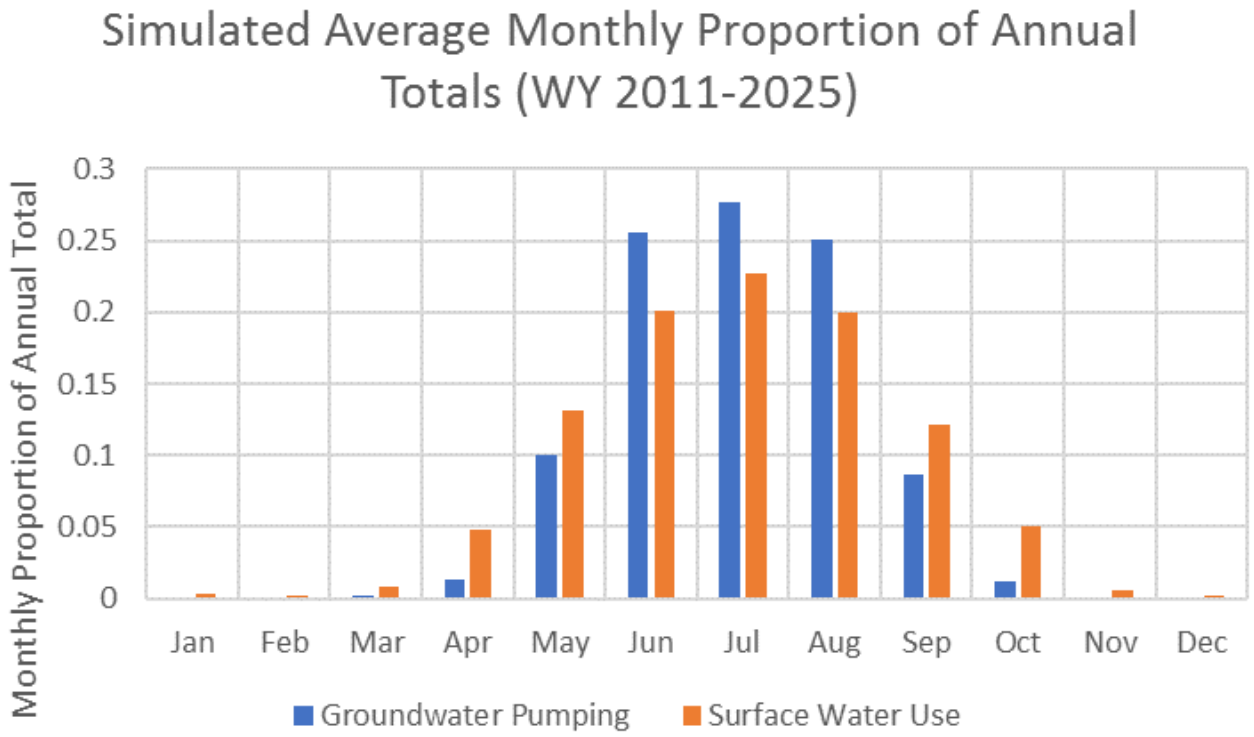


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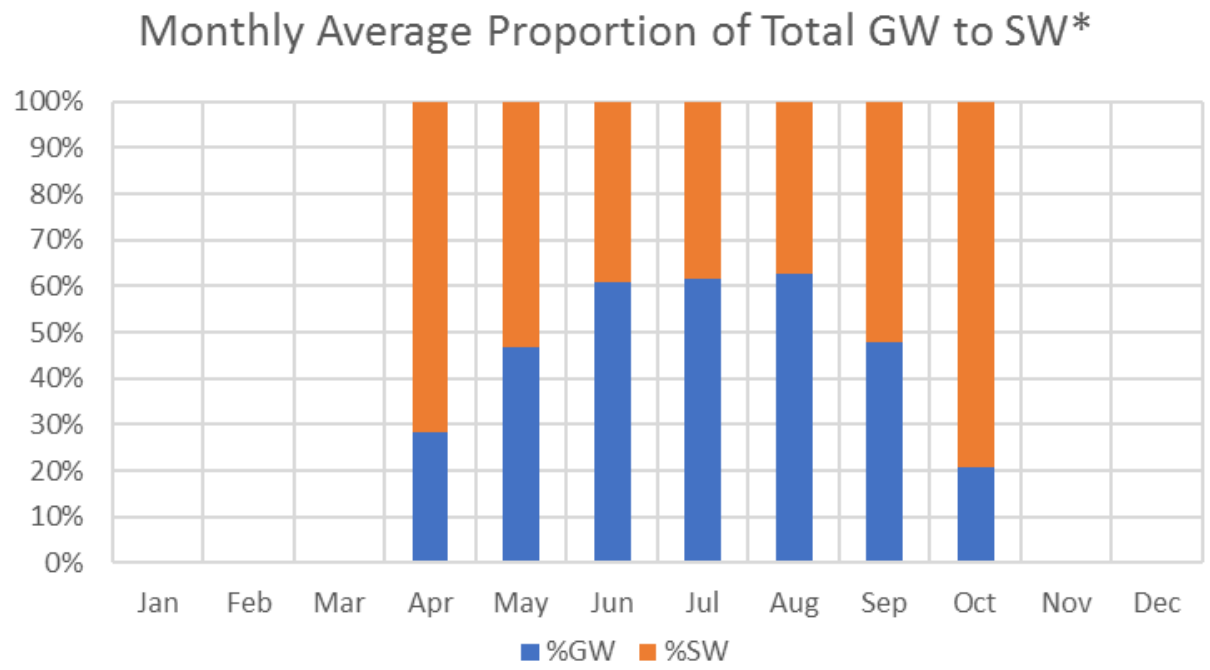
**FIGURE 6-2**
**Simulated Average Monthly Proportion of Annual Total Groundwater and Surface Water Use for Irrigation**




*Winter months were not estimated for this analysis.

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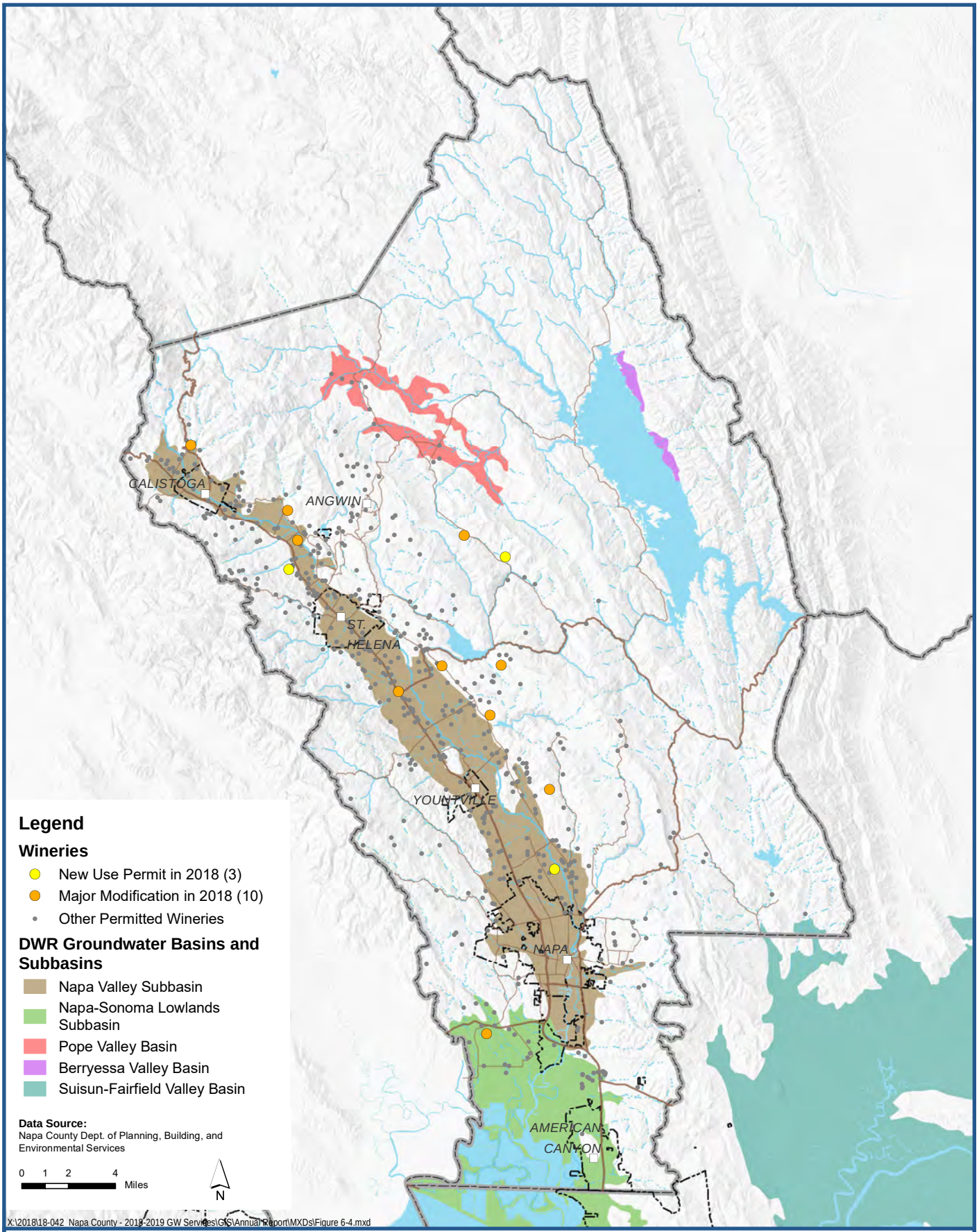
**FIGURE 6-3**
**Monthly Average Proportion of Total Groundwater and Surface Water Use for Irrigation**

*Napa County Groundwater Sustainability: Annual Report – Water Year 2018*

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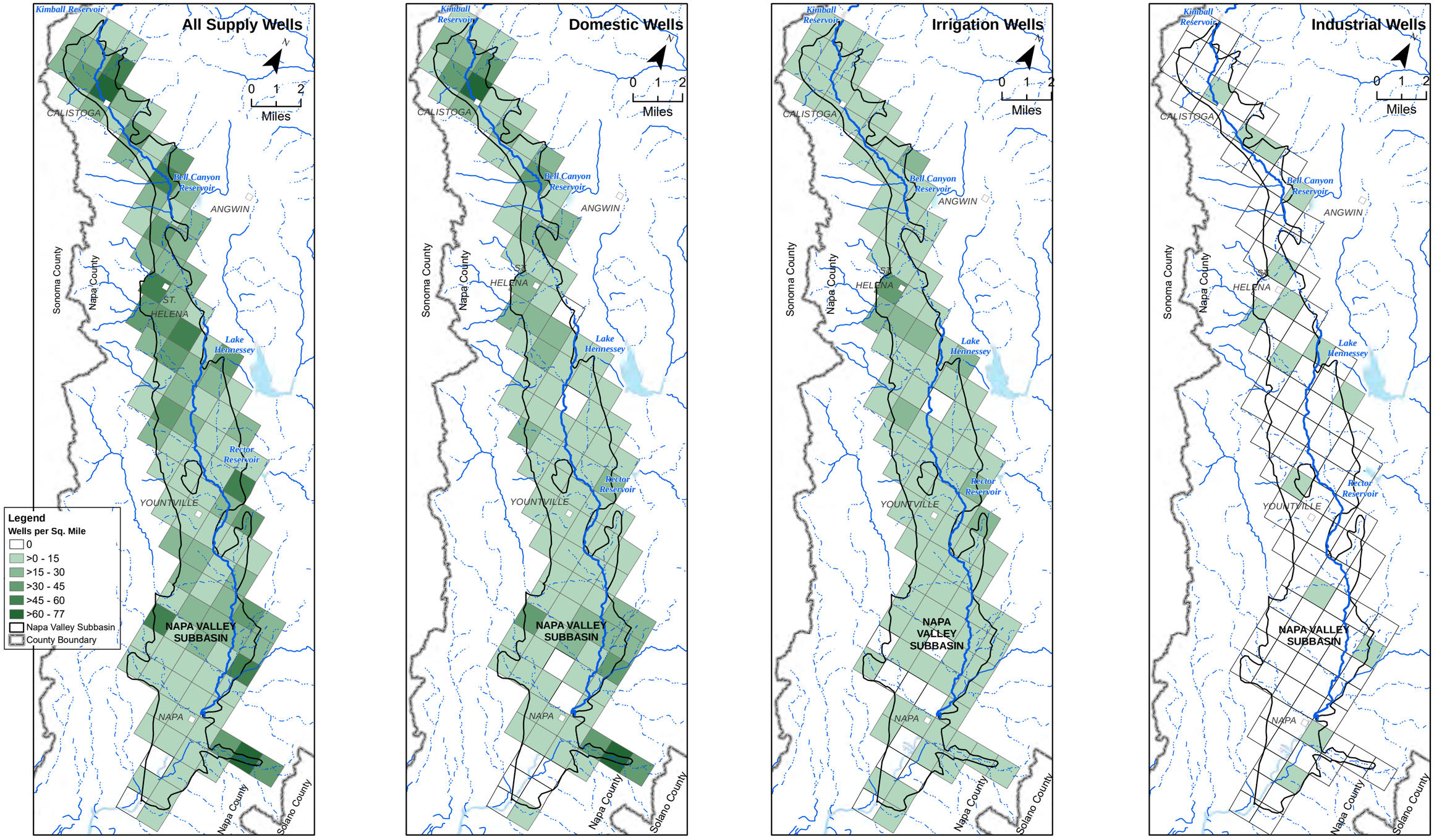
**Winery Permits Approved by Napa County in 2018**

**Figure 6-4**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*




**Data sources:** CA Dept. of Water Resources Bulletin 118 - Update 2003 downloaded 01/14/2016), CA Dept. of Water Resources Well Completion Report Summary for Napa County

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**Areas of Groundwater Use, Napa Valley Subbasin**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 6-5**

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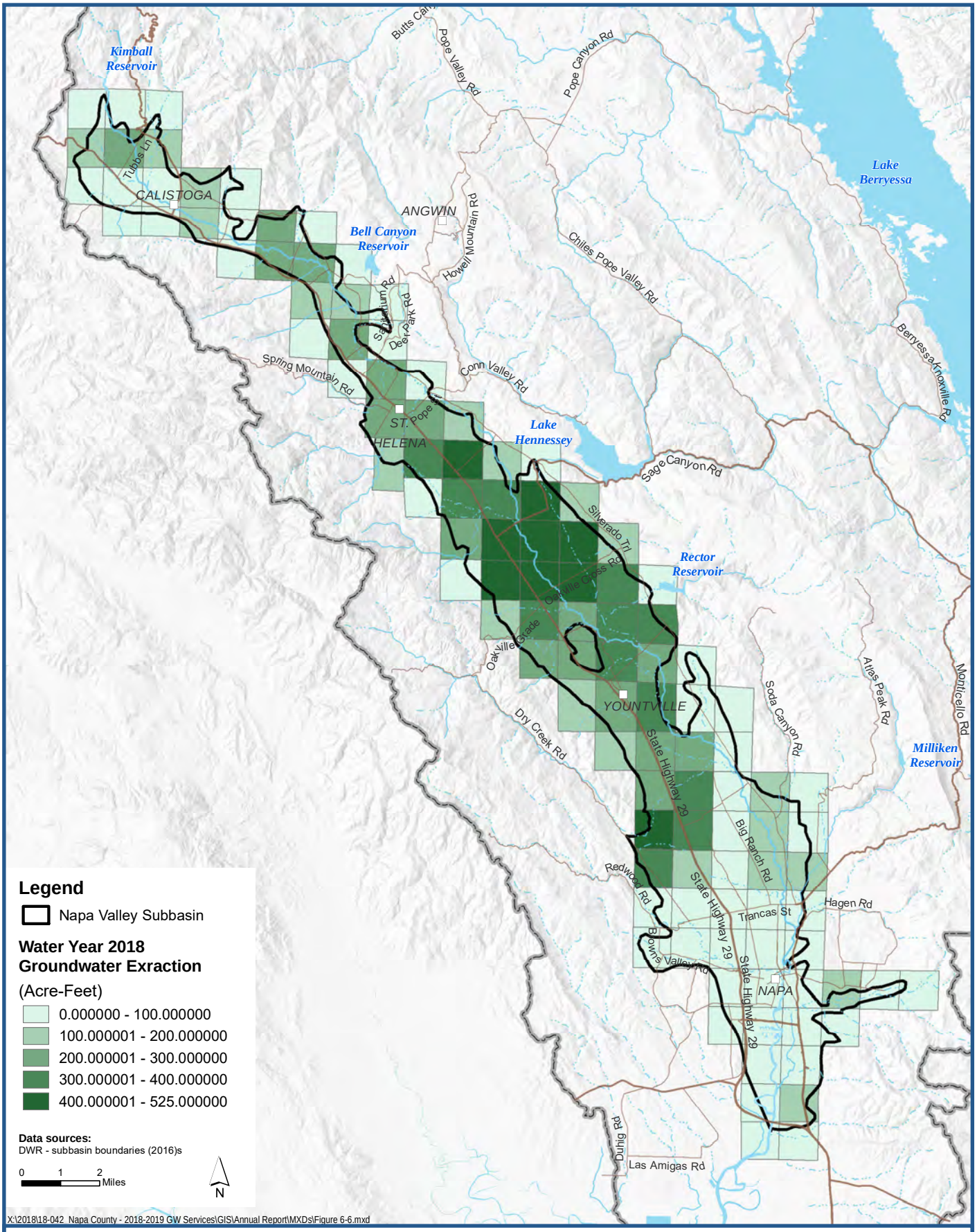


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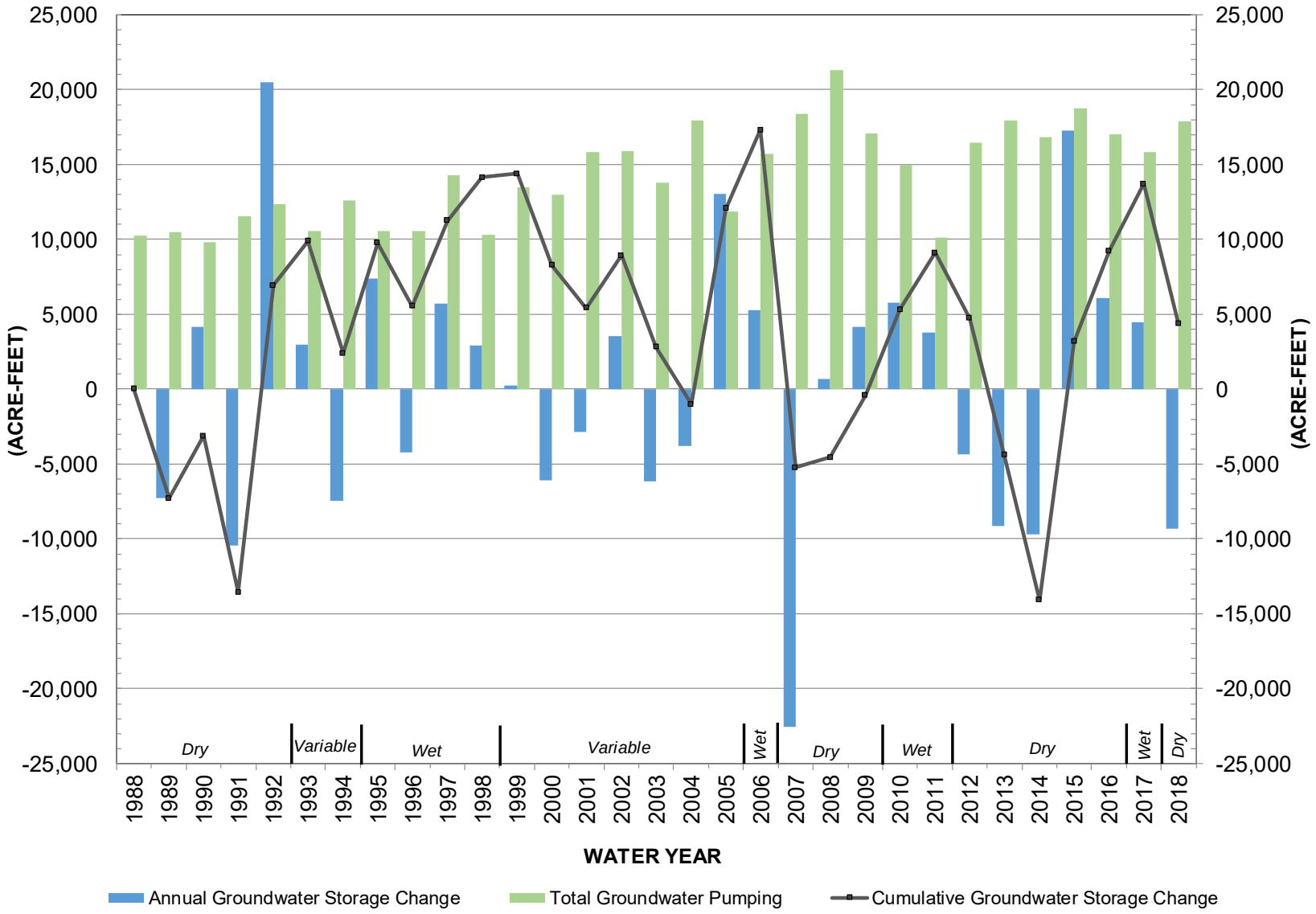
**Estimated Volume of Groundwater Use, Napa Valley Subbasin 2018**

**Figure 6-6**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

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X:\2018\18-042 Napa County - 2018-2019 GW Services\GIS\GWL Change in Storage\Change_in_GW_Storage_Updated_20180523.xlsx

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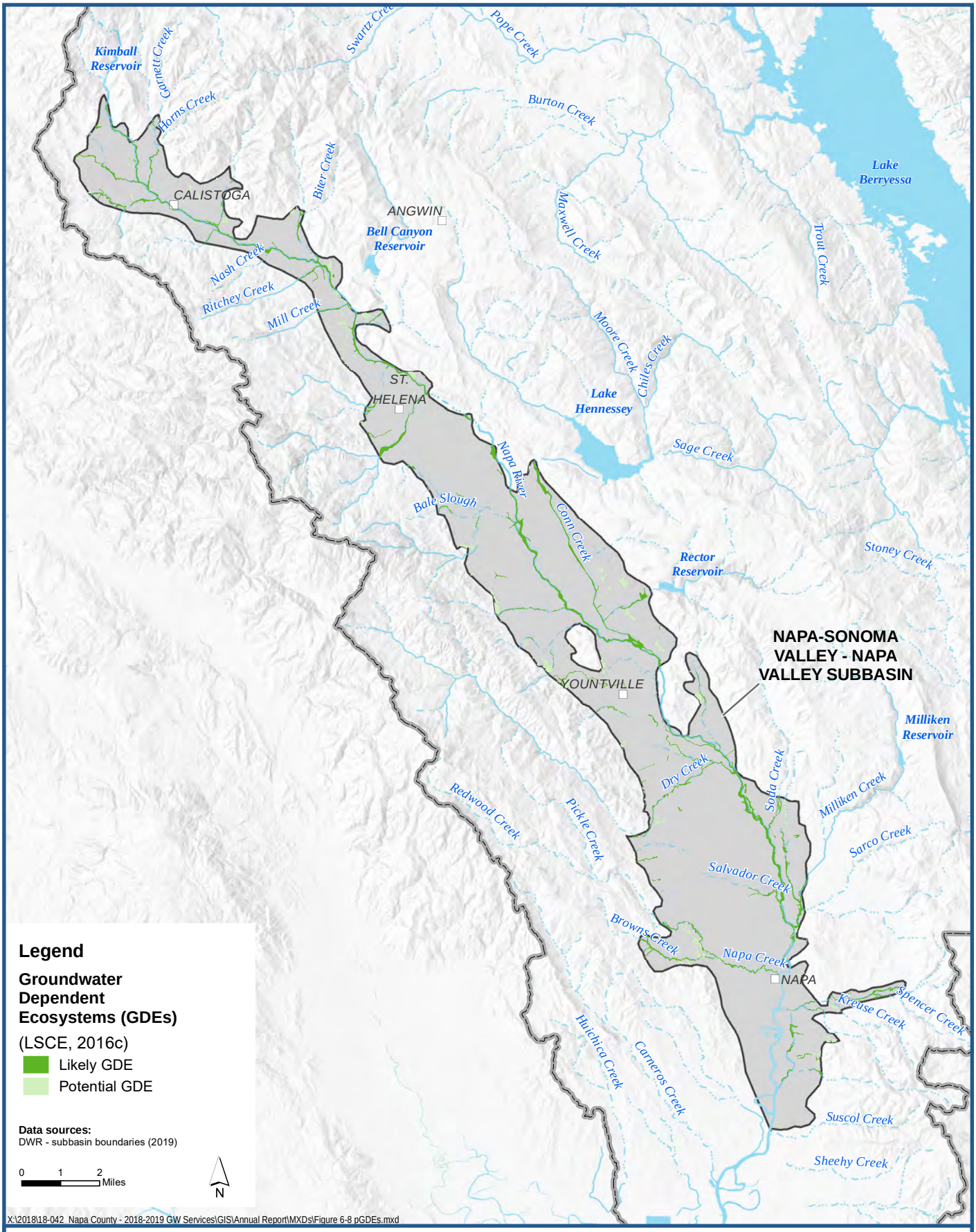
Consulting Engineers

**Napa Valley Subbasin Groundwater Use and Groundwater Storage Changes, Water Years 1988 - 2018**

**Figure 6-7**

*Napa County Groundwater Sustainability:*
*Annual Report - Water Year 2018*

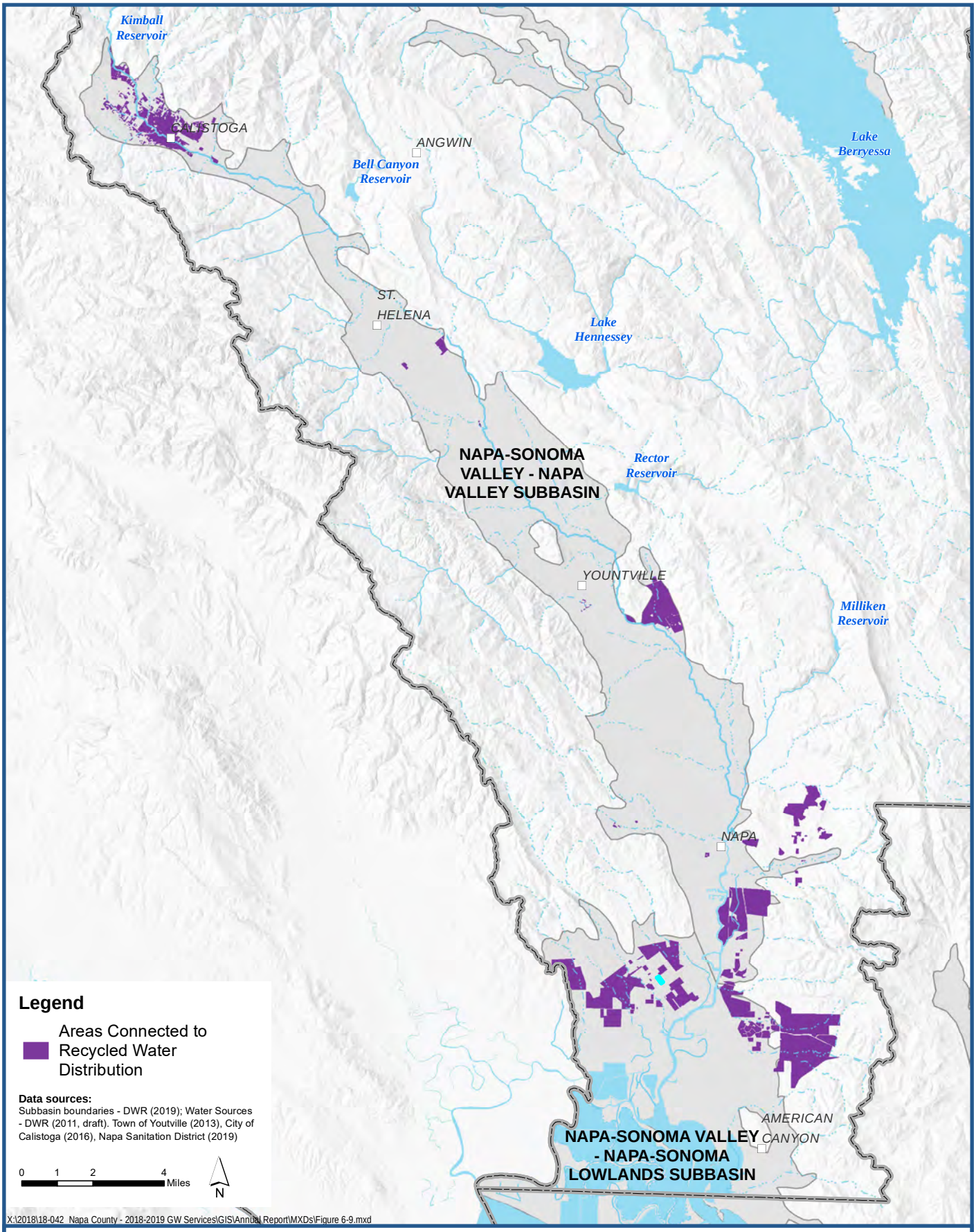



Luhdorff & Scalmanini Consulting Engineers

**Napa Valley Subbasin Groundwater Dependent Ecosystems Included in Groundwater Use Analysis**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 6-8**

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**Areas Receiving Recycled Water**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 6-9**

| Implementation Item or Activity | 2017 Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2018 Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2019 Jan | Feb | Mar | Apr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Outreach and Communications** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SGMA Implementation Updates and Outreach Communications (Board of Supervisors Meetings (BOS), WICC Outreach Meetings (OM), E-news Listserv Mailings (EN), Biennial Watershed Symposia (BWS)) | *EN* | *EN* | | *EN* | *BWS* | | *OM* | *EN* | | *EN (2)* | | *EN* | *OM EN* | *EN* | | *BOS EN* | *EN* | *EN* | | *OM EN* | | | | *EN* | *OM EN* | | *BOS EN* | |
| Continuing Outreach and Recruitment to Fill Data Gaps through the Voluntary Groundwater Monitoring Program | | | | | *WICC Outreach Meeting: 07/2017* | | | | | | *WICC Outreach Meeting : 01/2018* | | | | | | *WICC Outreach Meeting: 07/2018* | | | | | | *WICC Outreach Meeting: 01/2019* | | | | *Ongoing* |
| *Well Owners Guide: A Guide for Private Well Owners in Napa County* (Napa County, 2017) | | | | | *Guide: 07/2017* | | | | | | | | | | | | | | | | | | | | | | | |
| Do It Youself (DIY) Groundwater Level Monitoring Program | | | | | | | | | | | | | | | | | | | | | | | | | | | | *Ongoing* |
| **Land Use Coordination** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Revised Conditions of Approval for Discretionary Permits | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Northeast Napa Management Area: an Amendment to the 2016 Basin Analysis Report* (LSCE, 2018a) | | | | | | | | | | | *Report: 01/2018* | | | | | | | | | | | | | | | | | |
| Revised Grant Agreement for Water Rights | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Water Budget Refinement** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Northeast Napa Area: Special Groundwater Study* (LSCE, 2017b) | *Report: 09/2017, Presentation to BOS 10/2017* | | | | *Presentation to WICC 1/2018* | | | | | | | | | | | | | | | | | | | | | | | |
| Napa Valley Subbasin Groundwater Model Dataset Development | | | | | | | | | | | | | | | | | | | | | | | | | | | | *Ongoing* |
| Tracking Water Uses in Unincorporated Areas | | | | | *Grant Proposal: 08/2017* | | | | | | | | | | | | | | | | | | | | | | | |
| Napa-Sonoma Lowlands Subbasin Water Budget Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Monitoring Basin Conditions** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly and Semi-annual Groundwater Level Monitoring and Annual Groundwater Quality Monitoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | *Ongoing* |
| Groundwater Dependent Ecosystem Mapping: Countywide Spatial Vegetation Data Update | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Annual SGMA Implmentation Reports (LSCE, 2017a; LSCE, 2018b; LSCE, 2019) | | | | | | | | | | | | | | | | | | | | | | | | | | | | *Ongoing* |
| Continuing Outreach and Recruitment to Fill Data Gaps through the Voluntary Groundwater Monitoring Program | | | | | *WICC Outreach Meeting: 07/2017* | | | | | | *WICC Outreach Meeting : 01/2018* | | | | | | *WICC Outreach Meeting: 07/2018* | | | | | | *WICC Outreach Meeting: 01/2019* | | | | *Ongoing* |

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**Napa County SGMA Implementation Activities**

*Napa County Groundwater Sustainability*
*Annual Report - Water Year 2018*

**Figure 7-1**

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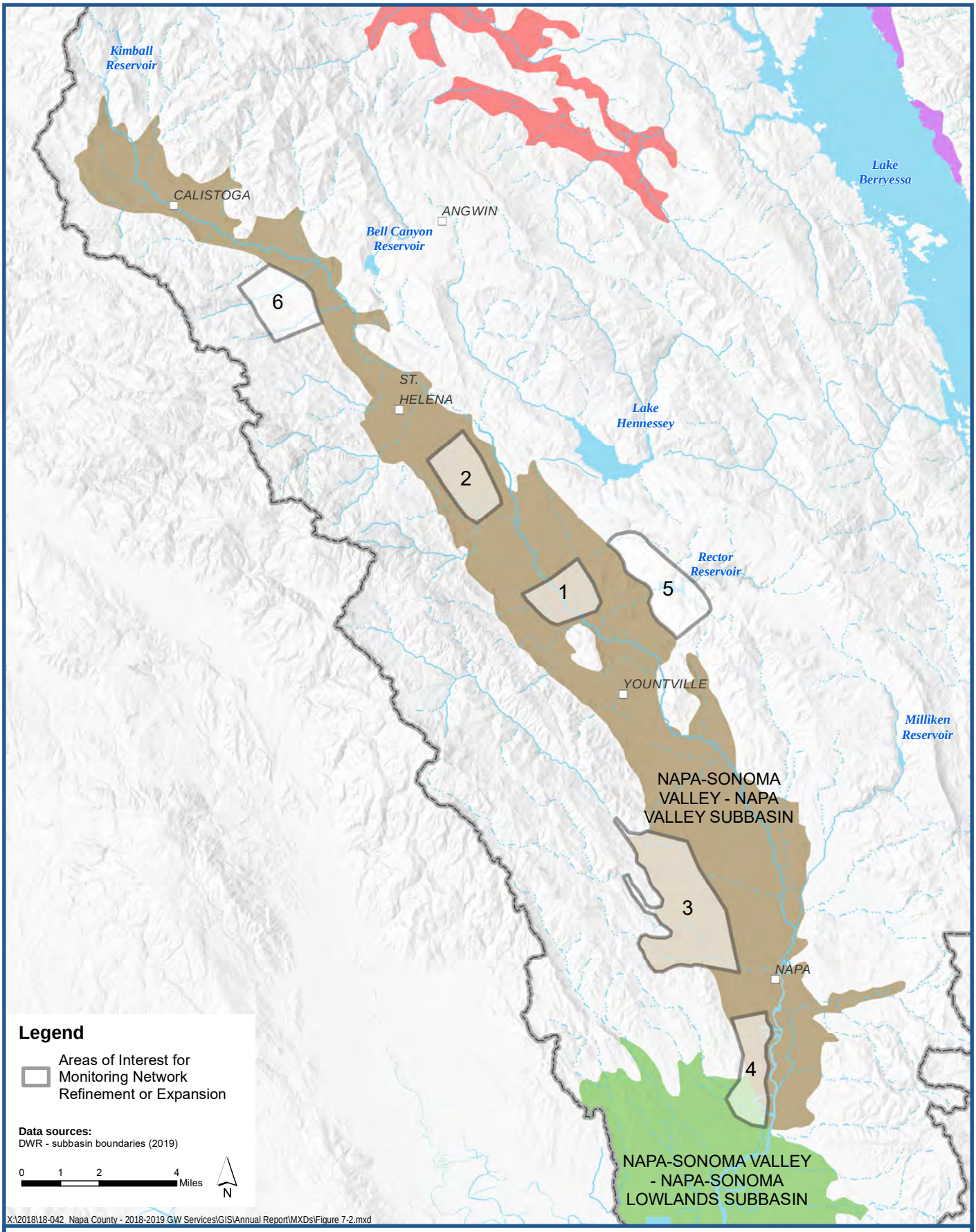


Luhdorff & Scalmanini Consulting Engineers

**Areas for Monitoring Network Refinement and Expansion**

*Napa County Groundwater Sustainability Annual Report - Water Year 2018*

**Figure 7-2**

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# APPPENDIX A

## Summary of Currently Monitored Wells

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| Well ID or System Number | Napa County Subarea | Primary Monitoring Entity | Primary Network | Monitoring Frequency | Period of Record | DWR Subbasin Number | DWR Basin | DWR Subbasin | Aquifer Designation |
|---|---|---|---|---|---|---|---|---|---|
| 08N06W10Q001M | Napa Valley Floor-Calistoga | DWR | CASGEM (Voluntary)/ Water Data Library | Monthly | 1949 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Not Defined |
| NapaCounty-127 | Napa Valley Floor-Calistoga | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1962 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-128 | Napa Valley Floor-Calistoga | Napa County | CASGEM (Voluntary)/ Water Data Library | Monthly | 1962 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-178 | Napa Valley Floor-Calistoga | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-224 | Napa Valley Floor-Calistoga | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-225 | Napa Valley Floor-Calistoga | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-230 | Napa Valley Floor-Calistoga | Napa County | CASGEM | Semi-Annual | 2018 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv |
| NapaCounty-122 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2001 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tss |
| NapaCounty-149 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2010 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-22 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-43 | Napa Valley Floor-MST | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 2001 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| T10000008932 | Napa Valley Floor-MST | SWRCB | Geotracker | Various | 2016 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| 06N04W27L002M | Napa Valley Floor-Napa | DWR | CASGEM (Voluntary)/ Water Data Library | Monthly | 1966 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-136 | Napa Valley Floor-Napa | Napa County | CASGEM | Monthly | 1979 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-152 | Napa Valley Floor-Napa | Napa County | CASGEM | Semi-Annual | 2012 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-182 | Napa Valley Floor-Napa | Napa County | CASGEM | Monthly | 2014 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv |
| NapaCounty-183 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa, Tsv? |
| NapaCounty-184 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv, Tss/h? |
| NapaCounty-185 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Monthly | 2014 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-187 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv?, KJgv? |
| NapaCounty-188 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv, KJgv |
| NapaCounty-189 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-214s-swgw1 | Napa Valley Floor-Napa | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-215d-swgw1 | Napa Valley Floor-Napa | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-218s-swgw3 | Napa Valley Floor-Napa | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-219d-swgw3 | Napa Valley Floor-Napa | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-227 | Napa Valley Floor-Napa | Napa County | CASGEM | Semi-Annual | 2015 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |

| Well ID or System Number | Napa County Subarea | Primary Monitoring Entity | Primary Network | Monitoring Frequency | Period of Record | DWR Subbasin Number | DWR Basin | DWR Subbasin | Aquifer Designation |
|---|---|---|---|---|---|---|---|---|---|
| NapaCounty-228 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2015 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-229 | Napa Valley Floor-Napa | Napa County | CASGEM | Semi-Annual | 2016 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tss |
| NapaCounty-76 | Napa Valley Floor-Napa | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv |
| SL0605536682 | Napa Valley Floor-Napa | SWRCB | Geotracker | Various | 2005 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| T0605514064 | Napa Valley Floor-Napa | SWRCB | Geotracker | Various | 2005 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| T0605547200 | Napa Valley Floor-Napa | SWRCB | Geotracker | Various | 2008 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| 07N05W09Q002M | Napa Valley Floor-St. Helena | DWR | CASGEM (Voluntary)/ Water Data Library | Monthly | 1949 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Not Defined |
| NapaCounty-131 | Napa Valley Floor-St. Helena | Napa County | CASGEM | Semi-Annual | 1963 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-132 | Napa Valley Floor-St. Helena | Napa County | CASGEM (Voluntary)/ Water Data Library | Monthly | 1962 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa, Tsvab |
| NapaCounty-138 | Napa Valley Floor-St. Helena | Napa County | CASGEM | Semi-Annual | 1949 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-169 | Napa Valley Floor-St. Helena | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-171 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Monthly | 2014 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tst/s |
| NapaCounty-172 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-173 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-174 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-177 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-204 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-212 | Napa Valley Floor-St. Helena | Napa County | Napa County Volunteer | Semi-Annual | 2015 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-222s-swgw5 | Napa Valley Floor-St. Helena | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-223d-swgw5 | Napa Valley Floor-St. Helena | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| 06N04W17A001M | Napa Valley Floor-Yountville | DWR | CASGEM (Voluntary)/ Water Data Library | Monthly | 1949 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-125 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1979 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsva |
| NapaCounty-126 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1984 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsva |
| NapaCounty-133 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Monthly | 1978 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-134 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1963 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-135 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Monthly | 1979 - 2019 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa, Tsv |
| NapaCounty-139 | Napa Valley Floor-Yountville | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1978 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-179 | Napa Valley Floor-Yountville | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |

| Well ID or System Number | Napa County Subarea | Primary Monitoring Entity | Primary Network | Monitoring Frequency | Period of Record | DWR Subbasin Number | DWR Basin | DWR Subbasin | Aquifer Designation |
|---|---|---|---|---|---|---|---|---|---|
| NapaCounty-181 | Napa Valley Floor-Yountville | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Tsv |
| NapaCounty-216s-swgw2 | Napa Valley Floor-Yountville | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-217d-swgw2 | Napa Valley Floor-Yountville | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-220s-swgw4 | Napa Valley Floor-Yountville | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-221d-swgw4 | Napa Valley Floor-Yountville | Napa County | CASGEM | Quarterly | 2014 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | Qa |
| NapaCounty-129 | Western Mountains | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1962 - 2018 | 2-2.01 | NAPA-SONOMA VALLEY | NAPA VALLEY | |
| NapaCounty-150 | Carneros | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 2011 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-153 | Carneros | Napa County | CASGEM | Semi-Annual | 2012 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | TQsb |
| NapaCounty-154 | Carneros | Napa County | CASGEM | Semi-Annual | 2012 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | TQsb |
| NapaCounty-155 | Carneros | Napa County | CASGEM | Semi-Annual | 2012 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | TQsb |
| NapaCounty-176 | Carneros | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-194 | Carneros | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-195 | Carneros | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-200 | Carneros | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-201 | Carneros | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-205 | Carneros | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-206 | Carneros | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-207 | Carneros | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-196 | Jameson/American Canyon | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 2-2.03 | NAPA-SONOMA VALLEY | NAPA-SONOMA LOWLANDS | |
| NapaCounty-211 | Pope Valley | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | 5-68 | POPE VALLEY | | |
| NapaCounty-165 | Angwin | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-166 | Angwin | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-167 | Angwin | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-168 | Angwin | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-202 | Angwin | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | | Outside | | |

| Well ID or System Number | Napa County Subarea | Primary Monitoring Entity | Primary Network | Monitoring Frequency | Period of Record | DWR Subbasin Number | DWR Basin | DWR Subbasin | Aquifer Designation |
|---|---|---|---|---|---|---|---|---|---|
| T0605500304 | Berryessa | SWRCB | Geotracker | Various | 2002 - 2018 | | Outside | | |
| T0605591908 | Berryessa | SWRCB | Geotracker | Various | 2006 - 2018 | | Outside | | |
| L10003756160 | Central Interior Valleys | SWRCB | Geotracker | Various | 1990 - 2018 | | Outside | | |
| NapaCounty-209 | Central Interior Valleys | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-175 | Eastern Mountains | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | Tsv |
| NapaCounty-193 | Eastern Mountains | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-210 | Eastern Mountains | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-208 | Napa Valley Floor-Calistoga | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | | Outside | | Tsv |
| NapaCounty-118 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2001 - 2018 | | Outside | | |
| NapaCounty-137 | Napa Valley Floor-MST | Napa County | CASGEM | Semi-Annual | 1979 - 2018 | | Outside | | |
| NapaCounty-142 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2001 - 2018 | | Outside | | |
| NapaCounty-18 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-191 | Napa Valley Floor-MST | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-192 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2014 - 2018 | | Outside | | |
| NapaCounty-2 | Napa Valley Floor-MST | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1979 - 2018 | | Outside | | |
| NapaCounty-20 | Napa Valley Floor-MST | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1978 - 2018 | | Outside | | Tsvd |
| NapaCounty-226 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2015 - 2018 | | Outside | | |
| NapaCounty-35 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-56 | Napa Valley Floor-MST | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1978 - 2018 | | Outside | | Tss/h |
| NapaCounty-69 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-72 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-74 | Napa Valley Floor-MST | Napa County | CASGEM | Semi-Annual | 1999 - 2018 | | Outside | | |
| NapaCounty-81 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-91 | Napa Valley Floor-MST | Napa County | CASGEM | Semi-Annual | 1992 - 2018 | | Outside | | Tsvt |
| NapaCounty-92 | Napa Valley Floor-MST | Napa County | CASGEM | Semi-Annual | 1999 - 2018 | | Outside | | |
| NapaCounty-95 | Napa Valley Floor-MST | Napa County | CASGEM (Voluntary)/ Water Data Library | Semi-Annual | 1979 - 2018 | | Outside | | Tsvt |
| NapaCounty-98 | Napa Valley Floor-MST | Napa County | Napa County Volunteer | Semi-Annual | 2000 - 2018 | | Outside | | |
| NapaCounty-213 | Western Mountains | Napa County | CASGEM | Semi-Annual | 2014 - 2018 | | Outside | | |

# APPEDNDIX B

## Groundwater Level Hydrographs for Currently Monitored Wells

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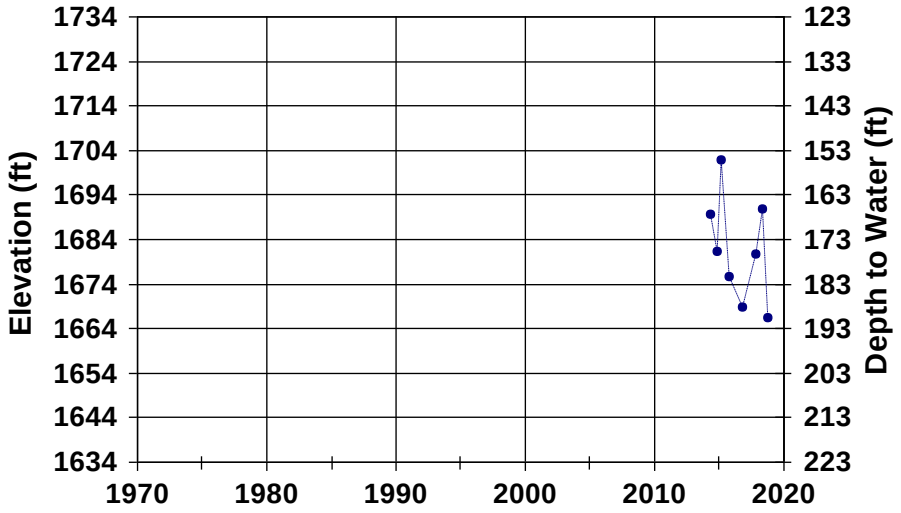
**WellID: NapaCounty-165**
Subarea: Angwin
Groundwater Basin Not within a basin

RPE: 1857 ft, msl
Source: NapaCounty

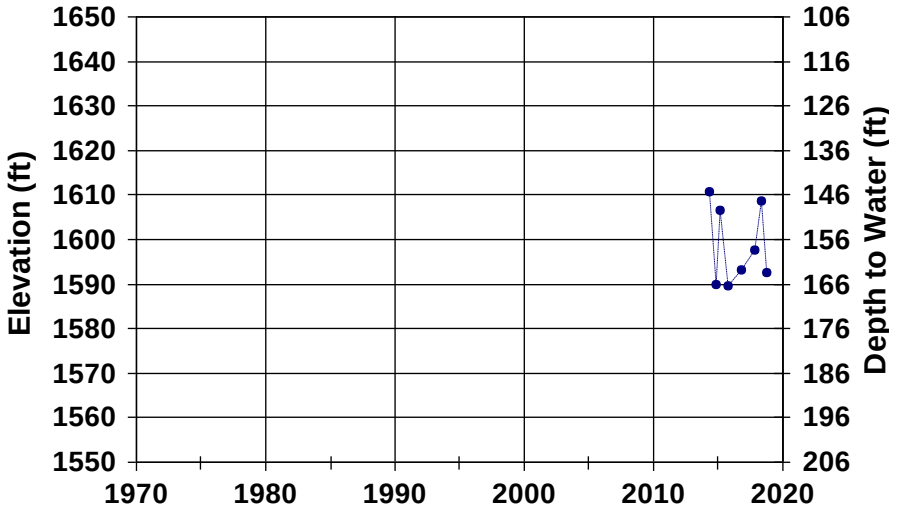
SWN: Unknown
Aquifer Zone:
Last Msmt Date 10/24/2018




**WellID: NapaCounty-166**
Subarea: Angwin
Groundwater Basin Not within a basin

RPE: 1755.8 ft, msl
Source: NapaCounty

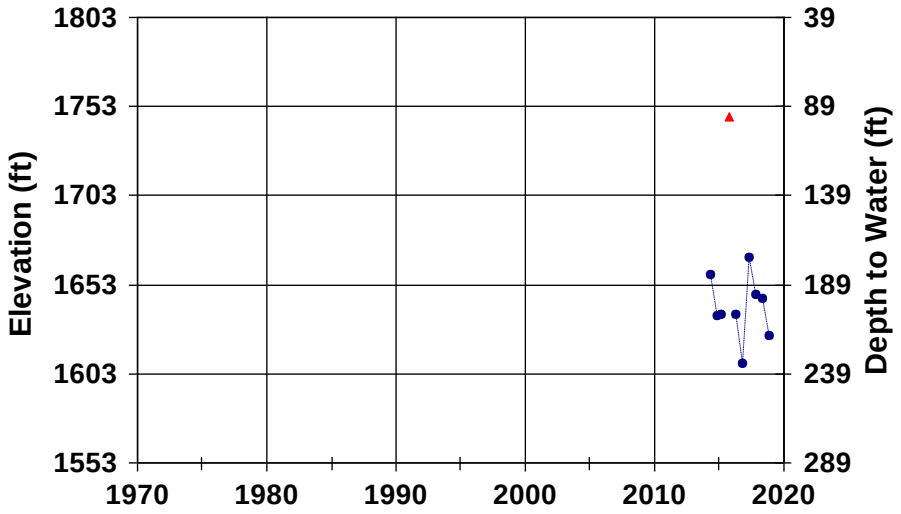
SWN: Unknown
Aquifer Zone:
Last Msmt Date 10/24/2018




**WellID: NapaCounty-167**
Subarea: Angwin
Groundwater Basin Not within a basin

RPE: 1842.3 ft, msl
Source: NapaCounty

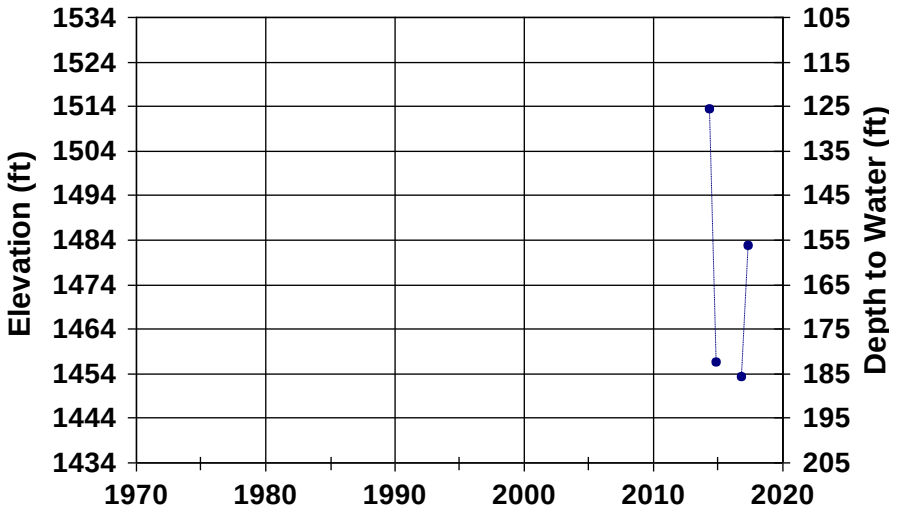
SWN: Unknown
Aquifer Zone:
Last Msmt Date 10/28/2018




**WellID: NapaCounty-168**
Subarea: Angwin
Groundwater Basin Not within a basin

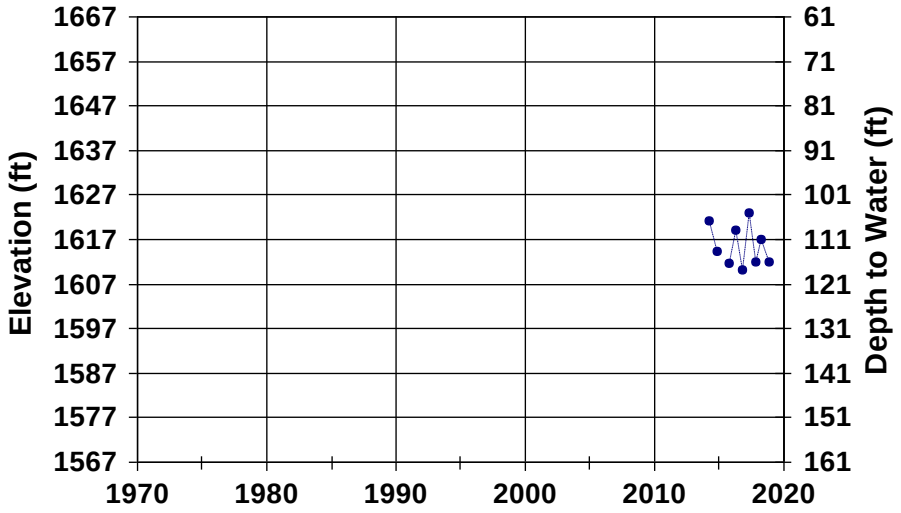
RPE: 1639 ft, msl
Source: NapaCounty

SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/12/2017

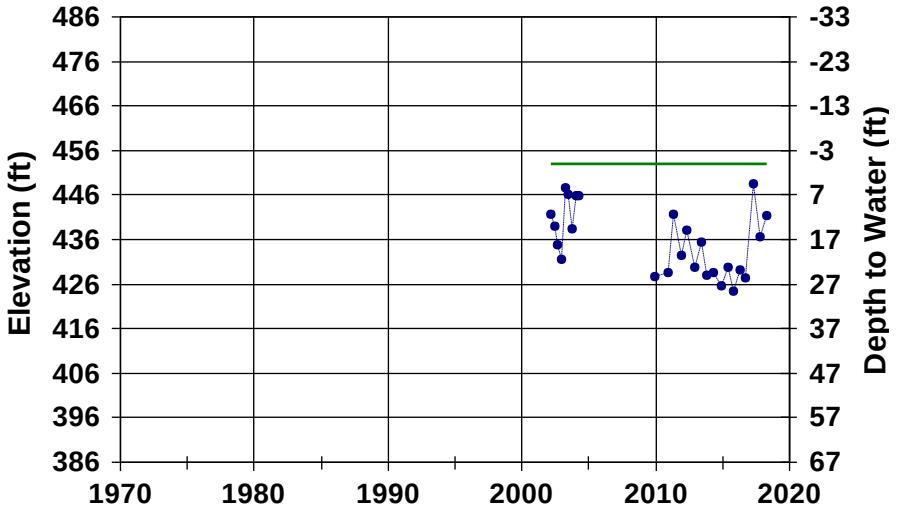



Measured Water Levels  Questionable Measurements  Reference Point Elevation

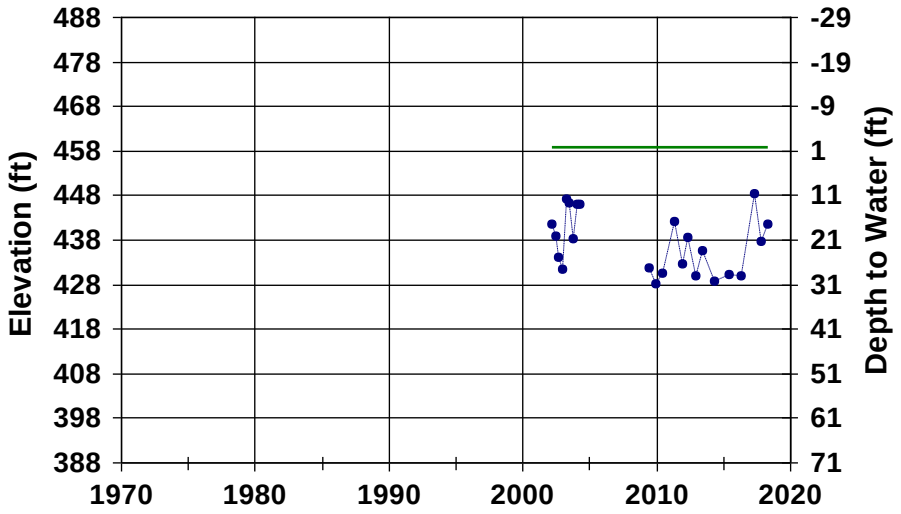
**WellID: NapaCounty-202**
Subarea: Angwin
Groundwater Basin Not within a basin
RPE: 1728.2 ft, msl
Source: NapaCounty
SWN: Unknown
Aquifer Zone:
Last Msmt Date 11/5/2018



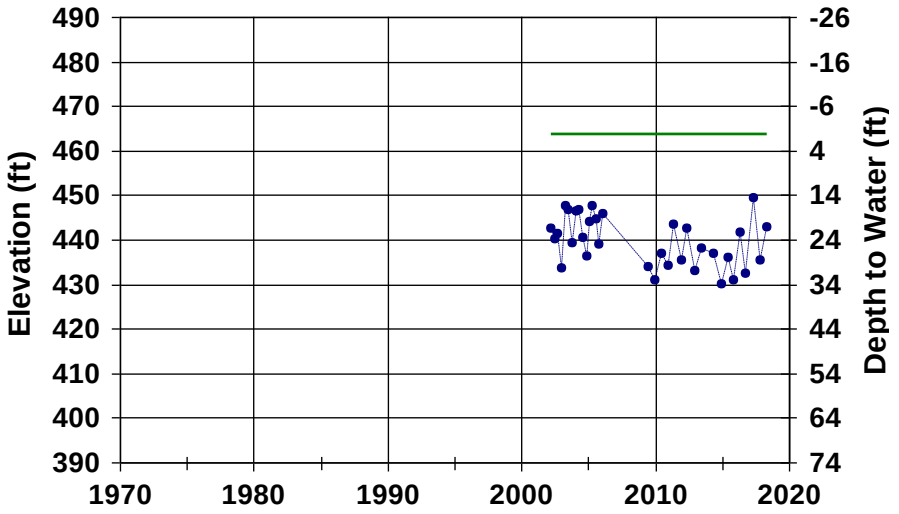

**WellID: T0605500304MW-1**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 452.82 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/19/2018




**WellID: T0605500304MW-4**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 458.83 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/18/2018

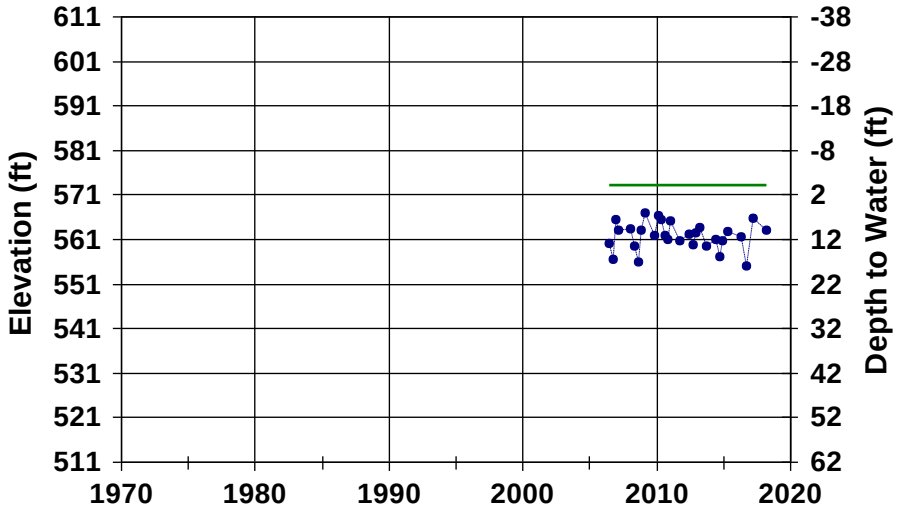



**WellID: T0605500304MW-8**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 463.73 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/18/2018

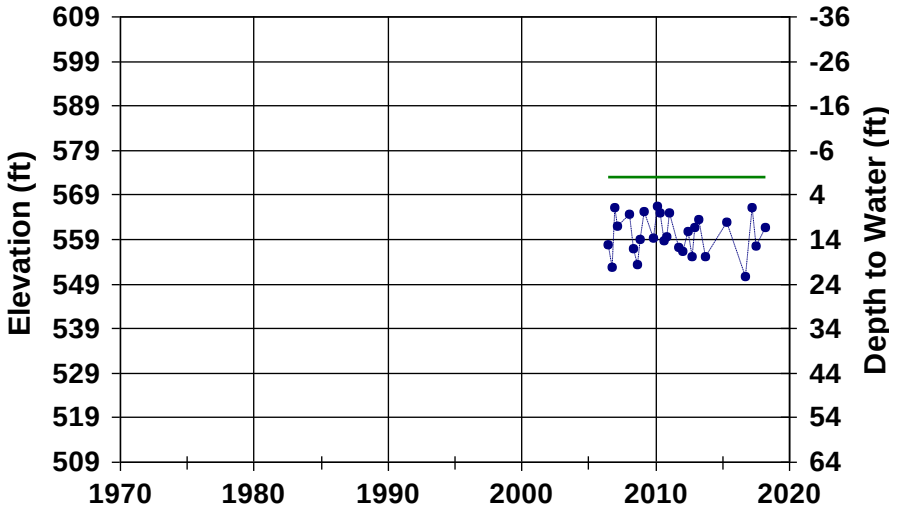



Measured Water Levels  Questionable Measurements  Reference Point Elevation

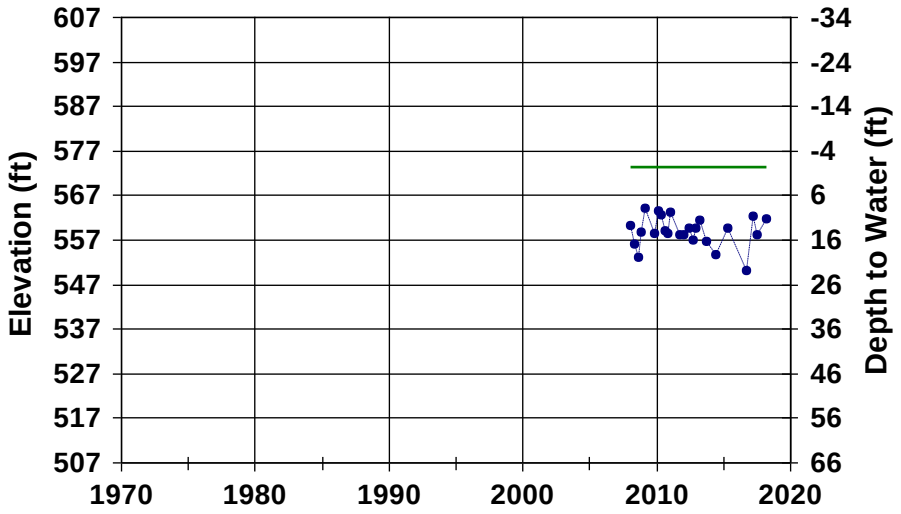
**WellID: T0605591908MW-1**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 573.28 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/3/2018



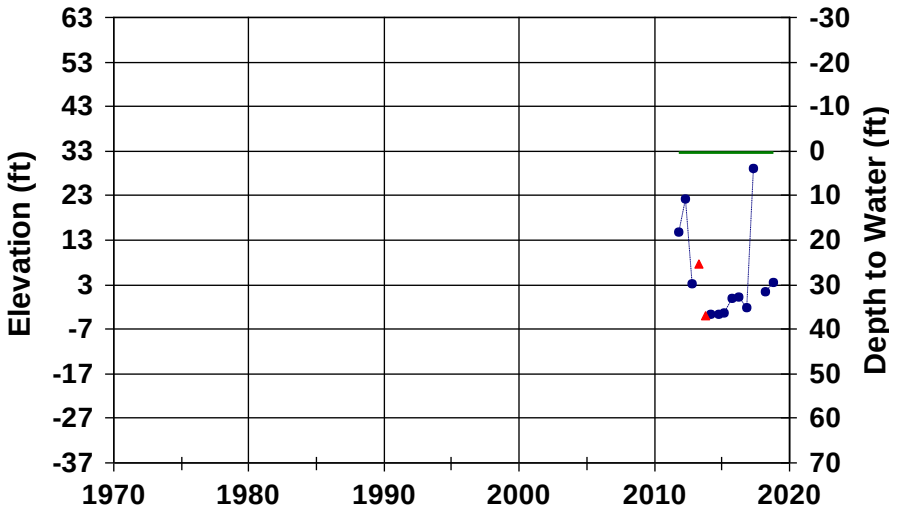

**WellID: T0605591908MW-2**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 573.08 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/3/2018




**WellID: T0605591908MW-6**
Subarea: Berryessa
Groundwater Basin Not within a basin
RPE: 573.3 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 4/3/2018

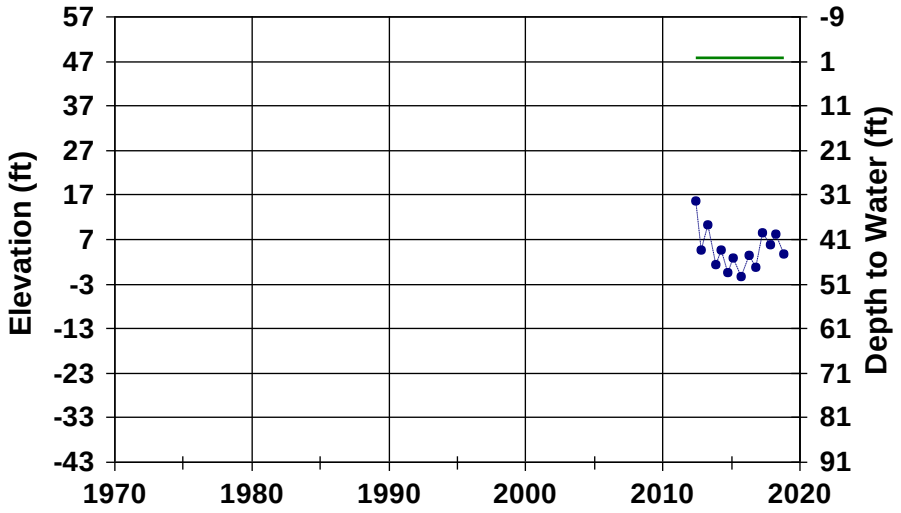



**WellID: NapaCounty-150**
Subarea: Carneros
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN
RPE: 32.7 ft, msl
Source: NapaCounty
SWN: 004N004W05C001
Aquifer Zone:
Last Msmt Date 10/23/2018

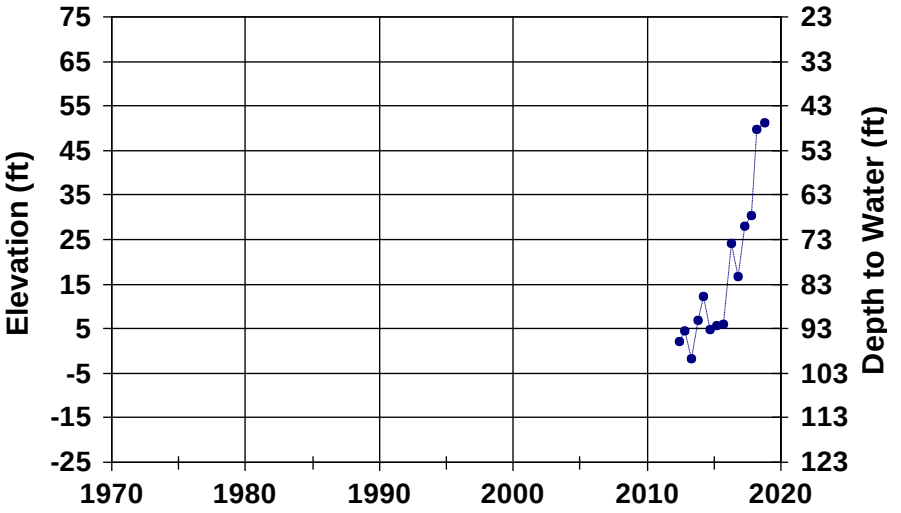



Measured Water Levels  Questionable Measurements  Reference Point Elevation

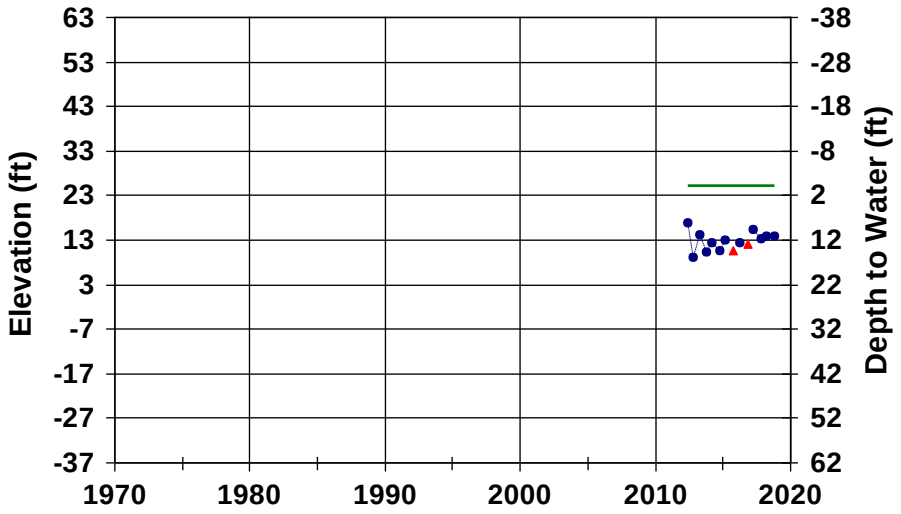
**WellID: NapaCounty-153** RPE: 47.35 ft, msl SWN: 004N004W05A001
Subarea: Carneros Source: NapaCounty Aquifer Zone: TQsb
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018



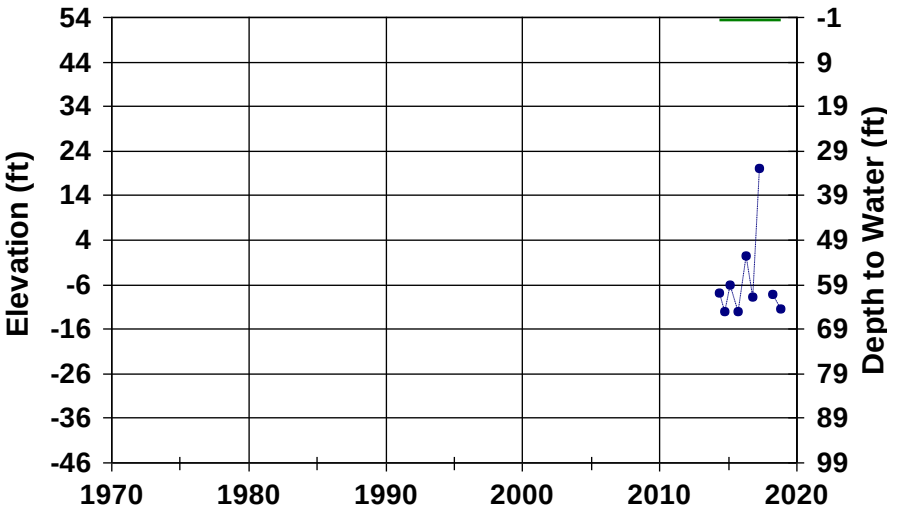

**WellID: NapaCounty-154** RPE: 98 ft, msl SWN: 005N004W31R001
Subarea: Carneros Source: NapaCounty Aquifer Zone: TQsb
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018




**WellID: NapaCounty-155** RPE: 25 ft, msl SWN: 004N004W06M001
Subarea: Carneros Source: NapaCounty Aquifer Zone: TQsb
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018

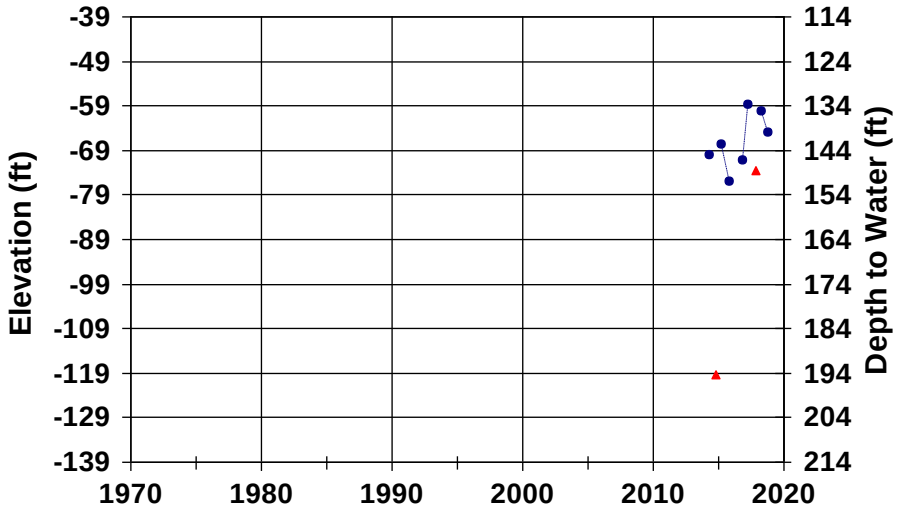



**WellID: NapaCounty-176** RPE: 53.4 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/24/2018

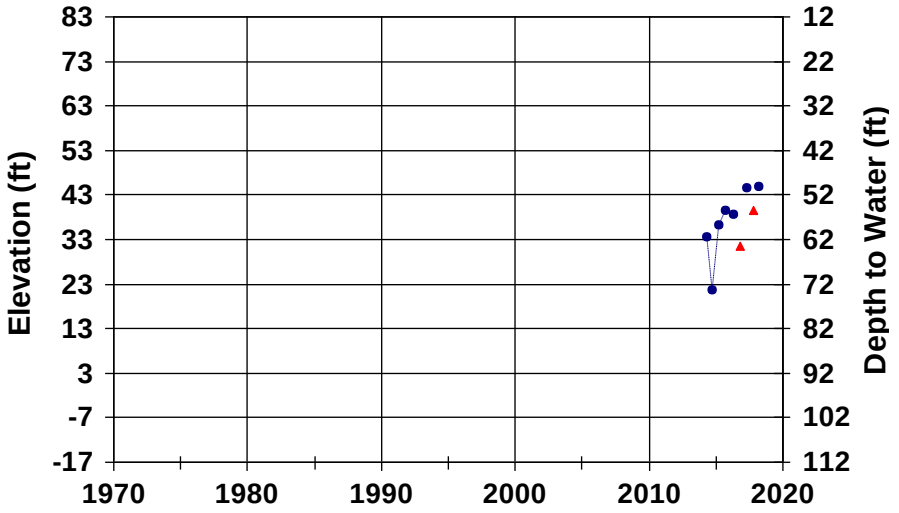



Measured Water Levels  Questionable Measurements  Reference Point Elevation

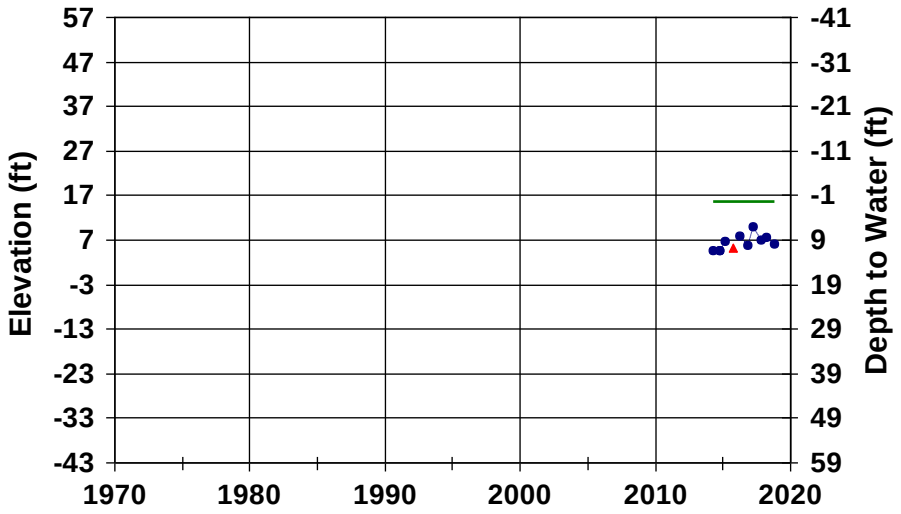
**WellID: NapaCounty-194** RPE: 75.1 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/24/2018



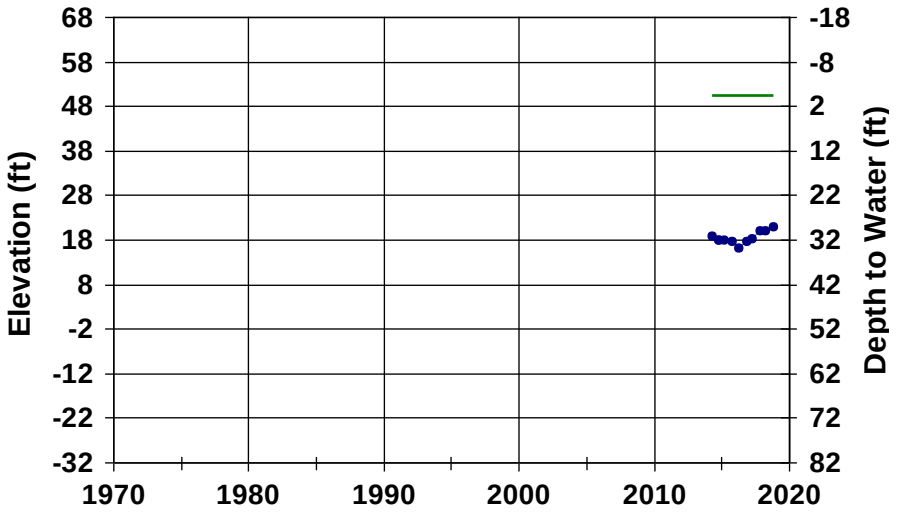

**WellID: NapaCounty-195** RPE: 94.8 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 4/3/2018




**WellID: NapaCounty-200** RPE: 15.7 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018

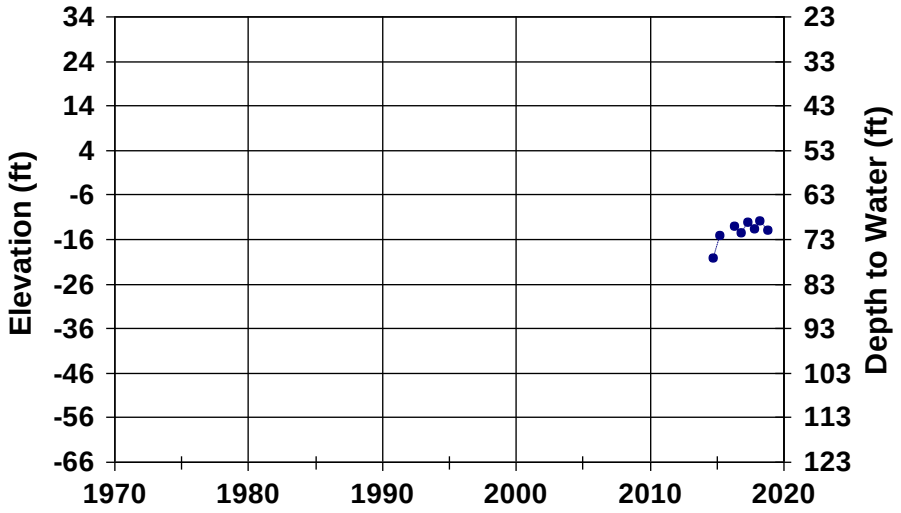



**WellID: NapaCounty-201** RPE: 50.4 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018

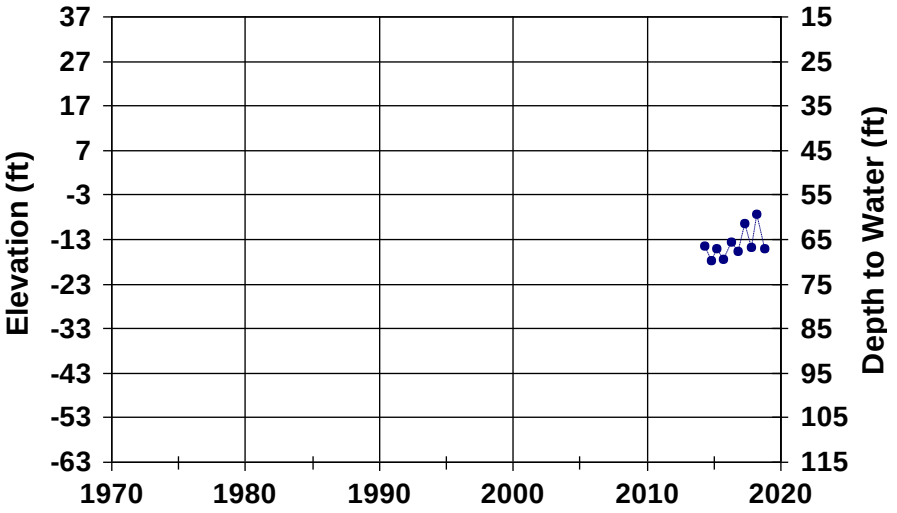



Measured Water Levels  Questionable Measurements  Reference Point Elevation

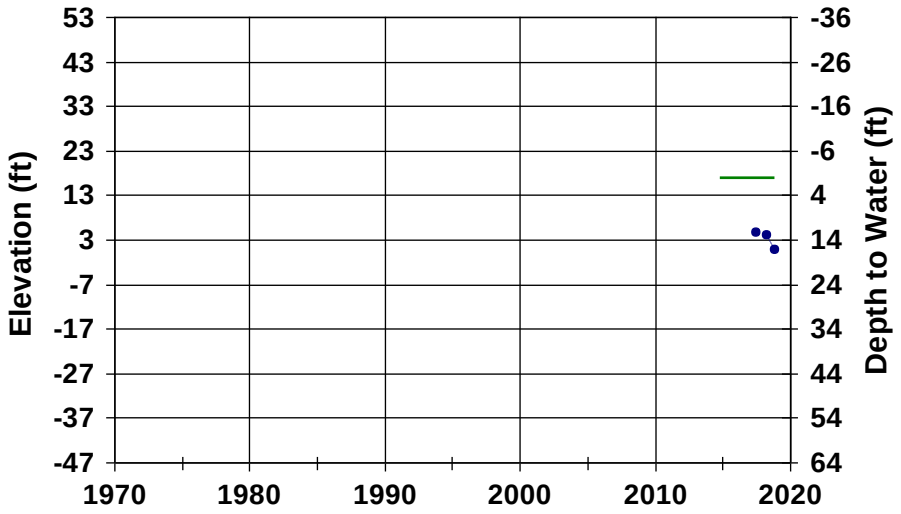
**WellID: NapaCounty-205** RPE: 56.8 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/25/2018



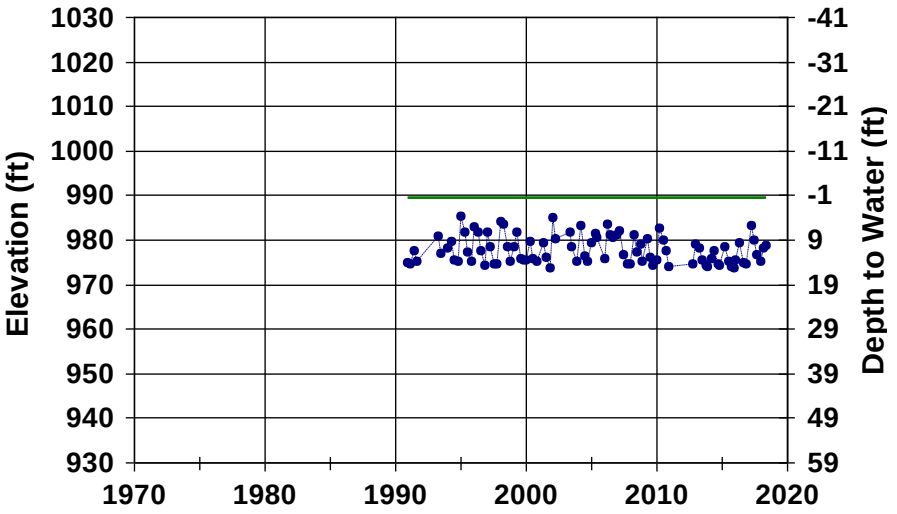

**WellID: NapaCounty-206** RPE: 52.4 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/24/2018




**WellID: NapaCounty-207** RPE: 17 ft, msl SWN: Unknown
Subarea: Carneros Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN Last Msmt Date 10/23/2018




**WellID: L10003756160MW-6** RPE: 989.39 ft, msl SWN: Unknown
Subarea: Central Interior Valleys Source: Geotracker Aquifer Zone:
Groundwater Basin Not within a basin Last Msmt Date 5/11/2018

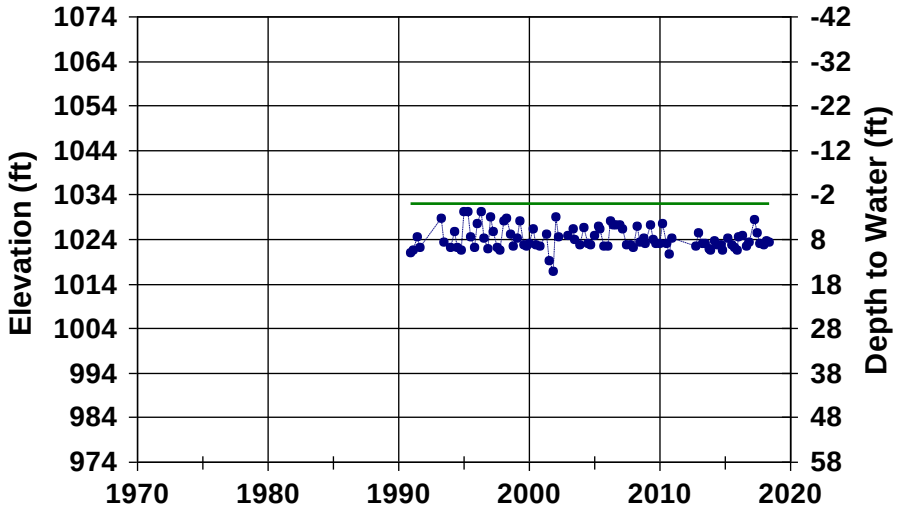



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

**WellID: L10003756160MW-7**
Subarea: Central Interior Valleys
Groundwater Basin Not within a basin

RPE: 1032.16 ft, msl
Source: Geotracker

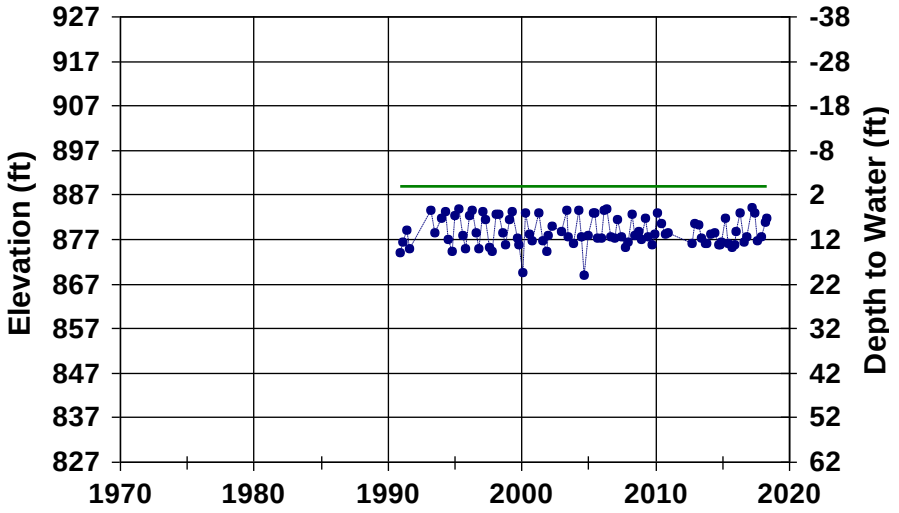
SWN: Unknown
Aquifer Zone:
Last Msmt Date 5/11/2018




**WellID: L10003756160MW-8**
Subarea: Central Interior Valleys
Groundwater Basin Not within a basin

RPE: 889.03 ft, msl
Source: Geotracker

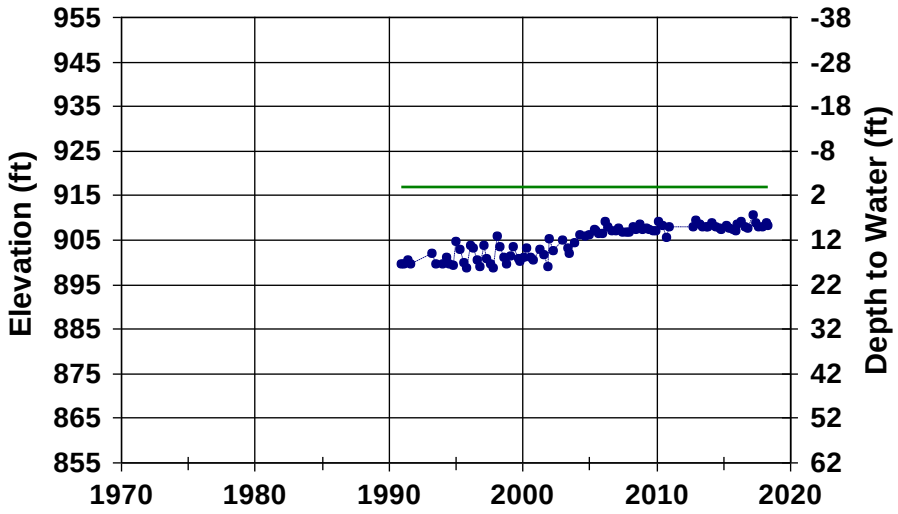
SWN: Unknown
Aquifer Zone:
Last Msmt Date 5/11/2018




**WellID: L10003756160MW-9**
Subarea: Central Interior Valleys
Groundwater Basin Not within a basin

RPE: 916.87 ft, msl
Source: Geotracker

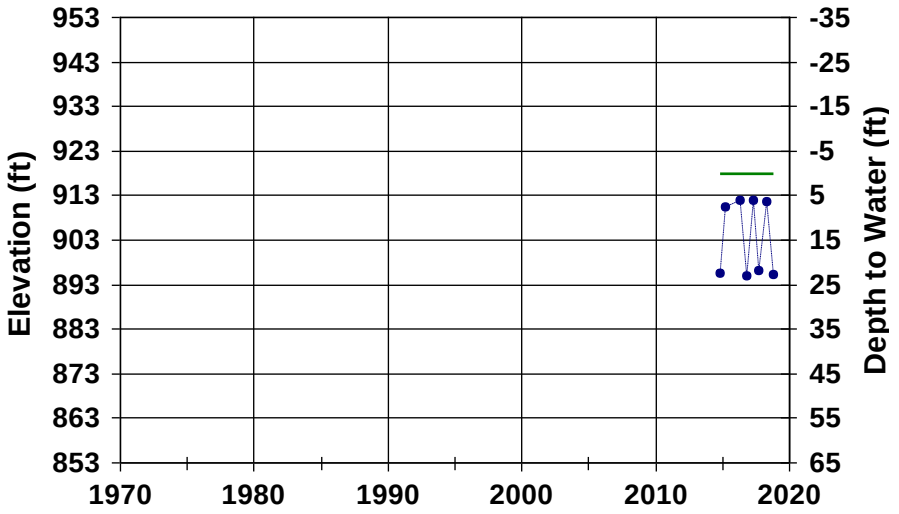
SWN: Unknown
Aquifer Zone:
Last Msmt Date 5/11/2018




**WellID: NapaCounty-209**
Subarea: Central Interior Valleys
Groundwater Basin Not within a basin

RPE: 918 ft, msl
Source: NapaCounty

SWN: Unknown
Aquifer Zone:
Last Msmt Date 10/15/2018

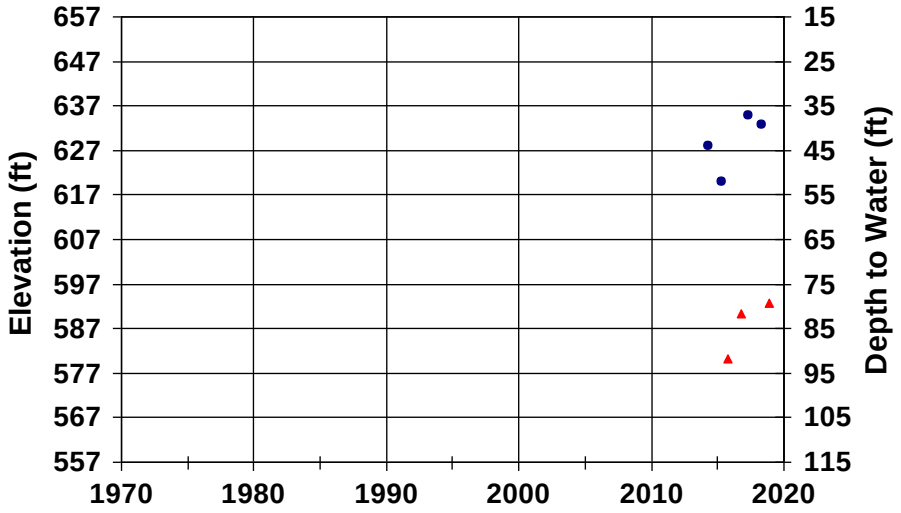



Measured Water Levels  Questionable Measurements  Reference Point Elevation

**WellID: NapaCounty-175**
Subarea: Eastern Mountains
Groundwater Basin Not within a basin

RPE: 672.3 ft, msl
Source: NapaCounty

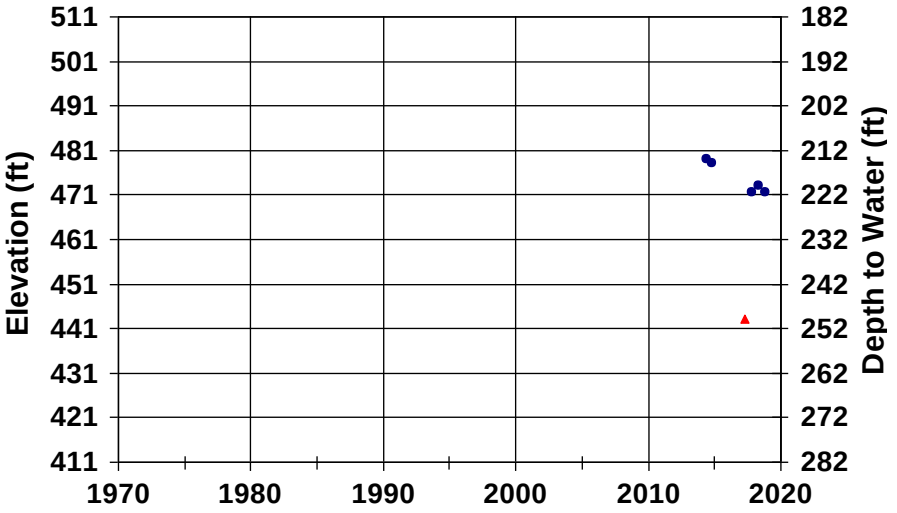
SWN: Unknown
Aquifer Zone: Tsv
Last Msmt Date 11/5/2018




**WellID: NapaCounty-193**
Subarea: Eastern Mountains
Groundwater Basin Not within a basin

RPE: 693.1 ft, msl
Source: NapaCounty

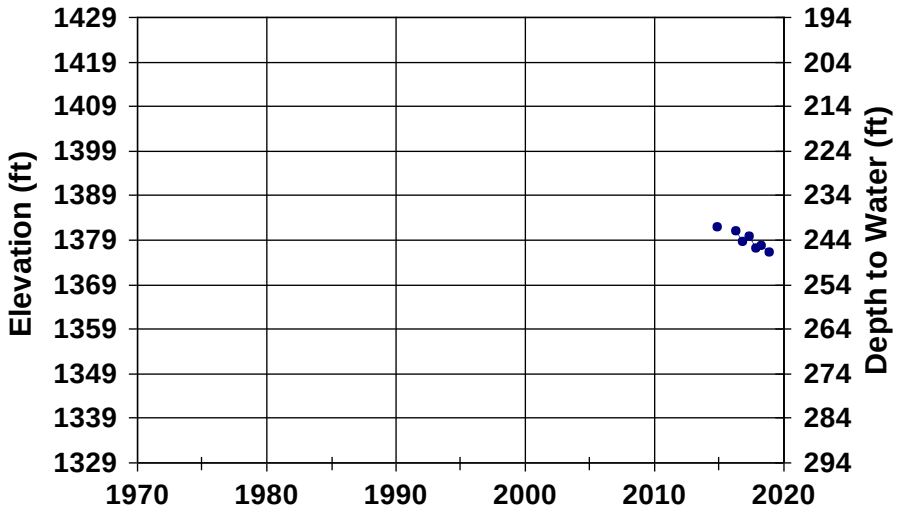
SWN: Unknown
Aquifer Zone:
Last Msmt Date 10/31/2018




**WellID: NapaCounty-210**
Subarea: Eastern Mountains
Groundwater Basin Not within a basin

RPE: 1622.9 ft, msl
Source: NapaCounty

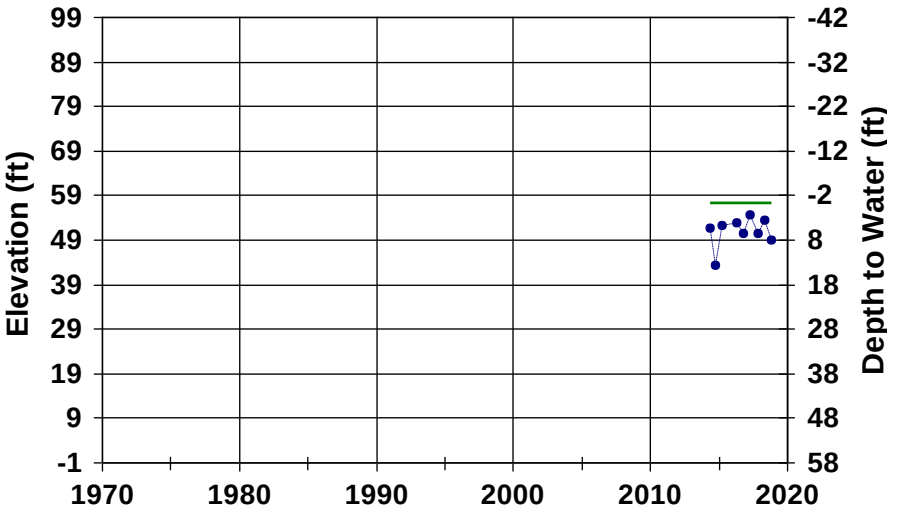
SWN: Unknown
Aquifer Zone:
Last Msmt Date 11/16/2018




**WellID: NapaCounty-196**
Subarea: Jameson/American Canyon
Groundwater Basin NAPA-SONOMA LOWLANDS SUBBASIN

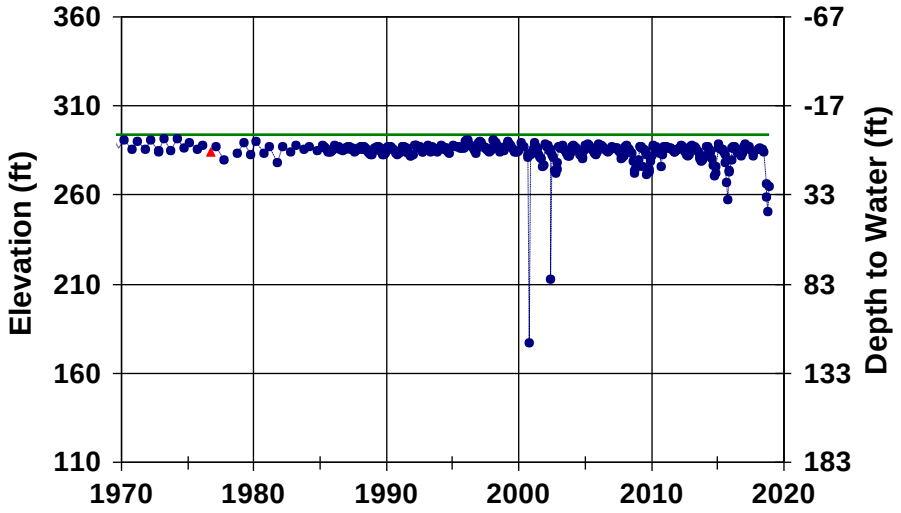
RPE: 57.4 ft, msl
Source: NapaCounty

SWN: Unknown
Aquifer Zone:
Last Msmt Date 11/6/2018

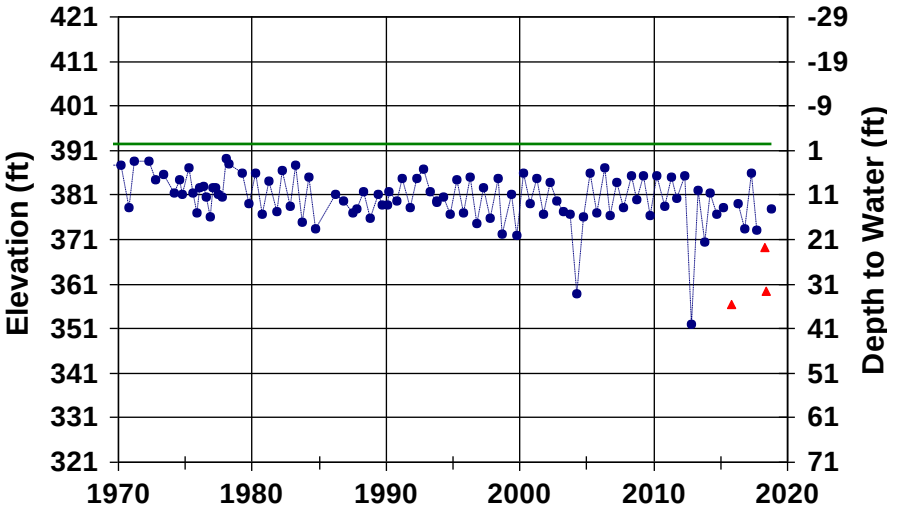



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

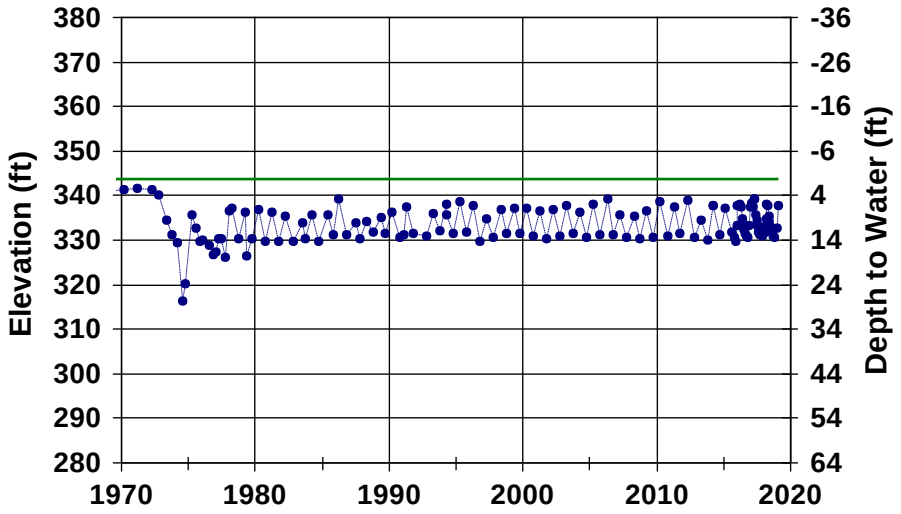
**WellID: 08N06W10Q001M** RPE: 293.43 ft, msl SWN: 008N006W10Q001
Subarea: Napa Valley Floor-Calistoga Source: DWR Aquifer Zone: Not Defined
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/7/2018



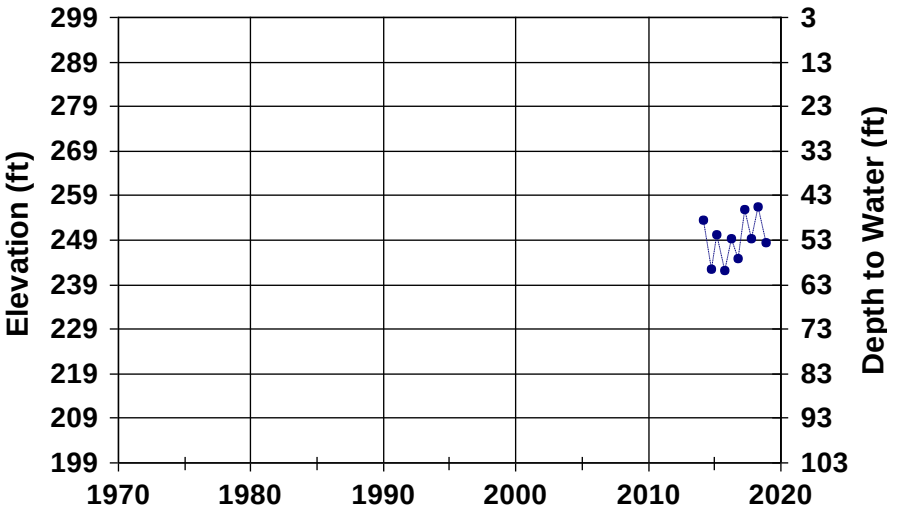

**WellID: NapaCounty-127** RPE: 392.5 ft, msl SWN: 009N007W25N001
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/17/2018




**WellID: NapaCounty-128** RPE: 343.7 ft, msl SWN: 009N006W31Q001
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019

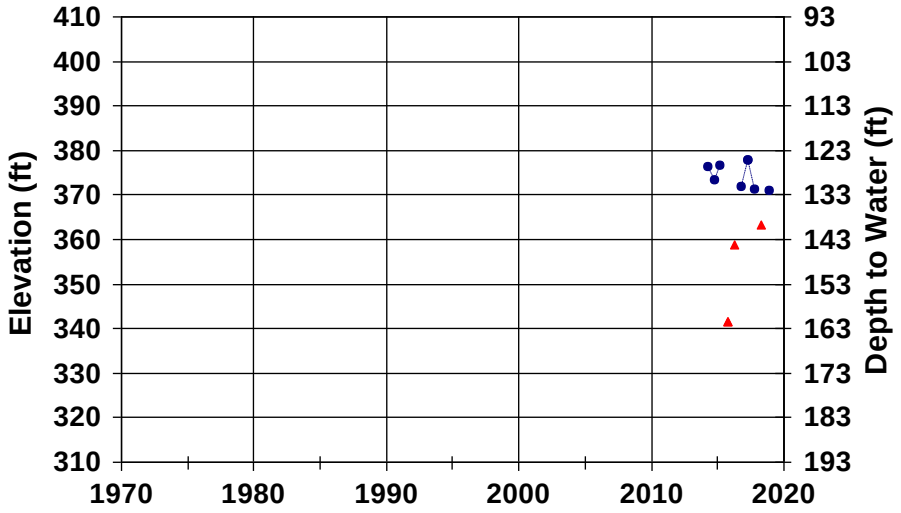



**WellID: NapaCounty-178** RPE: 301.5 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/5/2018

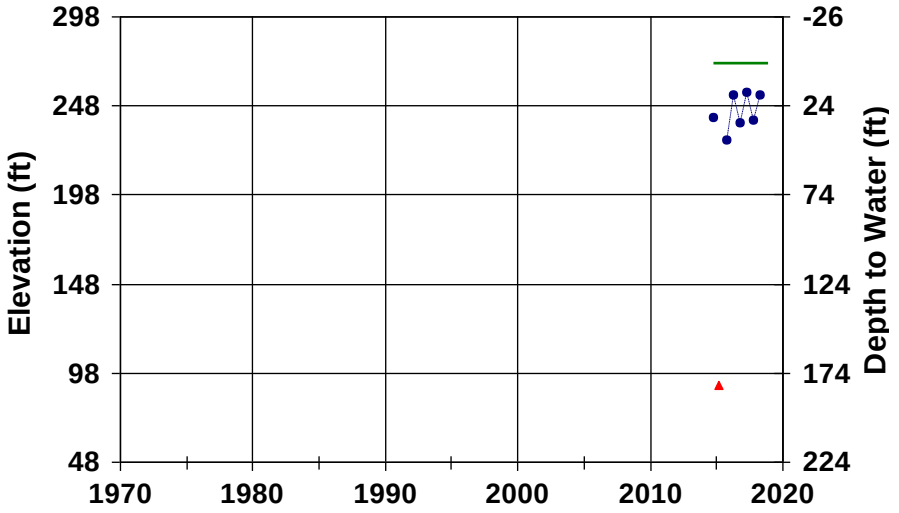



Measured Water Levels  Questionable Measurements  Reference Point Elevation

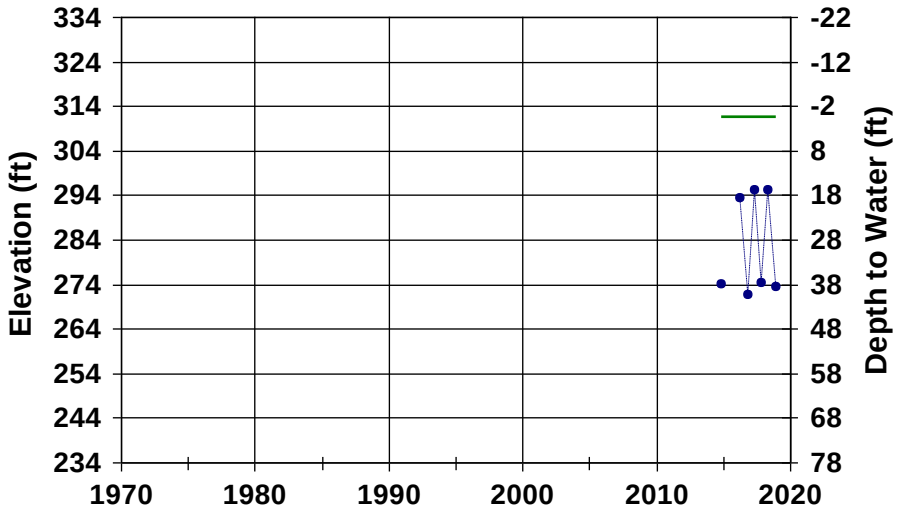
**WellID: NapaCounty-208** RPE: 503.4 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone: Tsv
Groundwater Basin Not within a basin Last Msmt Date 11/5/2018



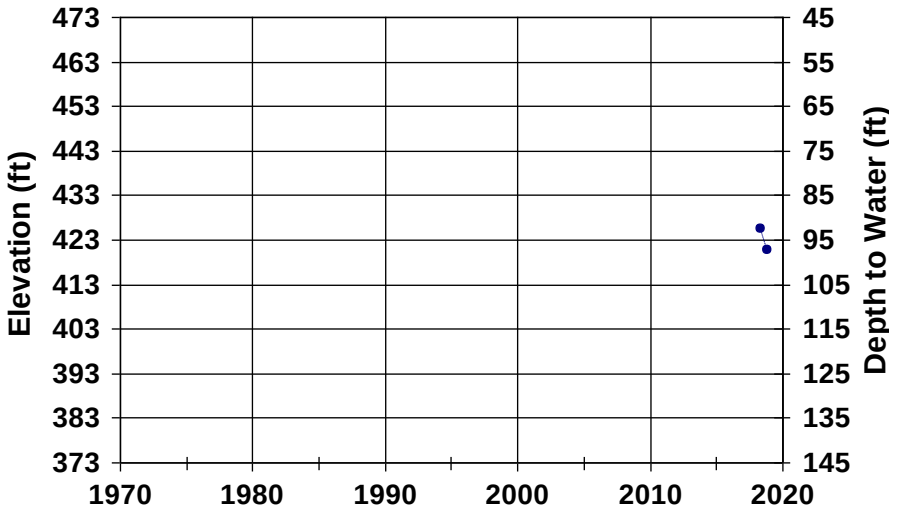

**WellID: NapaCounty-224** RPE: 272 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 4/18/2018




**WellID: NapaCounty-225** RPE: 311.75 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018

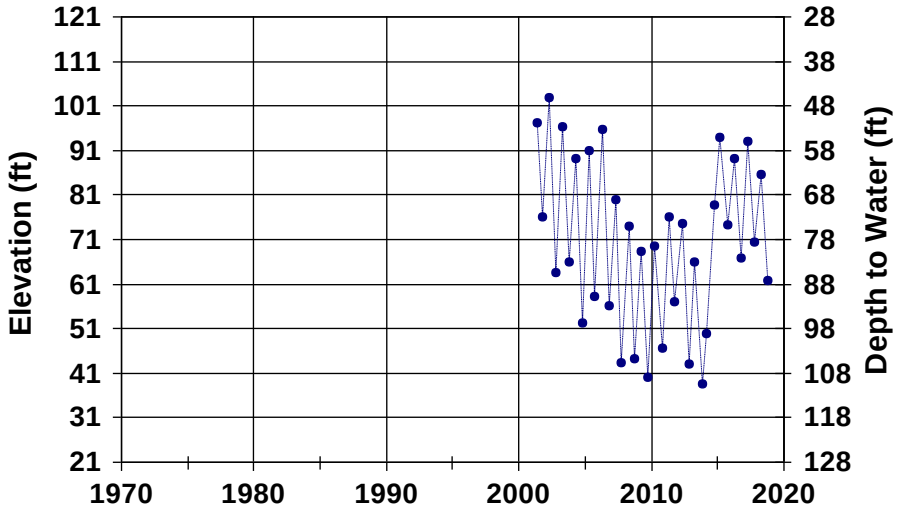



**WellID: NapaCounty-230** RPE: 518.09 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone: Tsv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/17/2018

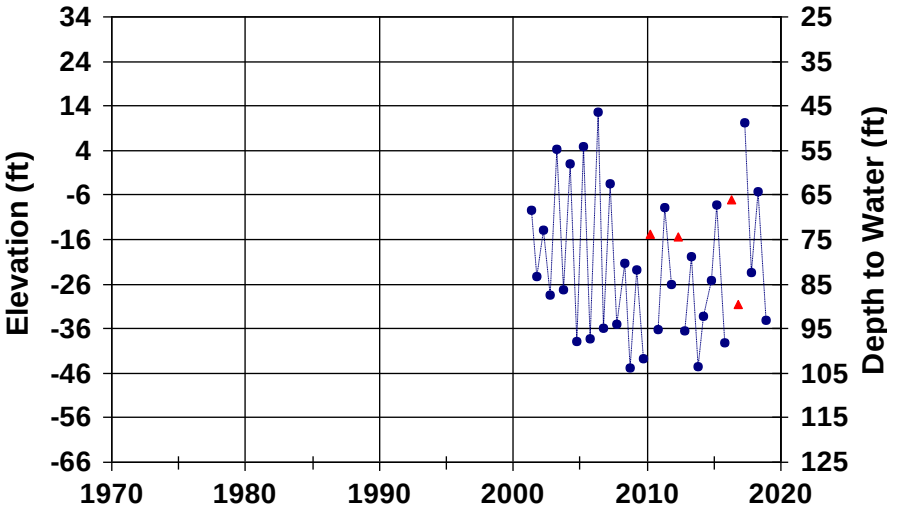



Measured Water Levels  Questionable Measurements  Reference Point Elevation

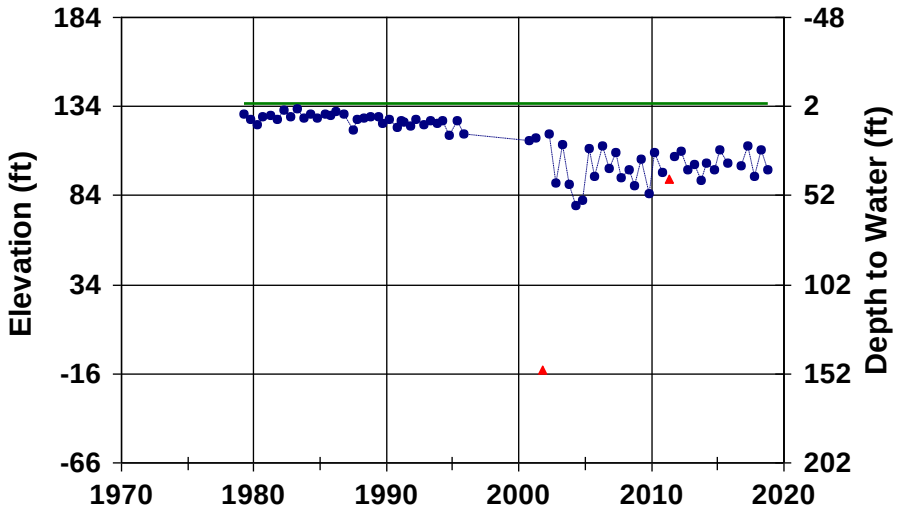
**WellID: NapaCounty-118**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 148.65 ft, msl
Source: NapaCounty
SWN: 005N003W07B00_
Aquifer Zone:
Last Msmt Date 11/1/2018



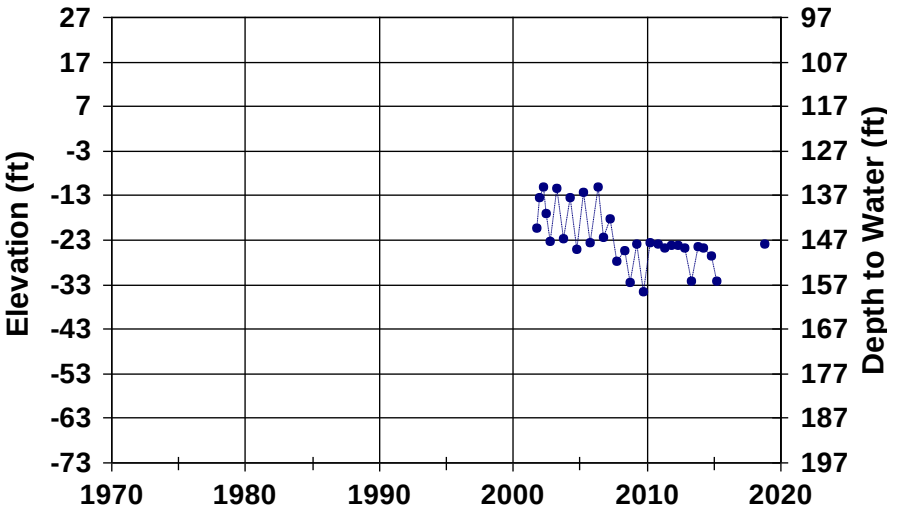

**WellID: NapaCounty-122**
Subarea: Napa Valley Floor-MST
Groundwater Basin NAPA VALLEY SUBBASIN
RPE: 59.15 ft, msl
Source: NapaCounty
SWN: 006N004W26L005
Aquifer Zone: Tss
Last Msmt Date 11/19/2018




**WellID: NapaCounty-137**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 135.9 ft, msl
Source: NapaCounty
SWN: 005N004W13H001
Aquifer Zone:
Last Msmt Date 10/31/2018

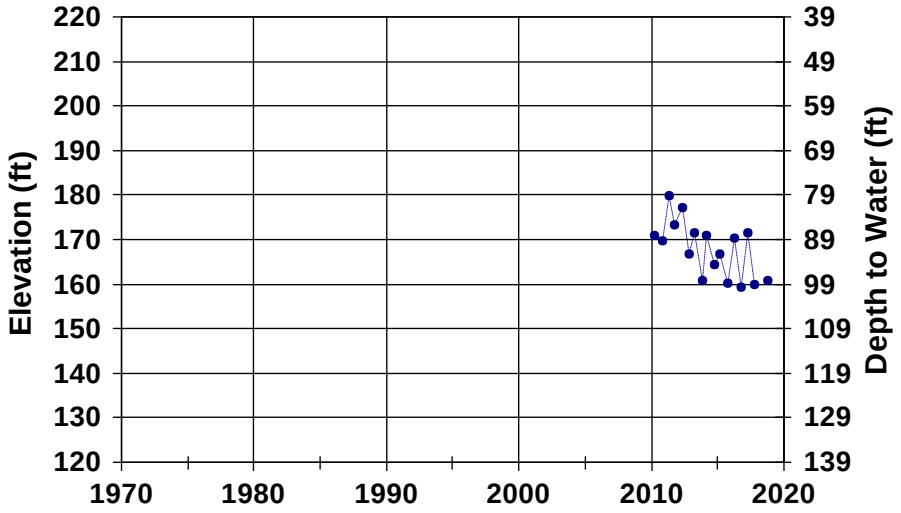



**WellID: NapaCounty-142**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 124.2 ft, msl
Source: NapaCounty
SWN: 006N004W25G00_
Aquifer Zone:
Last Msmt Date 11/1/2018

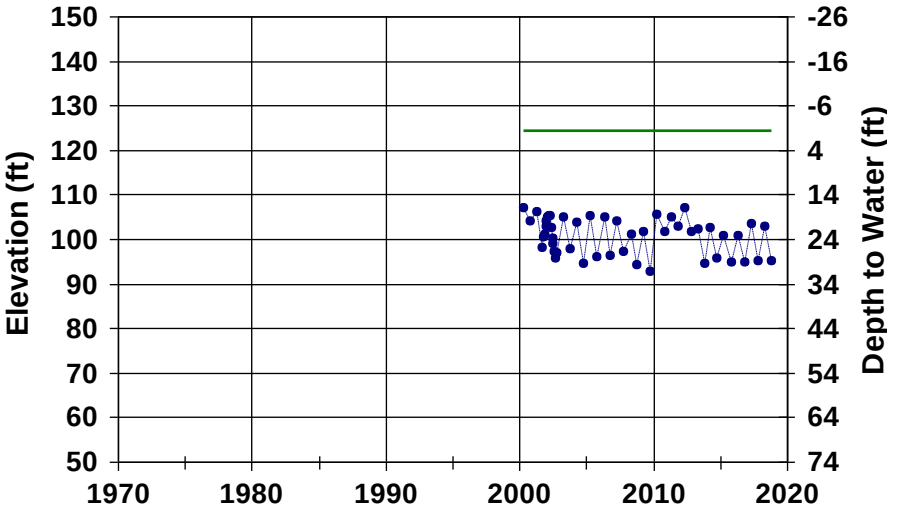



Measured Water Levels  Questionable Measurements  Reference Point Elevation

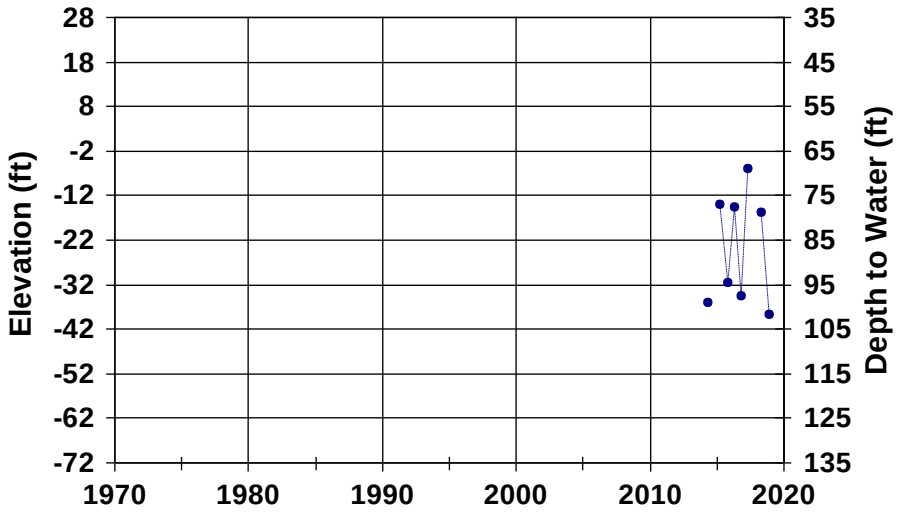
**WellID: NapaCounty-149** RPE: 258.9 ft, msl SWN: 005N003W08E00_
Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/1/2018



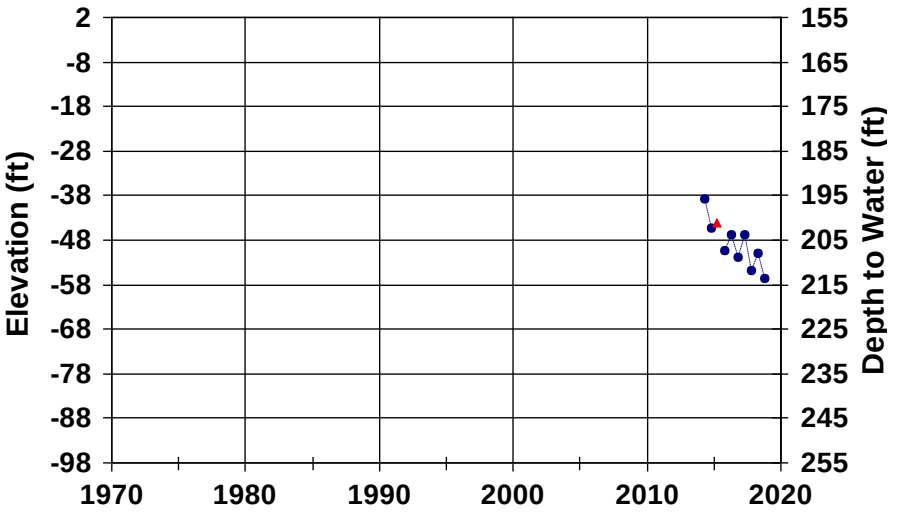

**WellID: NapaCounty-18** RPE: 124.3 ft, msl SWN: 005N004W13G004
Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
Groundwater Basin Not within a basin Last Msmt Date 10/31/2018




**WellID: NapaCounty-191** RPE: 63.1 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
Groundwater Basin Not within a basin Last Msmt Date 11/19/2018

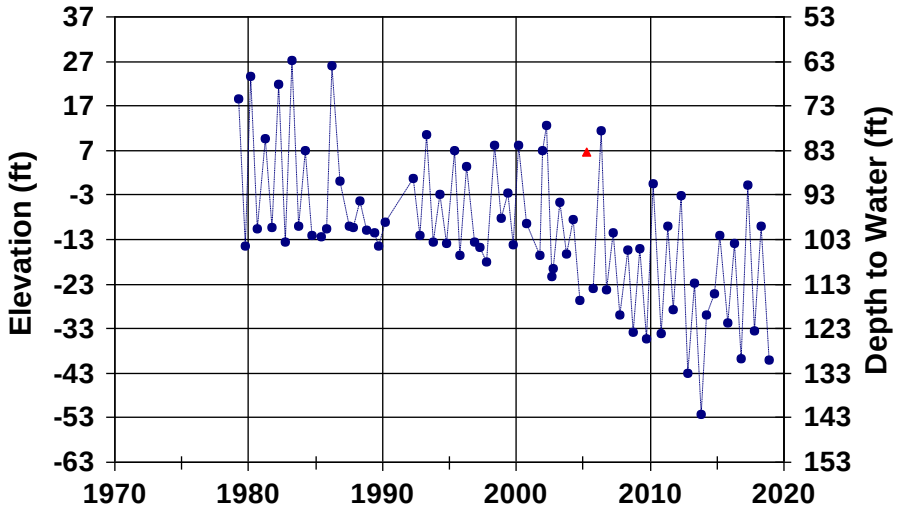



**WellID: NapaCounty-192** RPE: 156.8 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
Groundwater Basin Not within a basin Last Msmt Date 10/31/2018

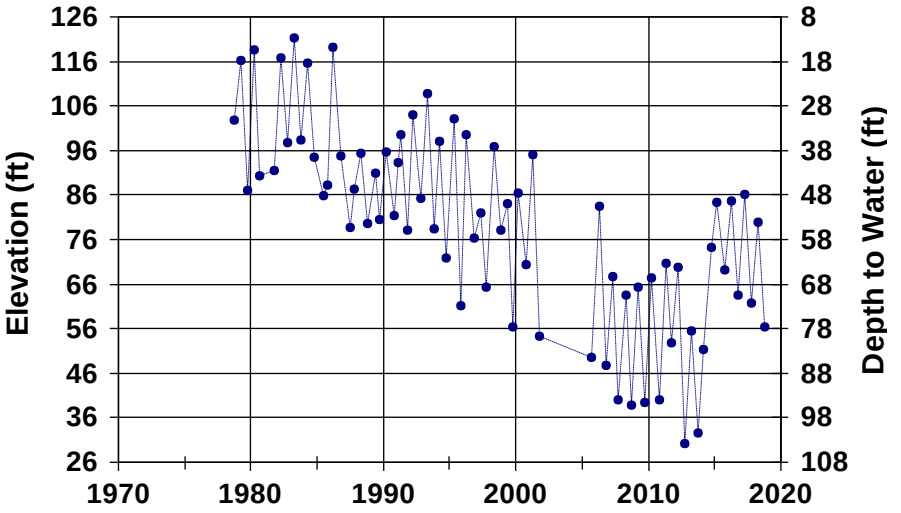



Measured Water Levels  Questionable Measurements  Reference Point Elevation

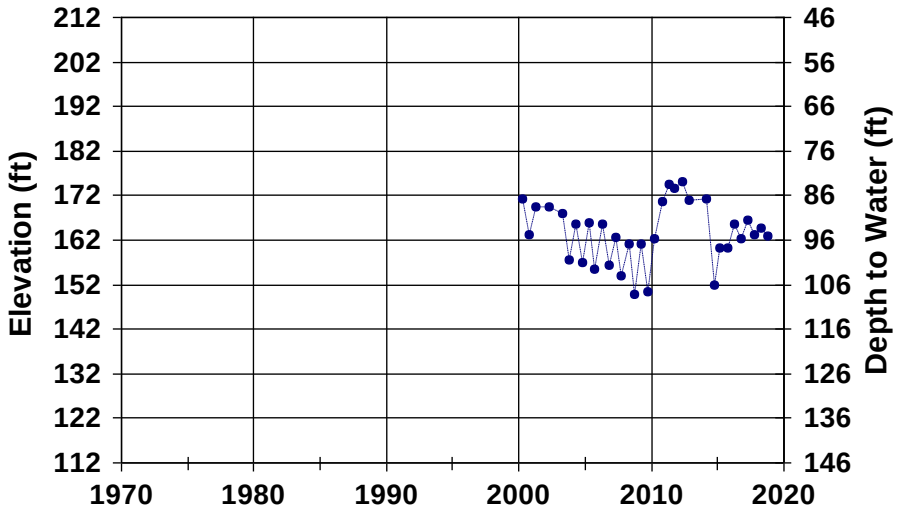
**WellID: NapaCounty-2**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 90.5 ft, msl
Source: NapaCounty
SWN: 006N004W23J001
Aquifer Zone:
Last Msmt Date 11/19/2018



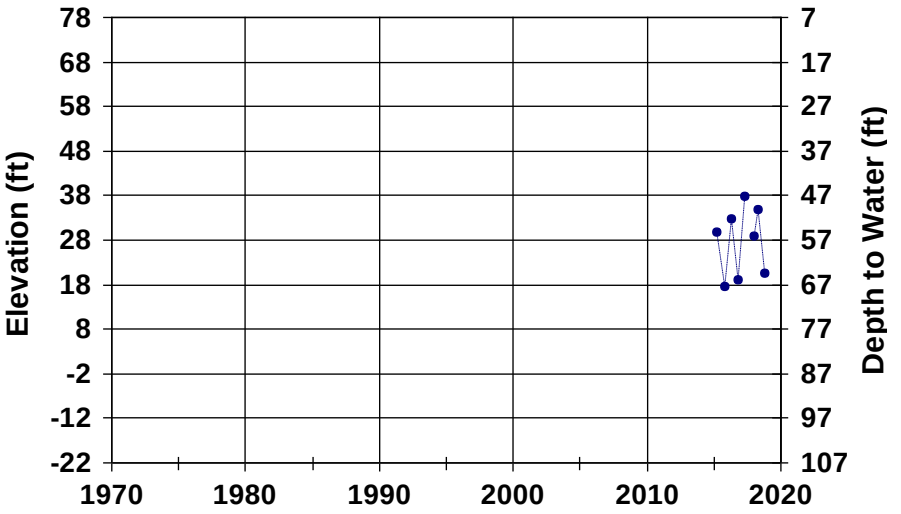

**WellID: NapaCounty-20**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 134.5 ft, msl
Source: NapaCounty
SWN: 005N003W07C003
Aquifer Zone: Tsvd
Last Msmt Date 11/1/2018




**WellID: NapaCounty-22**
Subarea: Napa Valley Floor-MST
Groundwater Basin NAPA VALLEY SUBBASIN
RPE: 257.7 ft, msl
Source: NapaCounty
SWN: 005N003W08E001
Aquifer Zone:
Last Msmt Date 11/1/2018

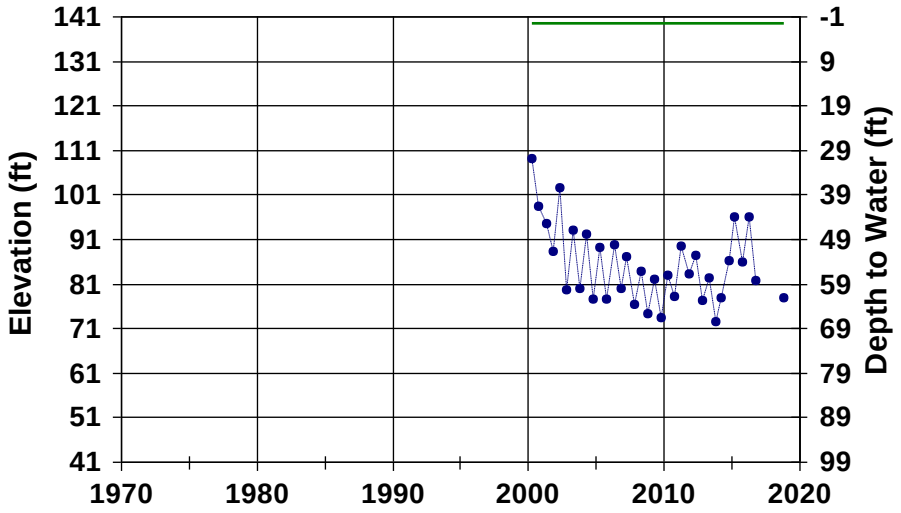



**WellID: NapaCounty-226**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 84.9 ft, msl
Source: NapaCounty
SWN: Unknown
Aquifer Zone:
Last Msmt Date 11/1/2018

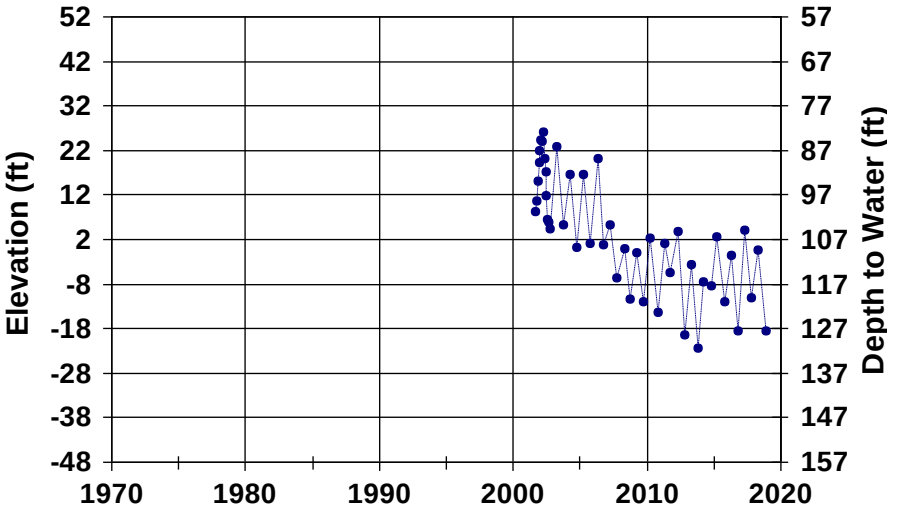



Measured Water Levels  Questionable Measurements  Reference Point Elevation

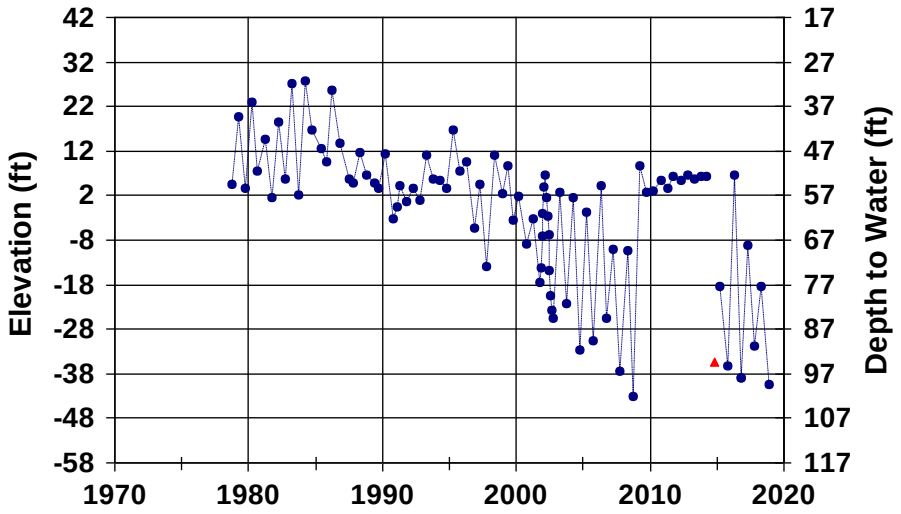
**WellID: NapaCounty-35**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 139.6 ft, msl
Source: NapaCounty
SWN: 005N003W18D001
Aquifer Zone:
Last Msmt Date 10/31/2018



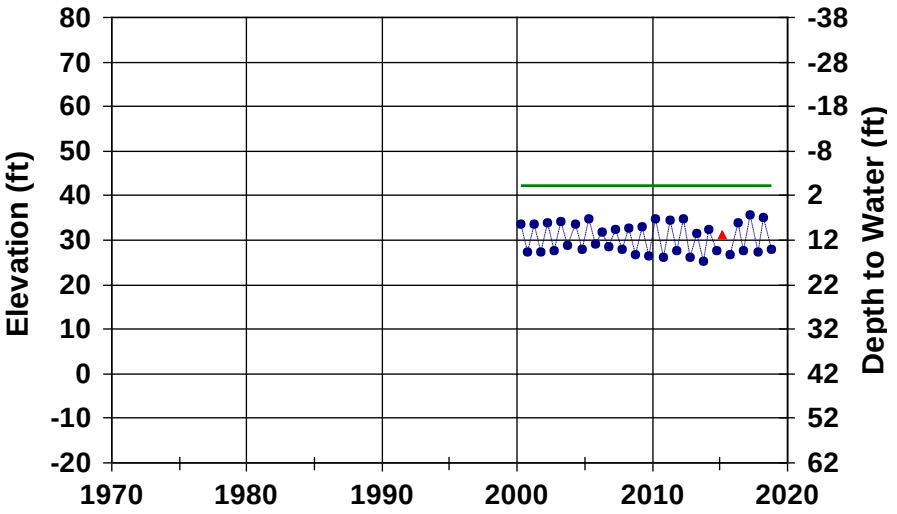

**WellID: NapaCounty-43**
Subarea: Napa Valley Floor-MST
Groundwater Basin NAPA VALLEY SUBBASIN
RPE: 109 ft, msl
Source: NapaCounty
SWN: 006N004W23Q003
Aquifer Zone:
Last Msmt Date 11/19/2018




**WellID: NapaCounty-56**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 58.6 ft, msl
Source: NapaCounty
SWN: 006N004W26G001
Aquifer Zone: Tss/h
Last Msmt Date 11/19/2018




**WellID: NapaCounty-69**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 42.1 ft, msl
Source: NapaCounty
SWN: 006N004W35G005
Aquifer Zone:
Last Msmt Date 11/1/2018

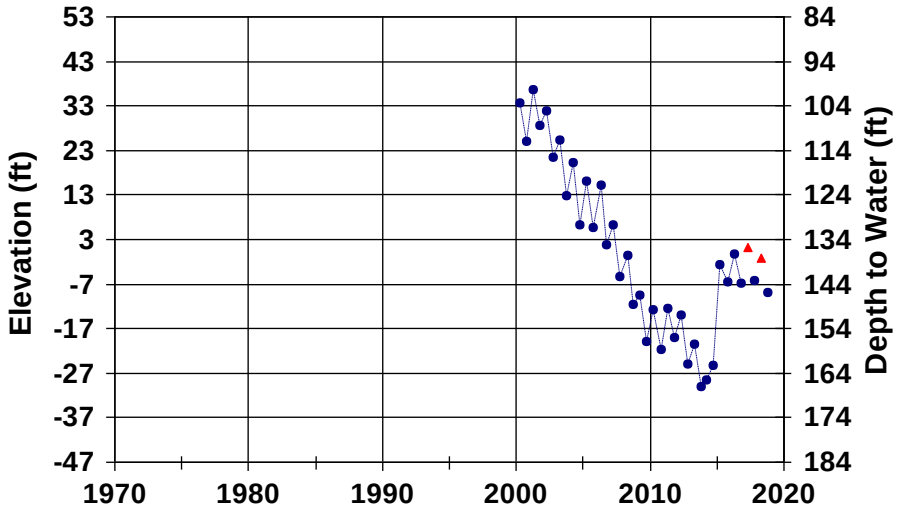



Measured Water Levels  Questionable Measurements  Reference Point Elevation

**WellID: NapaCounty-72**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin

RPE: 137.1 ft, msl
Source: NapaCounty

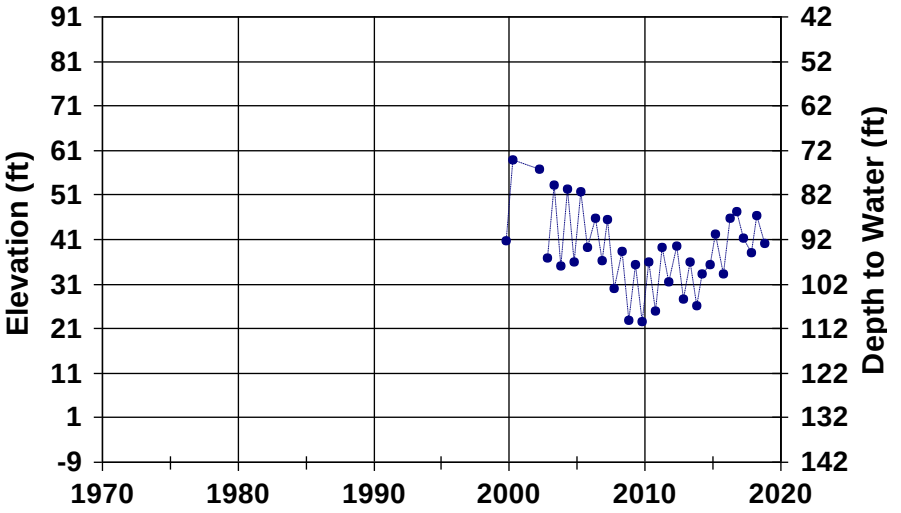
SWN: 005N003W07D003
Aquifer Zone:
Last Msmt Date 11/1/2018




**WellID: NapaCounty-74**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin

RPE: 133.3 ft, msl
Source: NapaCounty

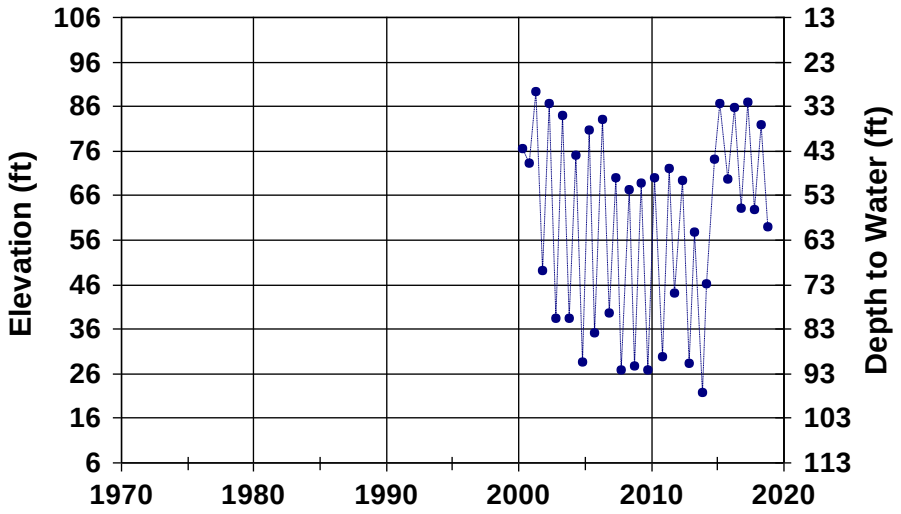
SWN: 005N003W06M001
Aquifer Zone:
Last Msmt Date 11/1/2018




**WellID: NapaCounty-81**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin

RPE: 118.6 ft, msl
Source: NapaCounty

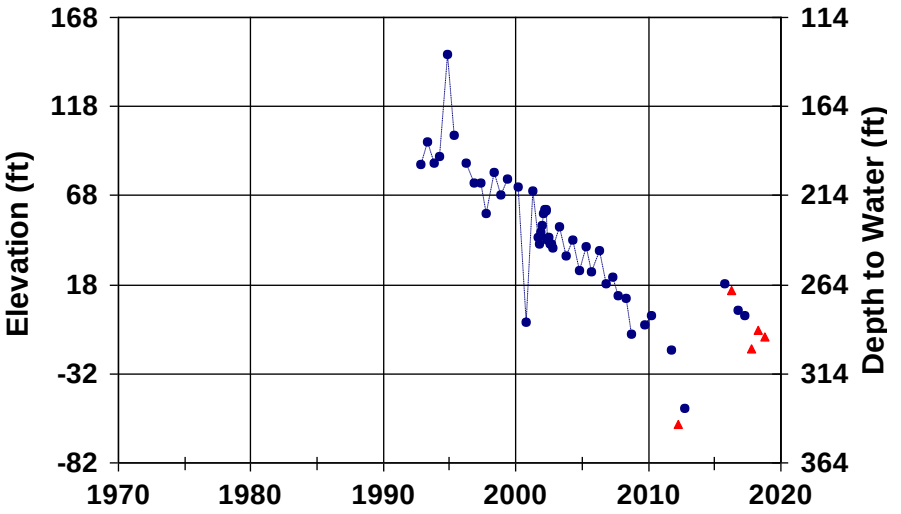
SWN: 005N003W07F003
Aquifer Zone:
Last Msmt Date 10/31/2018




**WellID: NapaCounty-91**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin

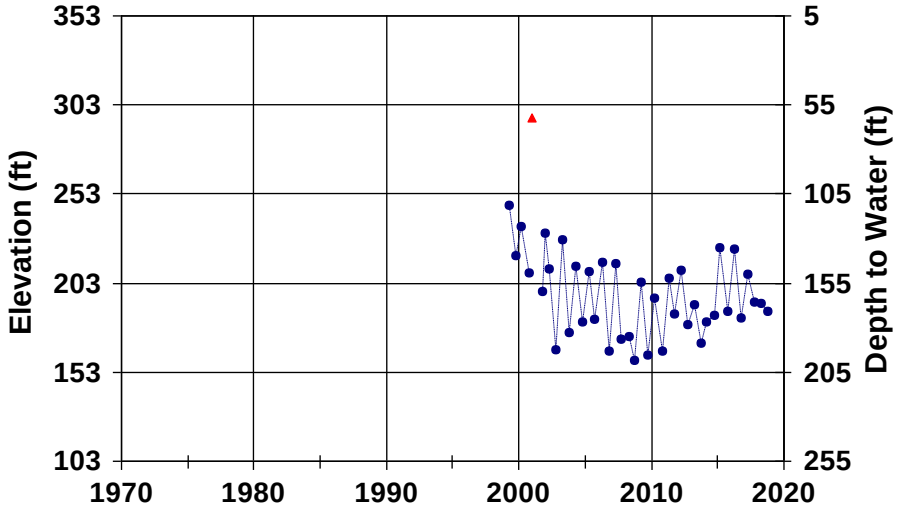
RPE: 281.9 ft, msl
Source: NapaCounty

SWN: 005N003W06B002
Aquifer Zone: Tsvt
Last Msmt Date 11/2/2018

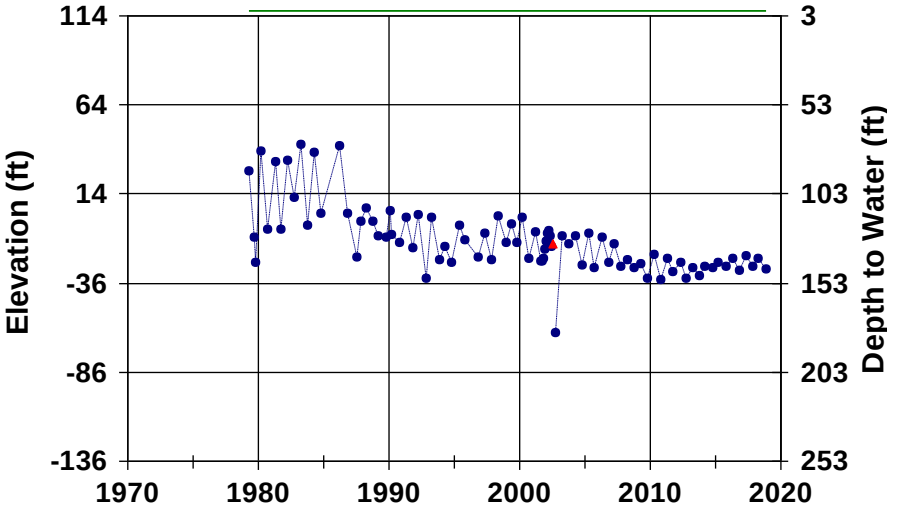



Measured Water Levels  Questionable Measurements  Reference Point Elevation

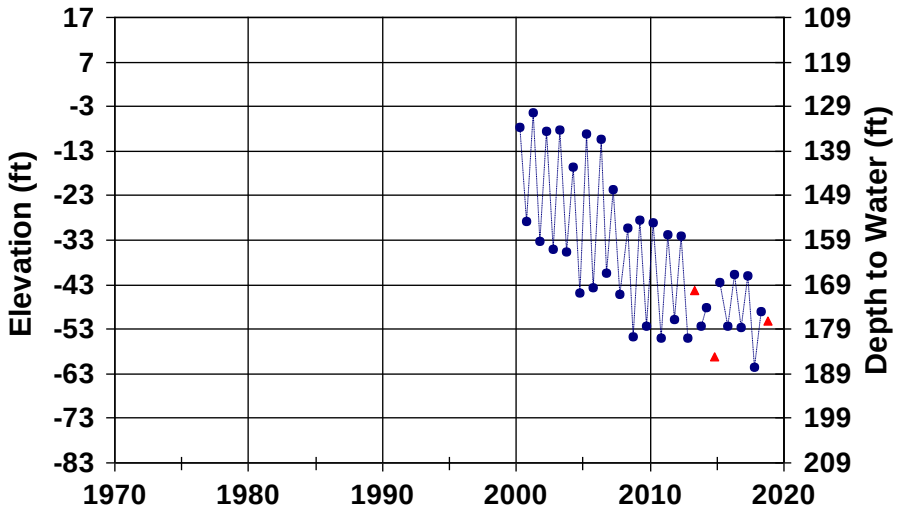
**WellID: NapaCounty-92**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 358.2 ft, msl
Source: NapaCounty
SWN: 005N003W06A001
Aquifer Zone:
Last Msmt Date 11/2/2018



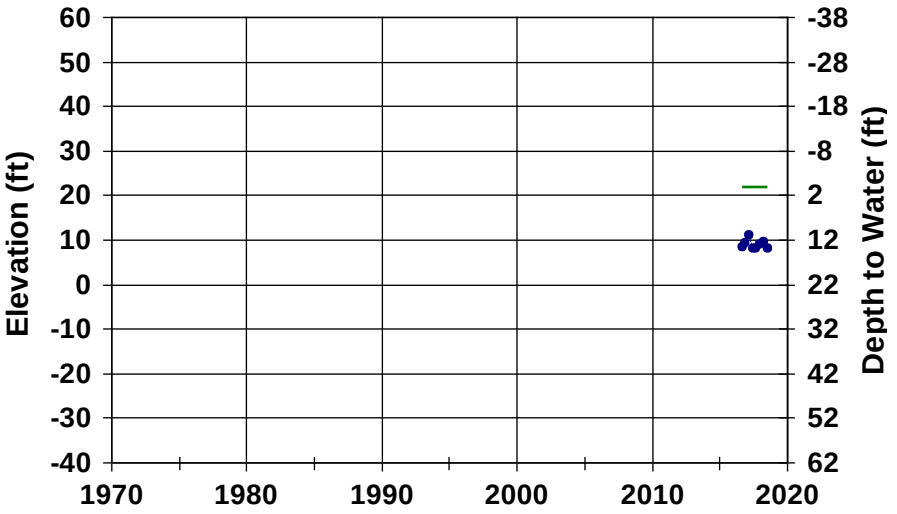

**WellID: NapaCounty-95**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 116.9 ft, msl
Source: NapaCounty
SWN: 006N004W36G001
Aquifer Zone: Tsvt
Last Msmt Date 11/2/2018




**WellID: NapaCounty-98**
Subarea: Napa Valley Floor-MST
Groundwater Basin Not within a basin
RPE: 125.7 ft, msl
Source: NapaCounty
SWN: 006N004W36A001
Aquifer Zone:
Last Msmt Date 11/6/2018

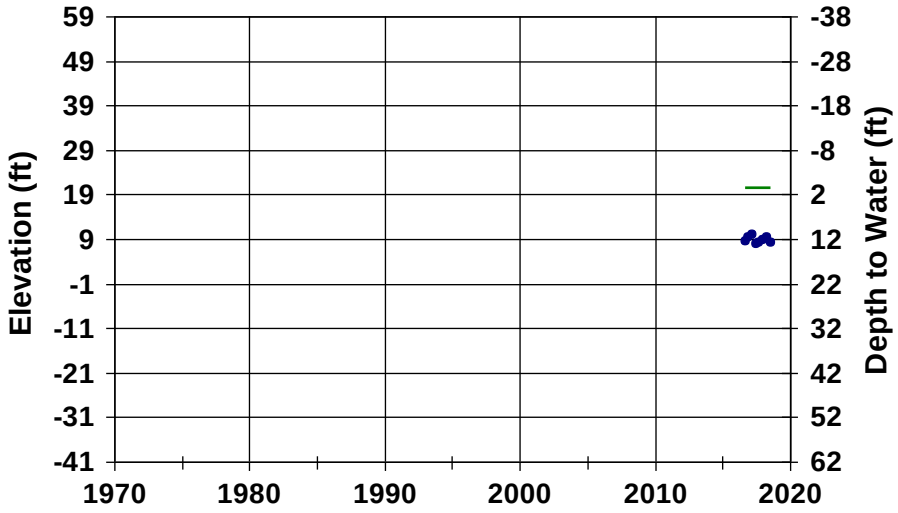



**WellID: T10000008932MW-3**
Subarea: Napa Valley Floor-MST
Groundwater Basin NAPA VALLEY SUBBASIN
RPE: 21.76 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:
Last Msmt Date 6/28/2018

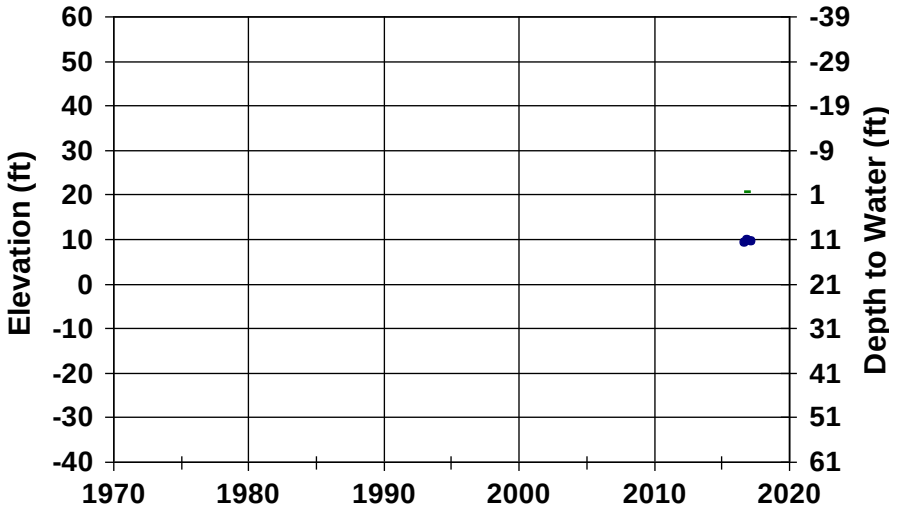



Measured Water Levels  Questionable Measurements  Reference Point Elevation

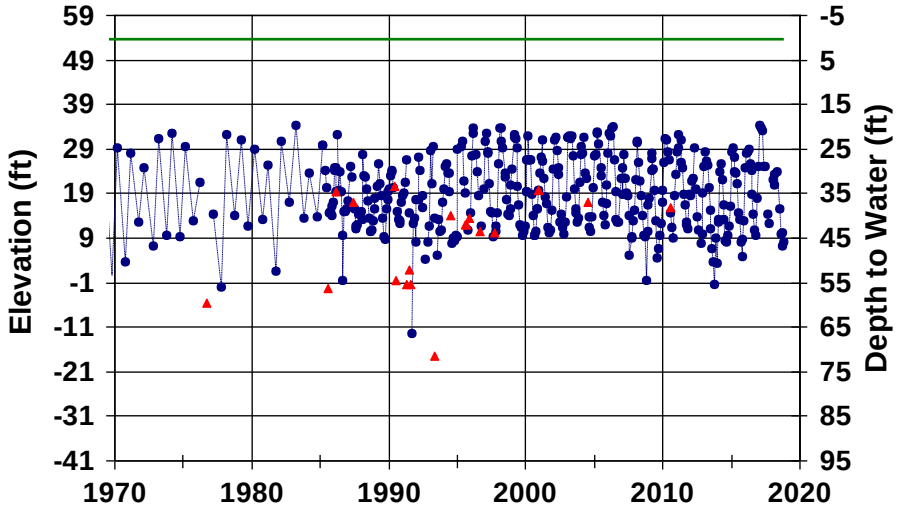
**WellID: T10000008932MW-4** RPE: 20.56 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-MST Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 6/28/2018



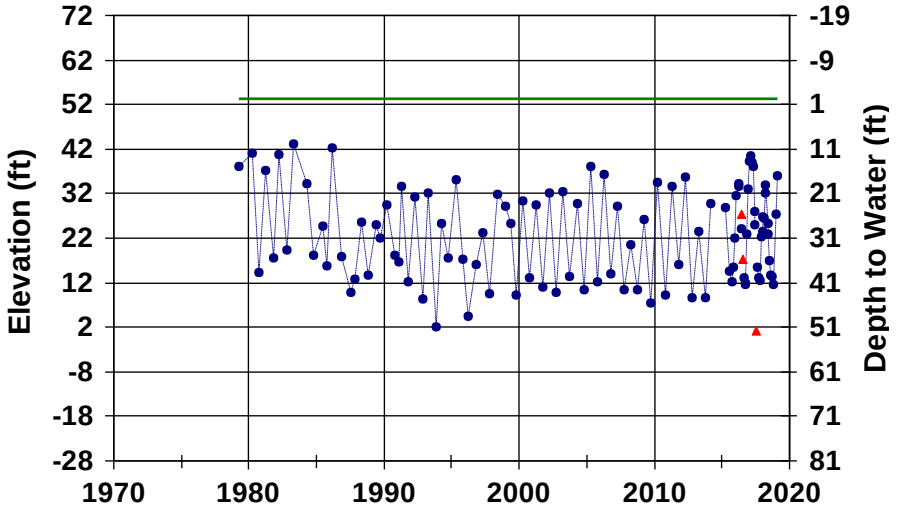

**WellID: T10000008932MW-5** RPE: 20.63 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-MST Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 3/1/2017




**WellID: 06N04W27L002M** RPE: 53.6 ft, msl SWN: 006N004W27L002
Subarea: Napa Valley Floor-Napa Source: DWR Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/7/2018

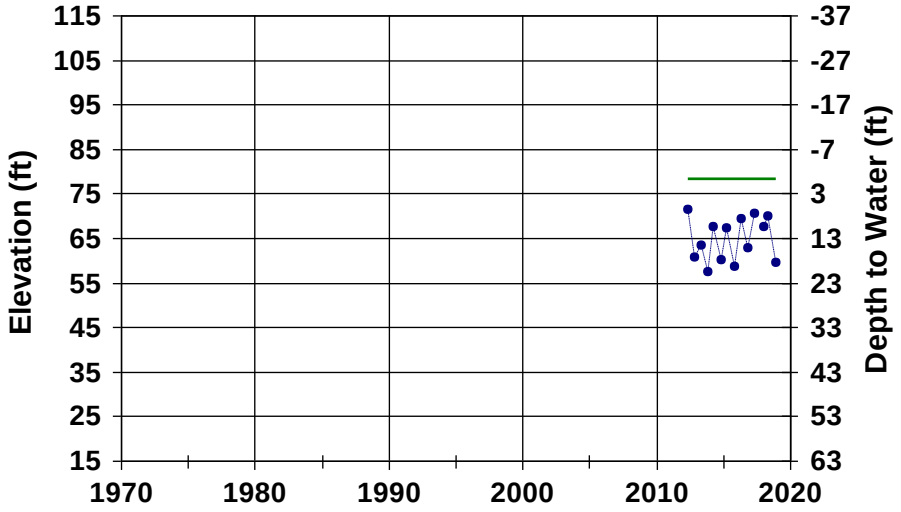



**WellID: NapaCounty-136** RPE: 53.2 ft, msl SWN: 006N004W27N001
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019

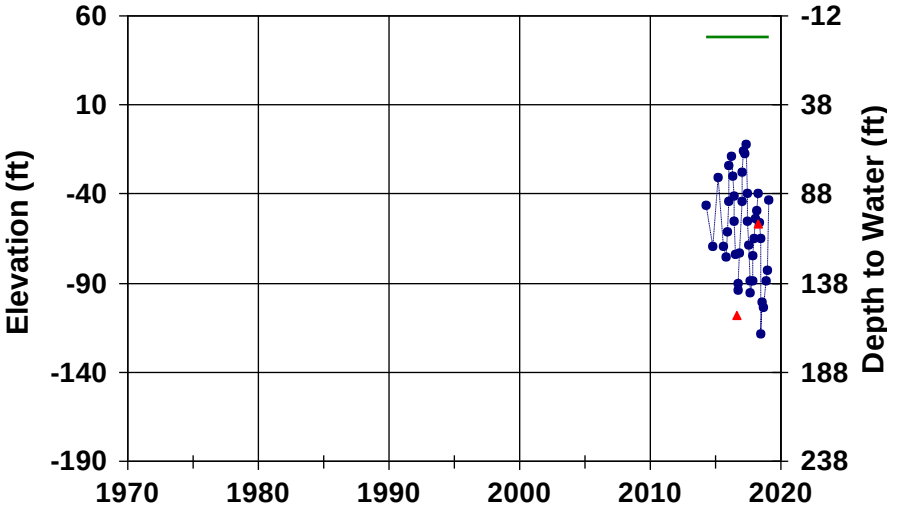



Measured Water Levels  Questionable Measurements  Reference Point Elevation

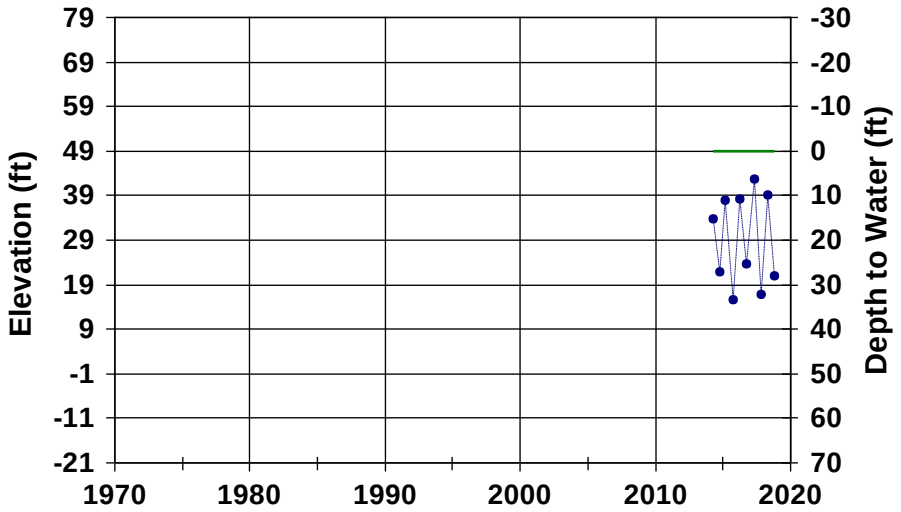
**WellID: NapaCounty-152** RPE: 78.3 ft, msl SWN: 006N004W28Mx
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/15/2018



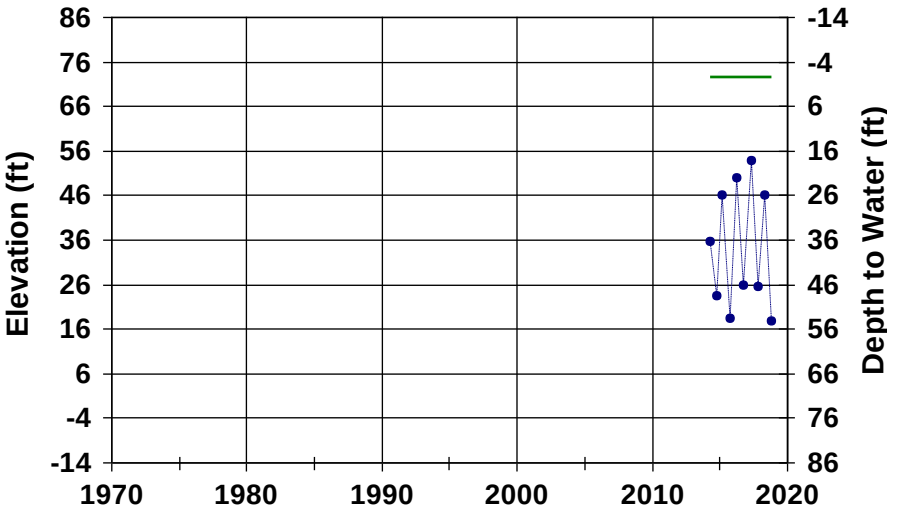

**WellID: NapaCounty-182** RPE: 48.1 ft, msl SWN: 006N004W22B00X
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019




**WellID: NapaCounty-183** RPE: 48.9 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa, Tsv?
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/25/2018

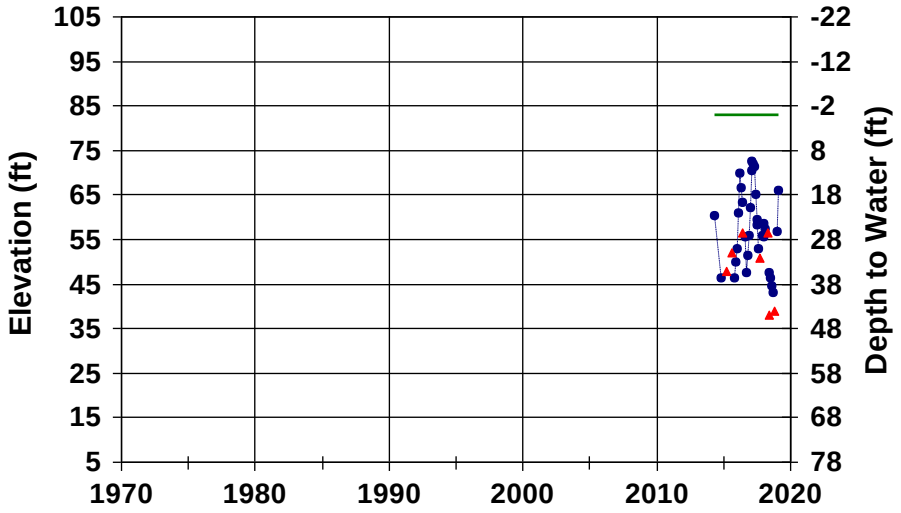



**WellID: NapaCounty-184** RPE: 72.5 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv, Tss/h?
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/30/2018

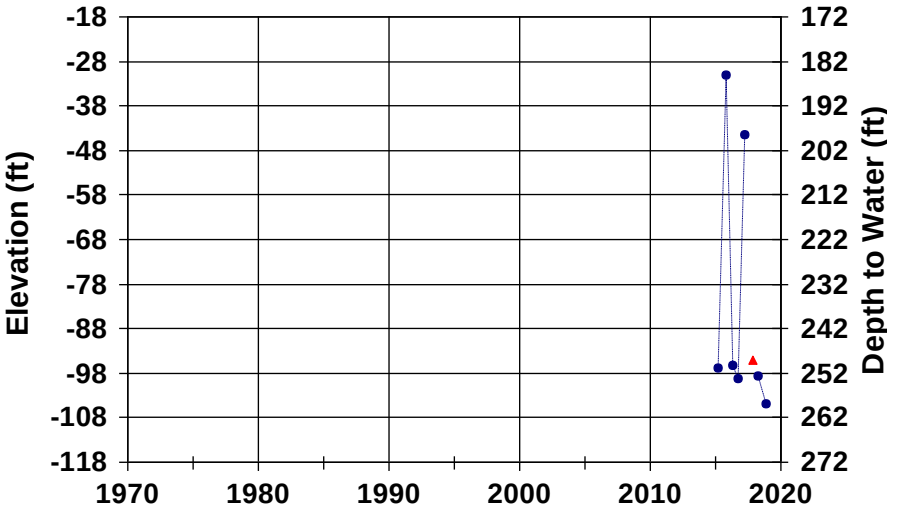



Measured Water Levels  Questionable Measurements  Reference Point Elevation

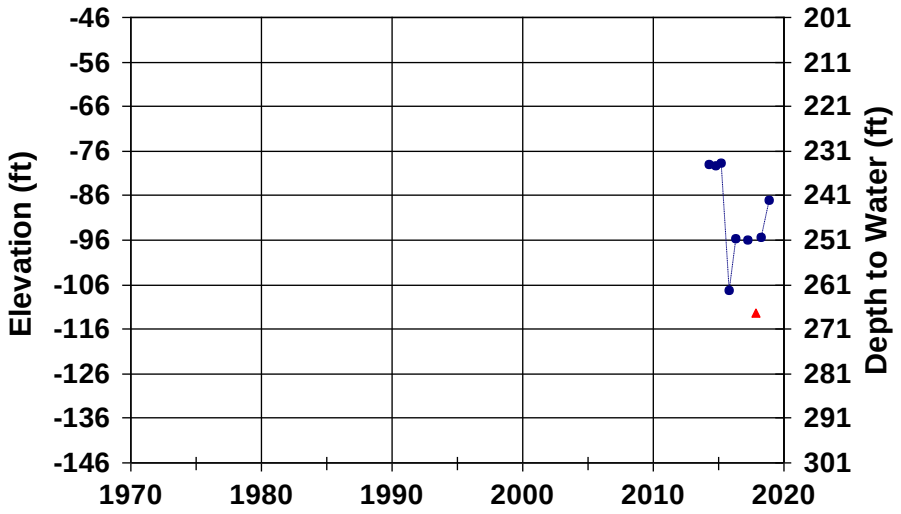
**WellID: NapaCounty-185** RPE: 83 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019



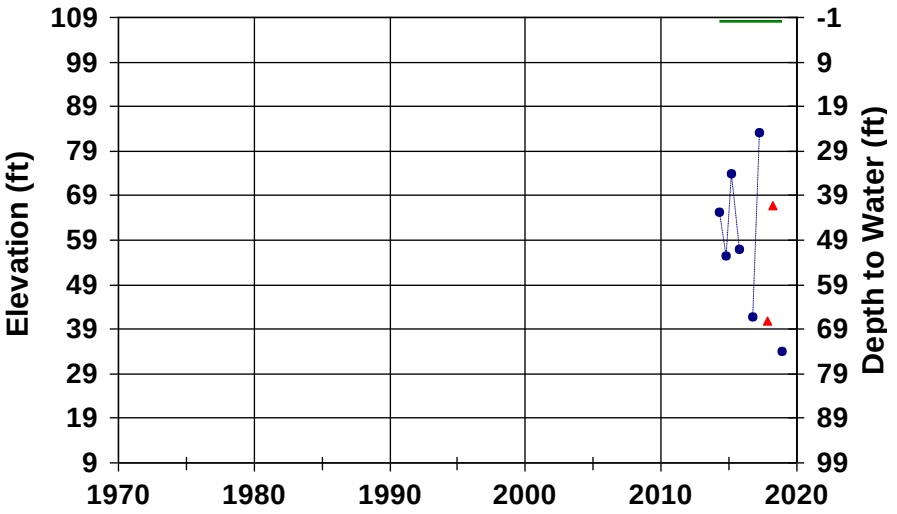

**WellID: NapaCounty-187** RPE: 153.5 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv?, KJgv?
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/19/2018




**WellID: NapaCounty-188** RPE: 154.6 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv, KJgv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/19/2018

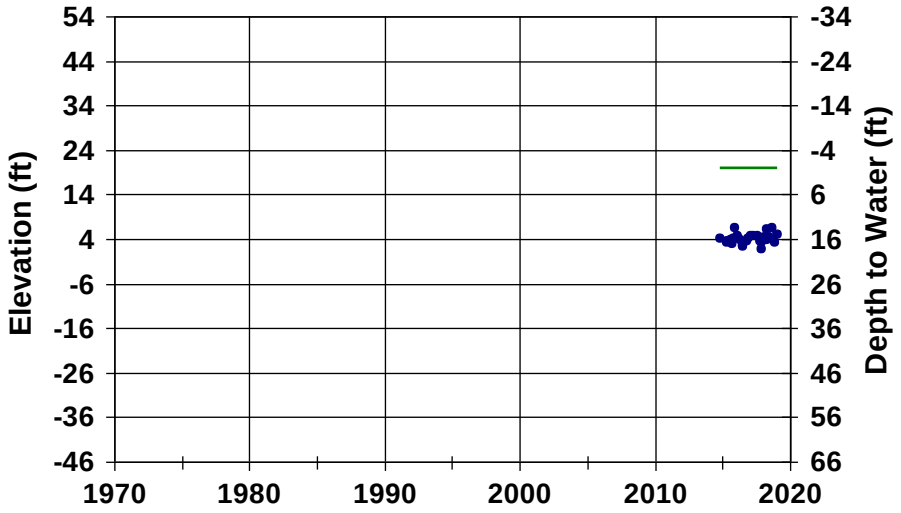



**WellID: NapaCounty-189** RPE: 108.25 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/19/2018

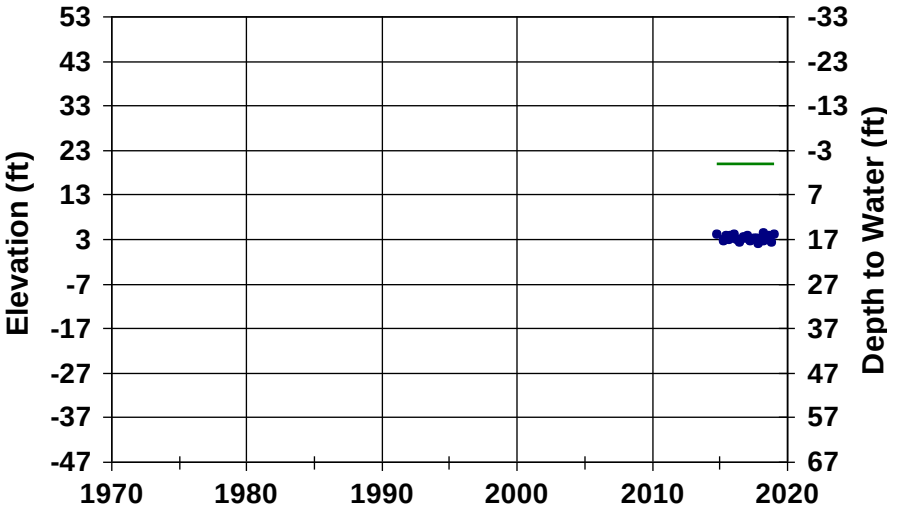



Measured Water Levels  Questionable Measurements  Reference Point Elevation

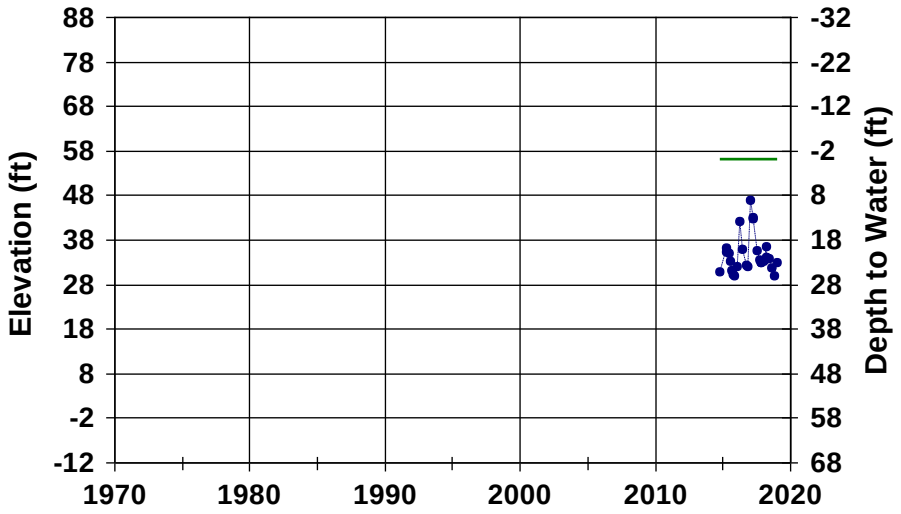
**WellID: NapaCounty-214s-swgw1** RPE: 20.12 ft, msl SWN: 05N04W02N002M
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018



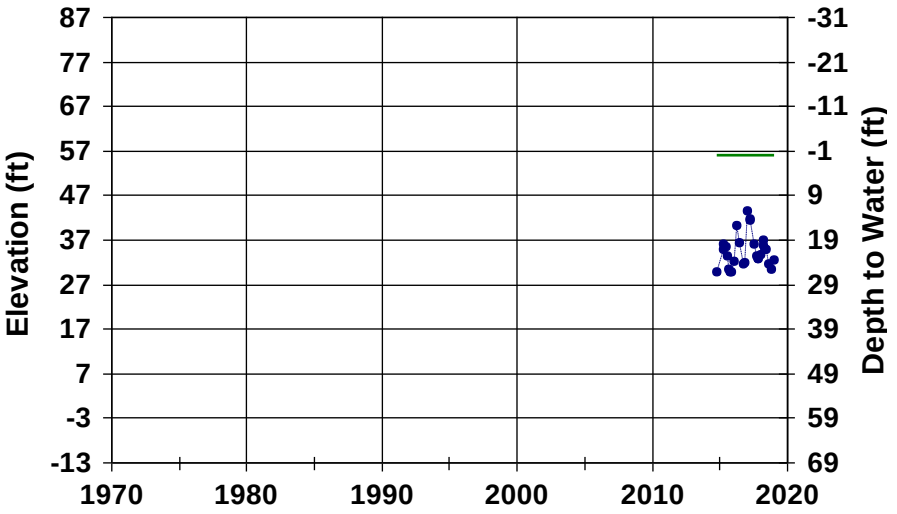

**WellID: NapaCounty-215d-swgw1** RPE: 20.07 ft, msl SWN: 05N04W02N001M
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018




**WellID: NapaCounty-218s-swgw3** RPE: 56.12 ft, msl SWN: 06N04W16G001M
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018

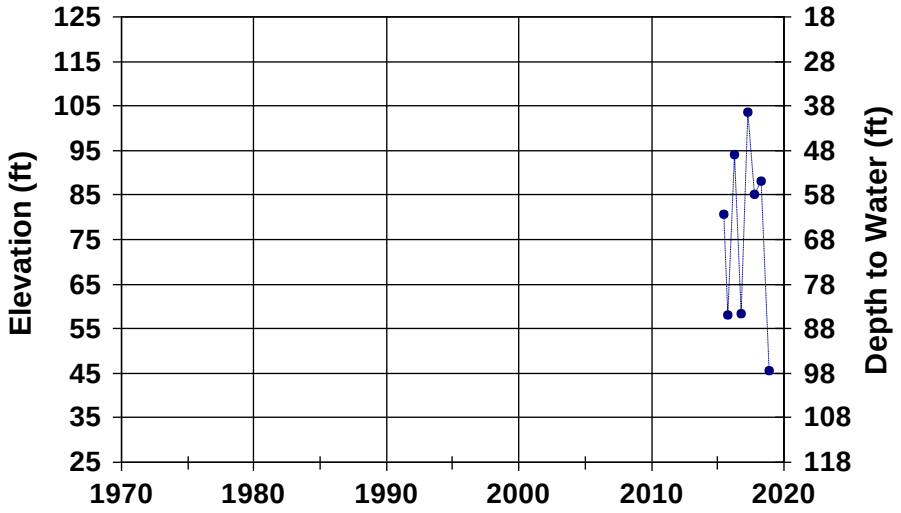



**WellID: NapaCounty-219d-swgw3** RPE: 56.14 ft, msl SWN: 06N04W16G002M
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018

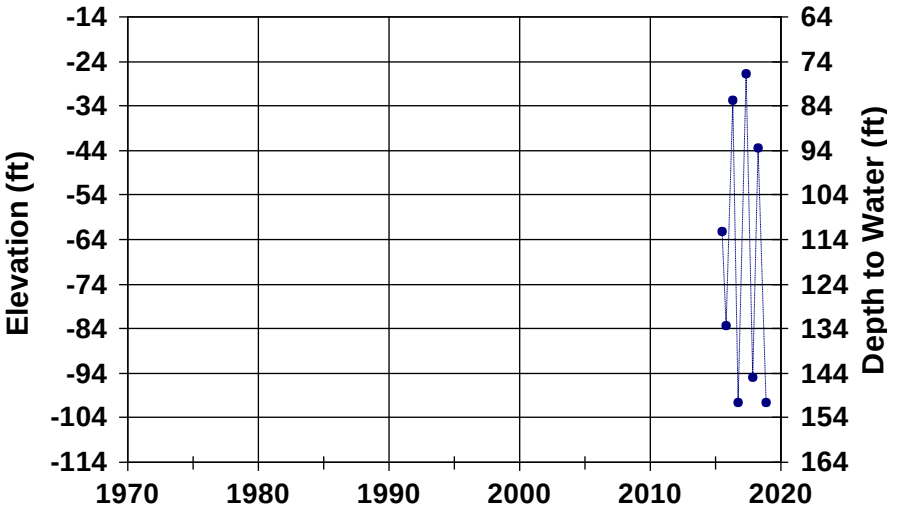



Measured Water Levels  Questionable Measurements  Reference Point Elevation

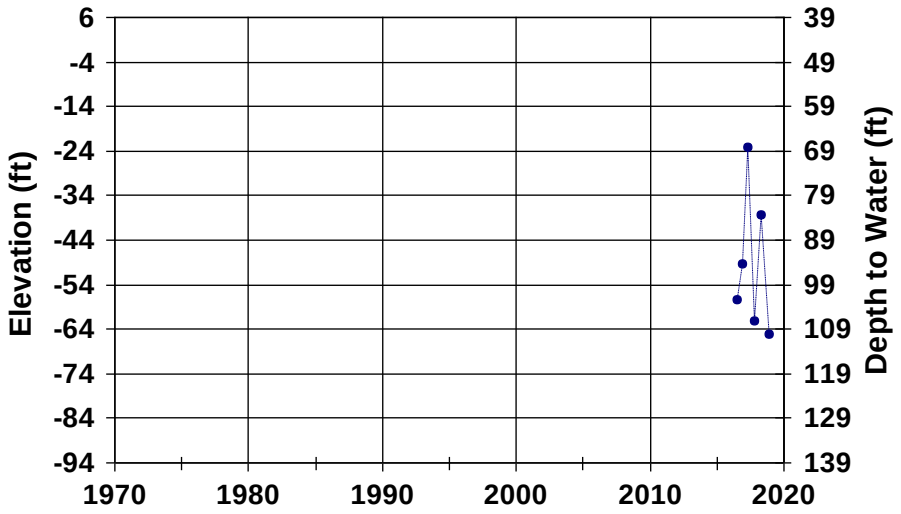
**WellID: NapaCounty-227** RPE: 143.3 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/19/2018



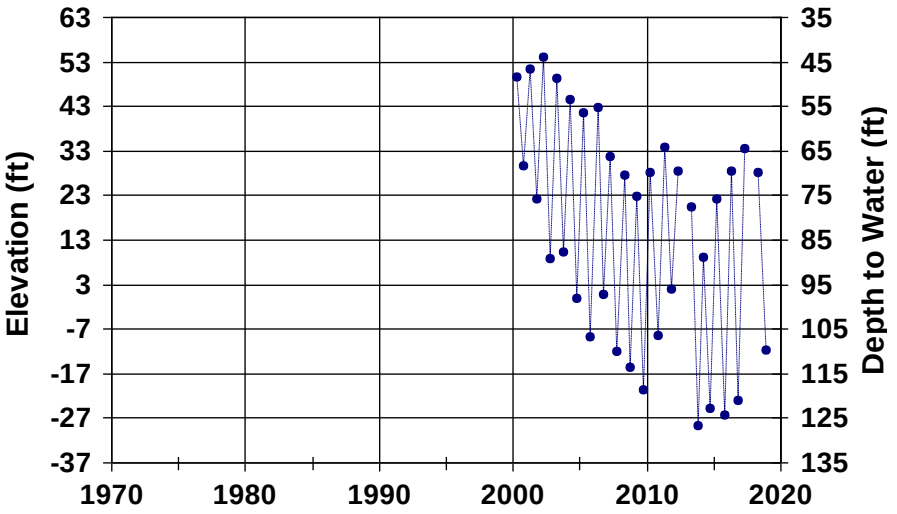

**WellID: NapaCounty-228** RPE: 50.2 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018




**WellID: NapaCounty-229** RPE: 45.07 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tss
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/19/2018

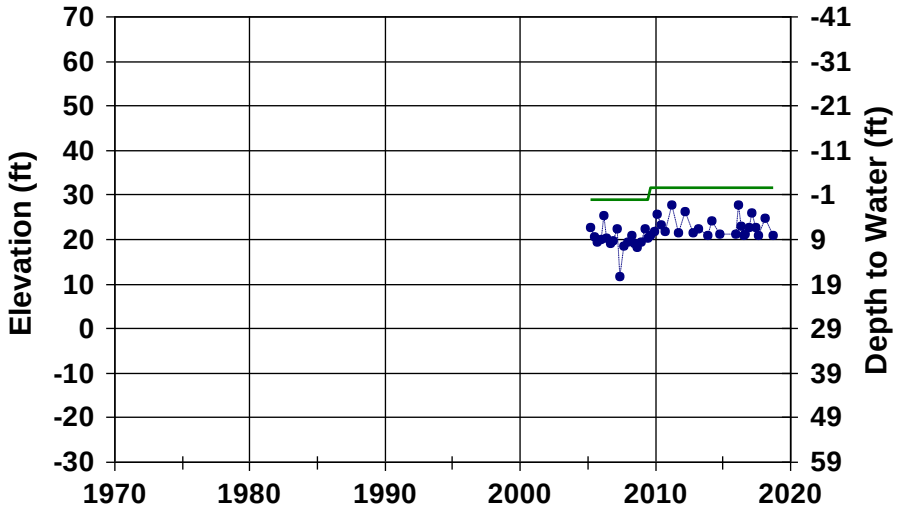



**WellID: NapaCounty-76** RPE: 97.7 ft, msl SWN: 006N004W15R003
Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018

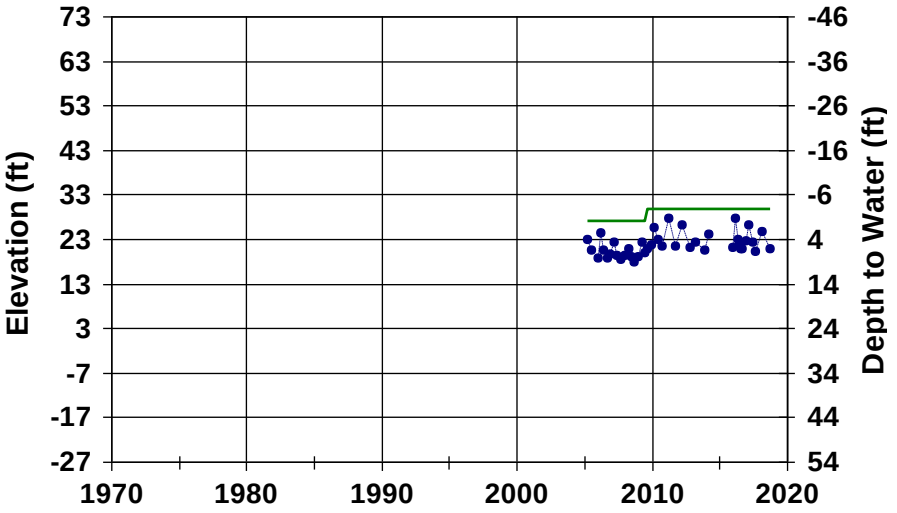



● Measured Water Levels ▲ Questionable Measurements ━ Reference Point Elevation

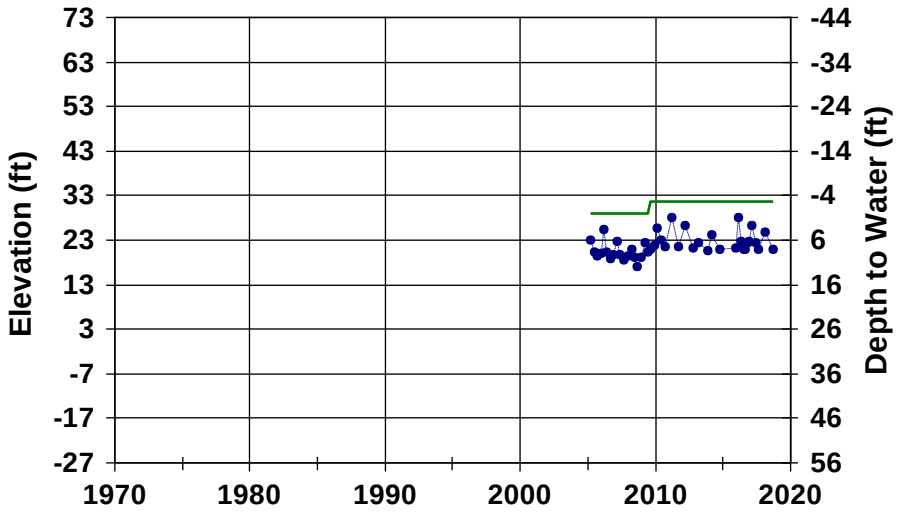
**WellID: SL0605536682MW-1** RPE: 31.63 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 9/10/2018



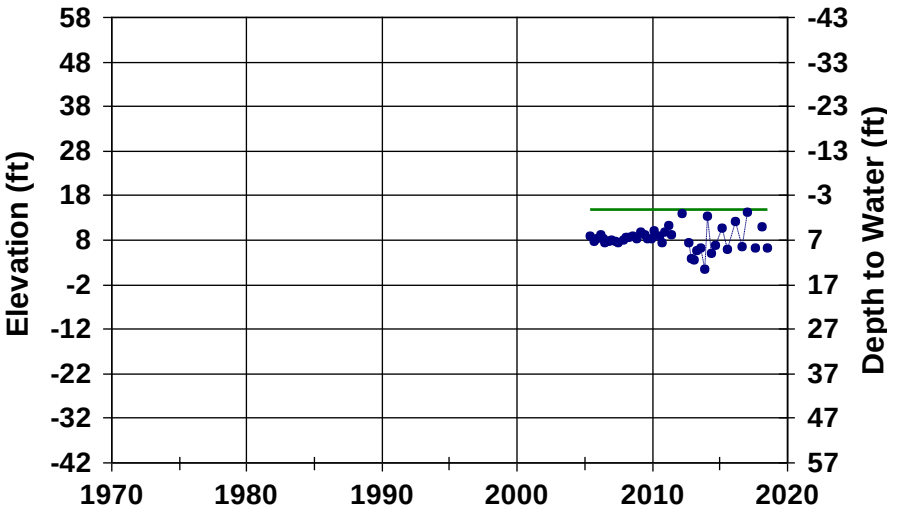

**WellID: SL0605536682MW-2** RPE: 27.24 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 9/10/2018




**WellID: SL0605536682MW-3** RPE: 28.86 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 9/10/2018

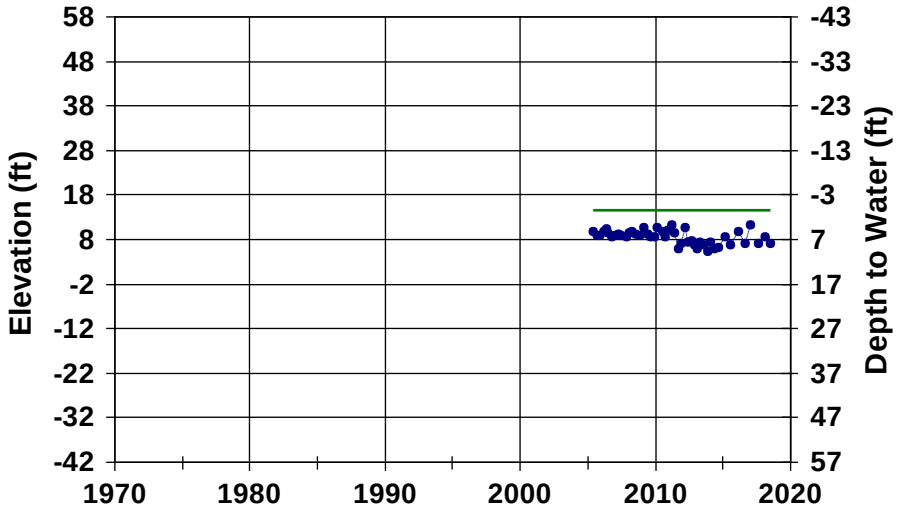



**WellID: T0605514064MW1** RPE: 14.72 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018

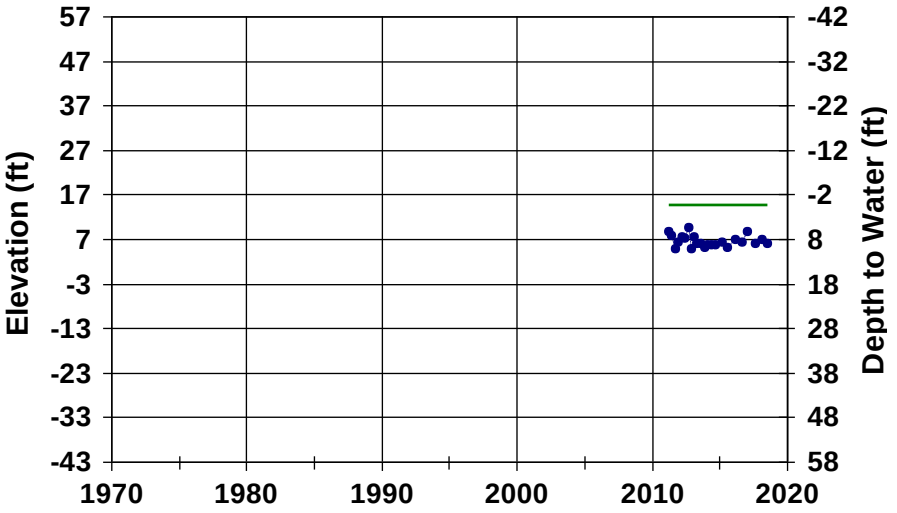



Measured Water Levels  Questionable Measurements  Reference Point Elevation

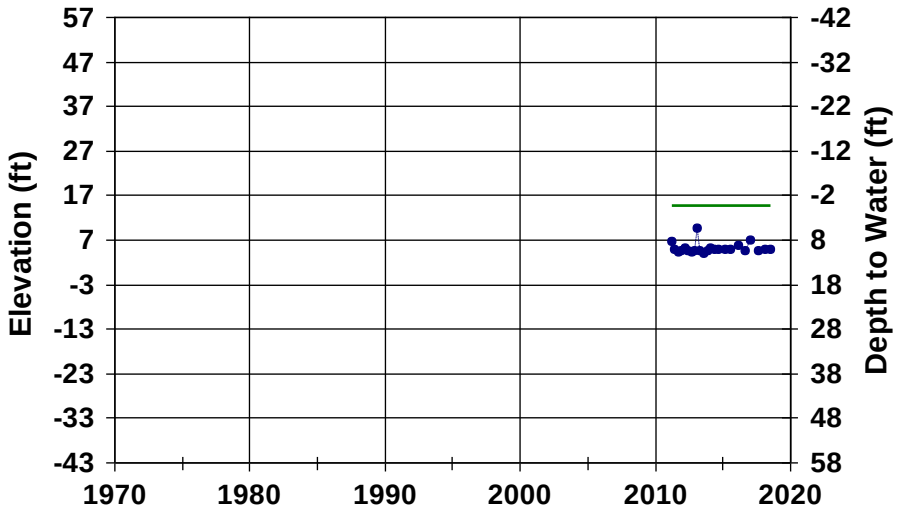
**WellID: T0605514064MW2** RPE: 14.61 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018



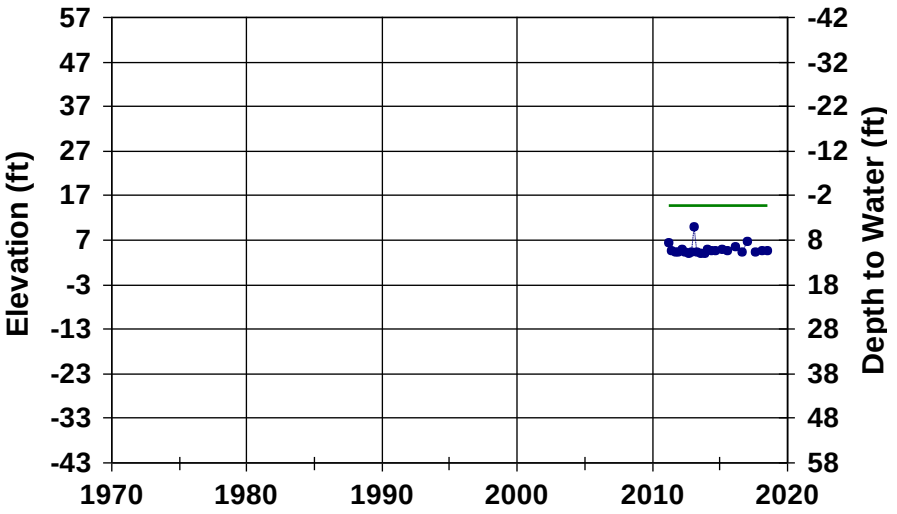

**WellID: T0605514064MW21A** RPE: 14.79 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018




**WellID: T0605514064MW21B** RPE: 14.85 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018

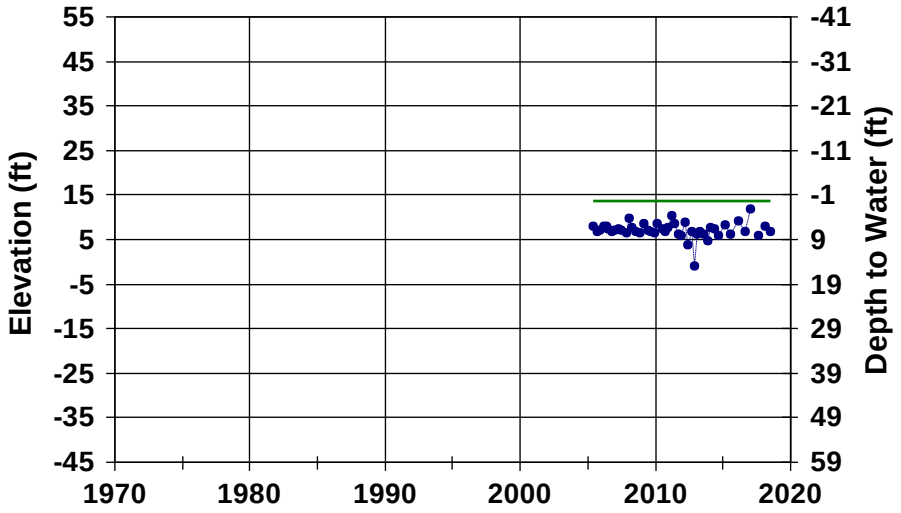



**WellID: T0605514064MW21C** RPE: 14.82 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018

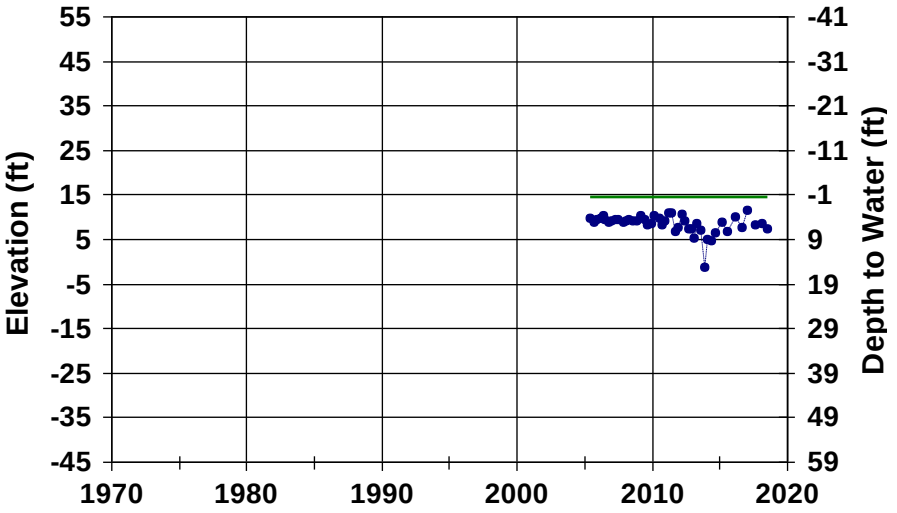



Measured Water Levels  Questionable Measurements  Reference Point Elevation

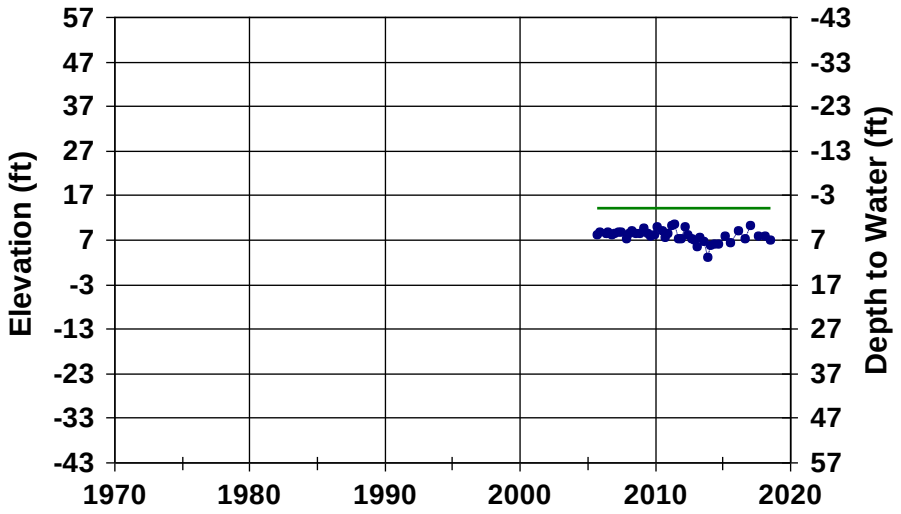
**WellID: T0605514064MW3** RPE: 13.68 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018



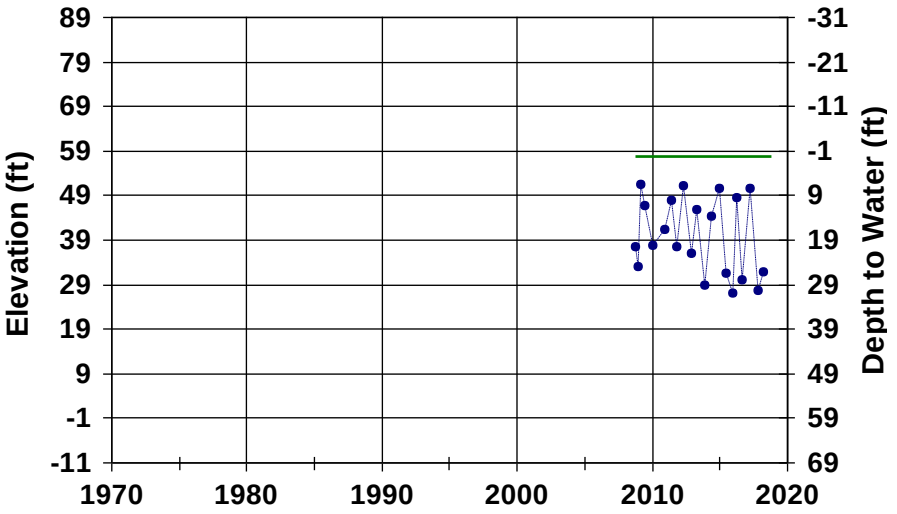

**WellID: T0605514064MW4** RPE: 14.4 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018




**WellID: T0605514064MW5** RPE: 14.09 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 7/16/2018

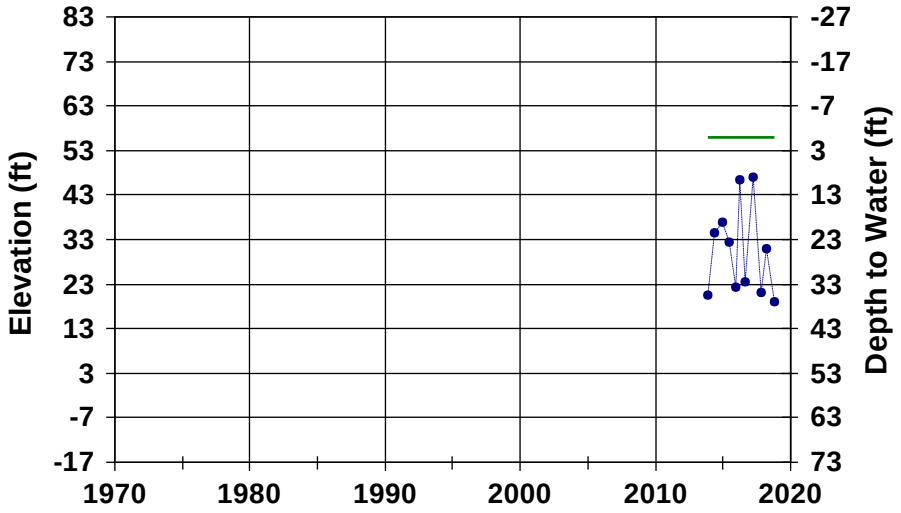



**WellID: T0605547200MW-1** RPE: 60.54 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 3/12/2018

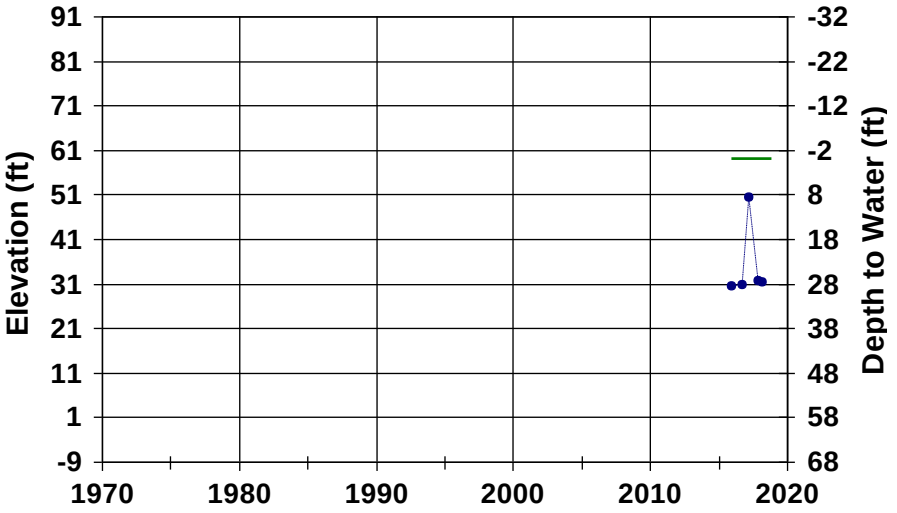



Measured Water Levels  Questionable Measurements  Reference Point Elevation

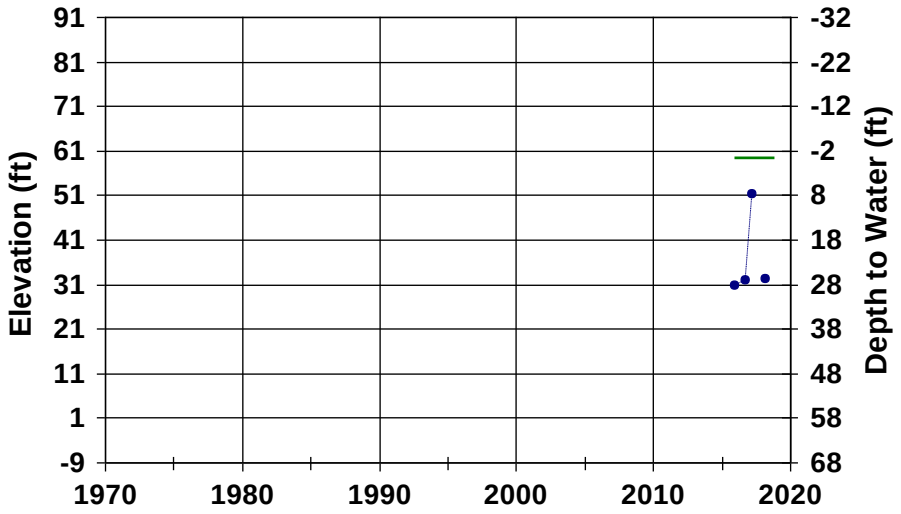
**WellID: T0605547200MW-8D** RPE: 55.87 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/24/2018



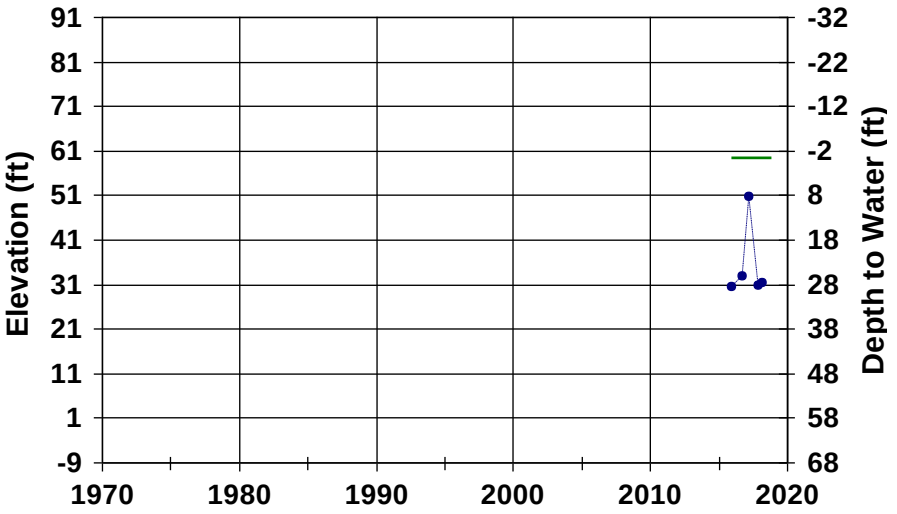

**WellID: T0605547200SVE-1** RPE: 59.16 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 3/12/2018




**WellID: T0605547200SVE-2** RPE: 59.43 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 3/12/2018

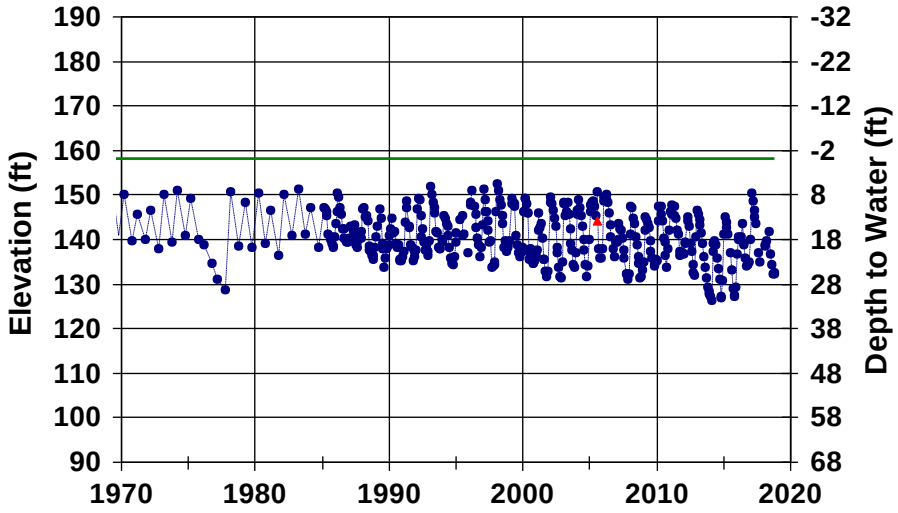



**WellID: T0605547200SVE-3** RPE: 59.33 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 3/12/2018

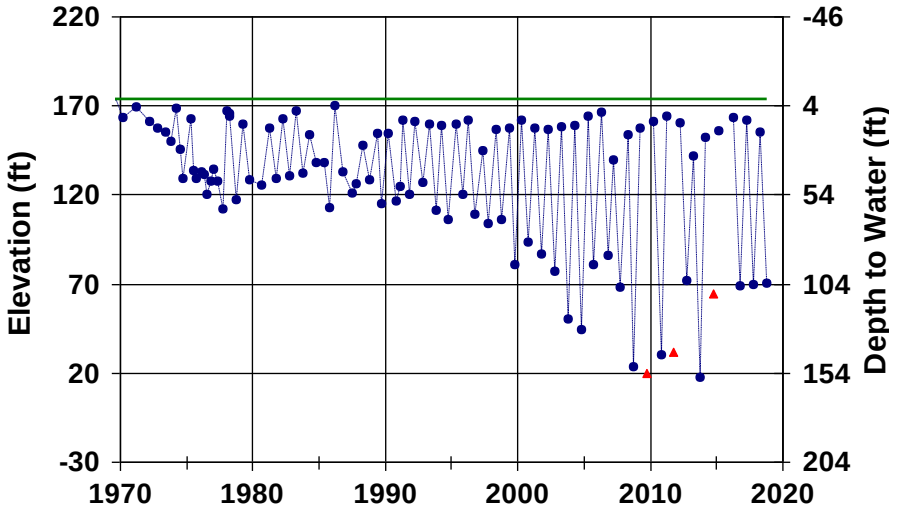



Measured Water Levels  Questionable Measurements  Reference Point Elevation

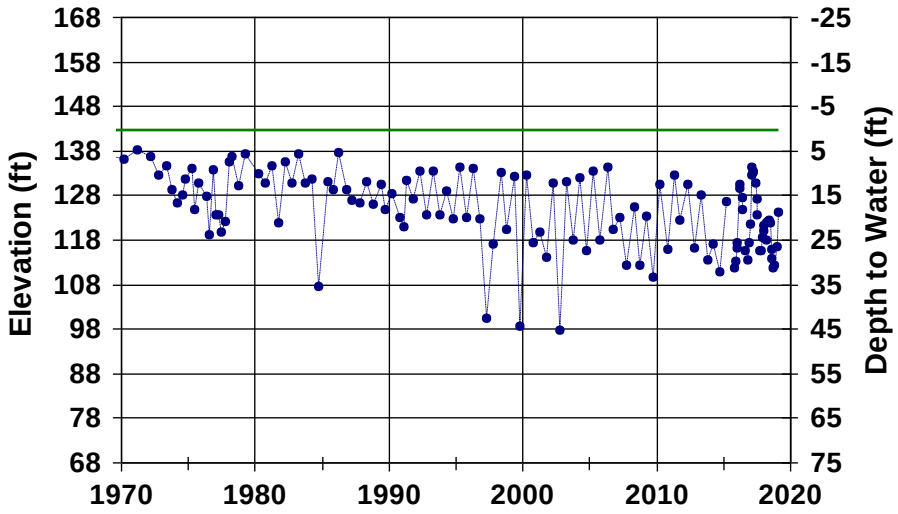
**WellID: 07N05W09Q002M** RPE: 158.24 ft, msl SWN: 007N005W09Q002
Subarea: Napa Valley Floor-St. Helena Source: DWR Aquifer Zone: Not Defined
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/7/2018



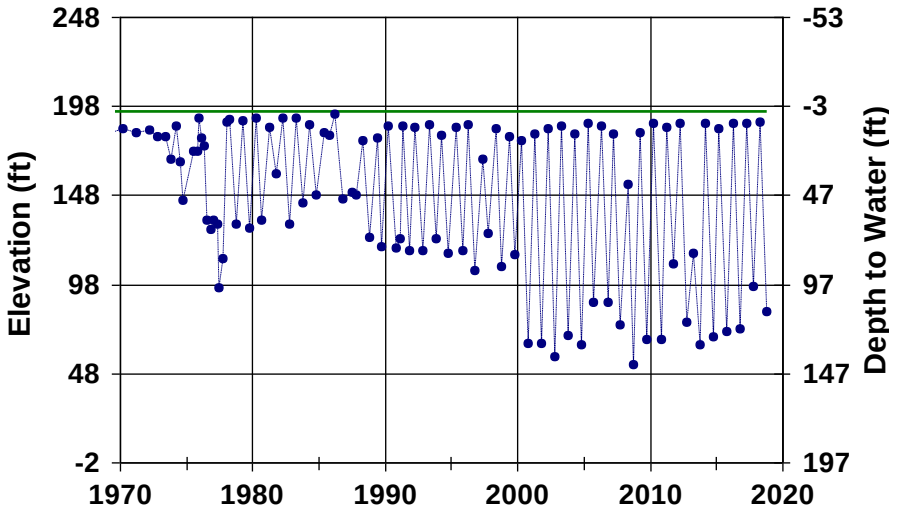

**WellID: NapaCounty-131** RPE: 173.5 ft, msl SWN: 007N005W16L001
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/24/2018




**WellID: NapaCounty-132** RPE: 142.7 ft, msl SWN: 007N005W14B002
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa, Tsvab
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019

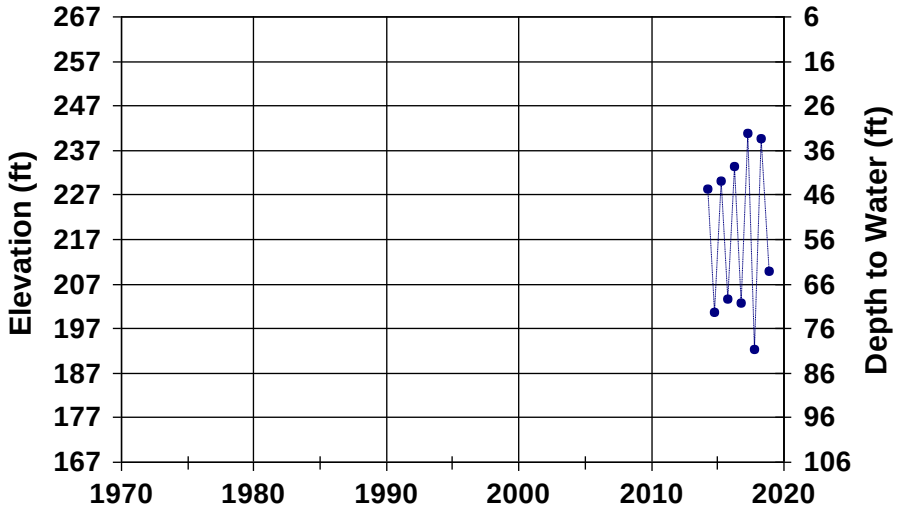



**WellID: NapaCounty-138** RPE: 195.1 ft, msl SWN: 007N005W16N002
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/24/2018

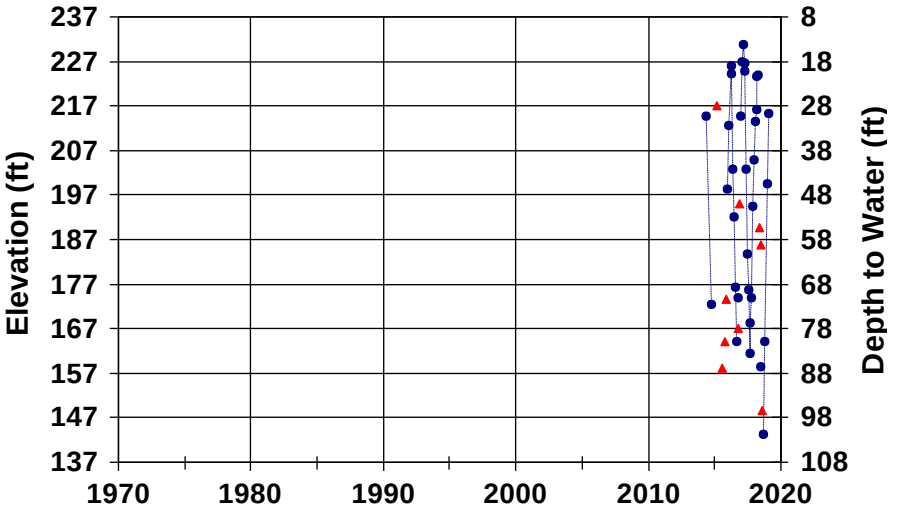



Measured Water Levels  Questionable Measurements  Reference Point Elevation

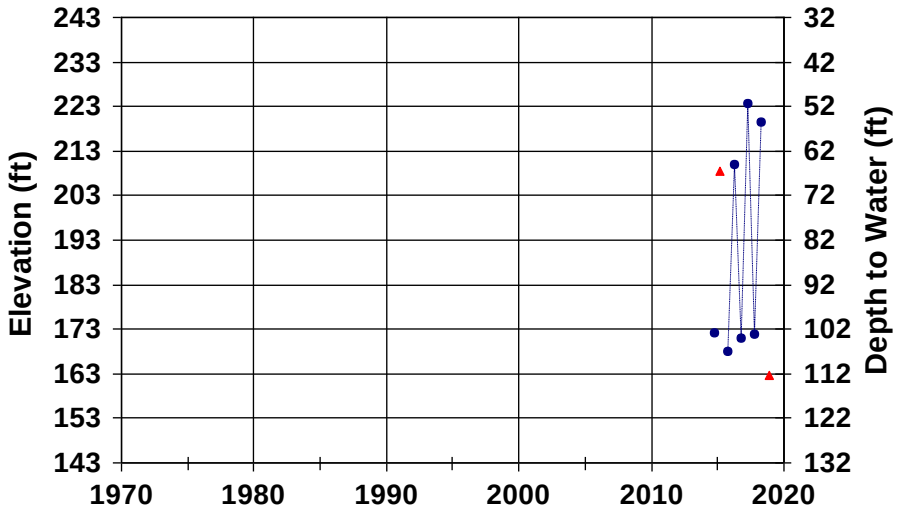
**WellID: NapaCounty-169** RPE: 273.4 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/29/2018



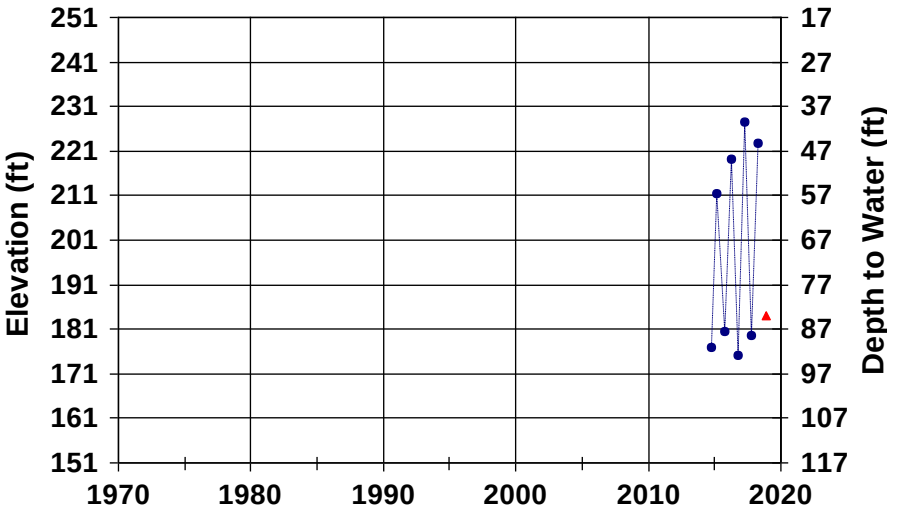

**WellID: NapaCounty-171** RPE: 245.1 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Tst/s
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019




**WellID: NapaCounty-172** RPE: 275.2 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/15/2018

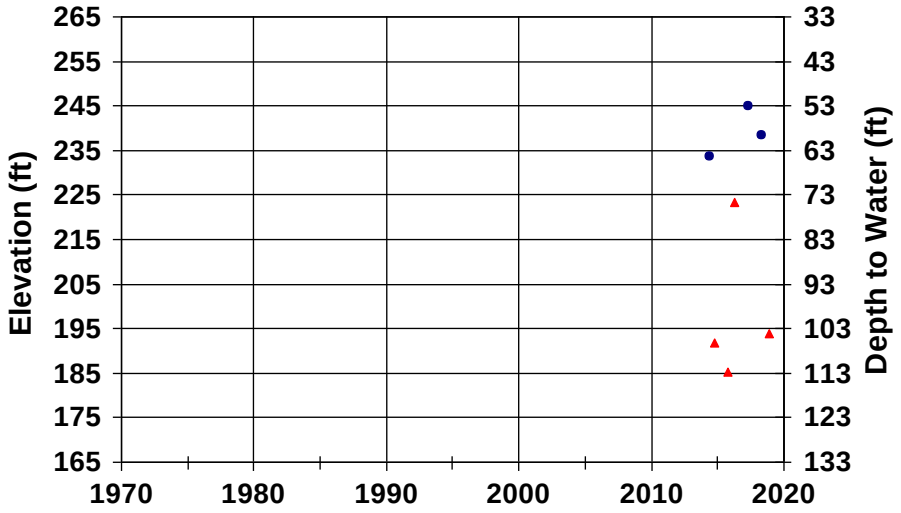



**WellID: NapaCounty-173** RPE: 268.3 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/15/2018

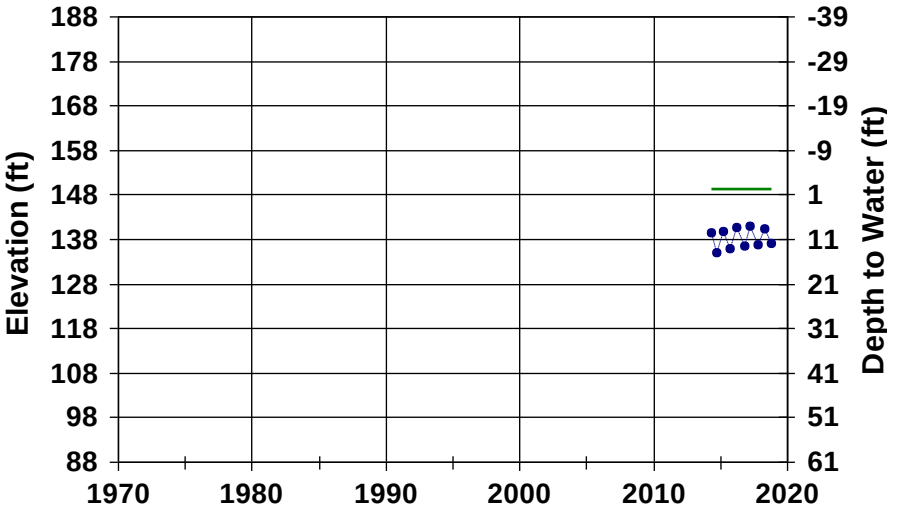



Measured Water Levels  Questionable Measurements  Reference Point Elevation

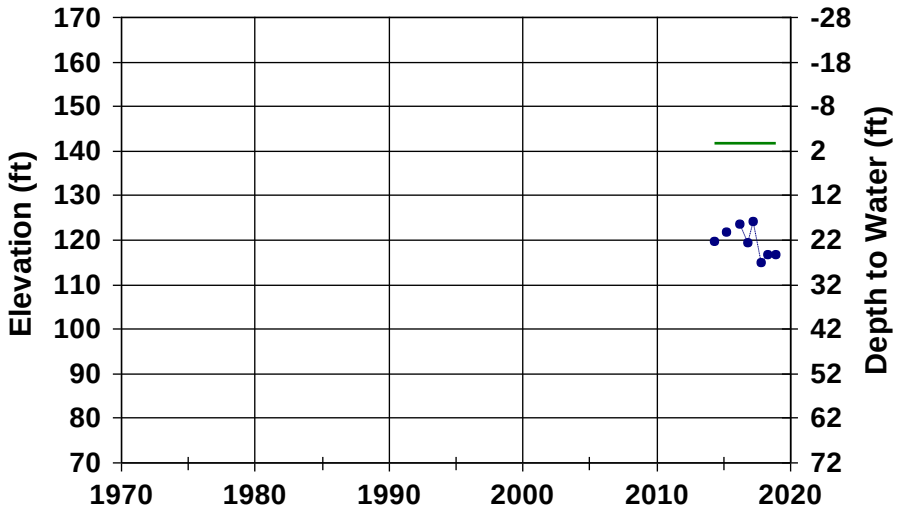
**WellID: NapaCounty-174** RPE: 298.2 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/15/2018



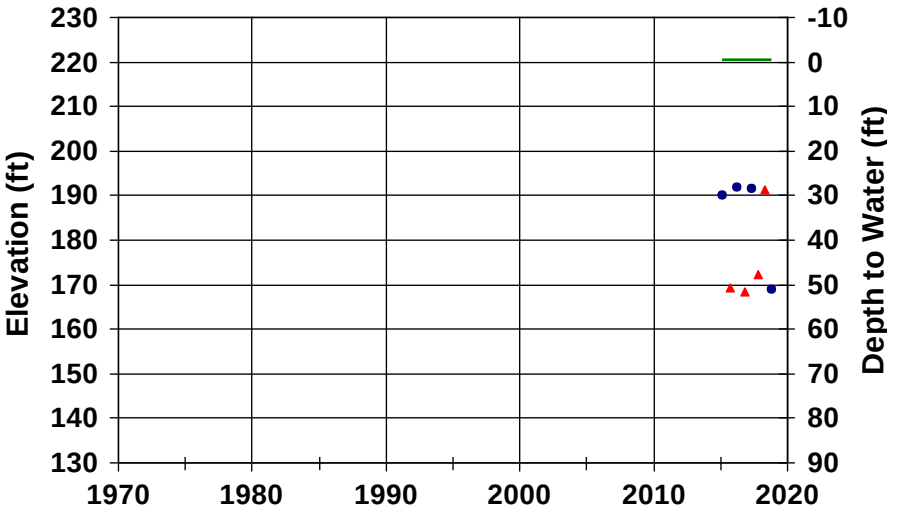

**WellID: NapaCounty-177** RPE: 149.3 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/29/2018




**WellID: NapaCounty-204** RPE: 141.7 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018

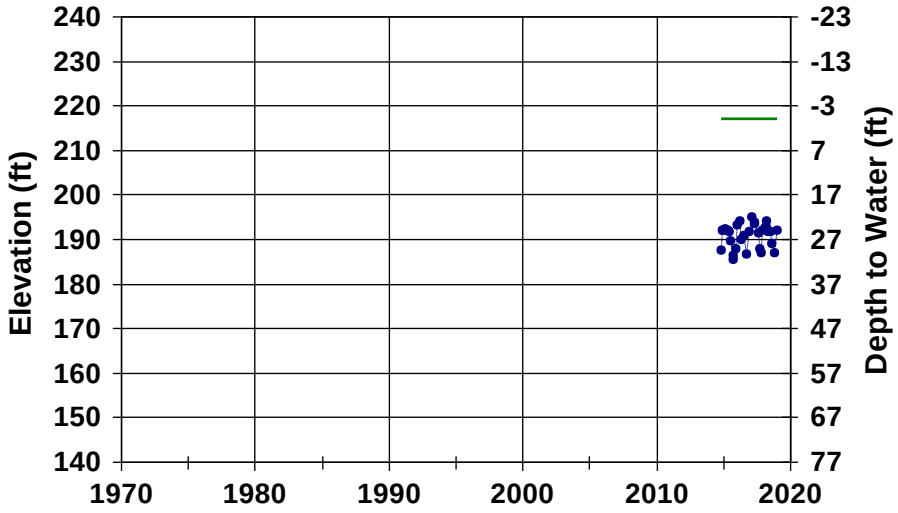



**WellID: NapaCounty-212** RPE: 220.5 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/24/2018

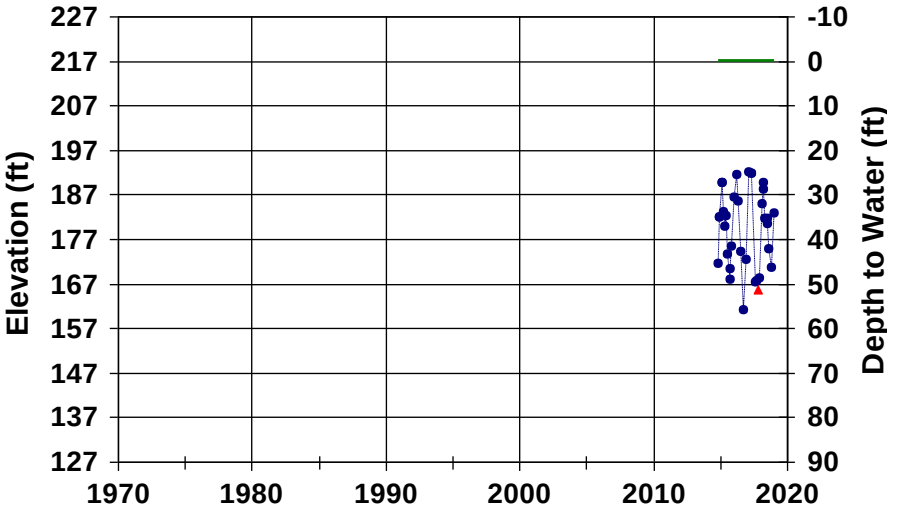



Measured Water Levels  Questionable Measurements  Reference Point Elevation

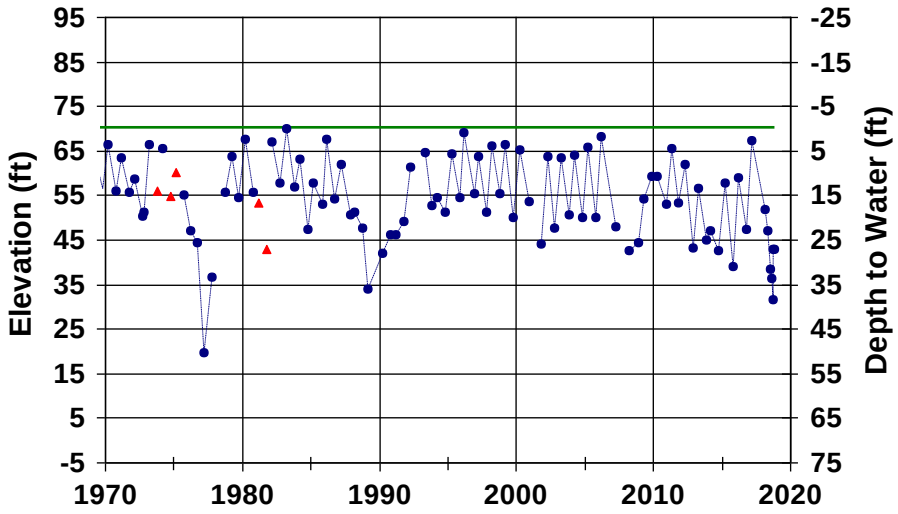
**WellID: NapaCounty-222s-swgw5** RPE: 217.07 ft, msl SWN: 08N05W30Q001M
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018



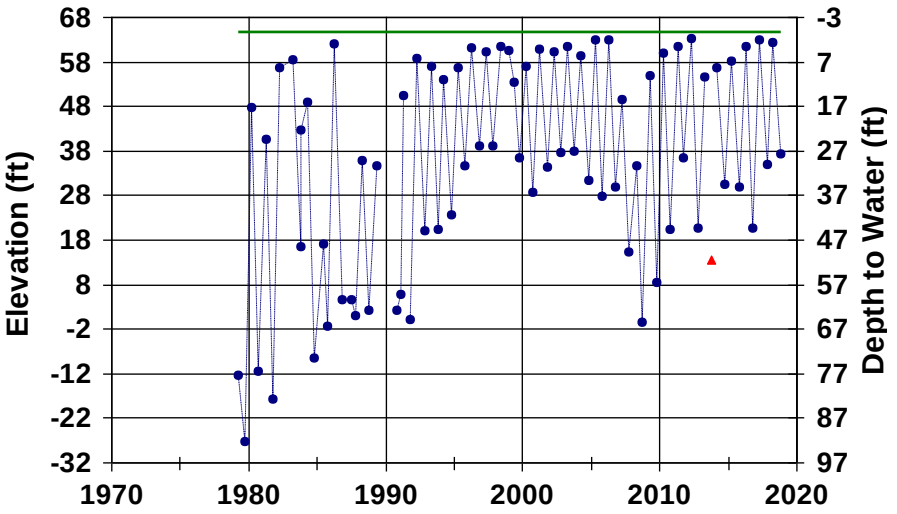

**WellID: NapaCounty-223d-swgw5** RPE: 217.1 ft, msl SWN: 08N05W30Q002M
Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018




**WellID: 06N04W17A001M** RPE: 70.26 ft, msl SWN: 006N004W17A001
Subarea: Napa Valley Floor-Yountville Source: DWR Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/7/2018

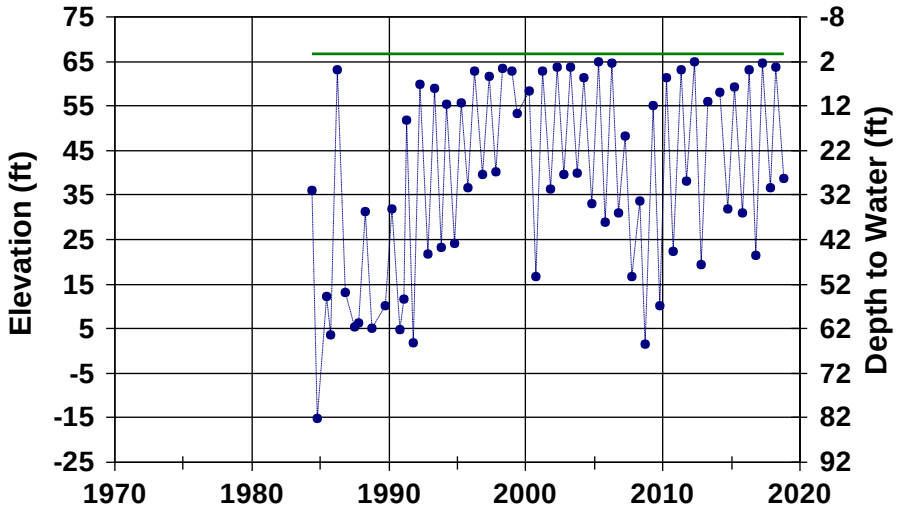



**WellID: NapaCounty-125** RPE: 64.6 ft, msl SWN: 006N004W09Q001
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Tsva
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018

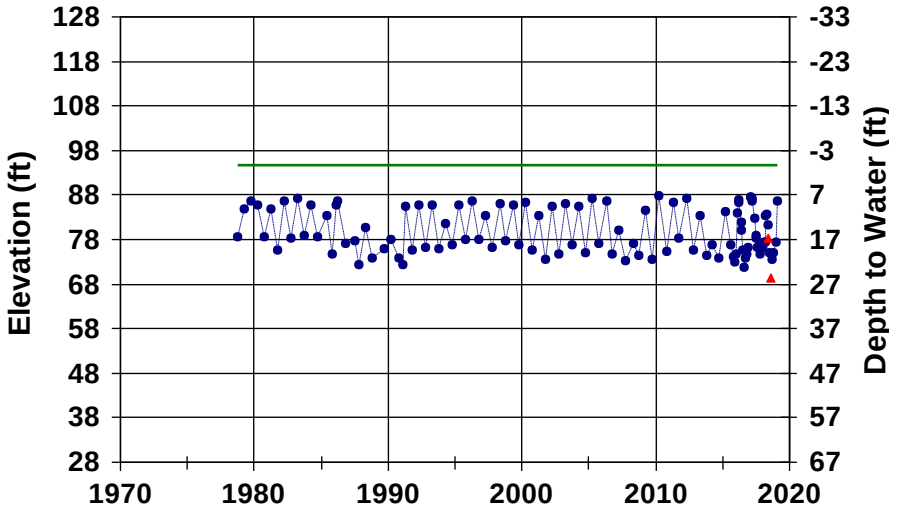



Measured Water Levels  Questionable Measurements  Reference Point Elevation

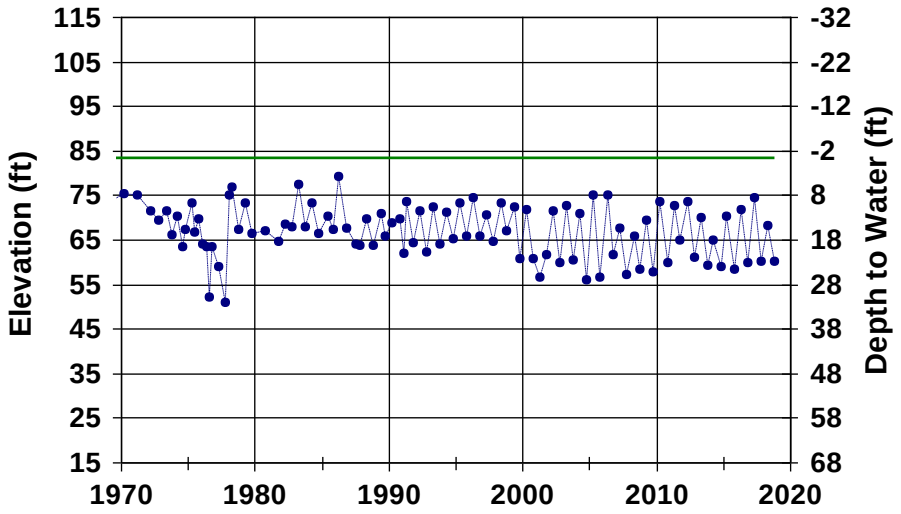
**WellID: NapaCounty-126** RPE: 66.7 ft, msl SWN: 006N004W09Q002
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Tsva
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/16/2018



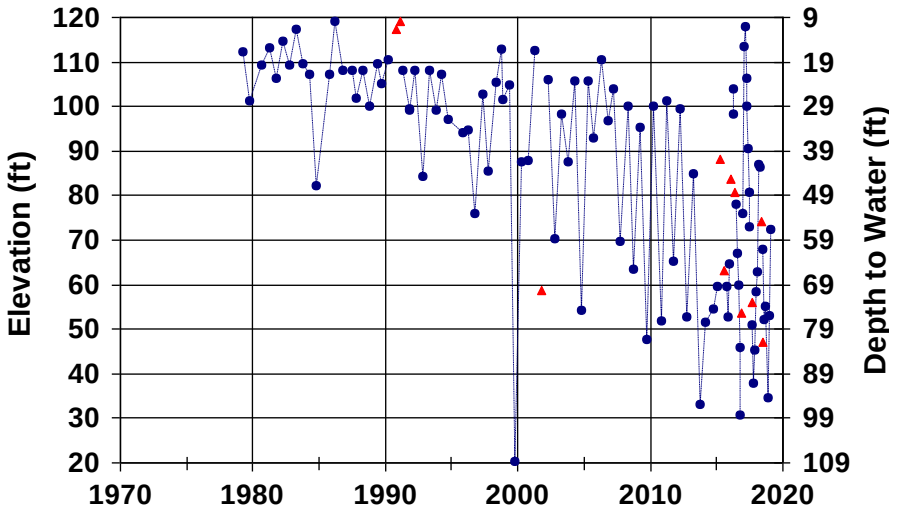

**WellID: NapaCounty-133** RPE: 94.7 ft, msl SWN: 007N004W31M001
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019




**WellID: NapaCounty-134** RPE: 83.4 ft, msl SWN: 006N004W06L002
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/25/2018

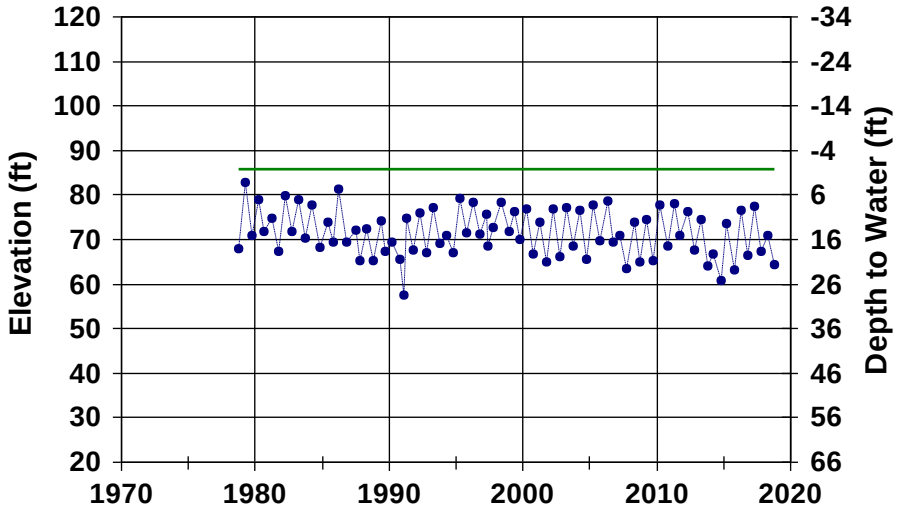



**WellID: NapaCounty-135** RPE: 129.2 ft, msl SWN: 006N004W19B001
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa, Tsv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 1/30/2019

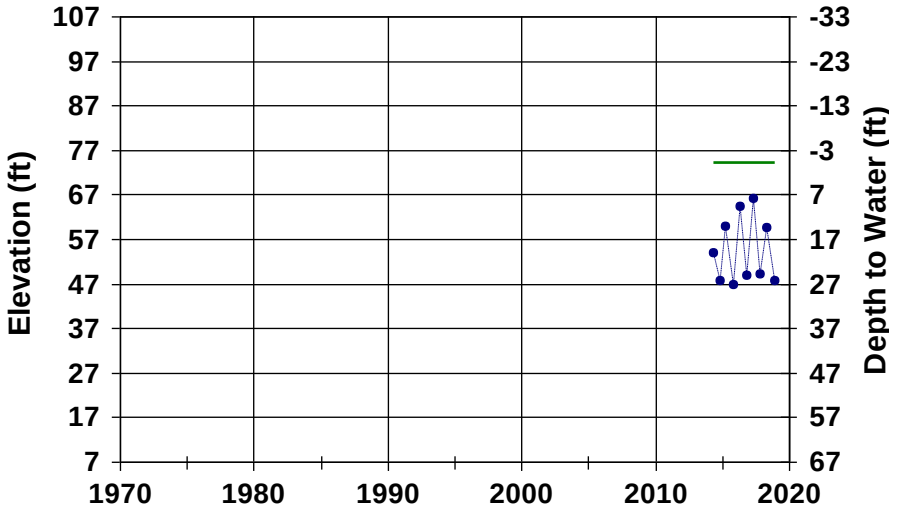



● Measured Water Levels ▲ Questionable Measurements ━ Reference Point Elevation

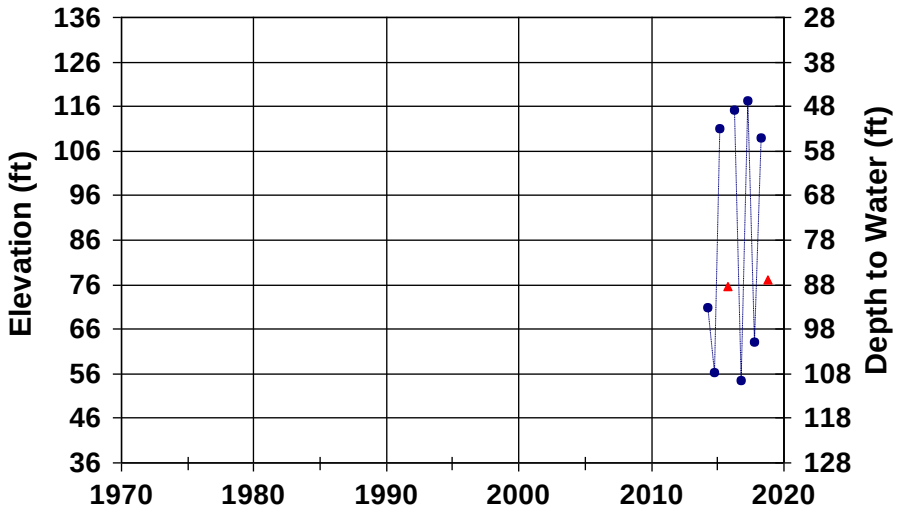
**WellID: NapaCounty-139** RPE: 85.8 ft, msl SWN: 006N004W17R002
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/25/2018



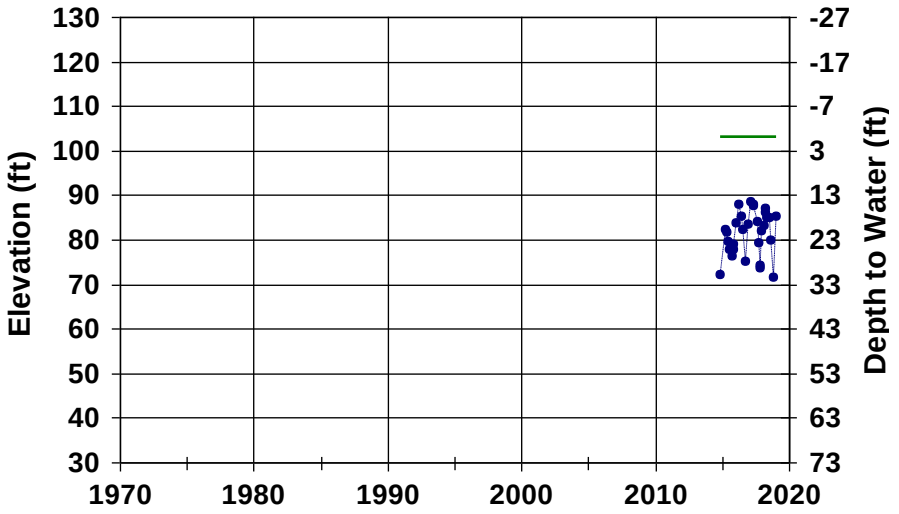

**WellID: NapaCounty-179** RPE: 74.3 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 11/15/2018




**WellID: NapaCounty-181** RPE: 163.6 ft, msl SWN: Unknown
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Tsv
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/29/2018

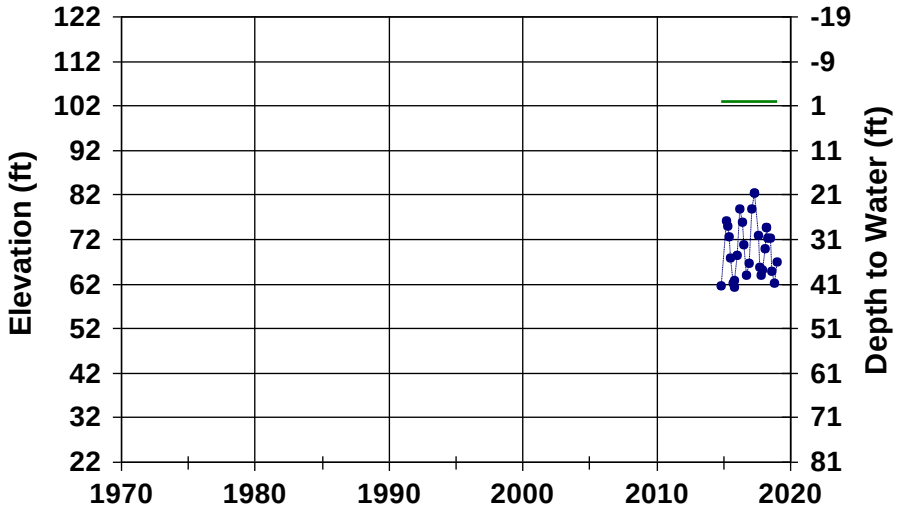



**WellID: NapaCounty-216s-swgw2** RPE: 103.1 ft, msl SWN: 06N04W18J003M
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018

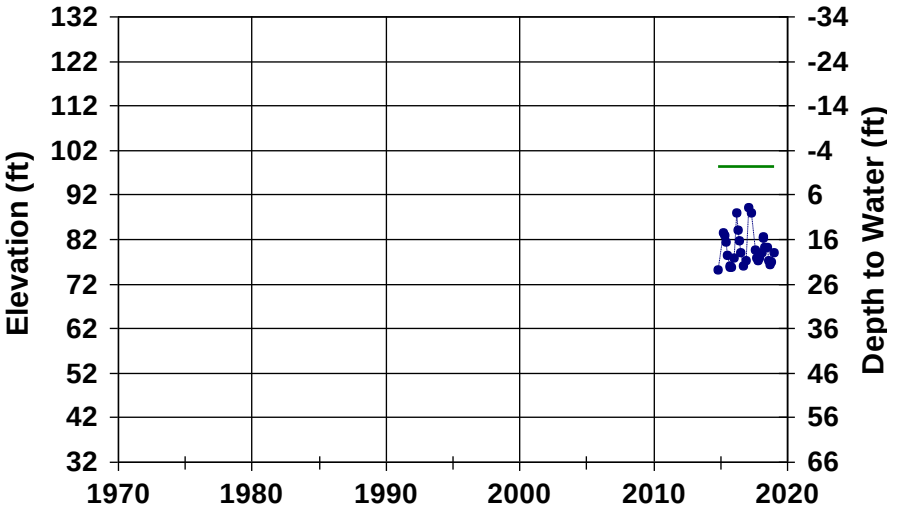



Measured Water Levels  Questionable Measurements  Reference Point Elevation

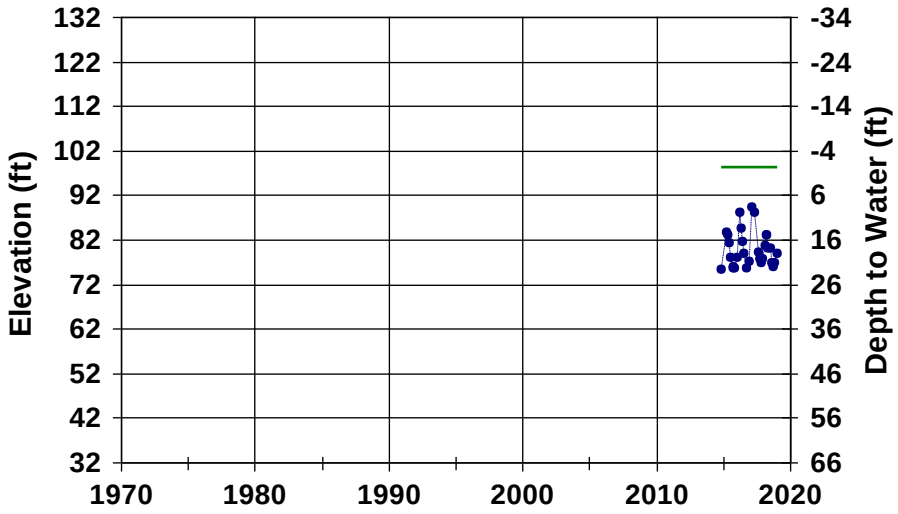
**WellID: NapaCounty-217d-swgw2** RPE: 103.08 ft, msl SWN: 06N04W18J004M
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018



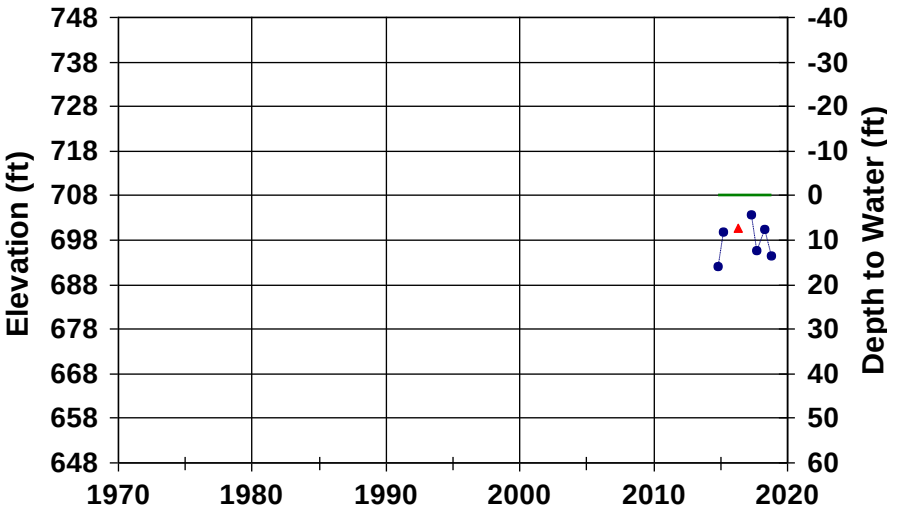

**WellID: NapaCounty-220s-swgw4** RPE: 98.22 ft, msl SWN: 07N04W31D001M
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018




**WellID: NapaCounty-221d-swgw4** RPE: 98.28 ft, msl SWN: 07N04W31D002M
Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 12/21/2018

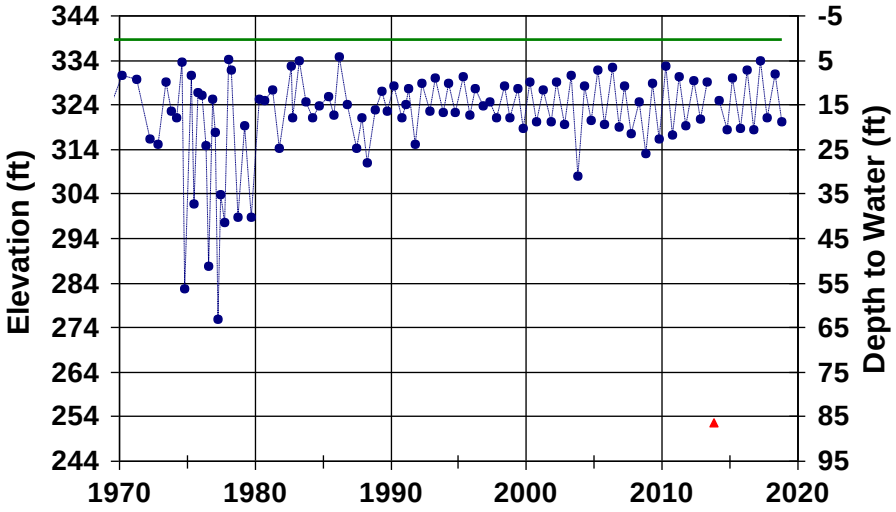



**WellID: NapaCounty-211** RPE: 708.2 ft, msl SWN: Unknown
Subarea: Pope Valley Source: NapaCounty Aquifer Zone:
Groundwater Basin POPE VALLEY BASIN Last Msmt Date 10/15/2018

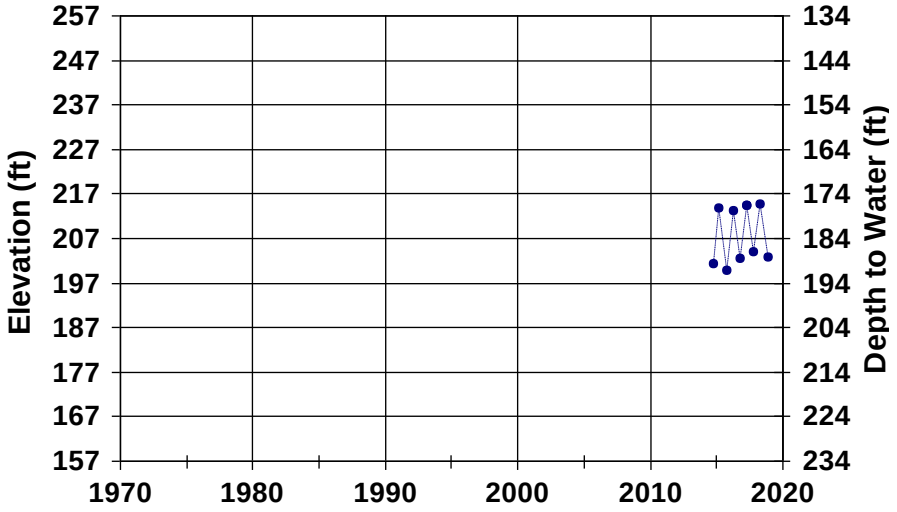



● Measured Water Levels ▲ Questionable Measurements ━ Reference Point Elevation

**WellID: NapaCounty-129** RPE: 338.7 ft, msl SWN: 008N006W06L004
Subarea: Western Mountains Source: NapaCounty Aquifer Zone:
Groundwater Basin NAPA VALLEY SUBBASIN Last Msmt Date 10/17/2018




**WellID: NapaCounty-213** RPE: 390.8 ft, msl SWN: Unknown
Subarea: Western Mountains Source: NapaCounty Aquifer Zone:
Groundwater Basin Not within a basin Last Msmt Date 11/5/2018




Measured Water Levels  Questionable Measurements  Reference Point Elevation

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# APPENDIX C

## Napa County Procedure for Measuring Groundwater Levels

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# NAPA COUNTY PROCEDURE FOR MEASURING

# THE DEPTH TO WATER IN MONITORING AND PRODUCTION WELLS

## Purpose

To obtain an accurate dated and timed measurement of the static depth to water in a well that can be converted into a water level elevation in reference to a commonly used reference datum (e.g., NAVD 1988). In this context, static means that the water level in the well is not influenced by pumping of the well. For comparability, measurements should be obtained according to an established schedule designed to capture times of both highest and lowest seasonal water level elevations. Also for comparability, measurements during a particular field campaign should be obtained consecutively and without delay within the shortest reasonable time.

## Measurement Procedure

- If well is being pumped, do not measure; return later, but not sooner than 60 minutes and preferably after 24 hours (see below "Special Circumstances – Pumping Water Level on Arrival" for additional instructions).
- Turn on water level indicator signaling device and check battery by hitting the test button.
- Remove access plug or well cap from the well cover and lower probe (electric sounder) into the well.
- When probe hits water a loud "beep" will sound and signal light will turn red.
- Retract slightly until the tone stops.
- Slowly lower the probe until the tone sounds.
- Note depth measurement at rim (i.e., the surveyed reference point for water level readings) of well to the nearest 0.01 foot and rewind probe completely out of well.
- Remove excess water and lower probe once again into well and measure again.
- If difference is within ±0.02 foot of first measurement, record measurement.
- If difference is greater repeat the same procedure until three consecutive measurements are recorded within ± 0.02 foot.
- Rewind and remove probe from well and replace the access plug or well cap in the well cover.
- Clean and dry the measuring device/probe and continue to next well.

## Special Circumstances

### Oil Encountered in Well

If oil is detected in the well structure, the depth to the air-oil interface is measured. To obtain such a measurement, the electric sounder is used similar to the way chalked steel tapes were traditionally used for depth-to-water measurements.

1. Lower the cleaned probe well below the air-oil interface (e.g., 1 foot). Read and record the depth at the reference point (since this depth is chosen somewhat arbitrarily by the field technician, an even number can be chosen, e.g., 37.00 feet). This measurement is the length of cable lowered into the well and corresponds to a line that the oil leaves on the probe or cable (i.e., the oil inundation line). Above this line, smudges of oil may appear on the cable. Below this line, the cable/probe is completely covered with oil. If the probe is lowered too far, completely penetrates the oil, and is far submerged in the water below the oil, parts of the probe/cable below the oil inundation line may also appear smudgy.
2. Retrieve probe, identify and record the oil inundation line on the cable (e.g., 2.72 feet). This measurement does not reflect the thickness of the oil. It reflects the length of the cable below the air-oil interface.
3. Compute the depth to oil by subtracting the length of line below the air-oil interface from the corresponding measurement at the reference point: Depth to oil = 37.00 feet – 2.72 feet = 34.28 feet.

Since oil has a slightly smaller density than water, a depth-to-oil measurement will always be smaller than a corresponding depth-to-water measurement in the same well if oil were not present. Depth-to-oil measurements yield a reasonable approximation to depth-to-water measurements unless the oil thickness is great. For each foot of oil in the well casing, the depth-to-oil measurement will be approximately 0.12 foot smaller than a corresponding depth-to-water measurement if oil were not present.

### Pumping Water Level on Arrival

If well is being pumped, do not measure. Return later when the water level has stabilized. Using past field notes, the field technician will use his/her experience to determine the appropriate duration necessary for static measurements. Upon returning to the well site (at a location where pumping was previously noted on the same day), the technician will measure the water level. The technician will have available historical water level data to determine whether the measurement is consistent with past measurements. If the initial measurement appears anomalous, the technician will measure water levels every 10 minutes over a period of 30 minutes.[1] If measurements vary significantly from past measurements (taking into account seasonal variations), the technician will note the circumstances (i.e., the date and time when the well was first visited, total time it was pumping (if known), when it was shutoff, when the

[1] During this period, if the groundwater level difference is greater than +/- 0.02 feet, repeat the same procedure until three consecutive measurements are recorded within +/- 0.02 feet.

technician returned, and subsequent water level measurements [on the same day, or as the case may be based on experience, the day immediately following]). Subsequent consideration of pumping effects at a site-specific well location will be addressed as necessary.

## Recordation

1. Name of field technician
2. Unique identification of well
3. Weather and site conditions (e.g., clear, sunny, strong north wind, intense dust blowing over wellhead from nearby plowed field; dry ground, easy access)
4. Condition of well structure (e.g., well cap cracked – replaced with new one; wasp hive between well casing and well housing; no action, discuss with project manager)
5. Time and date of depth-to-water reading
6. Any other pertinent comments (e.g., sounder hangs up at 33 feet, thus no measurement; or: fifth measurement of ~55.68 feet in a row…residual water in end cap?; or: oil in well…measurement is depth to oil; or: intense sulfur odor upon opening well cap; or: nearby (west ~100 feet) irrigation well pumping)

CALIFORNIA STATEWIDE GROUNDWATER ELEVATION MONITORING
(CASGEM)

STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES

# GROUND WATER LEVEL MEASUREMENTS

**Monitoring Entity: Napa County**
**Monitoring Period:_____**
**Measuring Agency Number: 3983**
**Measured By:_____**

| STATE WELL NUMBER | COUNTY WELL ID | MSRMNT DATE | R.P. ELEVATION (NAVD88 ft) | DIST. R.P. TO WATER | METHOD OF WATER DEPTH MSRMNT | MSRMNT QUALITY CODES[1] | MSRMNT TIME | COMMENTS |
|---|---|---|---|---|---|---|---|---|
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**1 MEASUREMENT QUALITY CODES:**

- If **no** measurement is taken, a specified "no measurement" code, must be recorded.
  0. Discontinued 1. Pumping 2. Pumphouse locked 3. Tape hung up 4. Can't get tape in casing 5. Unable to locate well 6. Well destroyed 7. Special 8. Casing leaking or wet 9. Temporarily inaccessible D. Dry well F. Flowing well
- If the quality of a measurement is **uncertain**, a "questionable measurement" code can be recorded.
  0. Caved or deepened 1. Pumping 2. Nearby pump operating 3. Casing leaking or wet 4. Pumped recently 5. Air or pressure gauge measurement 6. Other 7. Recharge operation at nearby well 8. Oil in casing 9. Acoustical sounder measurement

# APPENDIX D

## Linear Correlation Plots

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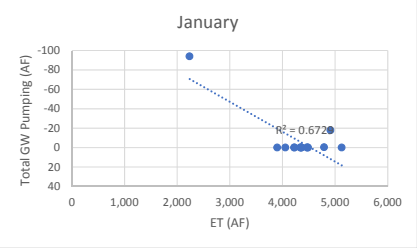
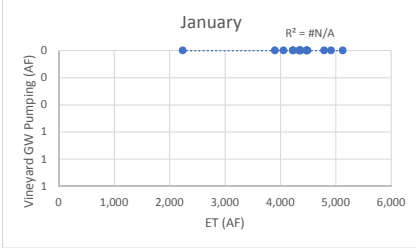
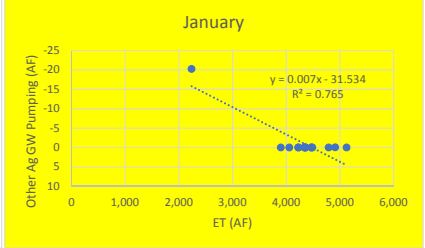
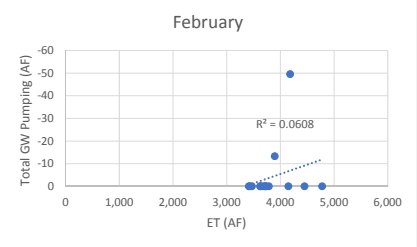
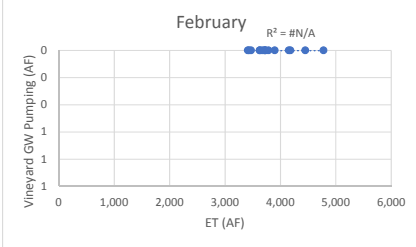
# Monthly Groundwater Components vs Evapotranspiration (Jan - June)

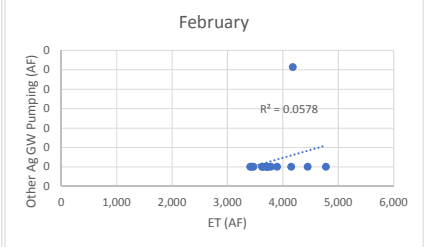


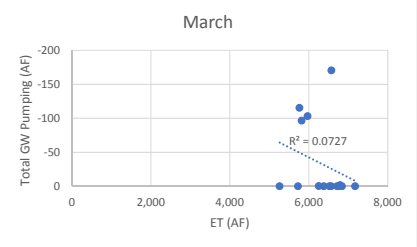



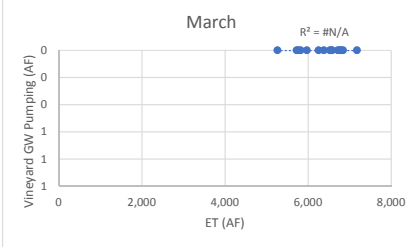



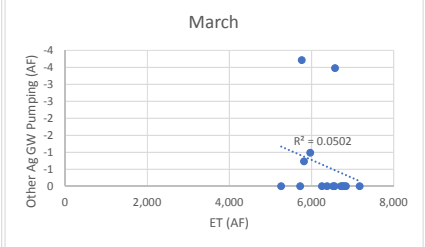



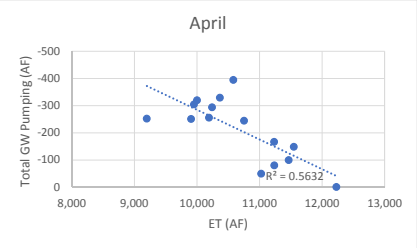



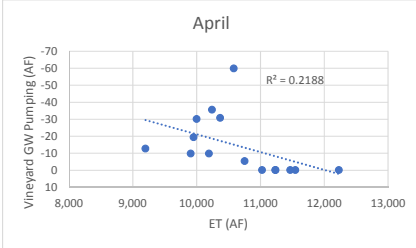



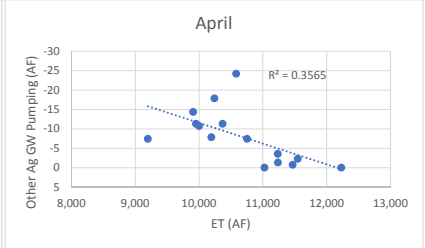



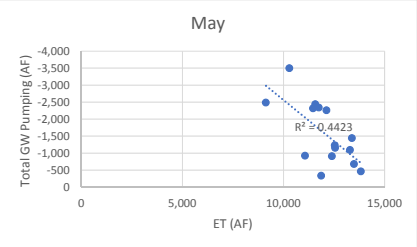



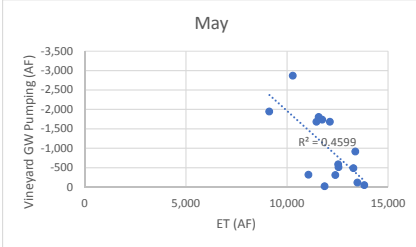



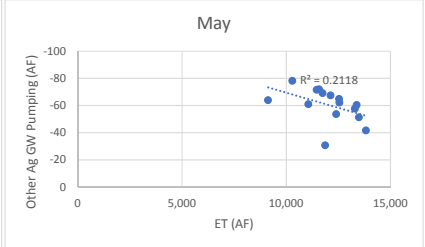



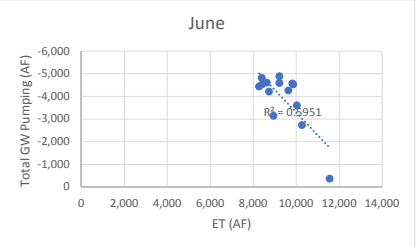



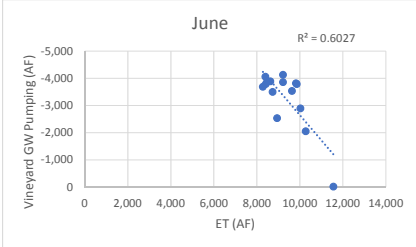



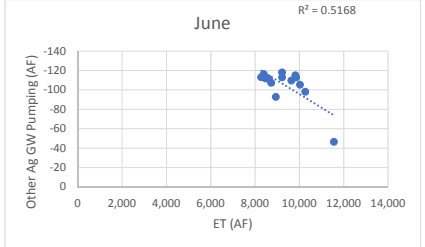



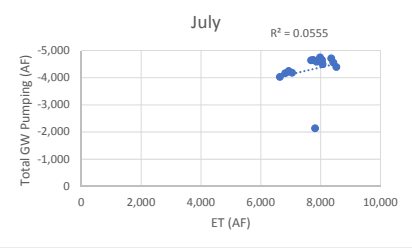



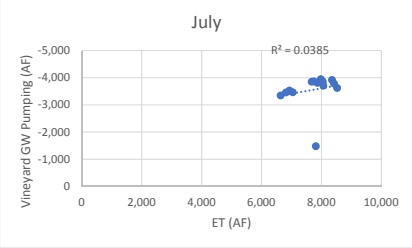



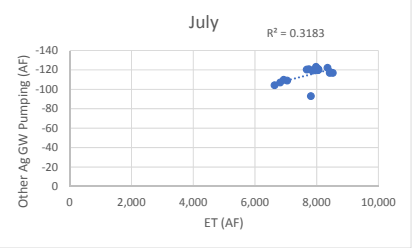



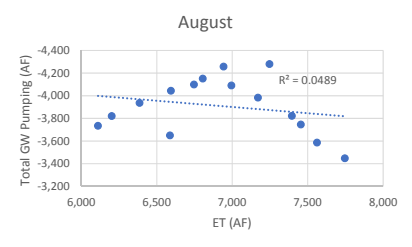



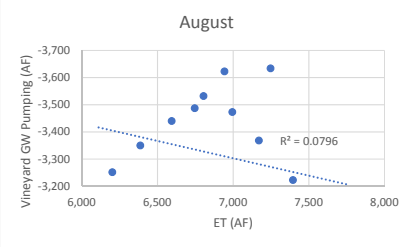
# Monthly Groundwater Components vs Evapotranspiration (July - Dec)

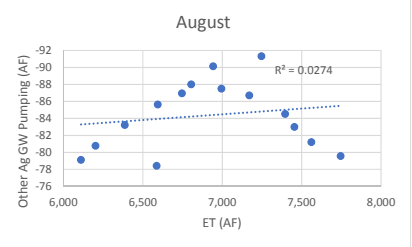


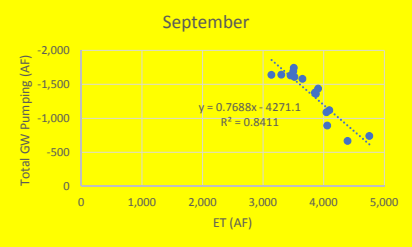



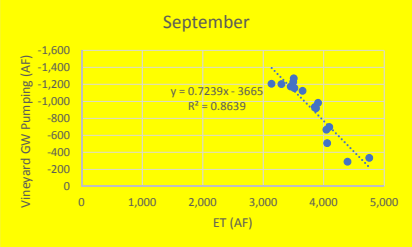



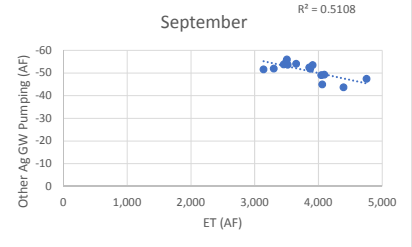



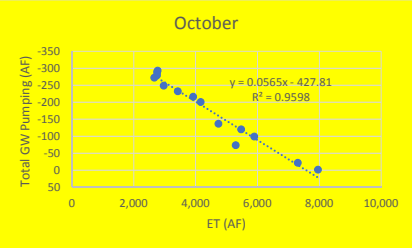



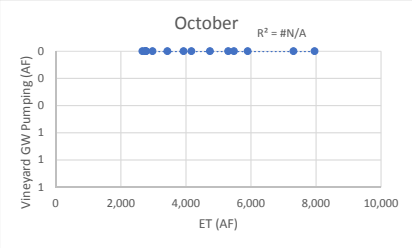



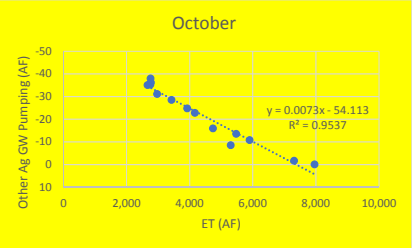



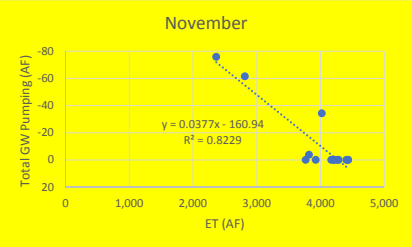



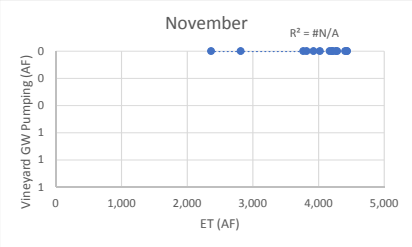



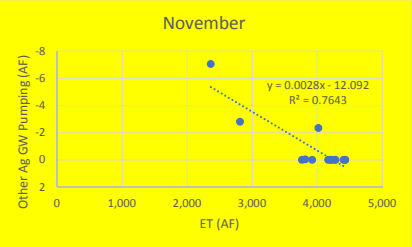



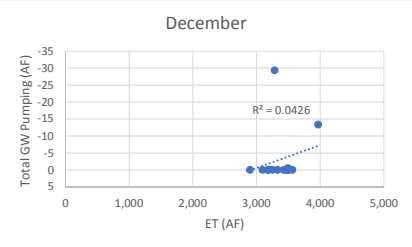



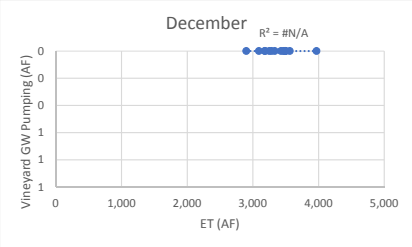



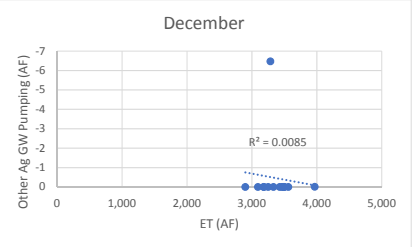



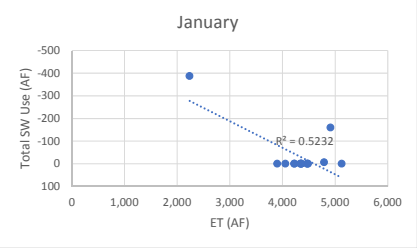



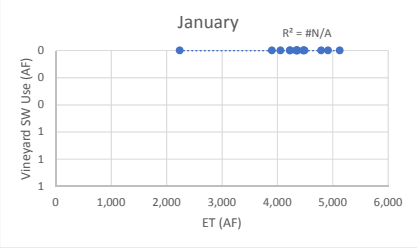



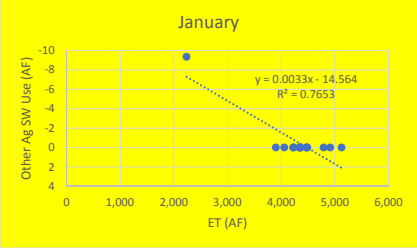



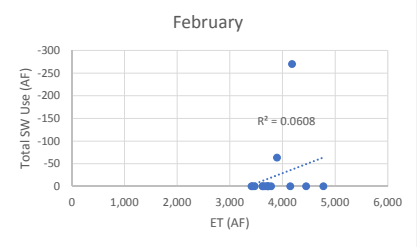



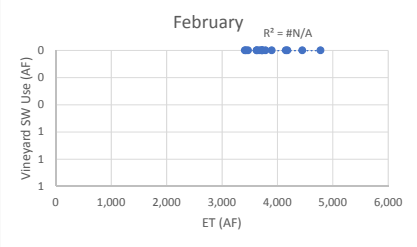
# Monthly Surface Water Components vs Evapotranspiration (Jan - June)

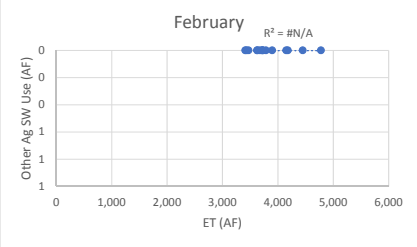


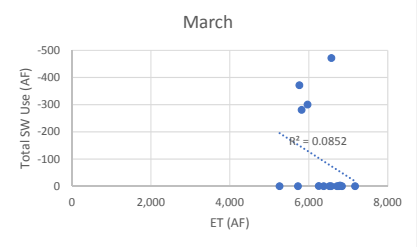



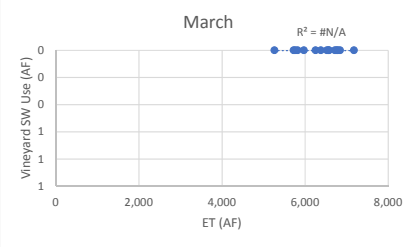



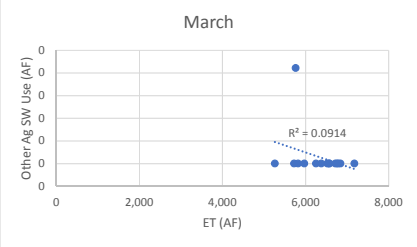



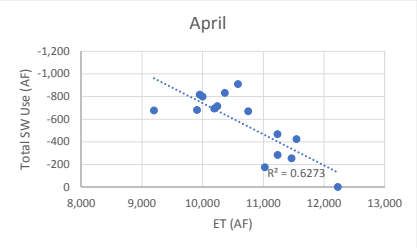



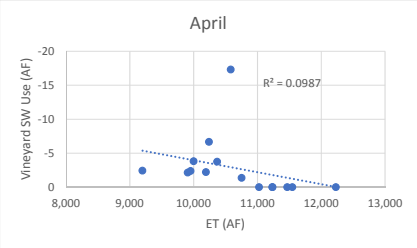



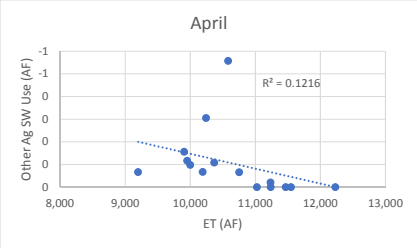



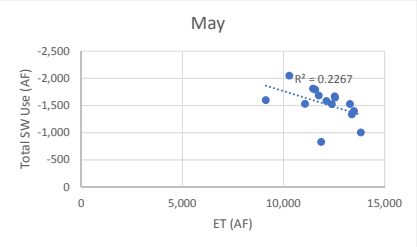



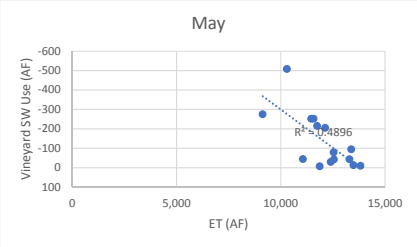



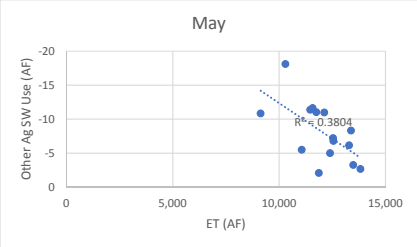



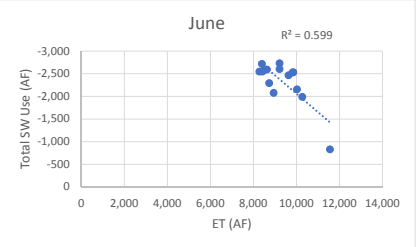



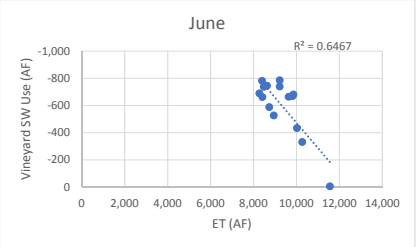



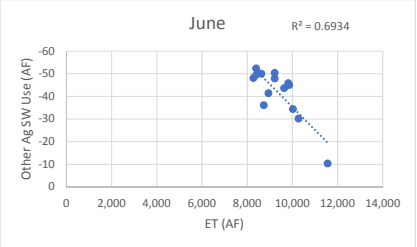



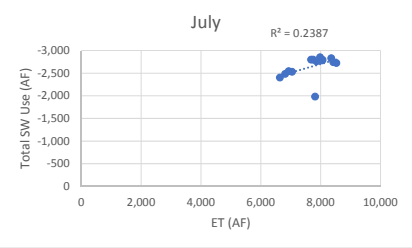



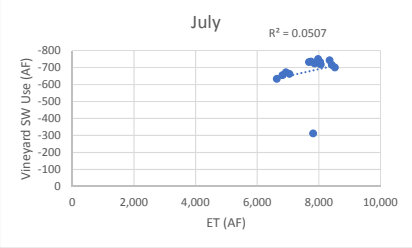



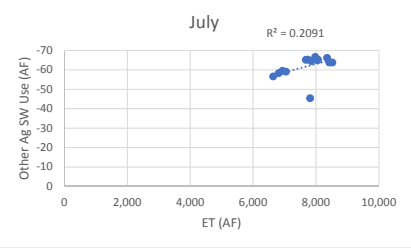



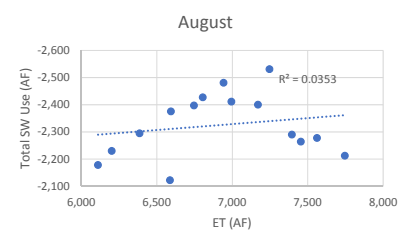



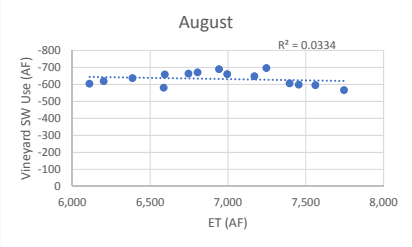
# Monthly Surface Water Components vs Evapotranspiration (July - Dec)

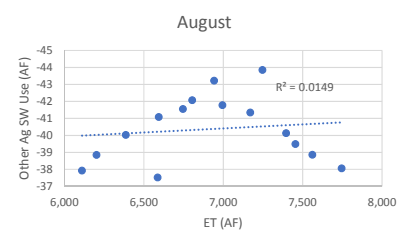


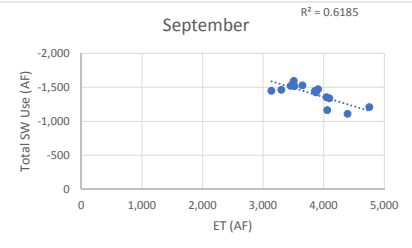



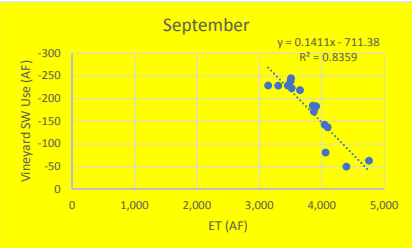



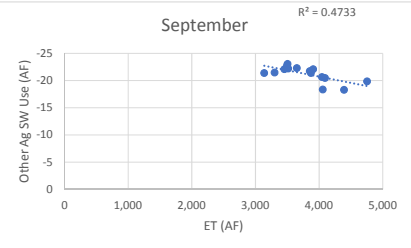



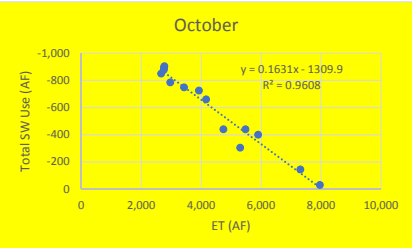



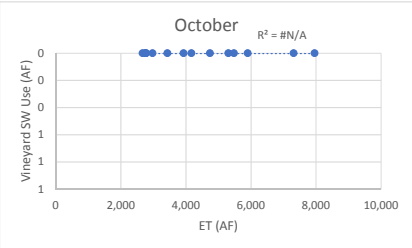



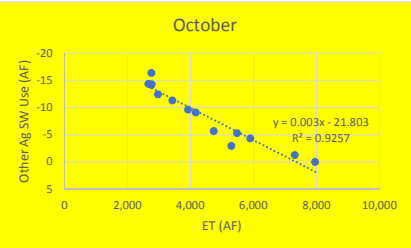



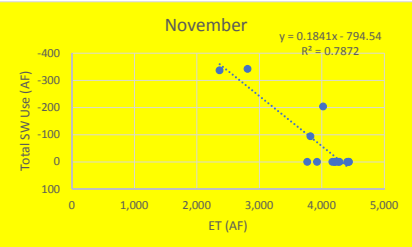



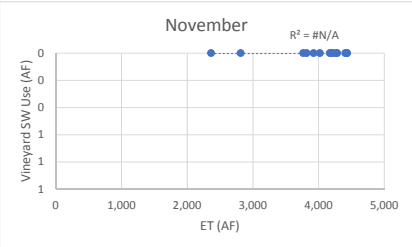



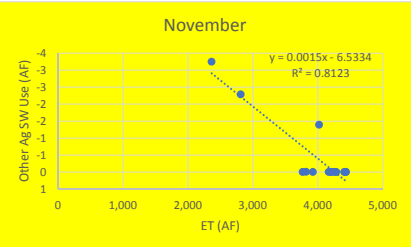



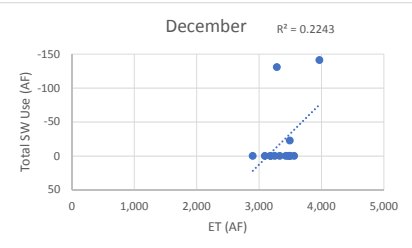



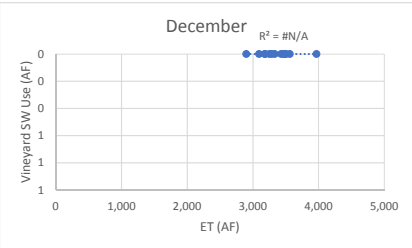



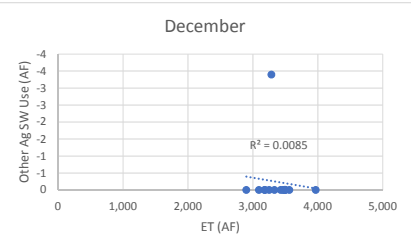



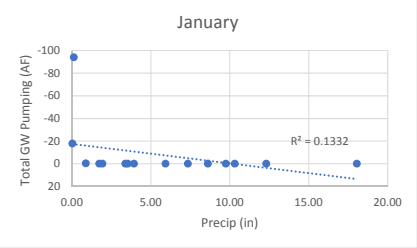



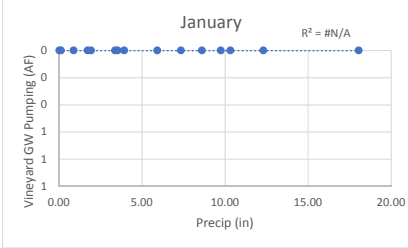



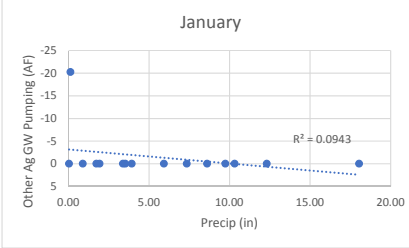



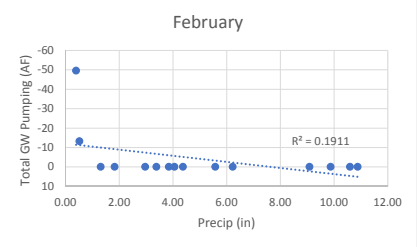



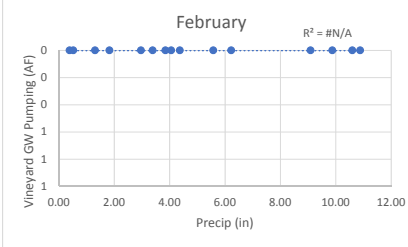
# Monthly Groundwater Components vs Precipitation (Jan - June)

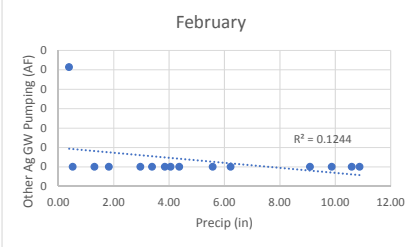


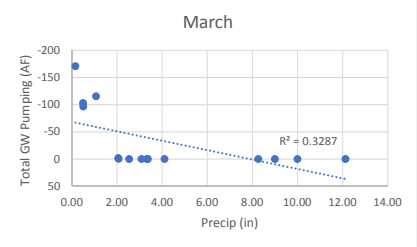



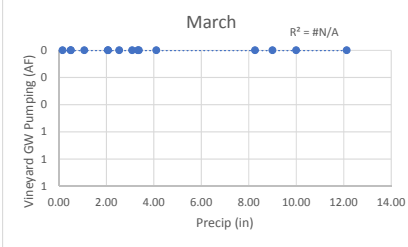



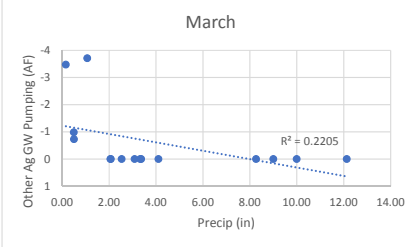



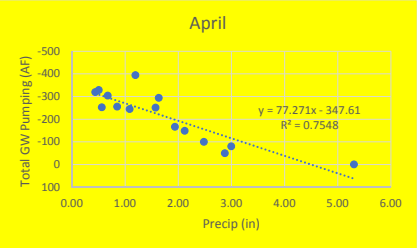



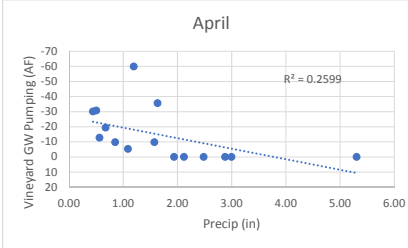



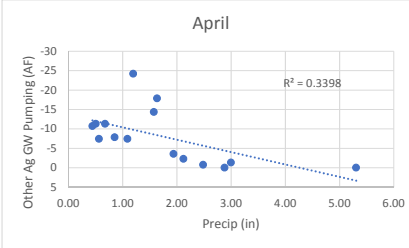



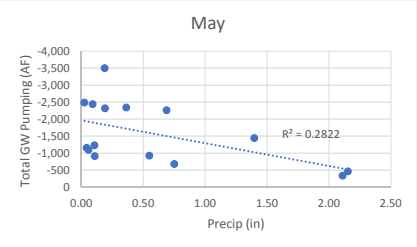



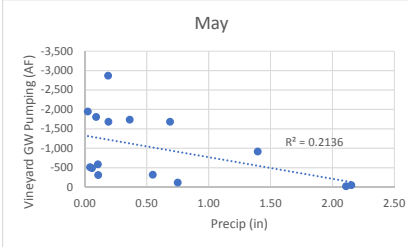



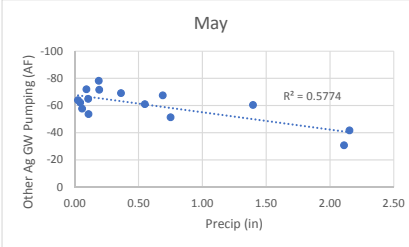



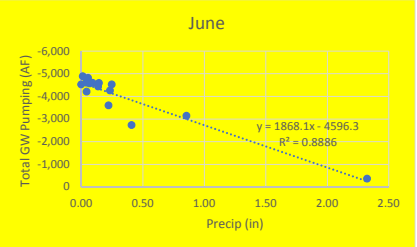



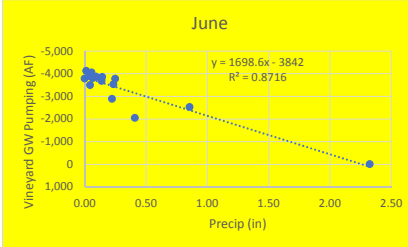



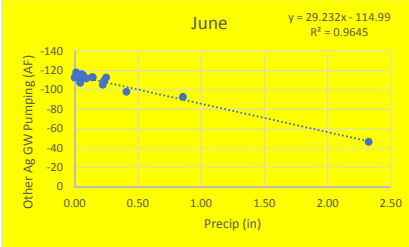



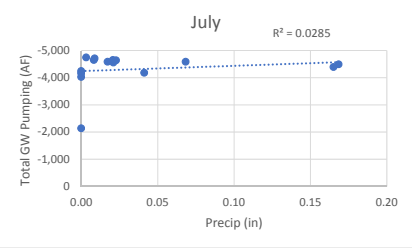



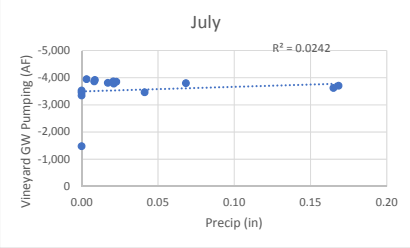



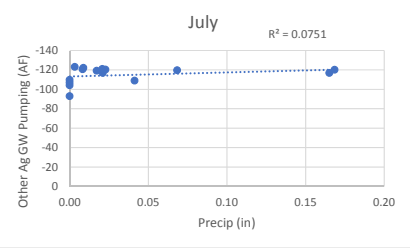



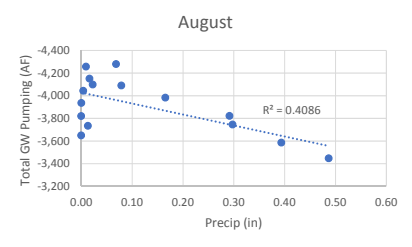



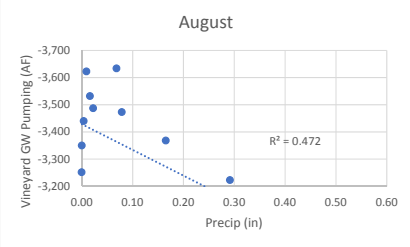
# Monthly Groundwater Components vs Precipitation (July - Dec)

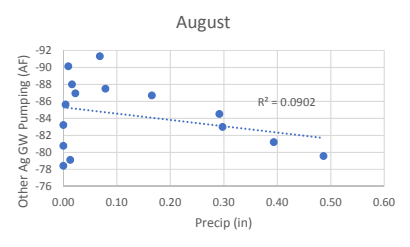


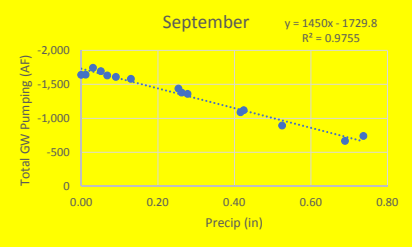



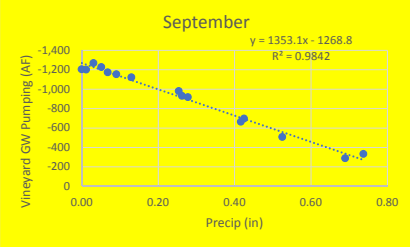



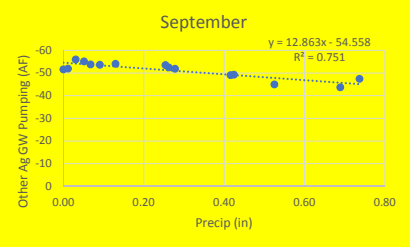



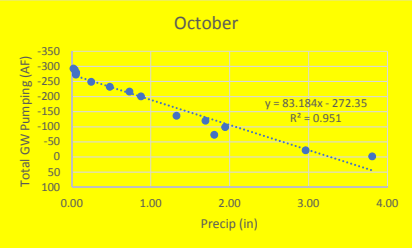



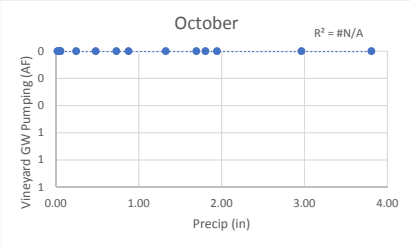



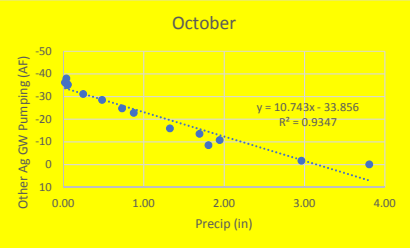



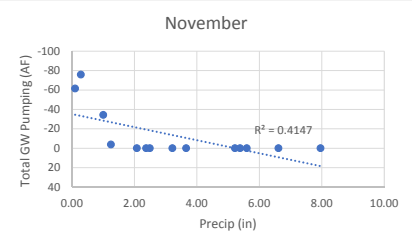



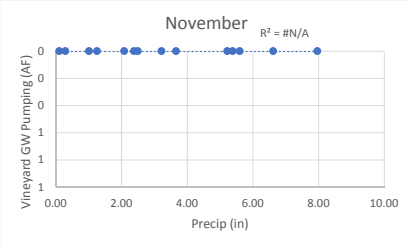



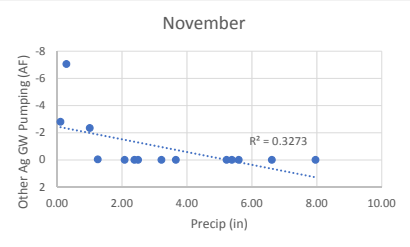



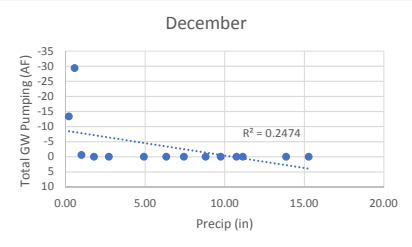



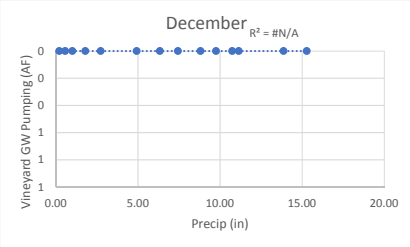



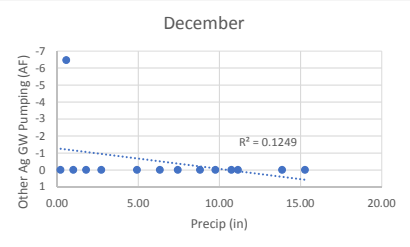



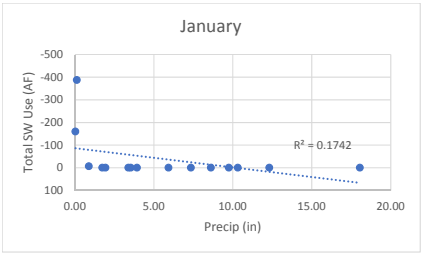



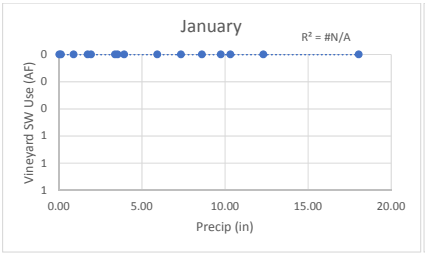



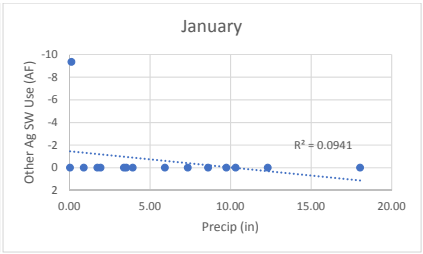



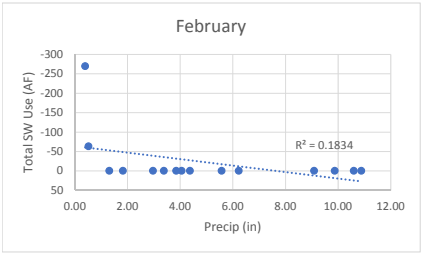



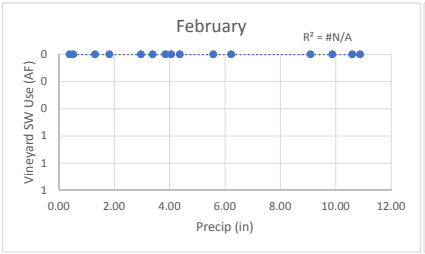
# Monthly Surface Water Components vs Precipitation (Jan - June)

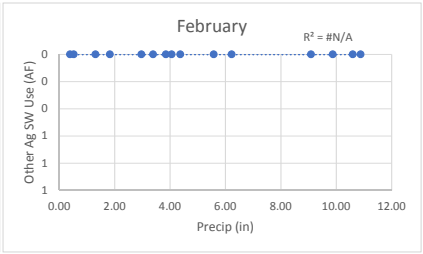


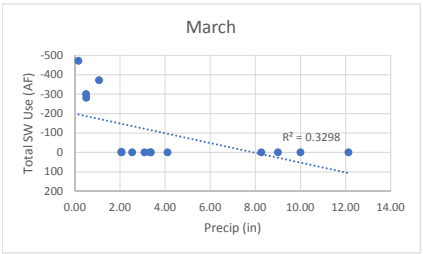



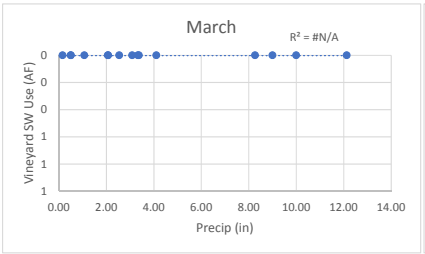



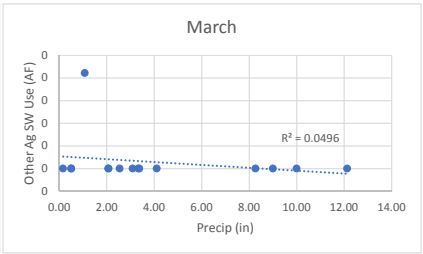



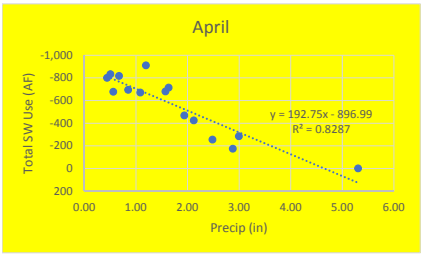



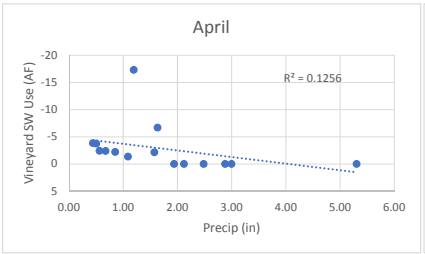



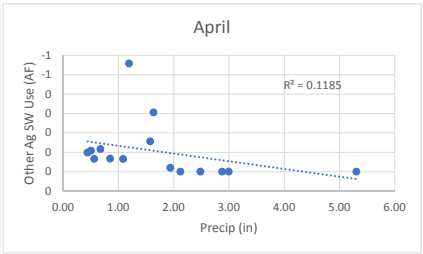



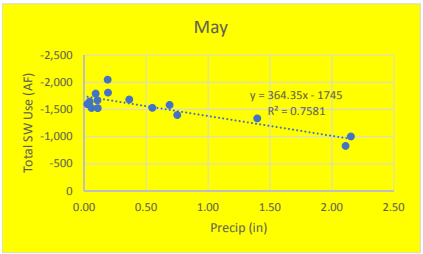



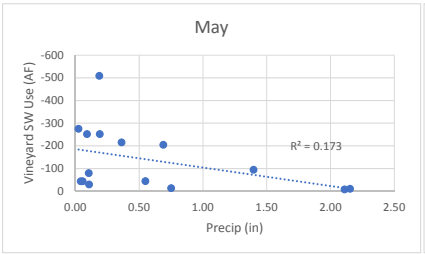



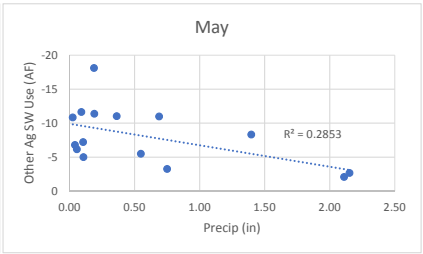



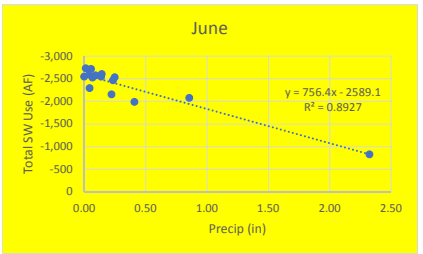



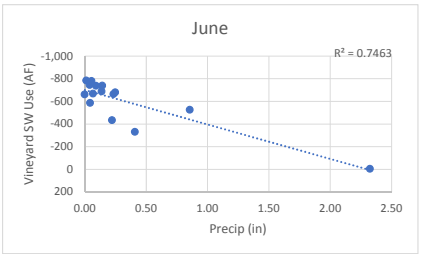



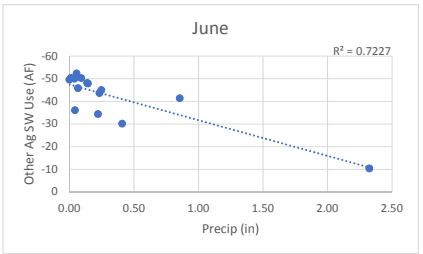



# Monthly Surface Water Components vs Precipitation (July - Dec)