



Napa County Comprehensive Groundwater Monitoring Program 2016 Annual Report and CASGEM Update

March, 2017



LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Napa County Comprehensive Groundwater Monitoring Program 2016 Annual Report and CASGEM Update

Prepared for
Napa County

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EXECUTIVE SUMMARY

ES 1 INTRODUCTION

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 the 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 and others' efforts have been instrumental in implementing groundwater management actions to better understand groundwater conditions, establish monitoring to track conditions, conduct education and outreach, 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 and creation of a Groundwater Resources Advisory Committee (GRAC; 2011 to 2014) to lead 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. This 2016 Annual Report is the third such report submitted to the Napa County Board of Supervisors.

ES 2 GROUNDWATER MONITORING GOALS AND OBJECTIVES

The California Department of Water Resources (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**). 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 the main 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, 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.

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 **Section 3** of this Report.

ES 3 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. SGMA applies to basins or subbasins that DWR designates as medium- or high-priority basins. Previously under the California Statewide Groundwater Elevation Monitoring Program (CASGEM), the California Department of Water Resources (DWR) classified California's groundwater basins and subbasins as either high, medium, low, or very low priority. The priority classifications are based on eight criteria that include the overlying population, the reliance on groundwater, and the number of wells in a basin or subbasin. In Napa County, the Napa Valley Subbasin was ranked medium priority. All other Napa County basins and subbasins were ranked as very low priority¹. For most basins designated by DWR as medium 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:

(b) (3) "An analysis of basin conditions that demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. 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 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 in December 2016 for DWR's review."

During the past seven years, Napa County has made significant progress towards implementing groundwater-related studies and implementing recommendations provided by those studies to improve local understanding of groundwater conditions. 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.

¹ http://www.water.ca.gov/groundwater/sgm/SGM_BasinPriority.cfm

A Napa Valley Subbasin Basin Analysis Report (LSCE, 2016c) was prepared per SGMA and provided to DWR December 16, 2016 in compliance with SGMA. The Basin Analysis Report will implement SGMA monitoring and reporting requirements and provide additional recommendations to maintain or improve groundwater conditions to ensure overall water resources sustainability. While the Basin Analysis Report focused on the Napa Valley Subbasin, this 2016 Annual Report discusses the countywide groundwater monitoring program and results of ongoing monitoring.

ES 4 GROUNDWATER MONITORING NETWORK DESIGN AND DEVELOPMENT

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in 2016 (**Table ES-1**). Out of the total 108 sites monitored in 2016 (**Figure 4-2**), 98 wells were monitored by Napa County. Four sites were monitored by DWR. The remaining six sites were regulated facilities with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Program (<https://geotracker.waterboards.ca.gov/>).

Minor changes in the sites monitored by Napa County between 2015 and 2016 occurred due to a combination of well-owner requests and decisions by the Napa County Department of Public Works. As recommended in the 2014 Annual Report, the County continued monthly monitoring of a subset of eight wells in order to provide greater temporal resolution in areas where semi-annual measurements showed variability and may not have accurately reflected the peak groundwater levels.

Table ES-1 Current Groundwater Level Monitoring Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites Through 2011	Number of Monitored Sites, Fall 2014	Number of Monitored Sites, Fall 2015	Number of Monitored Sites, Fall 2016
Napa Valley Floor-Calistoga	6	10	9	7
Napa Valley Floor-MST	29	27	27	26
Napa Valley Floor-Napa	18	21	20	21
Napa Valley Floor-St. Helena	12	14	14	14
Napa Valley Floor-Yountville	9	12	14	13
Carneros	5	12	12	12
Jameson/American Canyon	1	1	1	1
Napa River Marshes	1	1	-	-
Angwin	-	5	5	5
Berryessa	3	2	3	1
Central Interior Valleys	1	1	2	2
Eastern Mountains	-	3	4	3
Knoxville	1	-	-	-
Livermore Ranch	-	-	-	-
Pope Valley	1	1	1	1
Southern Interior Valleys	-	-	-	-
Western Mountains	-	2	1	2
Unknown ¹	-	3	-	-
Total Sites	87	115	113	108

¹ In 2014 three sites in the Geotracker regulated groundwater monitoring network were reporting groundwater level data, but had not yet reported location information for the monitored wells.

ES 5 SUMMARY OF CONDITIONS AND RECOMMENDATIONS

ES 5.1 Summary of Conditions

Napa County received below average precipitation at the Napa State Hospital gauge during water years² 2012, 2013, 2014, 2015, and 2016. Successive years of below average precipitation in water years 2012 through 2016 provide an important context for the review of recent groundwater level trends. The Napa Valley Subbasin overall experienced sufficient groundwater recharge relative to outflows to maintain relatively stable spring groundwater levels over a prolonged period when precipitation totals were below average on the whole. Groundwater levels in the alluvial geologic formations that comprise the primary aquifer system of the Napa Valley Subbasin have continued to experience groundwater recharge and corresponding rises in groundwater levels from fall to spring during this time.

Overall, the groundwater table in the alluvial aquifer system of the Napa Valley Subbasin is quite shallow; the depth to groundwater in the main part of the Napa Valley Floor in the spring is approximately 5 to 35 feet. While agricultural land use, especially vineyards, have covered much of the 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.

Groundwater levels have been generally stable over time in the Calistoga Subarea and northern portion of the St. Helena Subarea. Groundwater levels in representative wells are frequently very shallow at less than 10 feet below the ground surface in the spring. Elsewhere in the St. Helena Subarea, groundwater levels exhibit greater seasonal declines of about 20 feet. With above average precipitation during the 2016/2017 winter season a depth to groundwater of 7.2 feet has already been recorded as of January 26, 2017.

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 feet to 20 feet under non-drought conditions.

In the Napa Subarea, long-term trends have been generally stable with the exception of the area northeast of the City of Napa, west of the MST and the vicinity of Petra Drive, where groundwater levels locally declined until about 2009. Reasons for the declines in water levels in the Petra Drive area are currently part of a focused investigation of groundwater conditions and hydrogeologic constraints in this area. One possible factor is that lowered groundwater elevations in the northern MST Subarea could be drawing water from the northeast corner of the Napa Subarea towards the MST Subarea. Another factor is the density of private wells in the Petra Drive area, and the potential for mutual well interference among these wells. Another possible factor is that the northeast corner of the Napa Subarea

^{2 2} A water year is defined as the period from October 1 through the following September 30 and is numbered according to the calendar year on its final day. In this way, water years maintain continuity between the times when water supplies typically increase and the following dry season when water demand is greatest.

experiences limited groundwater recharge compared to the rest of the Napa Subarea as a result of poorly permeable geologic materials in the area and since the groundwater system in this area is potentially bounded by the East Napa Fault and Soda Creek Fault.

Although designated as a groundwater subarea for local planning purposes, the majority of the MST is located outside the areas that are DWR-designated groundwater basins³. Thin alluvial deposits overlie the Sonoma Volcanics. The Sonoma Volcanics, which consist of tuffs, ash-type beds, and agglomerates, are the principal water-yielding unit in the MST. Geologic units derived from lava flows, which are also in the MST, were reported to be generally non-water bearing (Kunkel and Upson, 1960; Farrar and Metzger, 2003). However, it may be possible that fractured, fragmental, or weathered lava flows could yield some water to wells. The hydrogeologic properties of the volcanic-sourced sedimentary deposits of the Sonoma Volcanics are complex and poorly understood. 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). These pumping depressions are associated with the poor permeability of the geologic materials in the MST and the longer time required for groundwater replenishment to occur.

After 2009, in the northern MST, groundwater levels have shown signs of stabilizing in three of four currently monitored wells in the northern MST, while one well has shown continued declines, possibly resulting from recent dry years. Groundwater elevations in the central and southern portion of the MST have stabilized since about 2009.

In 2016, the Carneros Subarea had 12 current groundwater level monitoring sites. The longest period of record among them extended back to October 2011. Groundwater levels have been stable to increasing in 10 of the currently monitored wells. Two wells have seen groundwater levels decline by 15 to 20 feet during the drought period since 2011.

SGMA establishes undesirable results for applicable sustainability indicators, including a description of the process and criteria used to define undesirable results (GSP regulations, Section 354.26). This Annual Report summarizes the sustainability criteria developed for the Napa Valley Subbasin and compares them with the most recent applicable data for each representative site. Groundwater conditions show that groundwater levels across the Subbasin were within the recorded range of conditions historically occurring. As described in the Napa Valley Subbasin Basin Analysis Report, the newly established SGMA metrics provide ongoing monitoring targets devised to evaluate sustainability indicators. The targets (minimum thresholds and measurable objectives) are anticipated to be updated as new or additional information becomes available.

ES 5.2 Recommendations

In response to the 2014 Sustainable Groundwater Management Act, Napa County prepared the Basin Analysis Report (see Section 2.4 of this report). Findings and Recommendations from the analyses conducted as part of the Basin Analysis Report and in consideration of prior activities by Napa County, the GRAC, the Watershed Information & Conservation Council (WICC), and others relevant to this 2016 Annual Report, are summarized below (see the Basin Analysis Report [LSCE, 2016c] for the complete set of recommendations).

³ DWR's identification of groundwater basins was initially based on the presence and areal extent of unconsolidated alluvial sediments identified on 1:250,000 scale, geologic maps published by the California Department of Conservation, Division of Mines and Geology (DWR, 2003).

Refine Spatial Distribution of Groundwater Monitoring Network

Four recommendations in the Basin Analysis Report involve refining the spatial distribution of the groundwater monitoring network, including:

- Address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the alluvial aquifer; additional wells are of interest in the St. Helena Subarea, northern part of the Yountville Subarea (east and west of the Napa River), and the western and southern parts of the Napa Subarea
- 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
- Implement Napa County groundwater quality monitoring program; includes water quality monitoring in a subset of current monitoring network wells
- Coordinate with existing discretionary permit applicants (e.g., wineries and others) regarding existing groundwater level and/or water quality information)

Expand Stream Gaging and Nearby Shallow Groundwater Monitoring

The implementation of the DWR Local Groundwater Assistance program to construct and implement coupled surface water and groundwater monitoring in and near the Napa River system has been very valuable for improving the understanding of surface water and groundwater interaction. Similar facilities at additional locations would help further this understanding, are important for the County's SGMA sustainability goal, and would be key to the objective of maintaining or improving streamflow during drier years and/or seasons. It is recommended that the County:

- 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 Local Groundwater Assistance [LGA] Grant Surface Water/Groundwater facilities)

Hydrogeology and Freshwater/Saltwater Interface Southern Part of Napa Sonoma Valley Groundwater Basin

The Jameson/American Canyons and Napa River Marshes Subareas, which make up the southern County area, have limited available data. These are very low priority basins located outside of the Napa Valley Subbasin. The two main issues facing this area are potential saltwater intrusion and the possibility that current water resources will not be sufficient to meet future demand. To establish current conditions and obtain information necessary for future development planning, further analysis is recommended that includes:

- Adding wells in these areas to monitor groundwater levels;
- Monitoring groundwater quality;
- Collection and interpretation of geologic data (primarily from well drillers' reports);
- Analysis of streamflow and precipitation;
- Estimation of recharge and discharge using both mass balance and streamflow infiltration methods; and
- Determination of the extent and properties of aquifer materials.

Review and Coordination with DWR Best Management Practices

Following DWR's preparation of GSP regulations, DWR staff began in earnest to work on many other SGMA efforts, especially the development of Best Management Practices (BMPs). DWR published BMPs in December 2016. While some County BMPs were included in the Basin Analysis Report, it is recommended that additional BMPs be incorporated in future updates (including Annual Reports).

Northeast Napa Subarea Hydrogeologic Investigation

Previously observed groundwater level declines in the northeast Napa Subarea, east of the Napa River and west of the MST, along with reports of increased well replacement activity along Petra Drive raised questions about the cumulative impacts of existing and potential future groundwater use in this area. In addition to completing the standard project-level planning review of the proposed projects, a focused study of hydrogeologic conditions affecting groundwater availability is underway for this specific area. The investigation is designed to address existing and future water use in the area, sources of groundwater recharge, and the geologic setting in order to assess and address the potential for cumulative impacts of future development. The investigation seeks to study the potential influence of previously documented groundwater cones of depression in the MST subarea on both the study area east of the Napa River and the Napa Subarea west of the Napa River. The investigation is also assessing the potential for mutual well interference as a factor in the historical lowering of groundwater levels in wells in the Petra Drive area. Additionally, the study is assessing the potential for streamflow depletion due to pumping in the study area and its adjacency to Napa River and Soda Creek. Recommendations from this study are forthcoming (LSCE, 2017b); a recommendation to include construction of surface water/groundwater (SW/GW) monitoring facilities (like the Napa County LGA facilities) east of the Napa River is likely.

Data Gap Refinement

Groundwater levels in two monitored wells located near to the Napa Valley margin east of Napa River midway between St. Helena and Yountville showed year to year declines in groundwater levels. Additional groundwater level monitoring was implemented in fall 2015 to consider the full range of possible causes for these declines and more accurately determine if they present emerging trends. Beginning in fall 2015, groundwater levels are measured monthly in this area. The monthly data show that the peak for spring water level recovery may vary, i.e., the month during which the highest groundwater level is measured may vary from year to year. Therefore, more frequent water level measurements provide a better understanding of this variability. Continuation of the increased frequency of data collection in this area is recommended.

As part of the vetting process for considering and adding wells to the County's monitoring network, construction information is reviewed and linked to geologic information to identify well construction relative to aquifer units. In cases where a well owner does not have a record of the construction, a review of Well Completion Reports is recommended. During 2016, well construction information was reviewed for currently monitored wells and, where an aquifer designation had not yet been determined, this linkage was completed for several wells.

Baseline Water Quality Sampling

It is recommended that wells added to the County monitoring network be reviewed for suitability in light of the groundwater quality monitoring objectives, with baseline sampling conducted for those wells with sufficient well construction records to enable interpretation of the results for specific aquifer units. In 2017, groundwater quality sampling is planned to occur at 16 wells distributed throughout the Napa-

Sonoma Valley Groundwater Basin. Although the 2017 sampling program will focus on wells located in the Napa-Sonoma Valley Groundwater Basin, other subareas should be considered as funding allows.

A second round of baseline water quality sampling is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites, as described in the Plan. An initial round of sampling and analysis was completed in June 2015 with a combination of County matching funds, DWR grant funds, and DWR in-kind support.

Coordination with Other Monitoring Efforts

Coordination with other county departments and other agencies that collect or utilize groundwater data could provide an additional source of data in places where data may be limited. 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. Another potential source of coordination would be a continuation of the in-kind support for laboratory analysis of water quality samples by DWR, as occurred in 2015.

Existing Activities in the MST Subarea

Currently, the Napa Sanitation District (NSD) provides recycled water along two main pipelines to the southeast and north of the Soscol Water Recycling Facility. The NSD is working with water users throughout Napa to identify areas where recycled water could replace the use of potable, surface or groundwater. During 2016, 26 participating properties were connected and another 10 properties are anticipated to be connected to the recycled water pipeline in 2017. The pipeline is designed to initially deliver up to 700 acre-feet (230 million gallons) per year of recycled water to the area and is expandable to 2,000 acre-feet per year (650 million gallons). An extension to this new system is currently under consideration following the recent award of drought-relief grant funding and additional interested property owners

1 INTRODUCTION

1.1 Purpose

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 the 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 arising during drought and flood conditions;
- Avoiding environmental effects due to water use; and
- Changes in long-term availability due to global warming and/or 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. In 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 identified action items 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 future coordinated, integrated water resources planning and dissemination of water resources information.

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 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 [levels and quality] 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 water 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:

- 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. This report is the third Annual Report – *Napa County Comprehensive Groundwater Monitoring Program 2016 Annual Report and CASGEM⁴ Update* (Report). This is also the first Annual Report prepared following the County’s submittal of the Napa Valley Subbasin Basin Analysis Report as an alternative to a Groundwater Sustainability Plan (GSP) in accordance with the Sustainable Groundwater Management Act (SGMA).

1.2 Organization of Report

This Report summarizes activities implemented as part of the County’s Comprehensive Groundwater Monitoring Program to improve the understanding of groundwater resource conditions and availability. This Report summarizes groundwater monitoring needed to fill the data gaps (i.e., relatively higher monitoring priorities) that were established in the Plan, recommendations made to address these priorities, and activities implemented since 2014. This Report also summarizes the overarching groundwater level and quality monitoring objectives defined by the County and the GRAC. These

⁴ CASGEM is the California Statewide Groundwater Elevation Monitoring program implemented under Water Code Part 2.11 Groundwater Monitoring and administered by DWR.

objectives provide the framework necessary to ensure that the data collected from the countywide monitoring facilities can address these objectives.

This 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 – 2015
- Recent Groundwater Reports

Section 3: Groundwater Resources Goals and Monitoring Objectives

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

Section 4: Groundwater Monitoring Network Design and Development

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

Section 5: Groundwater Level Trends and Flow Directions

- Napa Valley Floor Subareas
- Subareas South of the Napa Valley Floor
- Subareas East and West of the Napa Valley Floor
- Angwin and Pope Valley Subareas
- Napa Valley Surface Water-Groundwater Monitoring
- Napa Valley Subbasin Sustainability Indicators

Section 6: Coordination and Collaboration

- Integrated Regional Water Management Plans
- Groundwater Sustainability
- Napa County Watershed Information and Conservation Council

Section 7: Summary and Recommendations

- Basin Analysis Report Recommendations and Implementation
- Northeast Napa Area Groundwater Study
- Data Gap Refinement
- Baseline Water Quality Sampling
- Coordination with Other Monitoring Efforts
- Existing Activities in the MST Subarea

2 HYDROGEOLOGY OF NAPA COUNTY

This section summarizes the countywide geologic and hydrologic setting, and includes information about DWR groundwater basin/subbasin delineations and a description of the Napa County groundwater monitoring subareas. The studies that form the basis of the understanding of County hydrogeology are referenced, including the work for 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)⁵.

DWR has given the Napa Valley Subbasin a “medium priority”⁶ ranking according to the criteria specified in California Water Code Part 2.11 Groundwater Monitoring (i.e., this relates to the CASGEM program). The priority ranking 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. As required by SGMA, in 2016 DWR published a list of basins subject to conditions of critical overdraft. No basins or subbasins in Napa County are designated on that list. In Fall 2017 DWR is due to release updated priority rankings that will incorporate additional criteria to address connections between surface water and groundwater.

⁵ The majority of the MST is located outside the areas that are DWR-designated groundwater basins.

⁶ As part of the CASGEM Program, DWR has developed the Basin Prioritization process. The California Water Code (§10933 and §12924) requires DWR to prioritize California’s groundwater basins and subbasins statewide. As such, DWR developed the CASGEM Groundwater Basin Prioritization Process. Details are available at http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm.

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 section. **Table 2-1** shows the chronological sequence of these 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 groundwater 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).

Highlights of additional groundwater studies between 2009 to 2015 are provided in Section 2.3 followed by summaries of the recent reports in Section 2.4: 1) *Napa County Groundwater/Surface Water Monitoring Facilities to Track Resource Interrelationships and Sustainability*, 2) *Napa Valley Groundwater Sustainability: A Basin Analysis Report* (LSCE, 2016c), and the report in progress 3) *Northeast Napa Area: Special Groundwater Study* (LSCE, 2017b).

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

Hydrogeologic and/or Geologic Studies and Mapping Efforts	Year of Report or Map Publication							
	1940s	1950s	1960s	1970s	1980s	1990s	2000s	2010-2019
Weaver, 1949	◆							
Kunkel and Upson, 1960		◆						
DWR, 1962		◆						
Koenig, 1963		◆						
Fox et al., 1973			◆					
Sims et al., 1973			◆					
Faye, 1973			◆					
Johnson, 1977				◆				
Helley et al., 1979				◆				
Wagner and Bortugno, 1982					◆			
Fox, 1983					◆			
Graymer et al., 2002							◆	
Farrar and Metzger, 2003							◆	
Graymer et al., 2007							◆	
DHI, 2006 and 2007							◆	
LSCE, 2011a								◆
LSCE and MBK, 2013								◆
LSCE, 2013a								◆
LSCE, 2013b								◆
LSCE, 2014								◆
LSCE, 2015								◆
LSCE, 2016a								◆
LSCE, 2016b								◆
LSCE, 2016c								◆
LSCE, 2017a (This Report)								◆
LSCE, 2017b (Special Study in progress)								◆

◆ = Report and Map produced
 ◆ = Report only
 ◆ = Map only

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 Saint 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) and presented in the 2014 Annual Report (LSCE, 2015). 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 Saint 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 Saint 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.

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 Period of record used for frequency analysis: 1920 – 2015				

2.2.3 Summary of Geology and Groundwater Resources

The geology of Napa County can be divided into three broad geologic units based on their ages and geologic nature. These units are: 1) Mesozoic Basement Rocks (pre-65 million years (my)), which underlie all of Napa County, but are primarily exposed in the Eastern County area and the Western Mountains Subarea, 2) Older Cenozoic Volcanic and Sedimentary Deposits (65 my to 2.5 my), including Tertiary Sonoma Volcanics (Miocene and Pliocene; 10 my to 2.5 my) which are found throughout the county, especially in the mountains surrounding Napa Valley, and 3) Younger Cenozoic Volcanic and Sedimentary Deposits (post 2.6 my to present), including the Quaternary alluvium of the Valley Floor. The two primary water-bearing units in the county are the tuffaceous member of the Sonoma Volcanics and the Quaternary alluvium (LSCE, 2016c).

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 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 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.

2.3 Groundwater Studies and Programs: 2009 to 2015

This section summarizes the recently completed studies by Napa County and the recommendations relevant to ongoing groundwater monitoring that were developed.

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 and 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 & 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). This report and the other related documents can be found at: <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* (LSCE, 2013a [Plan]) was prepared to formalize and augment groundwater monitoring efforts [levels and quality] 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 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](#). 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.

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 other pre-existing groundwater monitoring that has been ongoing in Napa County for some time (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 (medium priority basin)
- Napa County was designated as the Monitoring Entity for the 2-2.03 Napa-Sonoma Lowlands Subbasin in Napa County (very low priority basin)

The current 2016 CASGEM network wells (which includes 33 wells) are located primarily on the Napa Valley Floor, Carneros Subarea, and in the MST Subarea. 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 gathering and surveying will be performed, and such information will be 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 (**Figure 4-2**).

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 Basin⁷. 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 Groundwater Basin has a very low DWR priority and extremely small utilization of groundwater⁸. Per discussions with DWR, outreach will continue but no monitoring is planned in this groundwater basin at this time.

The Suisun-Fairfield Valley Basin and the Napa-Sonoma Lowlands Subbasin are two examples of basins that do not conform to county boundaries, and they are also basins with a very low-priority designation from DWR. While these two basins have low groundwater utilization and less extensive monitoring than other basins, they are situated adjacent to the bay and delta water ways and are important areas to monitor for protection against saltwater intrusion. The Suisun-Fairfield Valley Basin, which is mostly in Solano County and has only a very small area (less than 0.3% of the total basin area) in Napa County, is being monitored in its entirety by Solano County Water Agency as the CASGEM Monitoring Entity for Solano County. The monitoring of Napa-Sonoma Lowlands Subbasin, whose area is shared with Solano County in more equitable portions (63% in Napa County, 37% in Solano County), is anticipated to have monitoring that is coordinated between the two respective Monitoring Entities in the future. Currently, all monitoring is within the Napa County portion of the subbasin. In the future, monitoring in this subbasin will expand as necessary to ensure representative coverage and will be coordinated between the two Monitoring Entities.

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) an updated Napa Valley hydrogeologic conceptualization, 2) linking well construction information to groundwater level monitoring data, 3) groundwater recharge characterization and estimates, and 4) surface water/groundwater interrelationships.

Updated Napa Valley Geologic Conceptualization

As 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

⁷ DWR Overall Basin Ranking Score is "0.0"; the very low priority basin ranking range is 0-5.4. http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NCRO%2074.pdf

⁸ DWR Overall Basin Ranking Score is "0.0"; the very low priority basin ranking range is 0-5.4. http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NCRO%2062.pdf

well drillers' reports, the Quaternary alluvium was separated from underlying units, and an isopach (contours of equal thickness) map was constructed.

The alluvium was divided into three facies according to patterns detected in the lithologic record and used to delineate the depositional environment which formed them: fluvial, alluvial fan, and sedimentary basin (LSCE and MBK, 2013 and LSCE, 2013b). The fluvial facies consists 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 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 pump test results have been found, and these are in the high yielding area just north of the Yountville Narrows.

The alluvial plain 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.

The alluvial facies shows some overlap with the shallowest depths to groundwater, as measured in spring 2010 (**Figures 2-4**). These areas of overlap occur generally to the west of the Napa River and adjacent to mapped perennial streams, including Hopper Creek, Sulpher Creek, York Creek, Bale Slough (west of Highway 29), and possibly Dry Creek. These areas represent somewhat likely areas of connection between surface waters (including the Napa River and perennial streams described above) and groundwater.

At the northern end of the lower valley, the sedimentary basin facies of the alluvium occurs. This facies is characterized by fine-grained silt, sand, and clays with thin to scattered thicker beds of sand and gravel. The sedimentary 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 pump test information makes hydraulic properties of the deposits difficult to assess.

Napa Creek and the Napa River east of Highway 29 in the vicinity of downtown Napa show a connection with groundwater in this portion of the Napa Valley.

Portions of Napa Valley north of Deer Park Road 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. From the geologic cross-sections, lateral correlations, and surficial map relationships, a structure contour map (elevations) of the top of these units and the subcrop⁹ pattern were developed (LSCE and MBK, 2013). From north of the City of Napa and southward, these deposits are dominated by fine-grained basin fill with few sand and gravels of floodplain, estuary 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 of 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 has been to identify construction information for 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 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 permits precipitation and surface water to readily infiltrate and recharge groundwater throughout the majority of the valley floor. These high permeability soils combined with the large volume of water that flows through the Napa River create the potential for significant recharge to occur

⁹ Occurrence of strata in contact with the undersurface of a stratigraphic unit, which in this case includes the strata beneath the alluvium.

under the hydrologic circumstances and hydraulic gradient that allow for recharge from the river to groundwater to occur.

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 estimate the potential for recharge to groundwater.

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 Dataset¹⁰ (**Figure 2-5**).

2.3.4 Annual Groundwater Reports

In 2015, Napa County began submitting Annual Reports to Napa County's Board of Supervisors and the public that summarize activities implemented as part of the County's Comprehensive Groundwater Monitoring Program to improve the understanding of groundwater resource conditions and availability.

¹⁰ In addition to the County-wide 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 County Resource Conservation District. The RCD dataset flow designations are generally consistent with the attributes provided by the USGS. The RCD dataset is under review as part of ongoing efforts to characterize connections between surface water and groundwater.

The 2014 and 2015 Annual Reports included 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). The 2014 and 2105 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. This 2016 Annual Report adds additional information pertaining to SGMA monitoring objectives and thresholds.

The 2015 Annual Report (LSCE, 2016a) presents groundwater quality data reported between 2009 and 2015 that were reviewed to provide an updated understanding of conditions and trends relative to the most recent County-wide review of groundwater quality data published as part of 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. Funding for the project was provided by the 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 Groundwater Subbasin (**Figure 2-6**). Prior to construction of the monitoring facilities, hydrologic and geologic data were compiled and evaluated for each site in order 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 transducers.

Data were regularly downloaded from project transducers in 2015 and 2016. The transducers recalibrated and serviced as needed. Project data were reviewed for quality control purposes and incorporated into an existing Napa County Data Management System. Data analysis occurred as the data were collected to track groundwater-surface water interactions. Project outreach occurred through a variety of means, including presentations to the WICC, presentations to community groups around Napa Valley, and a field tour 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. The only site that maintained losing stream conditions (flow from surface water into groundwater) throughout 2015 was located on a tributary to the Napa River. Water year 2015 marked the fourth year of California's statewide drought. Continued

data collection in subsequent years will provide a more robust understanding of the range of conditions at these sites.

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 is recommended that in coordination with the Napa County Resources Conservation District (RCD), the Napa County Flood Control and Water Conservation District and others, as appropriate, the County:

- Evaluate stream gaging network objectives, particularly with respect to the water budget requirements contained in the SGMA Groundwater Sustainability Plan 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 the 2014 Sustainable Groundwater Management Act (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, 2017 and is undergoing review by DWR. The Basin Analysis Report covers the entire Napa Valley Subbasin, which has been designated by the State as a medium priority basin and is subject to specific requirements under SGMA. The report includes analysis of 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.

During the past seven 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, 2017a), 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 about 100 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. Several wells have shown at least some degree of response to recent drought conditions; however, levels are generally higher than they were in the same wells during the 1976 to 1977 drought.

The Napa River system is affected by a number of factors, groundwater being only one of them. The river system is influenced by dry (low rainfall) years and also drier periods within the year. The Napa River system has experienced these temporal and seasonal effects over many decades (since the 1930s), 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. The timing and amount of precipitation and natural groundwater recharge events affect the amount of groundwater baseflow discharged to the Napa River system. Heterogeneous subsurface conditions also affect the spatial variability in and the amount of recharge to groundwater and discharge to surface water.

While outflows from the Subbasin, including groundwater pumping, influence the surface water system, monitoring data indicate that effects on the Napa River due to more or less groundwater pumping did not change during 1987-2015, 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. 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, and 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 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 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 unincorporated areas. The analysis includes estimated additional groundwater needs for wineries and

vineyards looking forward through 2025, based upon the past five years of development proposals within the Subbasin.

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 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 also 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 below 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) 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 has averaged about 18,000 AFY during the 2012 to 2015 drought, a time in which groundwater pumping is presumably at its highest.

The Napa Valley Subbasin Basin Analysis Report 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

Water levels monitored by the County at approximately four wells in northeastern Napa Subarea wells east of the Napa River have stabilized since 2009 in this area, though declines were observed over approximately the prior decade. To ensure continuation of the current stable groundwater levels, and follow up on the recommendation in the Napa County Groundwater Monitoring Program 2015 Annual Report and CASGEM Update (LSCE, 2016a), a special study of this area is being conducted. The study was recommended given the potential for a hydraulic connection between the aquifer units in the vicinity of these wells and those of the MST Subarea to the east and an apparent increase in new well permits over the past 10 years. The study is designed to examine existing and future water use in the area, sources of groundwater recharge, and the geologic setting to address questions regarding the potential for long-term effects. The study involves investigation of the potential influence of previously

documented groundwater cones of depression in the MST subarea on the Study Area both east and west of the Napa River.

The study began in fall 2016 and involves the following tasks:

1. Obtain and review existing information pertaining to Study Area data, including Petra Drive well locations, drillers' reports, water use information (if known), etc.;
2. Evaluate the geologic and hydrogeologic setting and historical groundwater conditions and trends for the Study Area, including previously mapped faults, the thickness of the alluvium in the Study Area, especially near the Napa River and Soda Creek;
3. Tabulate and evaluate existing well performance data (to the extent available) including yield, specific capacity, and pump test data (if any);
4. Estimate potential recharge to the Study Area;
5. Conduct well interference analysis, including an analysis of potential effects from the wells located in the Petra Drive area and also within the overall Study Area. A simplified numerical model will be used to assess mutual well interference and also to assess potential streamflow effects from current use and known proposed projects;
6. Estimate water demands for the overall Study Area along with sources of supply used to meet Study Area water demands. Water demands and supplies will be tabulated for the overall Study Area for variable water year types; and
7. Estimate groundwater supply sufficiency to meet the current and potential future groundwater demands for the overall Study Area and other potential considerations with respect to proposed future groundwater use.

The study results (LSCE, 2017b) will be evaluated to determine if potential groundwater management measures or controls (similar to those that have been successfully implemented in the MST) are warranted. The County's current monitoring network includes several wells in the Study Area. Additional monitoring wells are also recommended east of the Napa River to provide more definitive monitoring of the shallower part of the aquifer system and also the effect of local groundwater pumping on the deeper part of the aquifer system.

3 GROUNDWATER RESOURCES GOALS AND MONITORING 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 SWRCB¹¹, 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.

¹¹ SWRCB is the California State Water Resources Control Board. DPH is the California Department of Public Health.

The County continues to address the General Plan goals and actions. Additionally, through the efforts embarked upon through the implementation of the County's Comprehensive Groundwater Monitoring Program, those persons whose livelihoods depend upon the county's natural resources can help ensure the sustainability of groundwater resources for future generations and the environment.

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 sustainability¹²" 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, quality, and associated watersheds (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).

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.

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

¹² 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 7.2 of this Report for additional information.

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 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 groundwater sustainability or improve groundwater conditions, and provide ongoing monitoring 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. Many of the representative sites are monitored for more than one sustainability indicator. In the Napa Valley Subbasin, 18 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 utilizes components such as historical water budgets, seasonal and long-term trends, and periods of drought. See **Section 5** of this annual report for further discussion of the measurable objectives compared with 2016 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 2016 Annual Report summarizes 2016 groundwater levels and quality in comparison to the preliminary minimum thresholds and the measurable objectives established in the Basin Analysis Report.

3.2 Overarching Groundwater Monitoring Objectives

This section describes the water level and quality objectives established for the countywide Comprehensive Groundwater Monitoring Program¹³ (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 Data Management System (DMS).

Although this 2016 Annual Report focuses on an update of the groundwater monitoring network and groundwater level trends and conditions, groundwater quality objectives are also included for completeness.

¹³ 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.

3.2.1 Groundwater Level Monitoring Objectives

The focus of 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 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 NVF-MST Subarea and the northeastern part of the NVF-Napa Subarea to determine whether groundwater water conditions in the NVF-MST 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.

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, the key objectives for future groundwater level monitoring for each subarea are summarized in the Plan (LSCE, 2013a).

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.

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, the key objectives for future groundwater quality monitoring for each subarea are summarized in the Plan (LSCE, 2013a).

4 GROUNDWATER MONITORING NETWORK

4.1 Groundwater Level Monitoring

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in 2016 (Table 4-1). The overall number and distribution of monitored sites remained consistent with the monitoring conducted in 2014 and was increased relative to the 87 sites reported in the 2011 (LSCE, 2013a). Figure 4-1 shows the distribution of sites monitored in 2016 according to the monitoring entity.

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

Reporting Program	Number of Monitored Sites, Fall 2015	Number of Monitored Sites, Fall 2016
Napa County		
CASGEM		
<i>Surface Water-Groundwater Monitoring Wells</i>	10	10
<i>Domestic and Irrigation Wells</i>	23	23
CASGEM Subtotal	33	33
State Water Data Library	19	18
County Volunteer Groundwater Monitoring Program	48	47
Napa County Subtotal	100	98
California Department of Water Resources		
State Water Data Library / Volunteered Sites	4	4
State Water Resources Control Board		
Geotracker	9	6
Total Sites, All Entities	113	108
Note: This table has been revised since the 2015 annual monitoring report to clarify that the Napa County Surface Water-Groundwater Monitoring Wells are a subset of the overall CASGEM network monitored by Napa County.		

Out of the total 108 sites monitored in 2016, 98 were monitored by Napa County. Four sites were monitored by DWR. The remaining six sites were regulated facilities with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Program (Table 4-1).

Minor reductions in the number of sites monitored by Napa County between 2015 and 2016 occurred due to a well-owner requests and one well destruction. One additional well was added to the County's monitoring networks during 2016 based on a request by the well owner for monitoring in areas where additional sites were needed. The number of Geotracker sites with data reported in 2016 decreased by a

total of three sites compared to the number of sites with data reported in 2015. Changes to the Geotracker¹⁴ network included five sites that reported groundwater level data in 2015 but not in 2016. One site reported data in 2016 after not reporting any data in 2015. One new site also began reporting data in 2016.

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

Table 4-2 Current Groundwater Level Monitoring Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites Through 2011	Number of Monitored Sites, Fall 2014	Number of Monitored Sites, Fall 2015	Number of Monitored Sites, Fall 2016
Napa Valley Floor-Calistoga	6	10	9	7
Napa Valley Floor-MST	29	27	27	26
Napa Valley Floor-Napa	18	21	20	21
Napa Valley Floor-St. Helena	12	14	14	14
Napa Valley Floor-Yountville	9	12	14	13
Carneros	5	12	12	12
Jameson/American Canyon	1	1	1	1
Napa River Marshes	1	1	-	-
Angwin	-	5	5	5
Berryessa	3	2	3	1
Central Interior Valleys	1	1	2	2
Eastern Mountains	-	3	4	3
Knoxville	1	-	-	-
Livermore Ranch	-	-	-	-
Pope Valley	1	1	1	1
Southern Interior Valleys	-	-	-	-
Western Mountains	-	2	1	2
Unknown ¹	-	3	-	-
Total Sites	87	115	113	108

¹ In 2014 three sites in the Geotracker regulated groundwater monitoring network were reporting groundwater level data, but had not yet reported location information for the monitored wells.

4.1.1 Napa County Monitoring Network

In 2016, out of 108 monitoring wells in the total monitoring network, Napa County monitored 98 sites across the county. Eight sites were monitored by Napa County on a monthly interval, to address temporal data gaps identified in the 2014 Annual Monitoring Report (LSCE, 2015). Ten sites were

¹⁴ Geotracker wells most often include monitoring wells at facilities regulated under the authority of the Regional Water Quality Control Board.

monitored using continuously recording instrumentation at dedicated monitoring wells constructed as part of the County's Surface Water–Groundwater Monitoring Project.

4.1.2 CASGEM Monitoring Network

The CASGEM Monitoring Network is a subset of the total wells in the monitoring program. Well owners voluntarily choose whether or not to participate in the State's CASGEM Program. As of fall 2016 the Napa County CASGEM Monitoring Network included 23 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 monitoring 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 4-3 and Figure 4-2**). Nineteen of the CASGEM Network wells in Napa County are located in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (**Table 4-4**). In addition, six CASGEM Network wells are located in the very low priority Napa-Sonoma Lowlands Subbasin of the Napa-Sonoma Valley, while eight are not located in any groundwater basin or subbasin.

Table 4-3 Current CASGEM Network Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites, Fall 2016
Napa Valley Floor-Calistoga	1
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	33

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

Basin/Subbasin Number	Basin Name	Subbasin Name	Number of Monitored Sites, Fall 2016
2-2.01	Napa-Sonoma Valley	Napa Valley	19
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			33

4.1.3 DWR Monitoring Network

The DWR currently monitors four wells in Napa County as part of its voluntary groundwater monitoring efforts (**Table 4-1**). Three of these sites are monitored at monthly intervals, while one is monitored semi-annually. These wells are distributed within the Napa Valley Groundwater Subbasin and exclude the MST Subarea.

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 includes manual measurements and samples from groundwater monitoring wells (typically shallow) at each site. Groundwater level data are available for six Geotracker sites located throughout Napa County in 2016 (**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 2016 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 Groundwater Subbasin, while the other two 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 Napa Valley 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 is providing matching funds to cover a portion of the monitoring well construction and instrumentation costs (LSCE, 2016b).

4.2.1 Monitoring Network

Figure 2-6 shows the location of the five project sites, with four sites along the Napa River and one adjacent to Dry Creek. The five sites selected for the project are within the Napa, Yountville, and St.

Helena Subareas of the Napa Valley Floor. These are three of the six subareas where paired surface water-groundwater monitoring was recommended in the 2013 Plan.

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 sites 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 Representative Monitoring Sites

Groundwater level conditions are currently monitored at 57 wells spatially distributed throughout the Subbasin (**Figure 4-3**). These sites include 17 wells identified as groundwater level representative wells in the 2016 Basin Analysis Report. 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, in order 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 were selected because of their construction (as part of DWR’s Local Groundwater Assistance Grant that was awarded to Napa County) 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, and 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.

5 GROUNDWATER LEVEL TRENDS AND FLOW DIRECTIONS

Groundwater data availability in Napa County vary widely among local subareas. The bulk of sites with historical and current groundwater level and quality data are located in the Napa Valley Floor Subareas with less abundant records available in other Napa County subareas. With the exception of the MST Subarea, the Napa Valley Floor subareas generally coincide with the Napa Valley Groundwater 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 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 Saint 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 2013 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-year periods with below average precipitation occurred in 1990-1991 (both Dry), 1976-1977 (both Very Dry), and 1959-1962 (all Dry), 1954-1955 (both Dry), and 1947-1949 (all Dry).

Successive years of below average precipitation in water years 2012 through 2016 provide an important context for the review of recent groundwater level trends. 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. The long-term mean (average) of a set of climatic data, such as precipitation in an area of study, is first 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. Upon review of the curve, 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. A cumulative departure curve was developed for the Napa Valley Subbasin to identify precipitation trends. **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 2016. The cumulative departure values calculated for **Figure 5-1** provide a tally of precipitation received relative to the mean value over time.

Notably, the eight-year span from 1987 through 1994, with only one year of above average precipitation, resulted in a net cumulative departure deficit¹⁵ of 38.55 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 26.13 inches. Groundwater level records from the Napa Valley Groundwater 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

¹⁵ The progressive accumulation or deficit of precipitation (i.e., progressive annual departure relative to the mean) can have important effects on hydrologic relationships (e.g., streamflow) that are directly related to precipitation.

spring groundwater levels over an eight-year period when precipitation totals were below average on the whole.

The five-year span from 2012 through 2016 produced a net cumulative departure deficit of 18.42 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. **Figure 5-2** shows depths to groundwater for the Napa Valley Subbasin in spring 2015. These values are interpolated from measured wells throughout the Subbasin. Groundwater levels in the alluvial formations that comprise the primary aquifer of the Napa Valley Subbasin have continued to experience groundwater recharge and corresponding rises in groundwater levels from fall to spring during this time.

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 Valley Floor in the spring is approximately 5 to 35 feet. While agricultural land use, especially vineyards, have covered much of the 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.

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)
Napa State Hospital (NSH) Average Annual Water Year Precipitation (1920 – 2016) = 24.85 inches		

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 two wells located relatively near each other at the land surface which 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. 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. Knowledge of the geologic setting and construction details for a given well are 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 throughout the Napa Valley Floor and 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 Floor Subareas

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 alluvium from Calistoga to San Pablo Bay, and is assumed for purposes of contouring groundwater data on a regional basis, to represent a single aquifer. 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 larger areas or thicknesses of fine-grained, low-permeability materials leading to a semi-confined condition that results in groundwater levels in deeper portions of the alluvium being offset from groundwater levels in more shallow portions of the alluvium. These differences in groundwater levels are an indication of physical resistance to groundwater flow where semi-confined conditions are present. 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 2016 are shown in **Figures 5-5** and **5-6**, respectively. Groundwater elevation contours for Napa Valley spring 2016 appear similar to those developed for spring 2015, spring 2014, and spring 2010 (LSCE, 2013b and 2015). 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 2014 contours. Through the valley, groundwater elevations in spring 2016 ranged from 379 feet near Calistoga to 6 feet along the Napa River near First Street in Napa.

5.1.1 Napa Valley Floor – 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 available¹⁶. 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, including 2016 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, 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 2016 the spring groundwater level was measured as high as 14.3 feet below ground surface. With above average precipitation during the 2016/2017 winter season a depth to groundwater of 7.2 feet has already been recorded as of January 26, 2017.

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.

Monthly groundwater level monitoring conducted at NapaCounty-132 in 2016 showed groundwater levels as high as 11.6 feet below ground surface in spring 2016 (**Appendix B**). That level was 3 feet above the depth to water recorded in spring 2015 and reflects levels consistent with measurements made during dry years dating to the mid-to-late 1980s. As of the February 2017, the monthly measurement at this well, the groundwater level reached 7.4 feet below ground surface.

Monthly data collection at this well during spring 2016 showed groundwater levels varied by 2.9 feet between late March and late May. Between October 2016 and November 2016, groundwater levels in the well varied by 3.9 feet. These observations indicate that variations in the timing of data collection

¹⁶ Hydrographs contained in Figures 5-7, 5-8, 5-11, and 5-12 include data that are not designated with questionable measurement flags that 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.

can influence the result by several feet. In the case of NapaCounty-132 where recent annual groundwater level variations of approximately 20 feet have been recorded, potential differences between measured range in high and low groundwater conditions and actual conditions could be over 25%.

5.1.2 Napa Valley Floor – 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 feet 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 50 feet below ground surface during the spring. 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-75 and Napa County-76 where groundwater levels have locally declined by about 20 feet to 30 feet over the past 15 years¹⁷ (**Appendix B**). Reasons for the declines in water levels at these wells are currently the focus of a focused investigation of groundwater conditions and hydrogeologic constraints in the area. One possible factor is that lowered groundwater elevations in the northern MST Subarea could be drawing water from the northeast corner of the Napa Subarea towards the MST Subarea. Another possible factor is that the northeast corner of the Napa Subarea experiences limited groundwater recharge compared to the rest of the Napa Subarea as a result of being bounded by the East Napa Fault and Soda Creek Fault (**Figure 5-9**).

NapaCounty-75 and NapaCounty-76 are located east of the Napa River and East Napa Fault and west of Soda Creek Fault. Both wells are completed below the alluvium in the Sonoma Volcanics formation. The Sonoma Volcanics formation is also present in the MST Subarea to the east, where previous monitoring has shown several pumping depressions (LSCE, 2011a). The two nearest monitoring wells located west of the Napa River in the northeastern Napa Subarea constructed to depths of 120 feet or less and are completed in the alluvium. These wells have shown stable groundwater level trends. The monitoring well in the alluvium that is closest to the well constructed in the Sonoma Volcanics 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.

Although NapaCounty-75 is no longer actively monitored by Napa County, two additional wells have been added to the County's monitoring networks in this area in the last two years, NapaCounty-182 and NapaCounty-228 (**Appendix B**).

In the southwestern part of the Yountville Subarea and at the Napa Valley margin, groundwater levels in well NapaCounty-135 have also declined by about 30 feet since the first measurements were recorded in the late 1970s and early 1980s, with a particularly low spring groundwater level measurement recorded in 2014 (**Figure 5-8**). In response to these observations Napa County began monitoring this

¹⁷ NapaCounty-75 is among the wells that left the monitoring network in 2015. The latest available measurement from this well was recorded in October 2014.

well at monthly intervals in fall 2015. Spring 2016 monthly monitoring records show that levels reached 23.8 feet below ground surface in late March, 17 feet above the level measured during spring 2015 during a single monitoring visit.

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 2016 differed by more than 5 feet. These variations indicate the potential variability that semi-annual data collection at this well from 1979 through 2014 did not capture. Through February 2017 groundwater levels had risen to 9.9 feet below ground surface during water year 2017 to date.

Very little construction information is available for NapaCounty-135. All that is known is that it has a total depth of 125 feet. It 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 Floor – 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 alluvial deposits and the level of communication and connectivity between the two areas is believed to be limited. Groundwater levels used for contour mapping in the MST Subarea generally represent conditions of a composite aquifer system as previously described by Farrar and Metzger (2003).

Historically, groundwater flow directions in the MST Subarea were generally from the Howell Mountains in the east 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 2016 groundwater level contour maps (**Figure 5-9** and **5-10**).

In the northern MST, the highest groundwater elevations occurred between Monticello Road and Hagen Road along the lower one mile of Sarco Creek. Groundwater flow directions were to the east and north of this area. Flows to the east were towards an area of -40 feet groundwater elevations (NAVD88). Flows to the north were toward Milliken Creek where monitored wells recorded spring groundwater elevations of -14 feet and -15 feet, respectively. A groundwater elevation value of -2 feet recorded at a well along Hardman Avenue indicates a southward flow direction in that vicinity.

In the southern MST, groundwater flow continues to be generally northwest (unchanged direction since 2009) in the spring and fall 2016 with a minimum spring groundwater elevation of about -47 feet (NAVD88) in the southern MST; however, the western portion of this area has no coverage of wells with water levels which would be necessary to define the extent of the pumping depression.

Representative hydrographs for the MST illustrated on **Figures 5-11 and 5-12** show groundwater elevations and corresponding depths to groundwater since 1970 in the northern (**Figure 5-11**) and central/southern parts of the MST (**Figure 5-12**). 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 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 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. Recent measurements (post-2000) indicate that groundwater levels are about 20 to 30 feet higher on the eastern side of the fault.

In **Figure 5-12**, 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 primary aquifer of the Sonoma Volcanics, 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 seven years indicates that rate of groundwater extraction is being balanced by rates of groundwater recharge.

5.2 Subareas South of the Napa Valley Floor

South of the Napa Valley Floor the only subareas with current groundwater level monitoring sites in 2016 were the Carneros and Jameson/American Canyon Subareas.

In 2016, the Carneros Subarea had 12 current groundwater level monitoring sites. The longest period of record among them extended back to October 2011. All four monitored wells are located in the southern half of the subarea at land surface elevations between 100 feet to 25 feet (NAVD88). Patterns of groundwater level fluctuations in these wells have shown annual variations of approximately 5 feet from spring to fall, with groundwater elevations ranging from about 20 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 10 feet to 100 feet. Groundwater levels have been stable to increasing in 10 of the currently monitored wells. Two wells, NapaCounty-150 and NapaCounty-153, have seen groundwater levels decline by 15 to 20 feet during the drought period since 2011.

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 2016 found depths to groundwater ranging from 5 feet in the spring to 14 feet in the fall.

5.3 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 4-2**).

Groundwater level monitoring data for these wells are limited to no more than two years of semi-annual measurements. The depths to groundwater in these wells ranged from 44 feet to 240 feet from ground surface elevations ranging from 390 feet to 1660 feet, mean sea level.

5.4 Angwin and Pope Valley Subareas

In 2016, groundwater level monitoring in the Angwin and Pope Valley Subareas was performed by Napa County at recently volunteered wells. In the Angwin Subarea five wells were monitored, while one well was monitored in the Pope Valley Subarea (**Table 4-2**).

Groundwater level monitoring data for the Angwin Subarea wells are only available from 2014 to 2016. Depths to groundwater in these wells ranged from 95 feet to 233 feet from ground surface elevations ranging from 1608 feet to 1747 feet, mean sea level.

The only currently monitored groundwater level monitoring site in Pope Valley is a single well with data from 2014 to 2016. Depths to water have ranged from 8 to 16 feet below ground surface over that time.

5.5 Napa Valley Surface Water-Groundwater Monitoring

Data from Sites 1 (**Figure 5-13**), 3 (**Figure 5-15**), and 4 (**Figure 5-16**) show that groundwater levels were above or very near the riverbed at these sites, indicating connectivity between groundwater and surface water in 2016. Site 2 (**Figure 5-14**) and Site 5 (**Figure 5-17**) recorded groundwater levels in the uppermost part of the aquifer system at or above the streambed for a portion of the year in 2016. Groundwater levels in the deeper monitoring well at Site 5 (NapaCounty-223d-swgw5) were recorded to be at the elevation of the adjacent Napa River streambed in March 2016, while water levels in the deeper monitoring well at Site 2 (NapaCounty-217d-swgw2) remained several feet below the streambed throughout.

Site 1 is located within the City of Napa and is currently the farthest downstream of the four project monitoring sites along the Napa River (**Figure 2-6**). The river is perennially wetted and tidally-influenced at this site with a 5 to 7 foot tidal range observed during the period of record. Data collected at this site have shown very similar water level elevations at all three monitoring locations including a similar, though dampened, response to the tidal cycles in the two piezometers. 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.

Data from Sites 3 and 4 along the Napa River showed groundwater elevations upwards of 10 feet above the adjacent streambed in late spring, gradually declining to a level approximately equal to or slightly above the streambed by late September. This pattern is different from the pattern observed in the prior year at Site 3, where groundwater levels dipped below the streambed for a few months during what was a drier water year.

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 2016.

At Site 5 water level data indicate that the river was hydraulically connected to groundwater during the first half of the year, until flows in the river ceased in July, and again in October 2016 as storms generated runoff leading to renewed flow in the river. At Site 2, located along Dry Creek, a pattern similar to Site 5 occurred in 2016, 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 in 2016. 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 2016, indicating that groundwater was disconnected from the stream, although recharge to the groundwater system was likely occurring when water flowed in the creek.

Site 2 also showed groundwater level differences between the shallow and deep casings of at least 5 feet for most or all of 2016. 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.

Although the period of record at these sites is short compared to many wells monitored by Napa County, **Figure 5-18** 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 from Site 4 and a similar distance from the Napa River. Data from NapaCounty-133 from 1978 through 2016 show a similar range and stable trend in groundwater elevations from spring to fall across the full period of record, including 2016.

5.6 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 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 for the six types of undesirable results identified in SGMA (LSCE, 2016c). For SGMA purposes a “measurable objective” is “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).

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 utilizes 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.

Based on the analyses of surface water and groundwater interconnections, measurable objectives for streamflow depletion are set at 16 SGMA-related representative wells in the Subbasin (**Table 5-2**) (LSCE, 2016c). These objectives represent the mean fall groundwater level elevations that occurred historically.

Minimum thresholds for streamflow depletion are also set at the 16 representative wells in the Subbasin where measurable objectives are established (**Table 5-2**) (LSCE, 2016b). These 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. These thresholds 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.

At 12 wells the lowest recorded groundwater elevation for fall 2016 was below the measurable objective but equal to or greater than the minimum threshold (**Table 5-2**). In four wells the lowest recorded groundwater elevation for fall 2016 was above the measurable objective. One well from the dedicated monitoring facilities constructed in 2014, NapaCounty-223d-swgw5 saw fall groundwater levels recorded in 2016 that were below the values from the two prior years used to establish the sustainability criteria. These conditions show that groundwater levels across the Subbasin were within the recorded range of conditions historically, including the 1976-1977 drought. The minimum threshold exceedance condition at NapaCounty-223d-swgw5 was recorded for 150 hours over a span of 6.25 days in late September into early October. At the time of these measurements groundwater levels in NapaCounty-222s-swgw5, a monitoring well at the same site constructed to monitor groundwater conditions in the upper portion of the aquifer system recorded groundwater levels 27 feet higher than water levels in NapaCount-223d-swgw5. This large difference in groundwater levels at different depths within the aquifer system at the same site indicate that groundwater levels in the deeper well were not reflective of conditions in the upper part of the aquifer system where a direct connection with streamflow can occur. The minimum groundwater elevation recorded at NapaCounty-223d-swgw5 rose quickly through the end of 2016 with the onset of the return of rainfall in late fall.

The measurable objective for maintaining or improving groundwater quality is based on groundwater sample concentrations remaining above water quality objectives and groundwater quality at concentrations similar to and/or improved compared to historical observations in the groundwater Subbasin (**Table 5-3**) (LSCE, 2016c). The minimum threshold for avoidance of degraded groundwater quality is based on groundwater quality concentrations remaining above water quality objectives. The focus for SGMA purposes is on constituents contributed due to activities at the land surface rather than on the presence of naturally occurring constituents.

The measurable objective for avoidance of seawater intrusion is based on groundwater quality concentrations remaining stable in the representative well designated for this sustainability indicator (**Table 5-3**) (LSCE, 2016c). The minimum threshold for avoidance of seawater intrusion is based on groundwater quality concentrations remaining stable in the representative well designated for this sustainability indicator.

Table 5-3 presents groundwater quality data for samples collected in 2016 at representative wells in the Napa Valley Subbasin. These values were limited to one sample collected at 5N/4W-15E1 in August 2016. Both the total dissolved solids and nitrate concentrations reported in that sample were below the measurable objective established for the seawater intrusion and degraded groundwater quality undesirable results for the Subbasin. As described in **Section 7**, additional groundwater data collection at representative monitoring wells is planned for 2017.

Table 5-2. Sustainability Indicators: Groundwater Levels

Representative Monitoring Sites Well ID	Date	Measured Minimum 2016 FALL WLE (Feet, AMSL) ¹	Number of Measurements/ Duration	Chronic Lowering of GWLs		Reduced GW Storage		Land Subsidence		Streamflow Depletion	
				Minimum Threshold (Fall GWE, Feet AMSL)	Measurable Objective (Fall GWE, Feet AMSL)	Minimum Threshold (Fall GWE, Feet AMSL)	Measurable Objective (Fall GWE, Feet AMSL)	Minimum Threshold (Fall GWE, Feet AMSL)	Measurable Objective (Fall GWE, Feet AMSL)	Minimum Threshold (Fall GWE, Feet AMSL)	Measurable Objective (Fall GWE, Feet AMSL)
06N04W17A001M	10/18/2016	47		37	50	37	50	37	50	37	50
06N04W27L002M	11/16/2016	18		-2	12	-2	12	-2	12	-2	12
07N05W09Q002M	9/8/2016	134		127	135	127	135	127	135	127	135
08N06W10Q001M	10/17/2016	282		269	281	269	281	269	281	269	281
NapaCounty-128	10/11/2016	331		320	331	320	331	320	331	320	331
NapaCounty-133	9/26/2016	74		72	76	72	76	72	76	72	76
NapaCounty-135	10/12/2016	31		20	60	20	60	20	60	-	-
Napa County 214s-swgw1	9/25/2016	2		2	4	2	4	-	-	2	4
Napa County 215d-swgw1	10/19/2016	3		2	4	2	4	-	-	2	4
Napa County 216s-swgw2	10/8/2016	72		61	76	61	76	-	-	61	76
Napa County 217d-swgw2	9/23/2016	63		61	76	61	76	-	-	61	76
Napa County 218s-swgw3	11/16/2016	32		29	32	29	32	-	-	29	32
Napa County 219d-swgw3	10/5/2016	31		29	32	29	32	-	-	29	32
Napa County 220s-swgw4	10/4/2016	76		75	77	75	77	-	-	75	77
Napa County 221d-swgw4	10/4/2016	75		75	77	75	77	-	-	75	77
Napa County 222s-swgw5	10/14/2106	186		185	190	185	190	-	-	185	190
Napa County 223d-swgw5	10/1/2016	160	150 hours ² (6.25 days)	164	175	164	175	-	-	164	175

1. Values below a Minimum Threshold shown in bold.

2. The minimum threshold exceedances occurred primarily between 9/27 and 10/3 in the deeper monitoring well at Site 5, while levels in the shallow well, NapaCounty-222s-swgw5, were stable and 27 feet above levels in the deeper monitoring well.

Table 5-3. Sustainability Indicators: Groundwater Quality

Well ID	Sample Date	Sample Result (mg/L)	Sample Reporting Limit (mg/L)	Seawater Intrusion	
				Minimum Threshold (TDS, mg/L)	Measurable Objective (TDS, mg/L)
5N/4W-15E1	8/24/2016	240	1	450	300

Well ID	Sample Date	Sample Result (NO3-N, mg/L)	Sample Reporting Limit (mg/L)	Degraded GW Quality	
				Minimum Threshold (NO3-N, mg/L)	Measurable Objective (NO3-N, mg/L)
5N/4W-15E1	8/24/2016	0.1	0.1	10	8

6 COORDINATION AND COLLABORATION

6.1 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).

6.1.1 Napa County’s Participation in San Francisco Bay Area and Westside 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 has contributed to two larger regional IRWMPs. The County actively collaborated with the San Francisco Bay and Westside RWMGs to update the IRWMP for the San Francisco Bay (Kennedy Jenks et al., 2013) and to develop a new IRWMP for the Westside Sacramento Region (Kennedy Jenks, 2013). The County’s representation and participation in the San Francisco Bay and 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.

6.2 Watershed Information and Conservation Council of Napa County

The Watershed Information and Conservation Council¹⁸ (WICC) 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 14-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):

¹⁸ Prior to 2015 this organization was named the Watershed Information Center and Conservancy.

- 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 at www.napawatersheds.org/groundwater. This new initiative has involved adding groundwater summary data and graphs for the County's groundwater basins and/or subareas that are already delineated on the website's maps. Specifically, the WICC has established a portion of the WICC website dedicated to groundwater. Data and information are at a watershed scale and not be project or parcel specific scale. 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.
- Educational materials and resources on groundwater recharge areas and ways to improve these areas.
- Report on the Napa County Voluntary Groundwater Level Monitoring Program.

Napa County conducted public outreach regarding the status of SGMA implementation and groundwater conditions in several ways in 2016. An annual groundwater conditions presentation was provided to the Board of Supervisors in April 2016. WICC workshops were held in September and November 2016 to present drafts of the Basin Analysis Report and receive input from both the WICC members and the public. The County posted documents and other resources pertaining to the Basin Analysis Report to its groundwater information webpage as well as the WICC website including. These resources included copies of presentation slides, a frequently asked questions document, and the state's Groundwater Sustainability Plan Regulations. Links to pertinent state websites were also posted to the two websites including a link to the DWR website for providing public comment on submitted alternatives.

Throughout 2016, the County provided notifications of new document availability through the WICC's automated weekly news digest, distributed by email on the Thursday morning following the upload. 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 its existing groundwater list-serve. Sixteen separate announcements were sent to an average of 102 recipients on the list-serve between April 1, 2015 and 2/28/2017. County staff also provided presentations on SGMA implementation efforts at three additional public meetings held in the county between June 6, 2016 and July 14, 2016 (LSCE, 2016c).

7 SUMMARY AND RECOMMENDATIONS

Groundwater level monitoring was conducted at a total of 108 sites across Napa County in 2016 (**Table 4-1**). The overall number and distribution of monitored sites changed slightly compared with the monitoring conducted in 2015 (LSCE, 2016a).

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. While many wells have shown at least some degree of response to recent drought conditions (i.e., 2012-2015; precipitation in 2016 was slightly below the long-term mean annual precipitation), the water levels observed in recent years are generally higher than groundwater levels in the same wells during the 1976 to 1977 drought. Elsewhere in the County long-term groundwater level records are limited, with the exception of the 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. Groundwater level declines observed in the MST Subarea as early as the 1960s and 1970s have stabilized since about 2009. 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 conditions in the subarea.

While the majority of wells with long-term groundwater level records exhibit stable trends, periods of year to year declines in groundwater levels have been observed in a few wells. These wells are located near the Napa Valley margin in the northeastern Napa Subarea (former NapaCounty-75 [no longer accessible for County monitoring] and Napa County-76), southwestern Yountville Subarea (NapaCounty-135) and southeastern St. Helena Subarea (NapaCounty-132). These locations are characterized in part by relatively thin alluvial deposits, which may contribute to more groundwater being withdrawn from the underlying semi-consolidated deposits.

Water levels in northeastern Napa Subarea wells former NapaCounty-75 and Napa County-76, east of the Napa River, have stabilized since 2009, though declines were observed over roughly the prior decade (**Figure 5-7**). Despite the recent stability, given the potential for a hydraulic connection between the aquifer units in the vicinity of these wells and the aquifer units of the MST Subarea and an apparent increase in the number of new well permits in the area over the past 10 years¹⁹, led to further study of this area. As described in Section 2.4, this study is underway with a report to be completed in April 2017.

Water levels at NapaCounty-135 and NapaCounty-132 declined most distinctly between 2013 and 2014 (**Figures 5-6 and 5-7**). The increased monitoring frequency at these wells has shown groundwater levels already recovering to levels comparable to or higher than those of spring 2013. In 2016, groundwater levels in NapaCounty-132 and -135 both returned to levels consistent with long-term records. Groundwater level declines in these wells observed in 2014 could have one or more contributing factors, including variations in groundwater recharge due to changes in the timing and intensity of precipitation and changes in the level of pumping at the monitored well or in the vicinity of the monitored well. In fall 2015, monthly groundwater level monitoring was implemented at NapaCounty-132 and -135;

¹⁹ In a Memorandum to David Morrison, Director of Planning, Building, and Environmental Services, dated December 7, 2015 regarding groundwater conditions in the northeastern corner of the Napa Subarea Steven Lederer, Director of Public Works, noted that "12 of the approximately 30 homes on Petra Drive have applied for new well permits in the past 10 years."

continuation of the increased monitoring frequency is recommended to assist with interpretation of conditions at these wells in the future.

Groundwater quality data show stable conditions between 2009 and 2015 compared to the conditions reported previously with data through 2009 (LSCE, 2011a and LSCE, 2016a). Water quality standard exceedances in the Napa Valley Floor subareas and Napa Valley Subbasin were limited to the naturally-occurring constituent arsenic, with 4 of 26 sites showing maximum concentrations above the MCL of 10 µg/L (LSCE, 2016a).

Wells with long-term water quality data in the Napa Valley Subbasin show stable TDS and nitrate concentrations, with one exception. Well (06N04W27L002M) in the Napa Subarea which had a peak of 7.7 mg/L NO₃-N (nitrate as nitrogen) in 2011 compared to initial concentrations of 3.4 mg/L NO₃-N and 4.0 mg/L NO₃-N in 1982 and 1972, respectively. In the Napa-Sonoma Lowlands Subbasin, nitrate concentrations have been stable to decreasing in all five wells with long-term records in the Napa-Sonoma Lowlands Subbasin (LSCE, 2016a). Two wells have shown increasing TDS trends, though all four wells with long-term trends were initially at or above the secondary MCL.

7.1 Basin Analysis Report Recommendations and Implementation

Findings and Recommendations from the analyses conducted as part of the Basin Analysis Report and in consideration of prior activities by Napa County, the GRAC, the WICC, and others, and relevant to this 2016 Annual Report, are presented below (see the Basin Analysis Report [LSCE, 2016c] for the complete set of recommendations).

7.1.1 Refine Spatial Distribution of Groundwater Monitoring Network

Four recommendations in the Basin Analysis Report involve refining the spatial distribution of the groundwater monitoring network, including:

- Address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the alluvial aquifer; additional wells are of interest in the St. Helena Subarea, northern part of the Yountville Subarea (east and west of the Napa River), and the western and southern parts of the Napa Subarea
- 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
- Implement Napa County groundwater quality monitoring program; includes water quality monitoring in a subset of current monitoring network wells
- Coordinate with existing discretionary permit applicants (e.g., wineries and others) regarding existing groundwater level and/or water quality information)

The County successfully implemented a program to recruit volunteered wells for inclusion in the County's groundwater monitoring program. Based on very specific groundwater monitoring objectives to meet SGMA purposes, some additional wells remain of interest to fill data gaps. Specifically, with respect to monitoring in the alluvial aquifer system, additional wells are of interest in the St. Helena Subarea, northern part of the Yountville Subarea, and the southern part of the Napa Subarea. Additional wells are also of interest to monitor conditions in older formations underlying the alluvial aquifer system. The County has the opportunity, through Conditions of Approval on new and modified discretionary permits, to obtain additional wells and monitoring data by requiring new permittees to

monitor and record water level and extraction data, and provide the County access to project wells and data when it is needed to maintain or expand the monitoring network.

The County has already planned for groundwater quality sampling of a subset of its currently monitored wells. This sampling will be implemented in 2017 (see additional discussion in Section 7.4). The additional water quality information would expand the understanding of background water quality, particularly with respect to salinity and nutrients.

7.1.2 Expand Stream Gaging and Nearby Shallow Groundwater Monitoring

The implementation of the DWR Local Groundwater Assistance Grant (LGA) program to construct and implement coupled surface water and groundwater monitoring in and near the Napa River system has been very valuable for improving the understanding of surface water and groundwater interaction. Similar facilities at additional locations would help further this understanding, are important for the County's SGMA sustainability goal, and would be key to the objective of maintaining or improving streamflow during drier years and/or seasons. It is recommended that the County:

- 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)

7.1.3 Hydrogeology and Freshwater/Saltwater Interface Southern Part of Napa Sonoma Valley Groundwater Basin

The Jameson/American Canyons and Napa River Marshes Subareas, which make up the southern County area, have limited available data. These are very low priority basins located outside of the Napa Valley Subbasin. The two main issues facing this area are potential saltwater intrusion and the possibility that current water resources will not be sufficient to meet future demand. To establish current conditions and obtain information necessary for future development planning, further analysis is recommended that includes:

- Adding well in these areas to monitor groundwater levels;
- Monitoring groundwater quality;
- Collection and interpretation of geologic data (primarily from well drillers' reports);
- Analysis of streamflow and precipitation;
- Estimation of recharge and discharge using both mass balance and streamflow infiltration methods; and
- Determination of the extent and properties of aquifer materials.

The limited groundwater data in the southern County area make it difficult to determine the source and distribution of salinity in this area with any certainty. A series of multi-level monitoring well facilities installed stepping south from the City of Napa toward San Pablo Bay would help in determining the geology of the Napa River Marsh Subarea and distribution of high salinity groundwater. This further subsurface exploration and characterization of the aquifer system, in conjunction with efforts to estimate subsurface outflow from the Napa Valley, would also help determine if freshwater within the Napa River Marshes Subarea could possibly be used to sustain increasing demand in the Jameson/American Canyon Subarea. For similar reasons, the County would benefit from updating reference point elevation data for some currently monitored wells with surveyed values in order to more accurately monitor groundwater level gradients and the potential for future seawater intrusion.

7.1.4 Review and Coordination with DWR Best Management Practices

Following DWR's preparation of GSP regulations, DWR staff began in earnest to work on many other SGMA efforts, especially the development of Best Management Practices (BMPs). DWR published BMPs in December 2016. While some County BMPs were included in the Basin Analysis Report, it is recommended that additional BMPs be incorporated in future updates (including Annual Reports).

7.2 Northeast Napa Area Groundwater Study

Previously observed groundwater level declines in the northeast Napa Subarea, east of the Napa River and west of the MST, along with reports of increased well replacement activity along Petra Drive raised questions about the cumulative impacts of existing and potential future groundwater use in this area. In addition to completing the standard project-level planning review of the proposed projects, a focused study of hydrogeologic conditions affecting groundwater availability is underway for this specific area. The investigation is designed to address existing and future water use in the area, sources of groundwater recharge, and the geologic setting in order to assess and address the potential for cumulative impacts of future development. The investigation seeks to address the potential influence of previously documented groundwater cones of depression in the MST subarea on both the study area east of the Napa River and the Napa Subarea west of the Napa River. The investigation is also assessing the potential for mutual well interference to be a factor in the historical lowering of groundwater levels in wells in the Petra Drive area. Additionally, the study is assessing the potential for streamflow depletion due to pumping in the study area and its adjacency to Napa River and Soda Creek. Recommendations from this study are forthcoming (LSCE, 2017b); a recommendation to include construction of SW/GW monitoring facilities (like the Napa County LGA facilities) east of the Napa River is likely.

7.3 Data Gap Refinement

Groundwater levels in two monitored wells located near to the Napa Valley margin east of Napa River midway between St. Helena and Yountville showed year to year declines in groundwater levels. Additional groundwater level monitoring was implemented in fall 2015 to consider the full range of possible causes for these declines and more accurately determine if the present emerging trends. Beginning in fall 2015, groundwater levels are measured monthly in this area. The monthly data show that the peak for spring water level recovery may vary, i.e., the month during which the highest groundwater level is measured may vary from year to year. Therefore, more frequent water level measurements provide a better understanding of this variability. Continuation of the increased frequency of data collection in this area is recommended.

As part of the vetting process for considering and adding wells to the County's monitoring network, construction information is reviewed and linked to geologic information to identify well construction relative to aquifer units. In cases where a well owner does not have a record of the construction, a review of Well Completion Reports is recommended. During 2016, well construction information was reviewed for currently monitored wells and, where an aquifer designation had not yet been determined, this linkage was completed for several wells.

7.4 Baseline Water Quality Sampling

The groundwater quality monitoring objectives contained in the *Napa County Groundwater Monitoring Plan 2013* (Plan) included investigating variations in water quality at different points within the groundwater Subareas and at different aquifer units within a given subarea (LSCE, 2013a). The Plan recommended baseline sampling in wells at each of 18 Areas of Interest for additional monitoring and at the then proposed dedicated surface water-groundwater monitoring wells. It is recommended that wells added to the County monitoring networks in these areas be reviewed for suitability in light of the groundwater quality monitoring objectives, with baseline sampling conducted for those wells with sufficient well construction records to enable interpretation of the results for specific aquifer units. In 2017, groundwater quality sampling is planned to occur at 16 wells distributed throughout the Napa Valley Groundwater Basin. Although, the 2017 sampling program will focus on wells located in the Napa Valley Subbasin, other subareas should be considered as funding allows.

A second round of baseline water quality sampling is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites, as described in the Plan. An initial round of sampling and analysis was completed in June 2015 with a combination of County matching funds, DWR grant funds, and DWR in-kind support. In 2016, water quality parameters continued to be collected from dedicated transducers. Sampling these wells again in 2017 will provide a more robust baseline dataset that would be used to characterize any inter-annual variability at each well and provide a basis for interpreting future groundwater quality data.

7.5 Coordination with Other Monitoring Efforts

Coordination with other county departments and other agencies that collect or utilize groundwater data could provide an additional source of data in places where data may be limited. 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. Another potential source of coordination would be a continuation of the in-kind support for laboratory analysis of water quality samples by DWR, as occurred in 2015.

7.6 Existing Activities in the MST Subarea

In 1999 the County passed a Groundwater Ordinance which, among other things, limited approval of discretionary permits in the MST Subarea to those projects that could meet the “Fair Share” requirement of 0.3 acre-foot/per acre of land. In 2004, discretionary approvals were further limited to those projects that could meet a “no net increase” standard. These actions were intended to slow the decline of water levels in the MST Subarea while a more permanent solution could be found.

It was recognized at the time that these actions by themselves would not “fix” the problem, but were a good step given the constraints of land use and groundwater law. It is reasonable to assume that these actions restricting increased use of groundwater have had beneficial impacts. However, ministerial projects (such as a single family home on a parcel without any other development, or Track II replants) were not so regulated, nor were existing (pre-1999) water users regulated.

Currently, the Napa Sanitation District (NSD) provides recycled water along two main pipelines to the southeast and north of the Soscol Water Recycling Facility. The NSD is working with water users throughout Napa to identify areas where recycled water could replace the use of potable, surface or groundwater.

Recycled water finally made its way to the Coombsville/MST area (outside the Napa Valley Subbasin) after 10 years of planning and almost two years of construction. In mid-December 2015, the NSD tested the newly constructed MST Recycled Water Project, a 5-mile pipeline and booster pump station that brings irrigation water to vineyards, homes, an elementary school, and the Napa Valley Country Club. The project has been constructed through a partnership between Napa County, the NSD, and property owners that have joined the specially formed MST Community Facilities District to fund the project. Napa Valley Country Club completed construction of a new pond to receive the recycled water for irrigation of its 182 acres of property. Through a partnership with the NSD, their new pond will be utilized to receive recycled water resulting from the performance-testing of the new MST pump station located over five miles away on Napa State Hospital property. Irrigation of the Napa Valley Country Club with recycled water will result in conservation of between 150 and 200 acre-feet (over 50 million gallons) per year of groundwater that is pumped from the MST area.

During 2016, 26 participating properties connected to the recycled water pipeline and another 10 properties are anticipated to be connected in 2017. The pipeline is designed to initially deliver up to 700 acre-feet (230 million gallons) per year of recycled water to the area and is expandable to 2,000 acre-feet per year (650 million gallons). An extension to this new system is currently under consideration following the recent award of drought-relief grant funding and additional interested property owners

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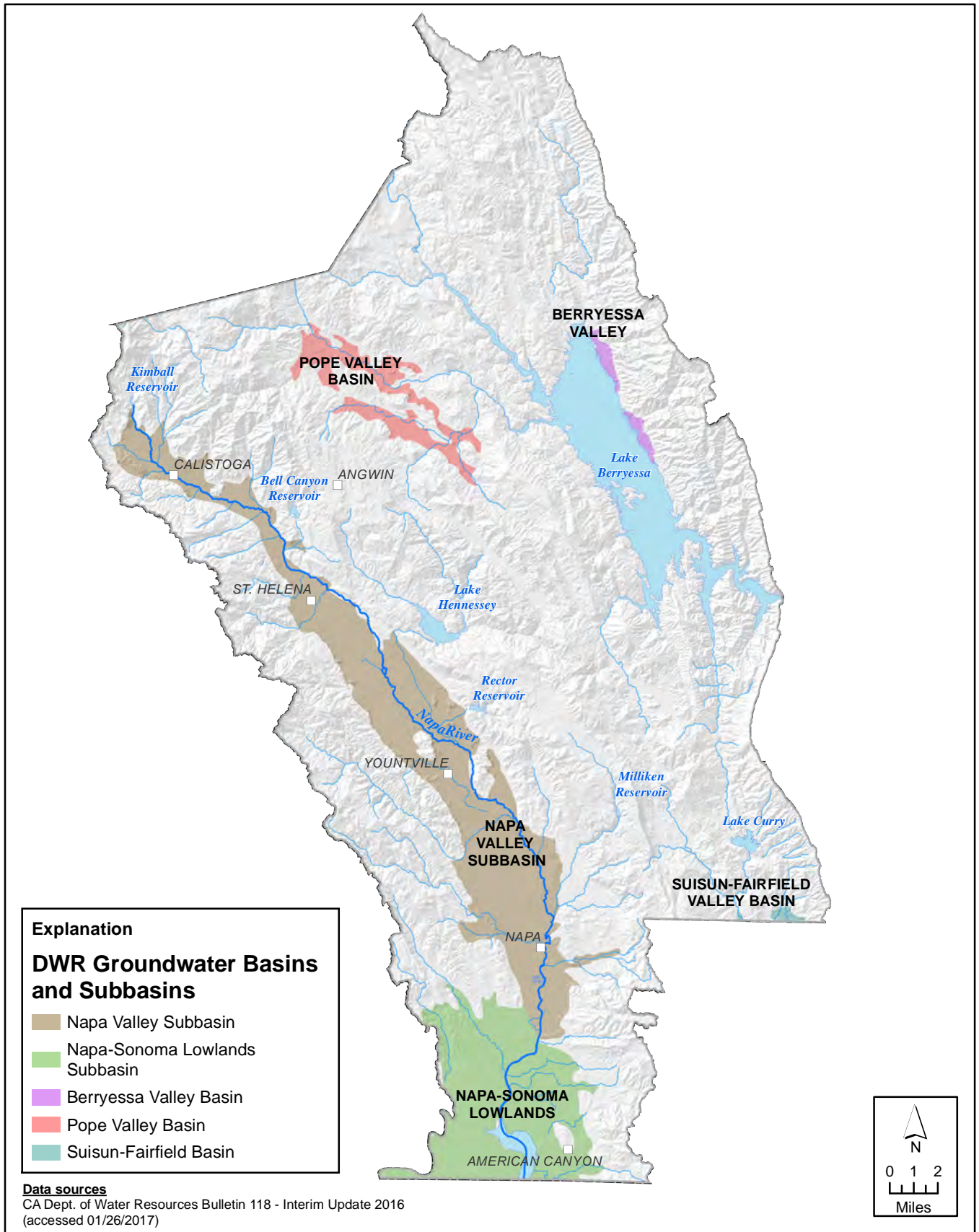
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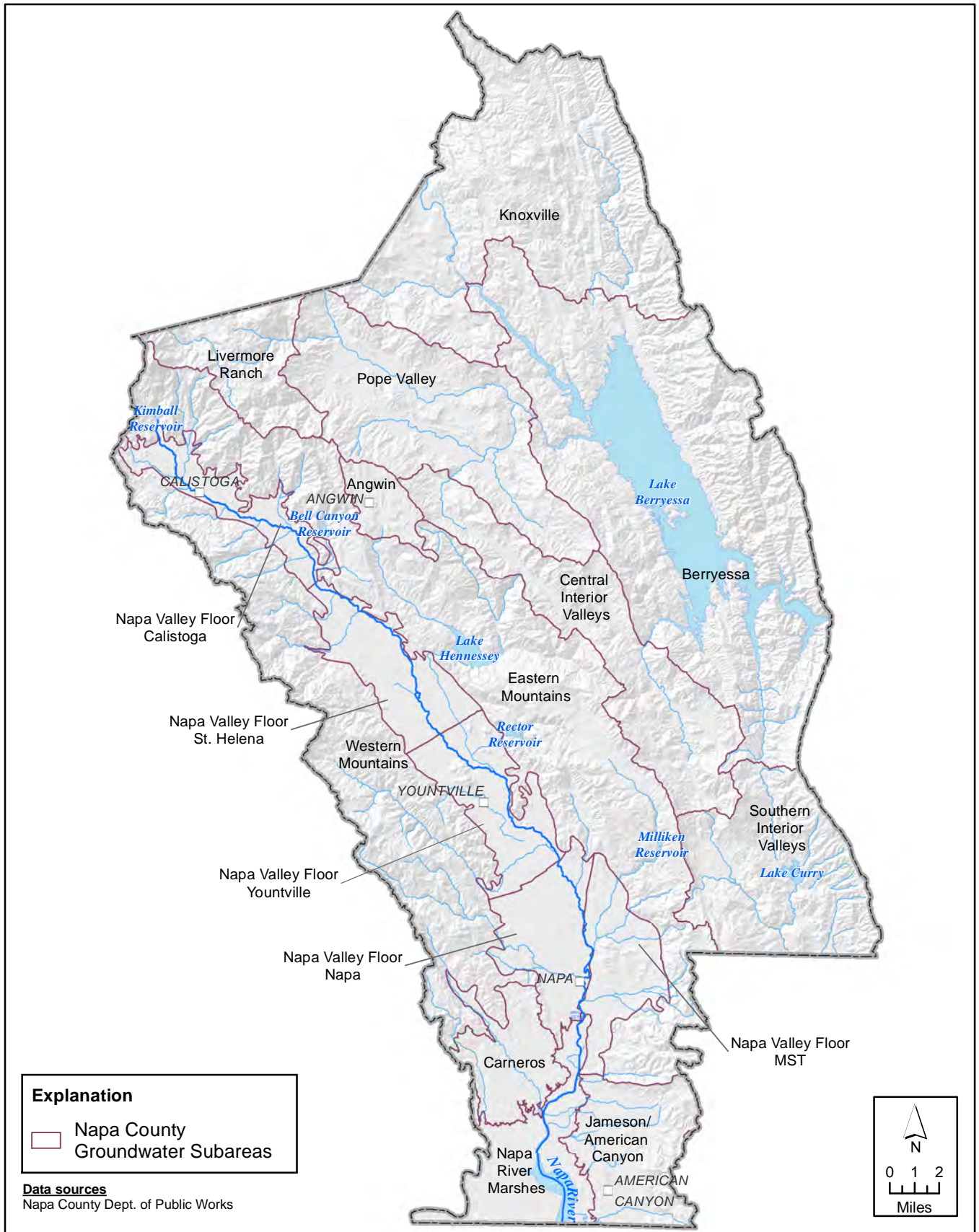
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FIGURES



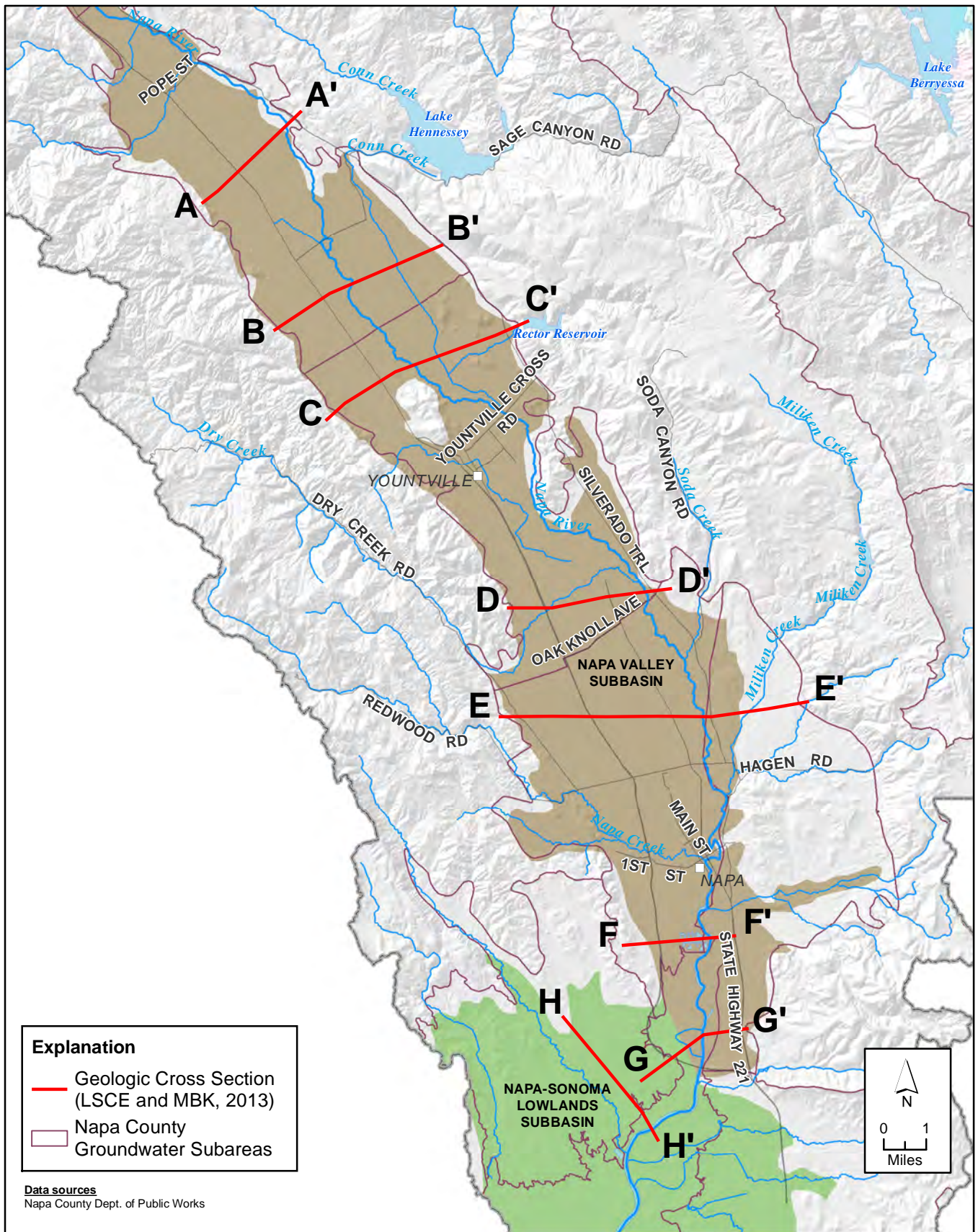


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FIGURE 2-2
Napa County Groundwater Subareas

Napa County Comprehensive Groundwater Monitoring Program
2016 Annual Report and CASGEM Update



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FIGURE 2-3
Updated Hydrogeologic Conceptualization
Geologic Cross Section Locations

Napa County Comprehensive Groundwater Monitoring Program
2016 Annual Report and CASGEM Update

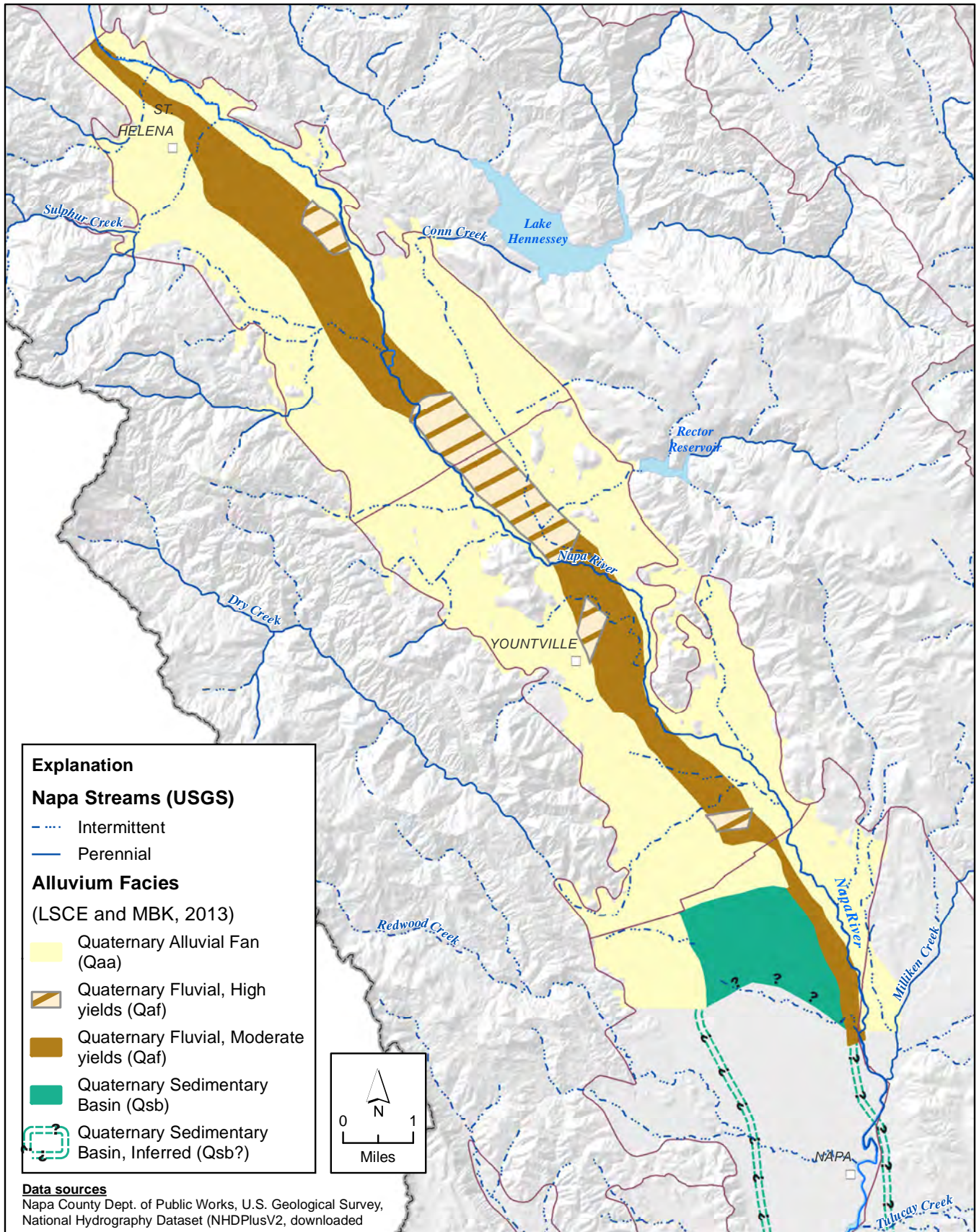
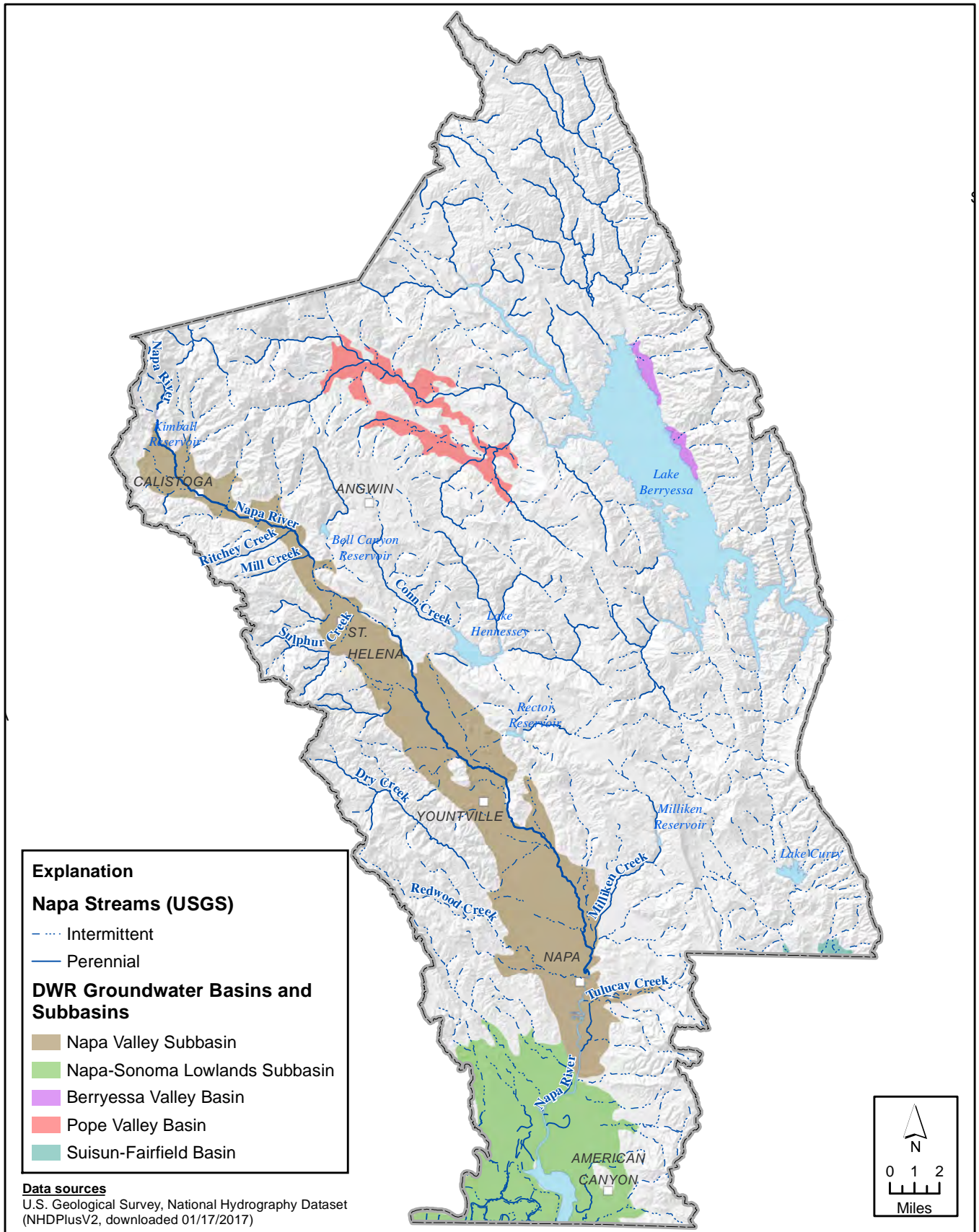
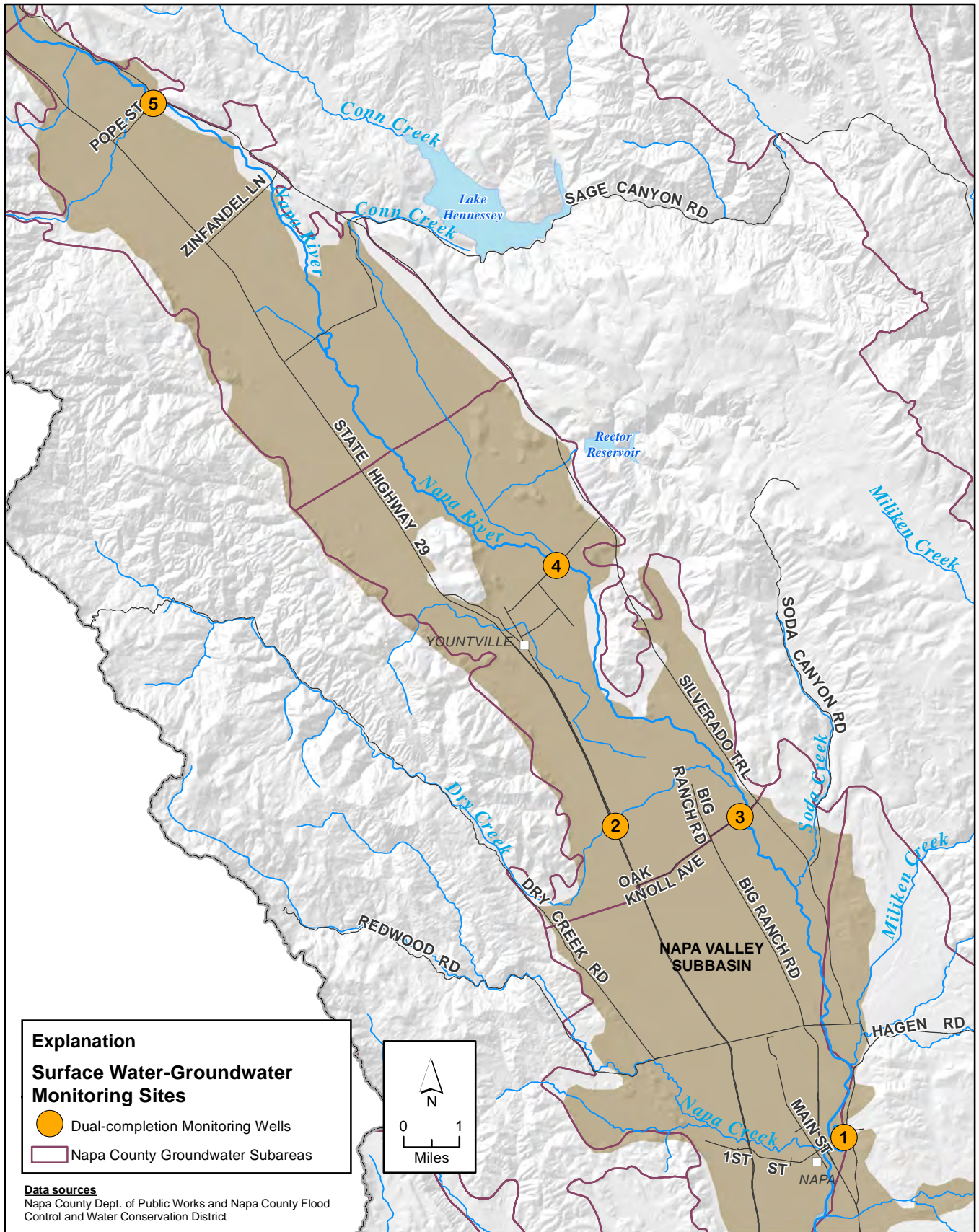


FIGURE 2-4
Streams and Alluvium Facies,
Napa Valley Floor



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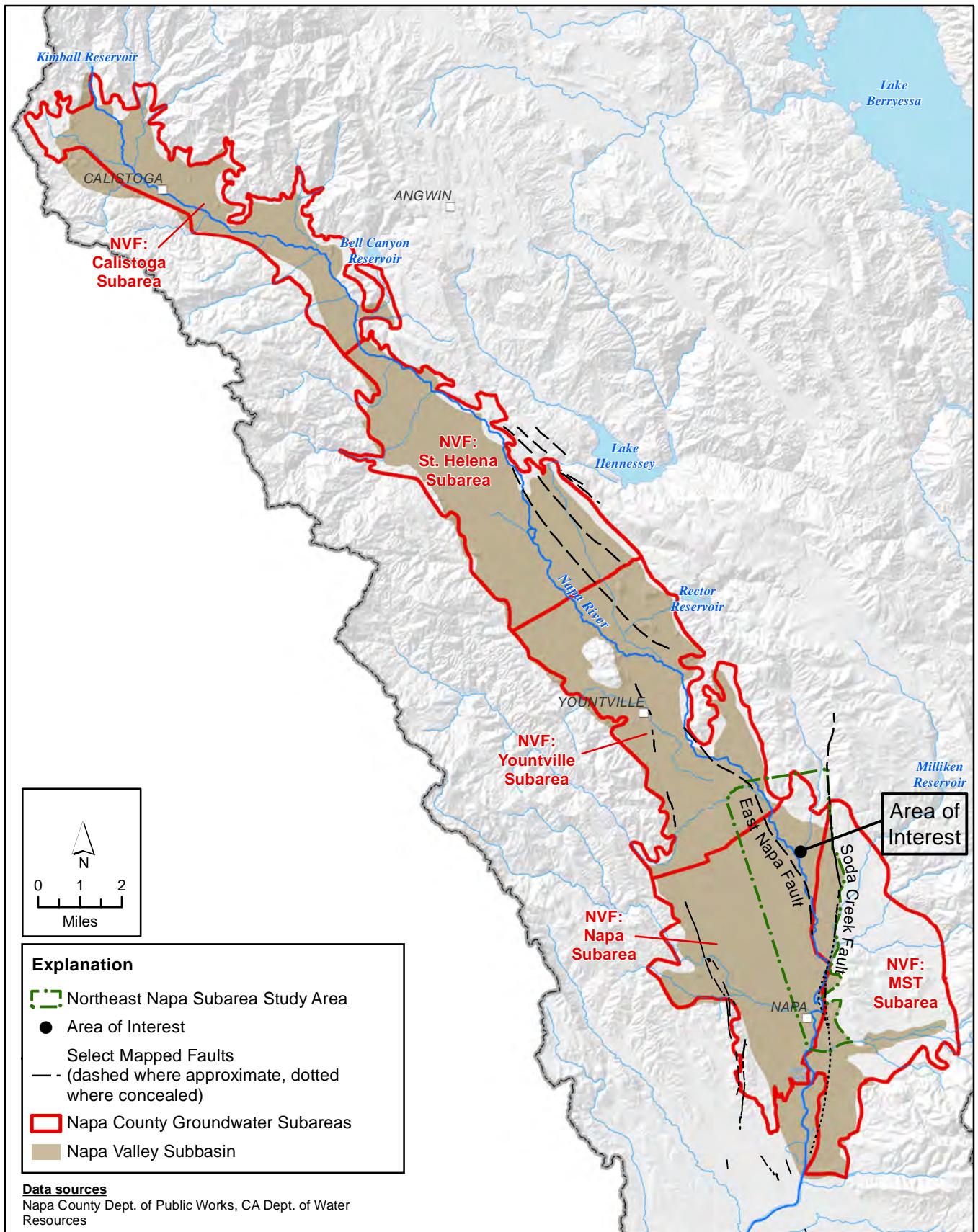


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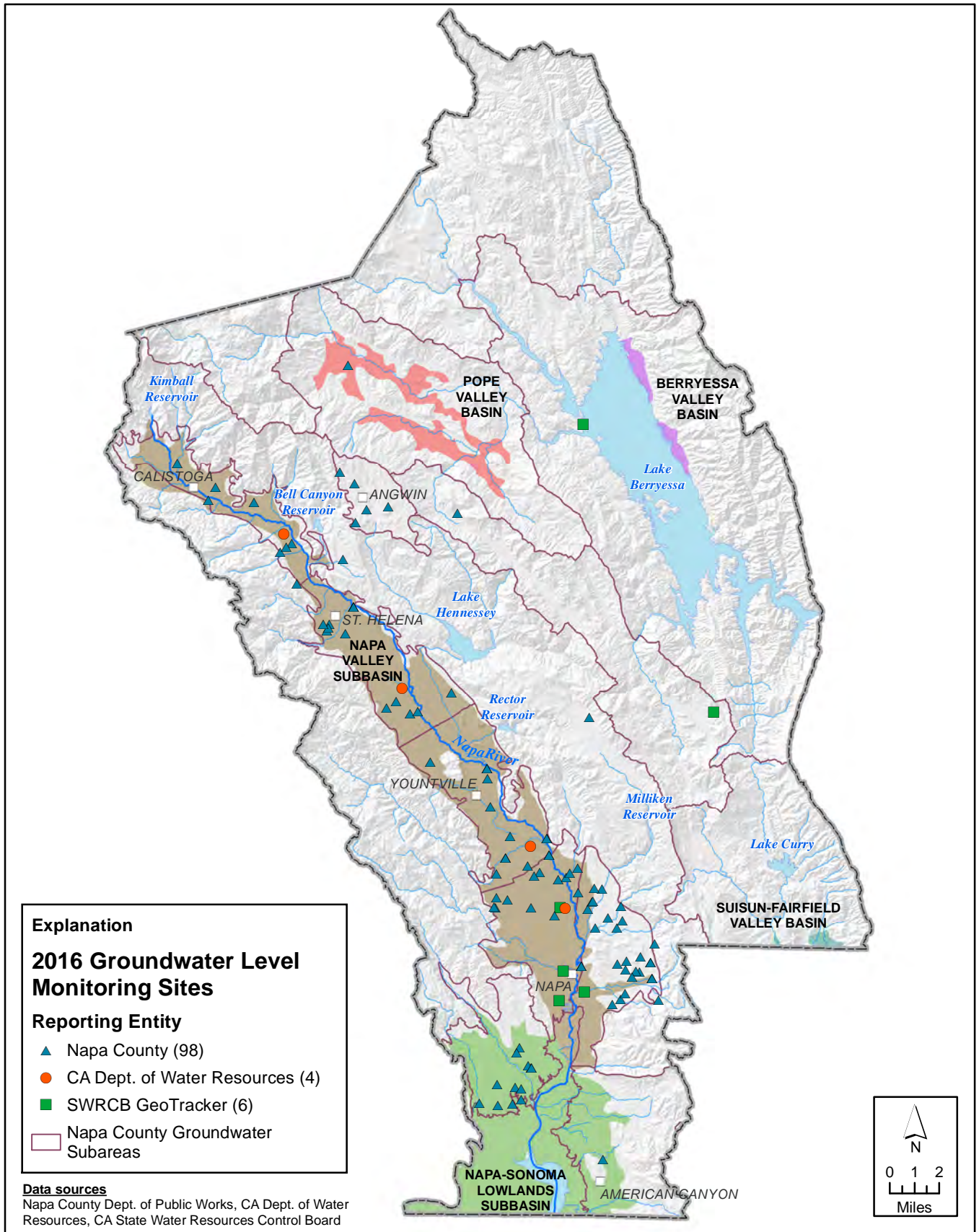


FIGURE 2-6
Napa County Surface Water-Groundwater Monitoring Sites

Napa County Comprehensive Groundwater Monitoring Program
 2016 Annual Report and CASGEM Update



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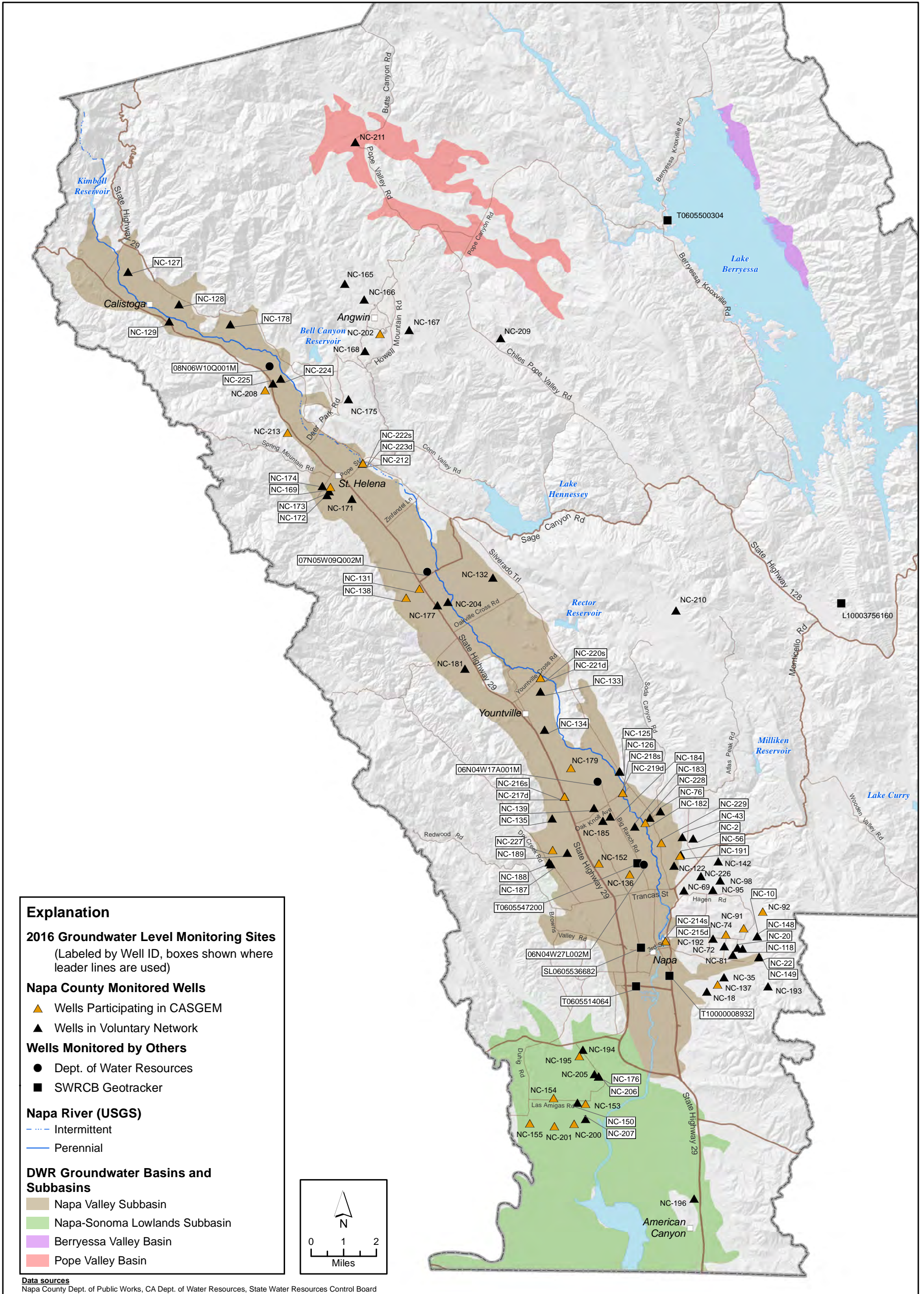


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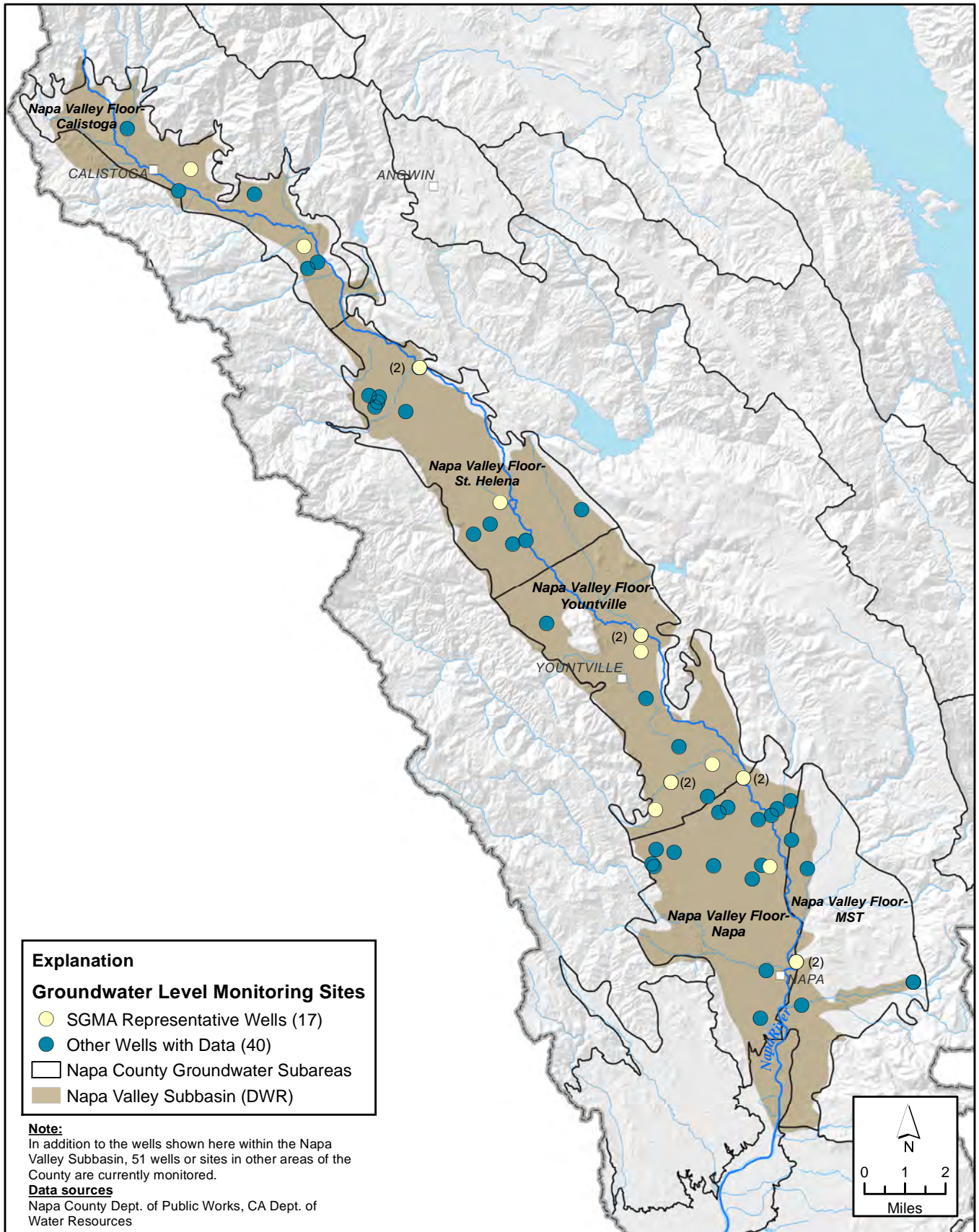


FIGURE 4-1
Current Groundwater Level Monitoring Sites
by Reporting Entity

*Napa County Comprehensive Groundwater Monitoring Program
 2016 Annual Report and CASGEM Update*

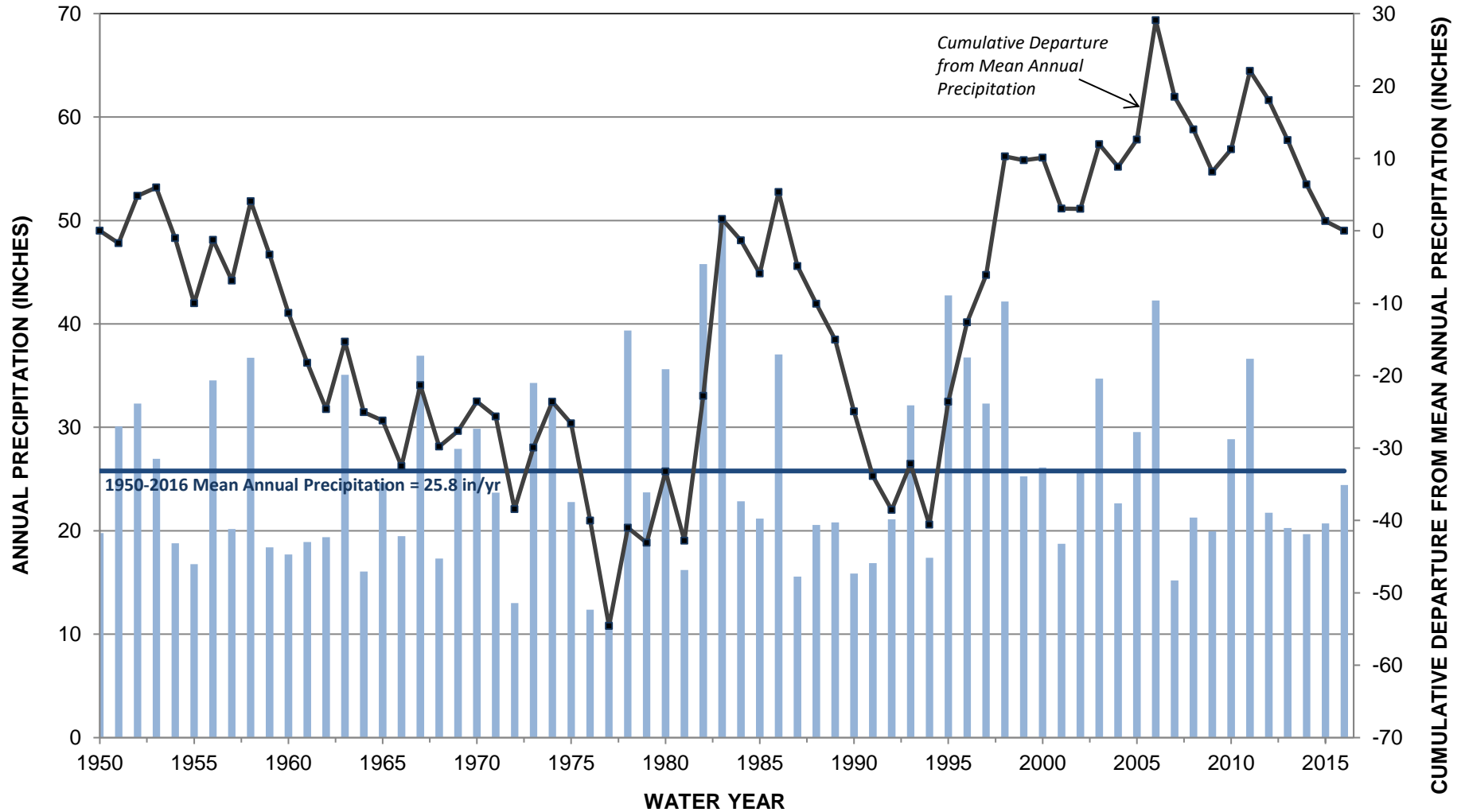


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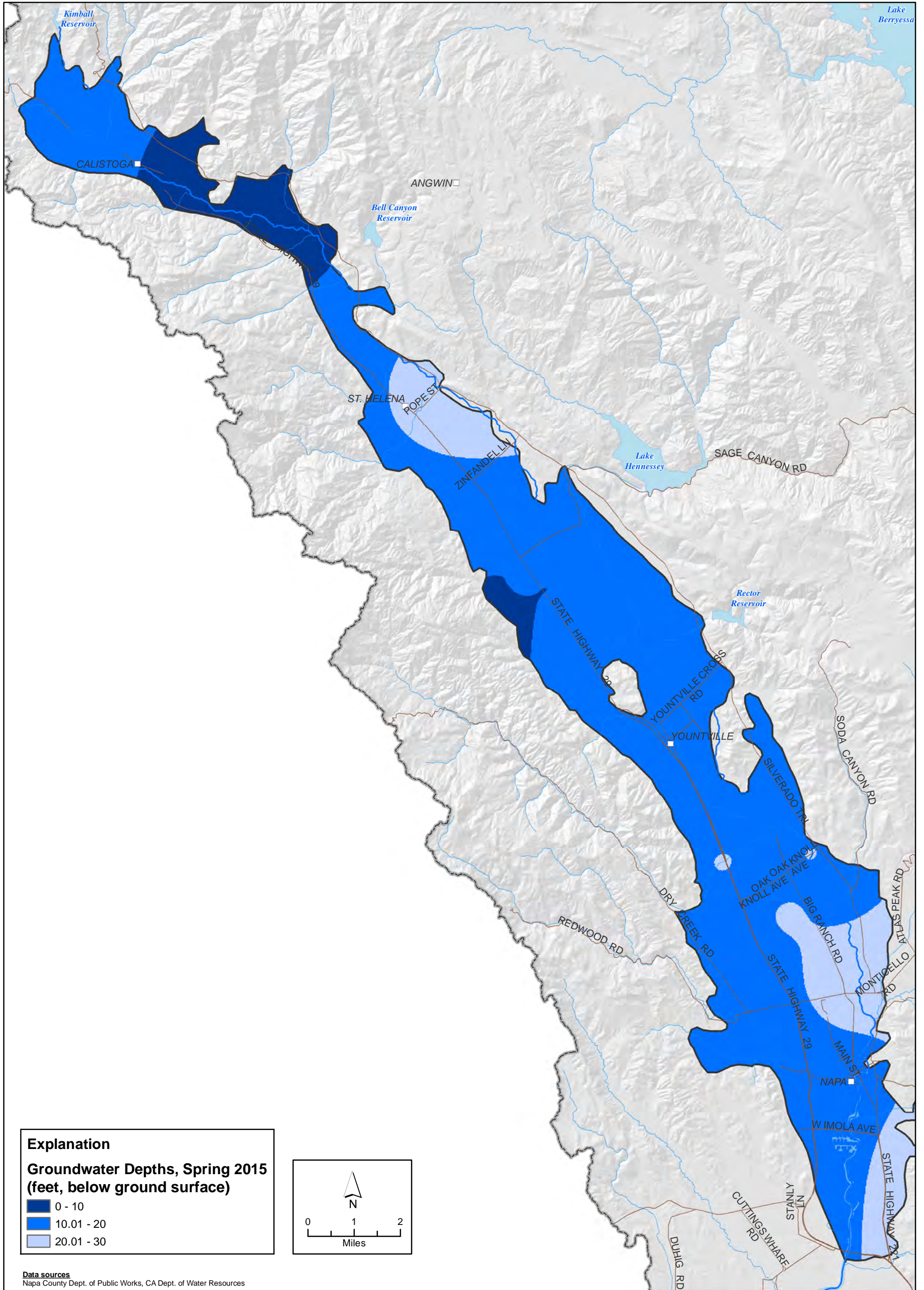
X:\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\GIS\mapfiles\2016 Annual Report\4-3 Representative Wells and Wells Utilized for Analyses.mxd

Napa State Hospital Annual Precipitation (inches)

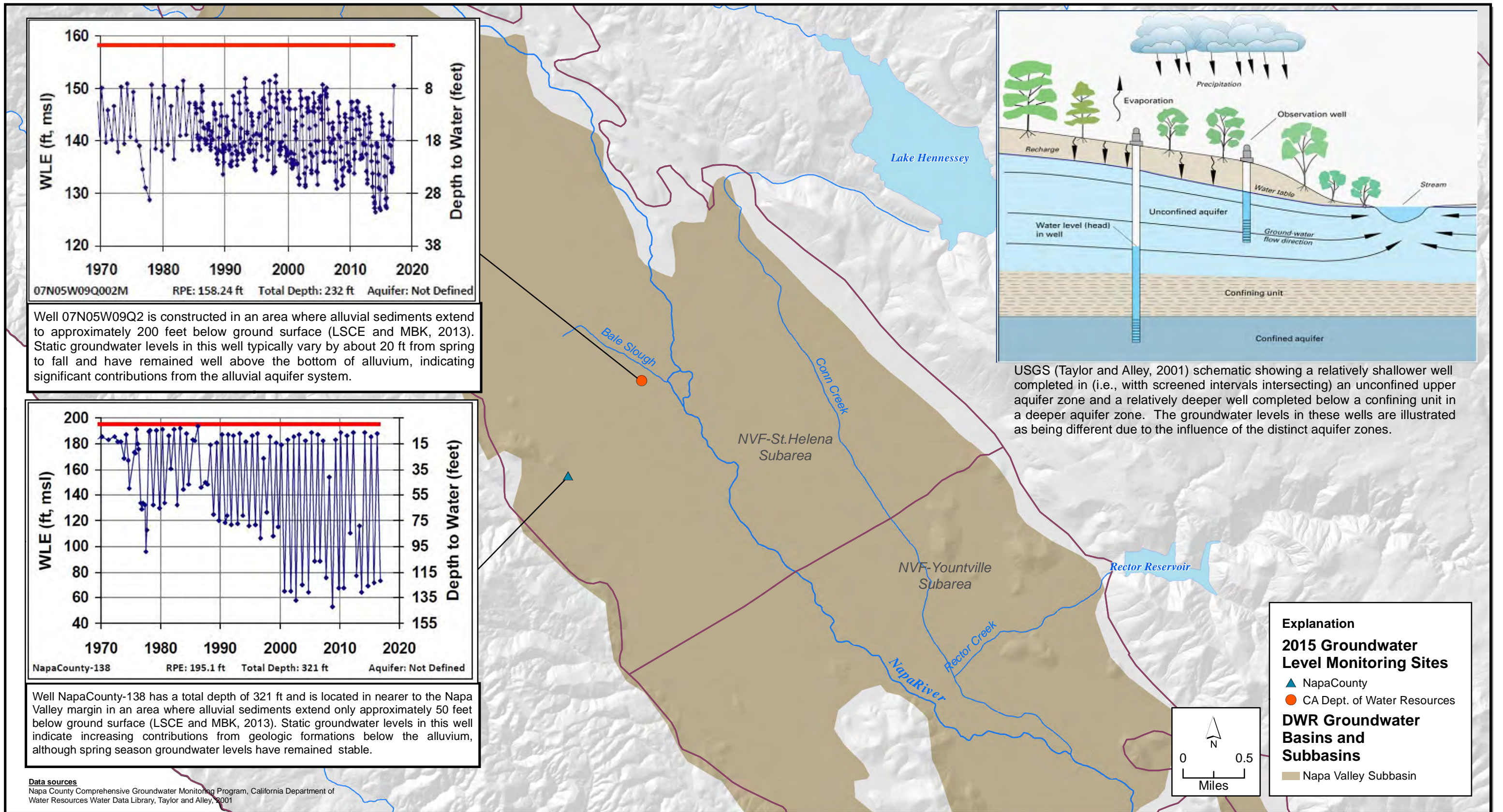


NOTE: Gaps in this data record have been reconstructed using data from the Oakville CIMIS station (77) and NOAA Saint Helena, CA US station (GHCND:USC0004764).

Figure 5-1
Napa State Hospital Water Year Precipitation and
Cumulative Departure , Water Years 1950 - 2016



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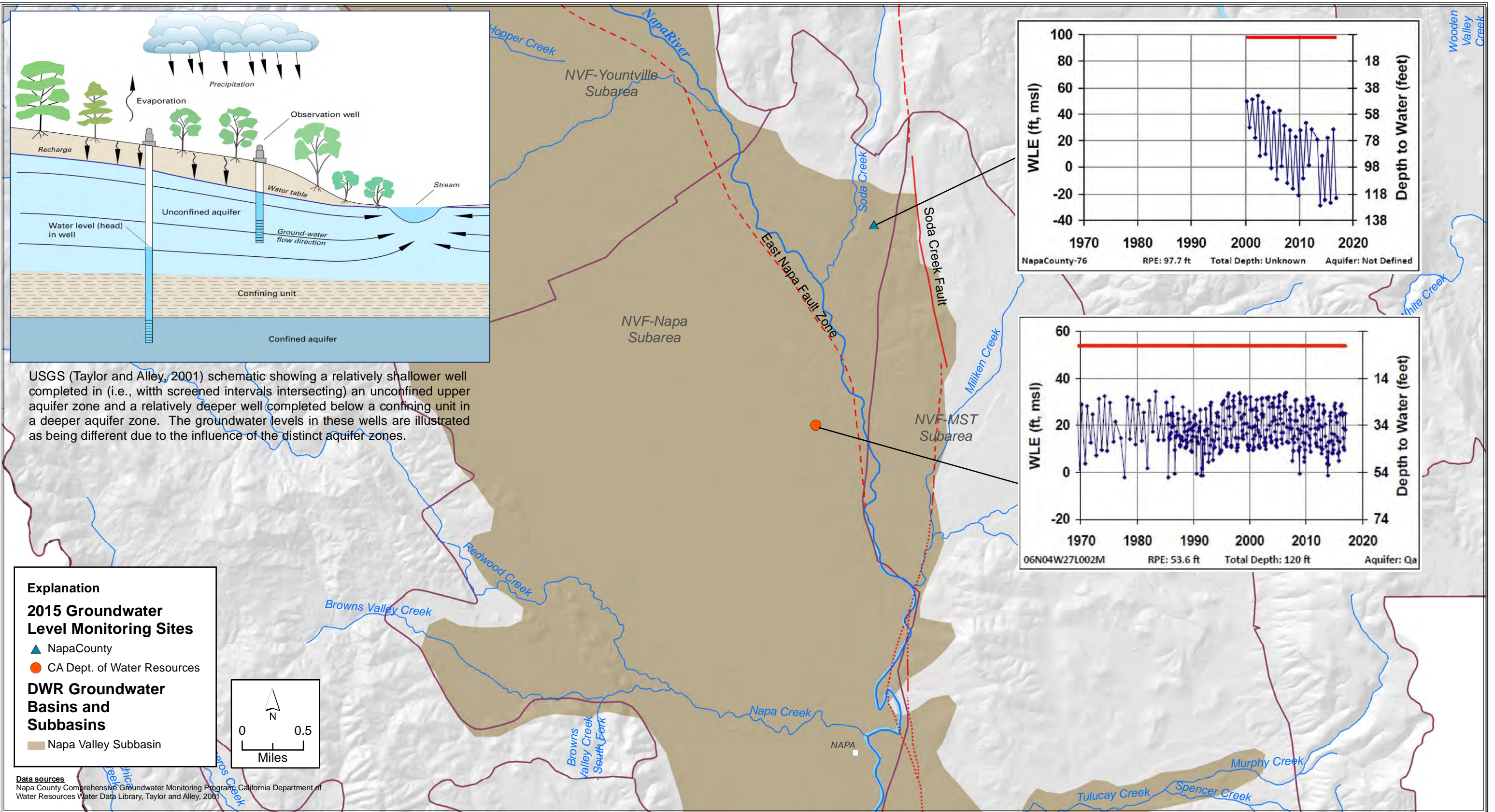


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FIGURE 5-3

Southern St. Helena Subarea Aquifer Zone Schematic and Representative Hydrographs



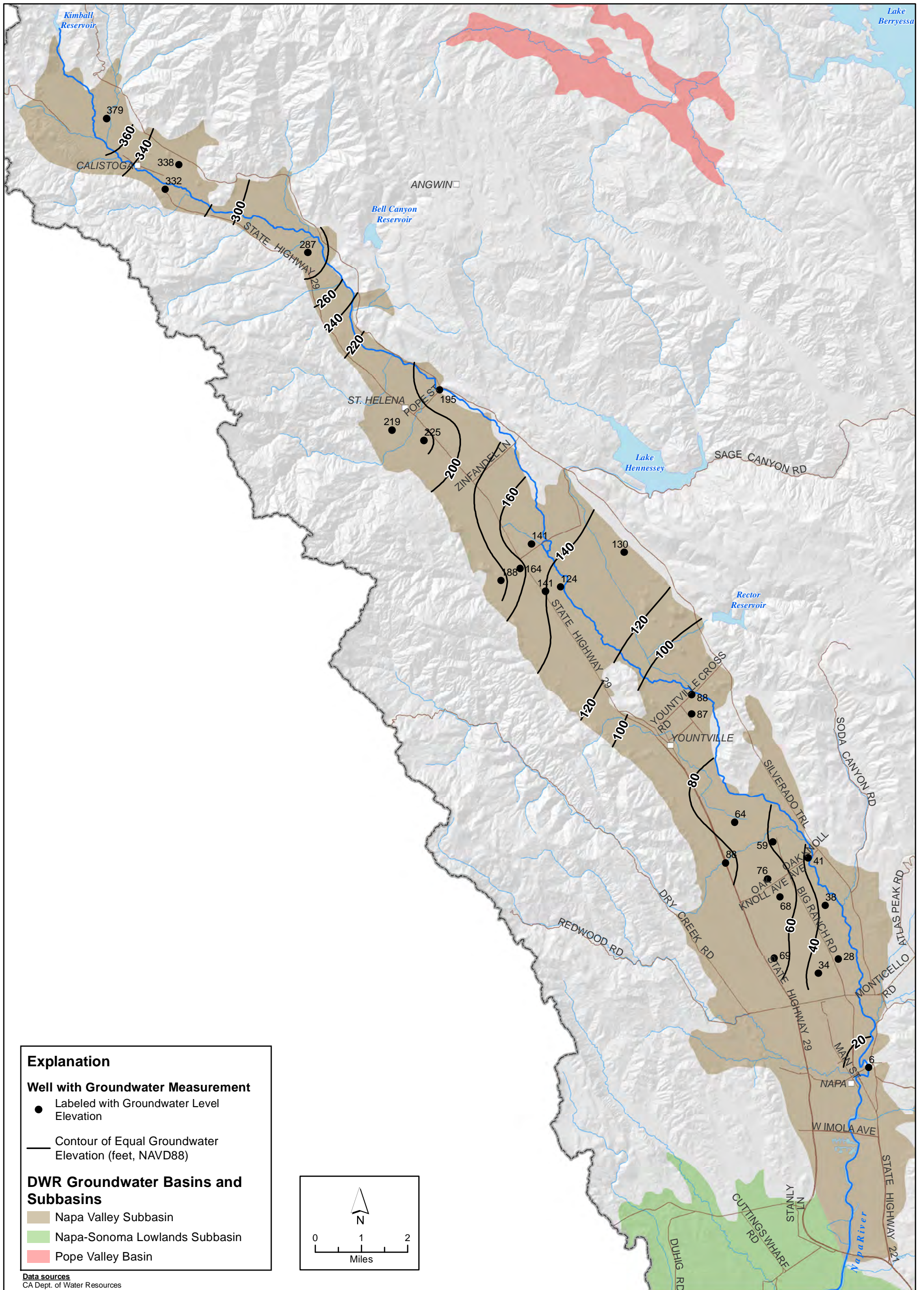
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FIGURE 5-4

Northeast Napa Subarea Aquifer Zone Schematic and Representative Hydrographs

Napa County Comprehensive Groundwater Monitoring Program
 2016 Annual Report and CASGEM Update



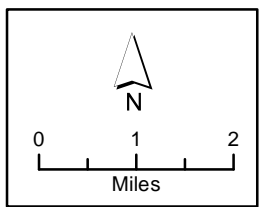
Explanation

Well with Groundwater Measurement

- Labeled with Groundwater Level Elevation
- Contour of Equal Groundwater Elevation (feet, NAVD88)

DWR Groundwater Basins and Subbasins

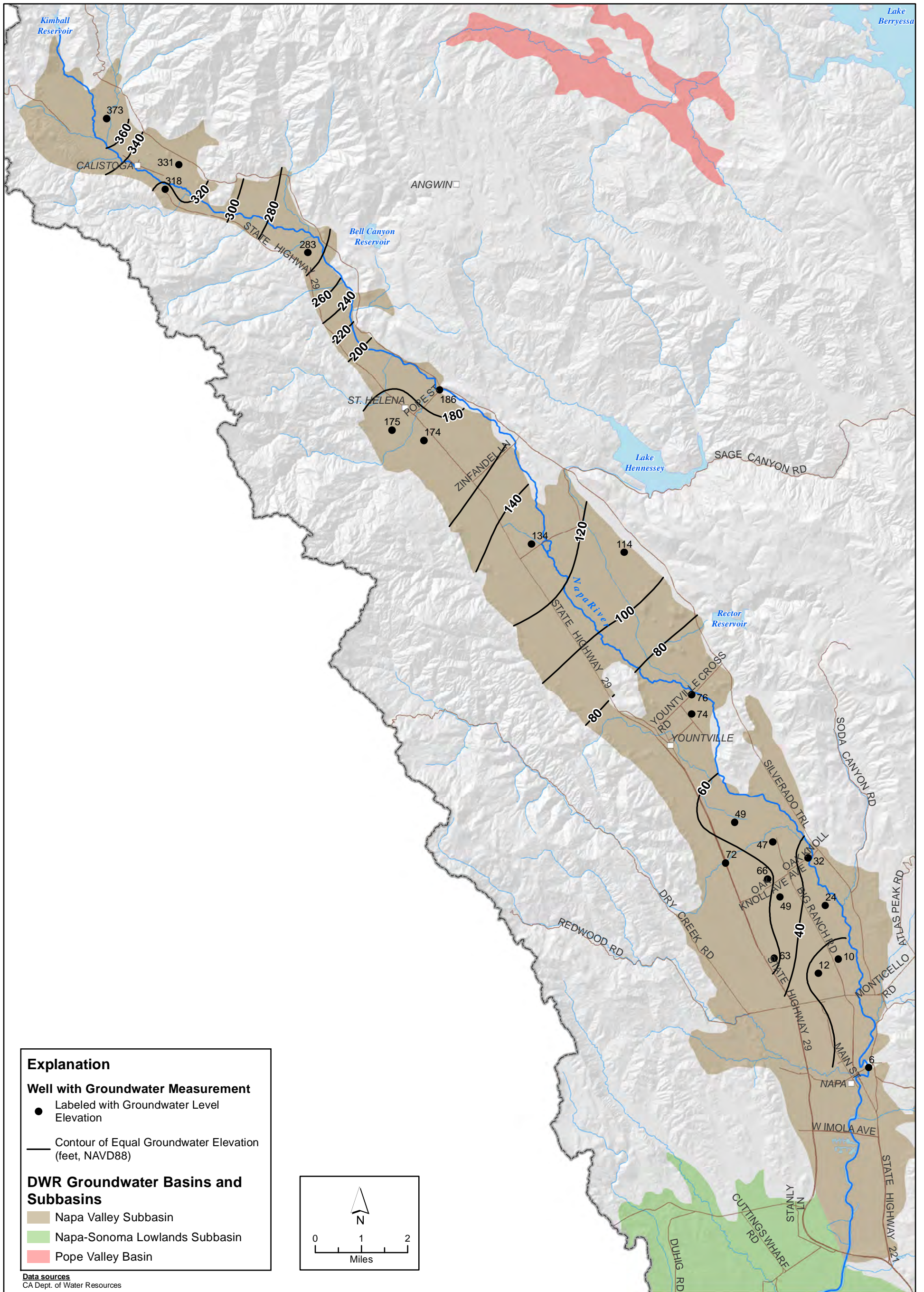
- Napa Valley Subbasin
- Napa-Sonoma Lowlands Subbasin
- Pope Valley Basin

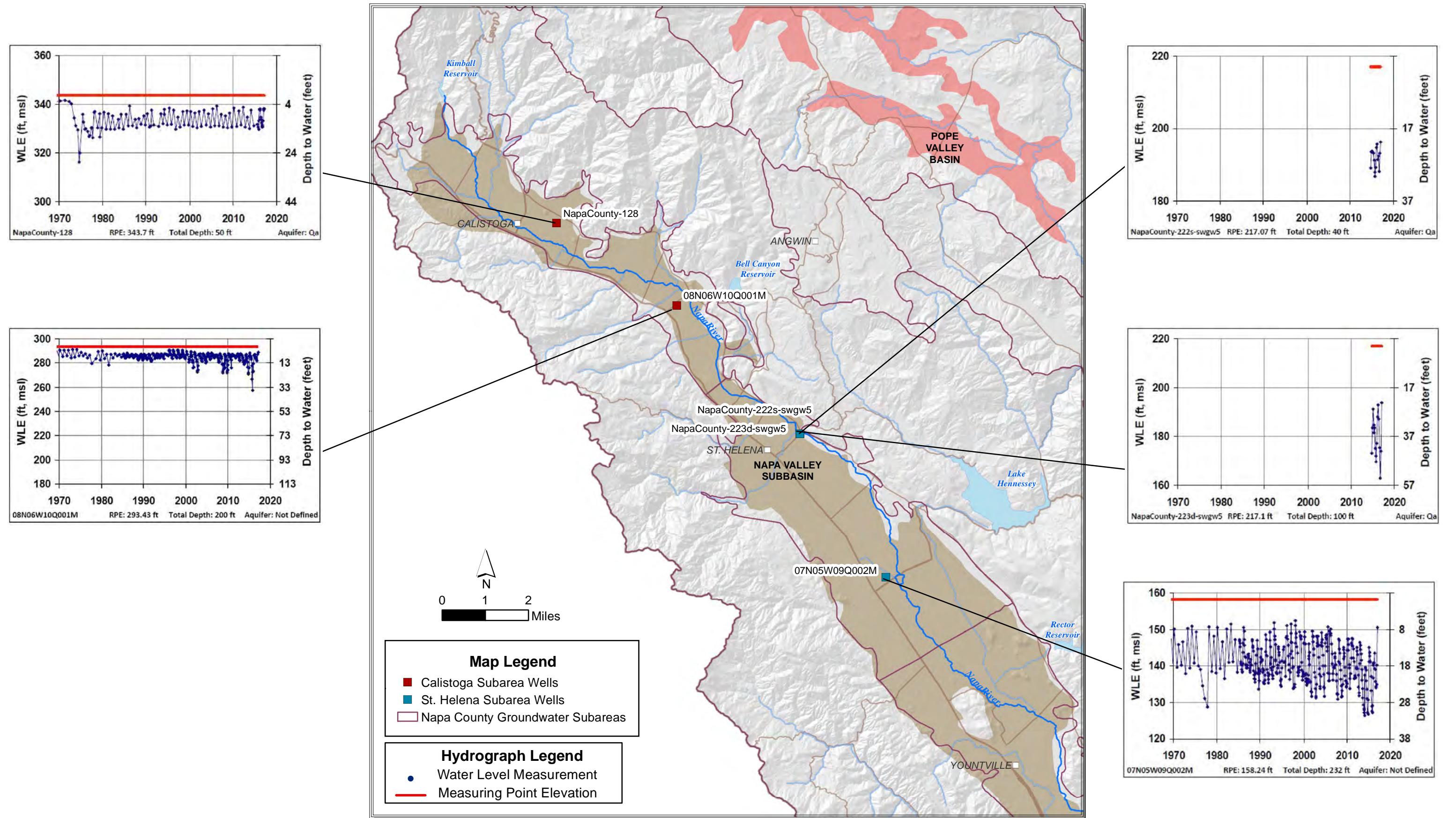


Data sources
CA Dept. of Water Resources

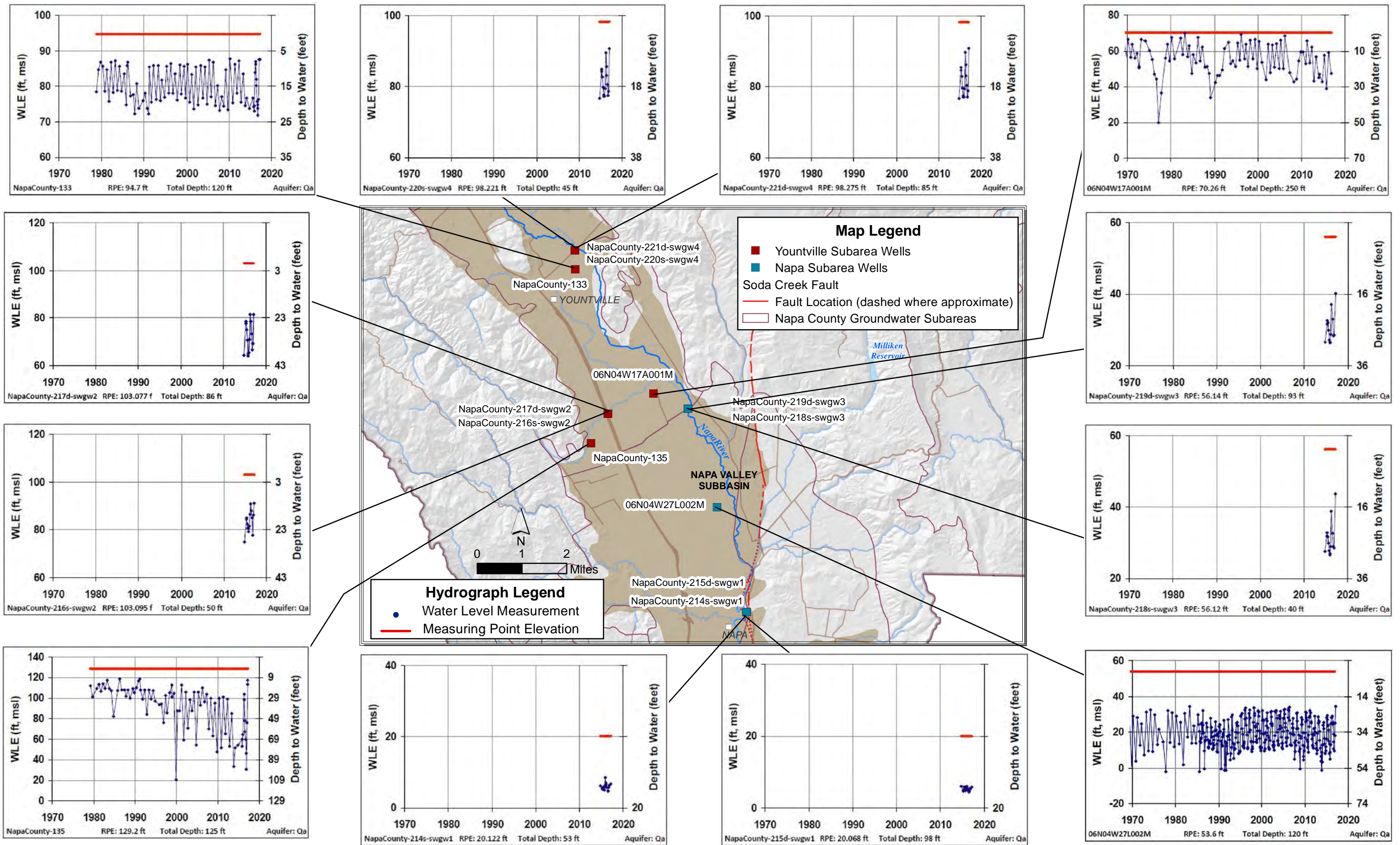
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FIGURE 5-5
Contours of Equal Groundwater Elevation, Spring 2016
Napa Valley Subbasin, Napa County, CA



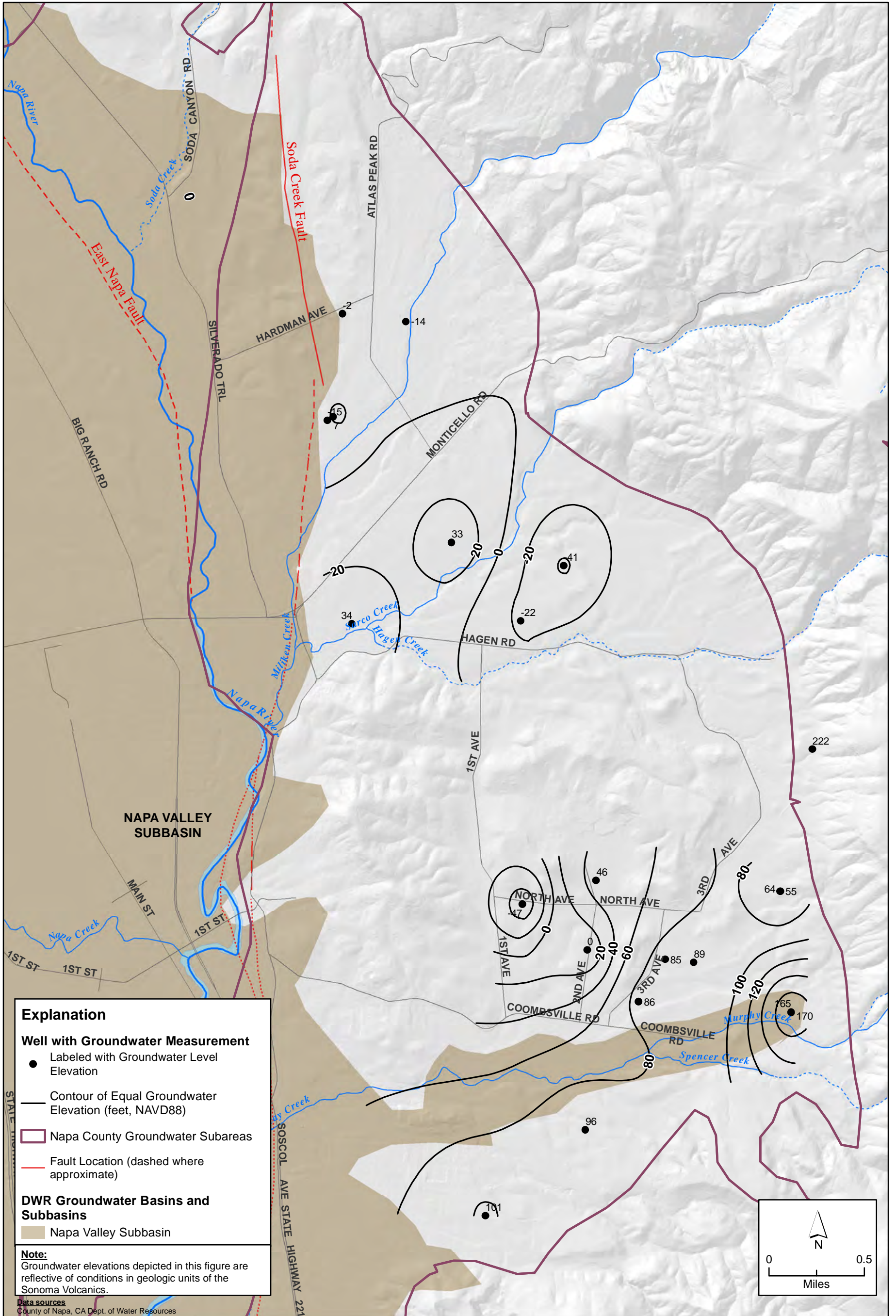


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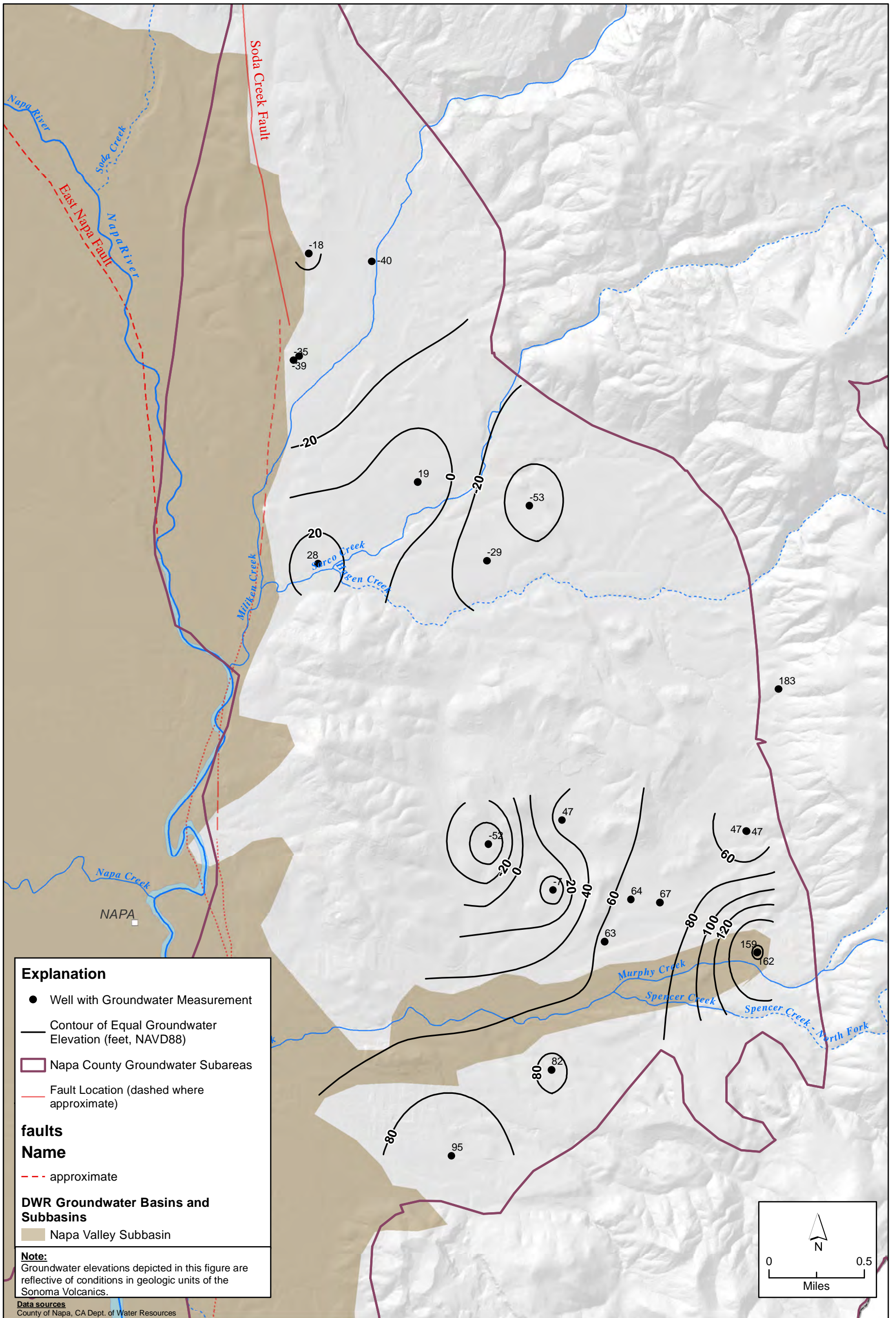


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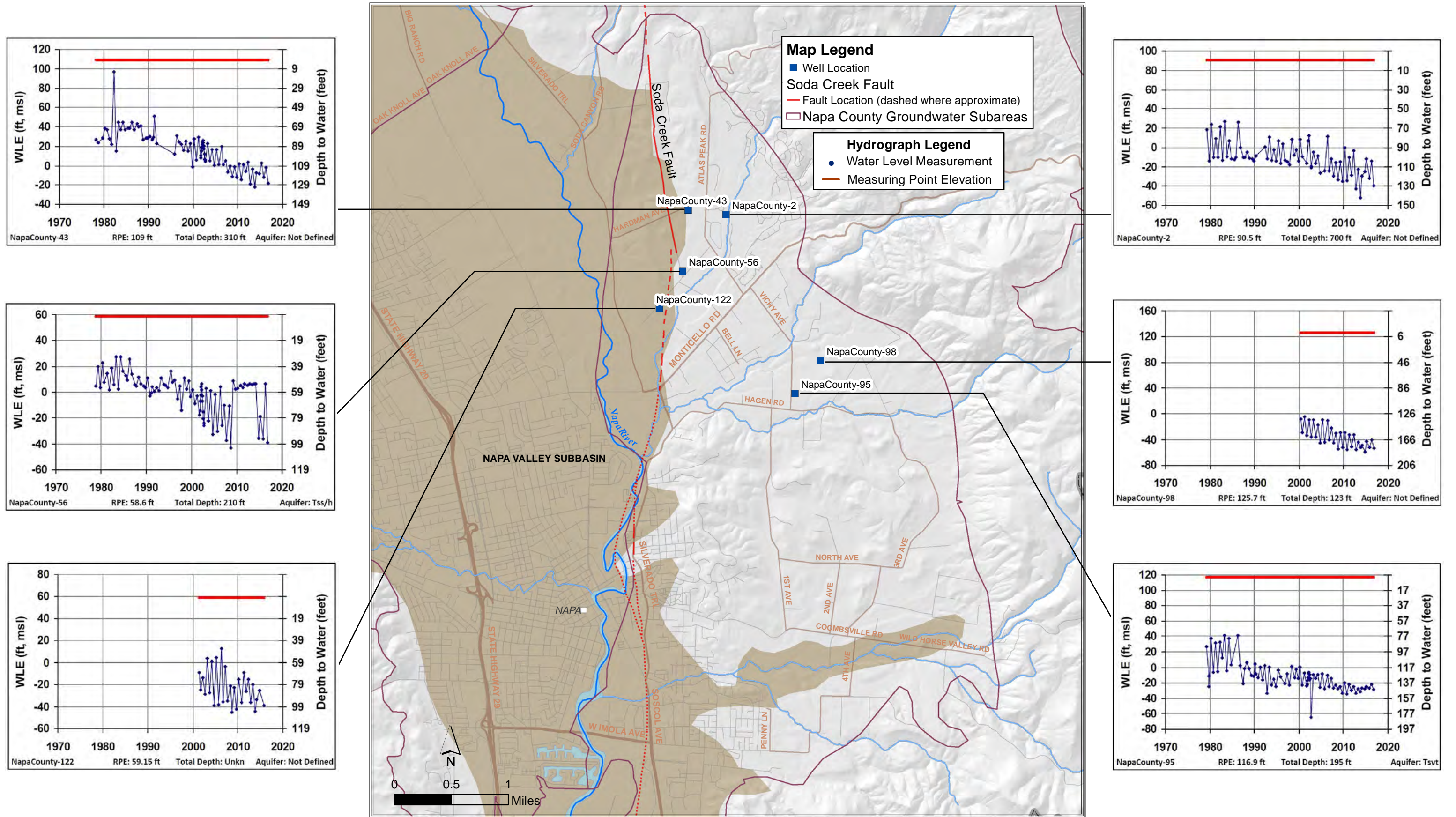
FIGURE 5-8
Sustainable Groundwater Management Act Representative Groundwater Hydrographs, Southern Napa Valley Subbasin



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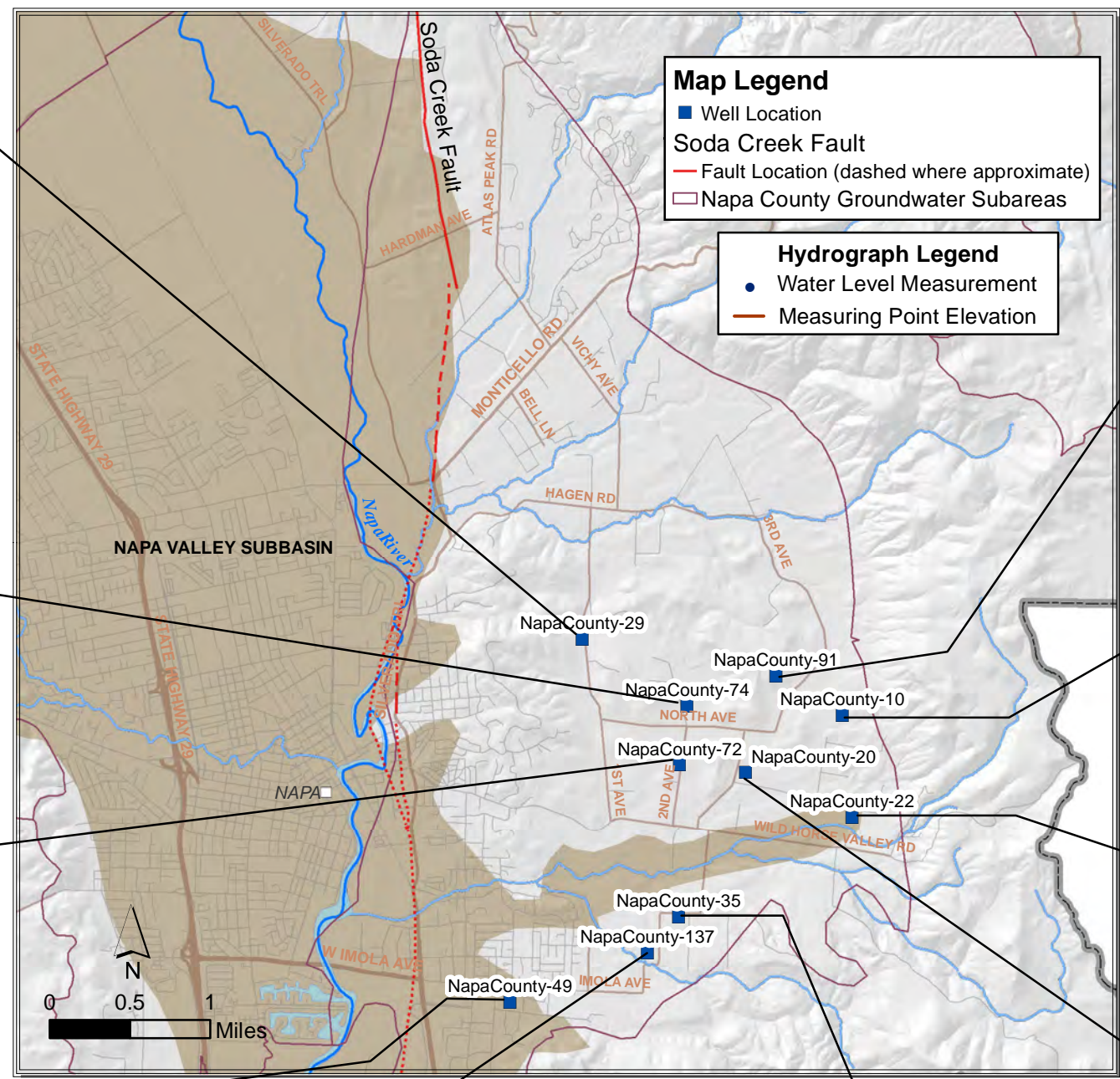
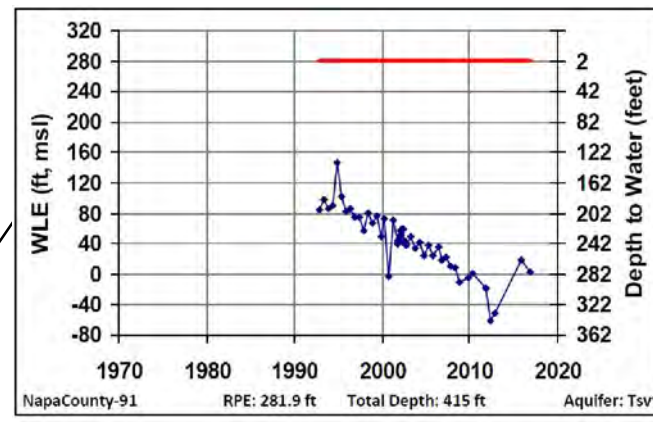
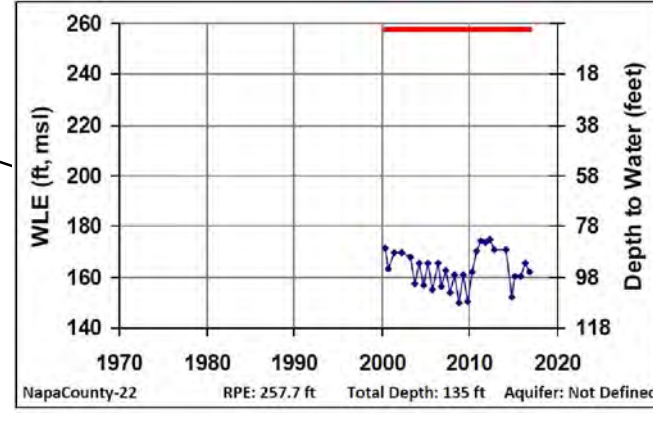
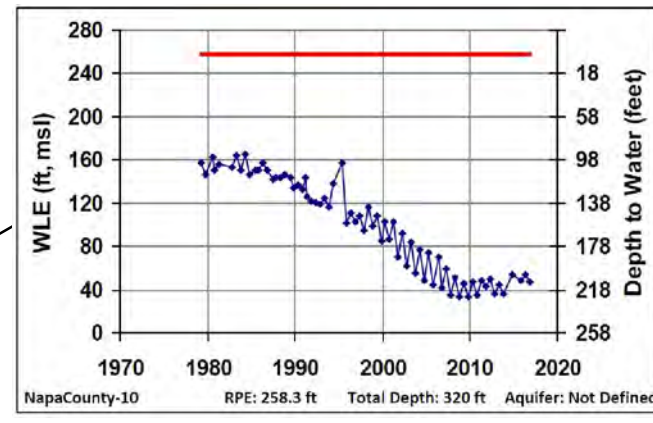
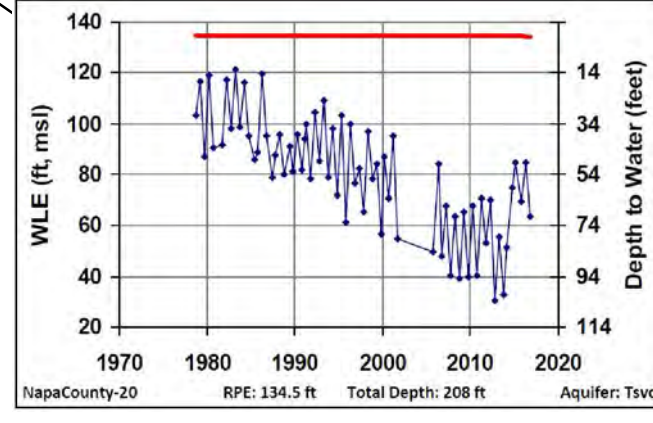
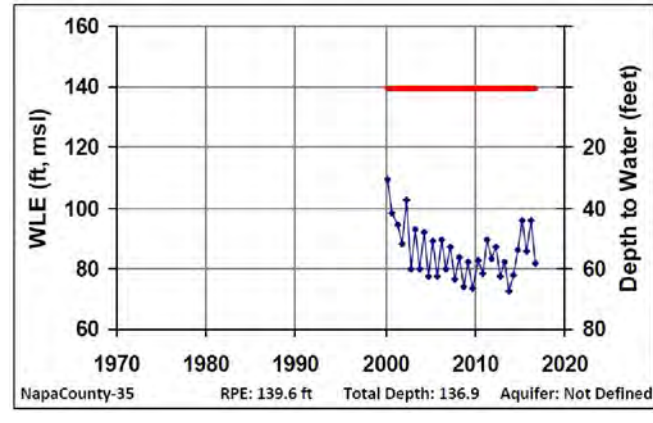
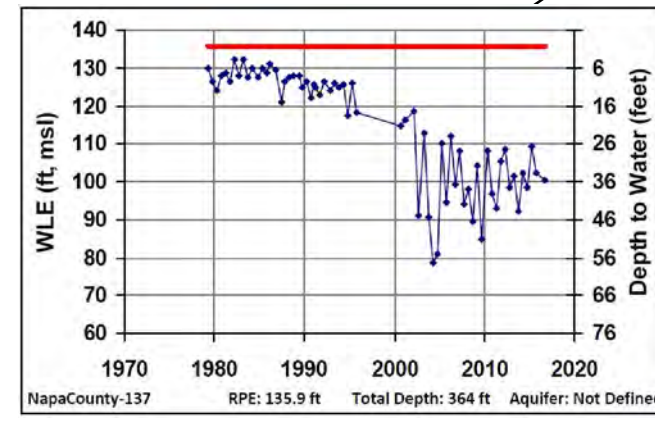
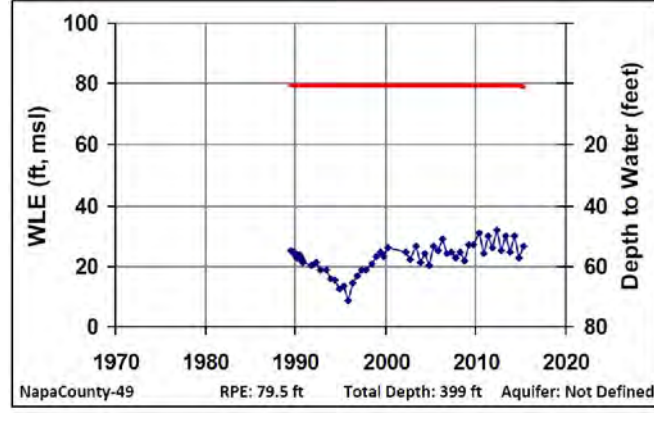
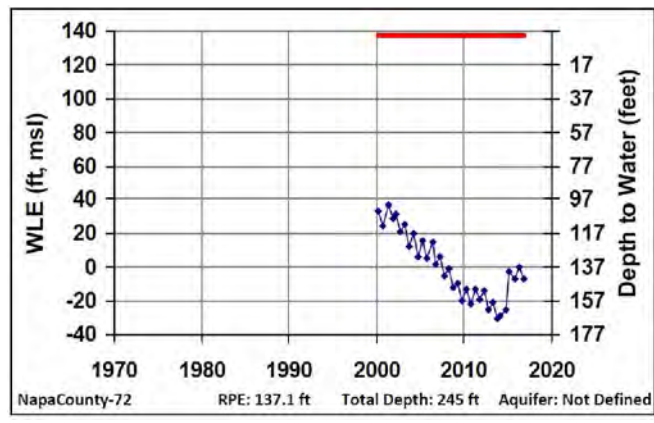
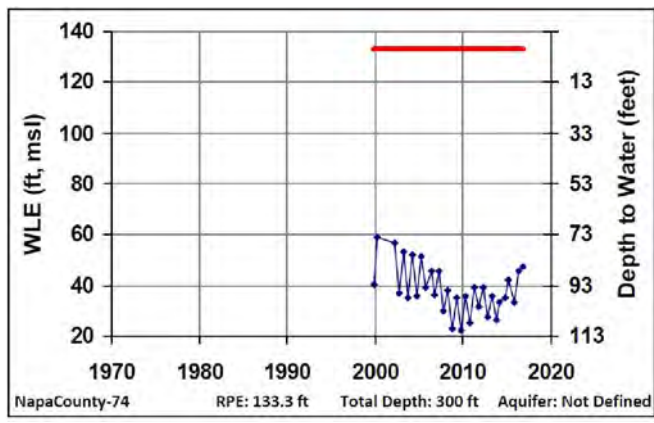
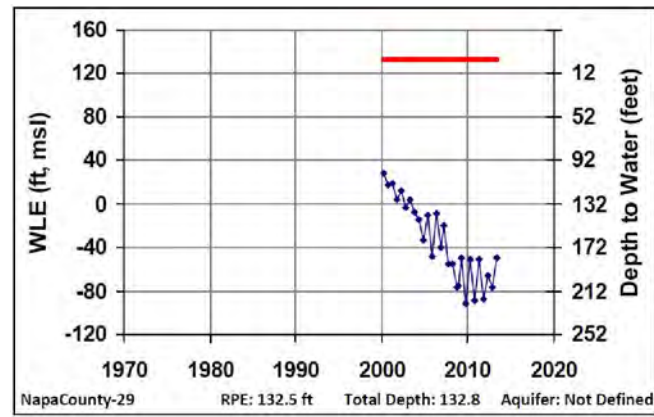


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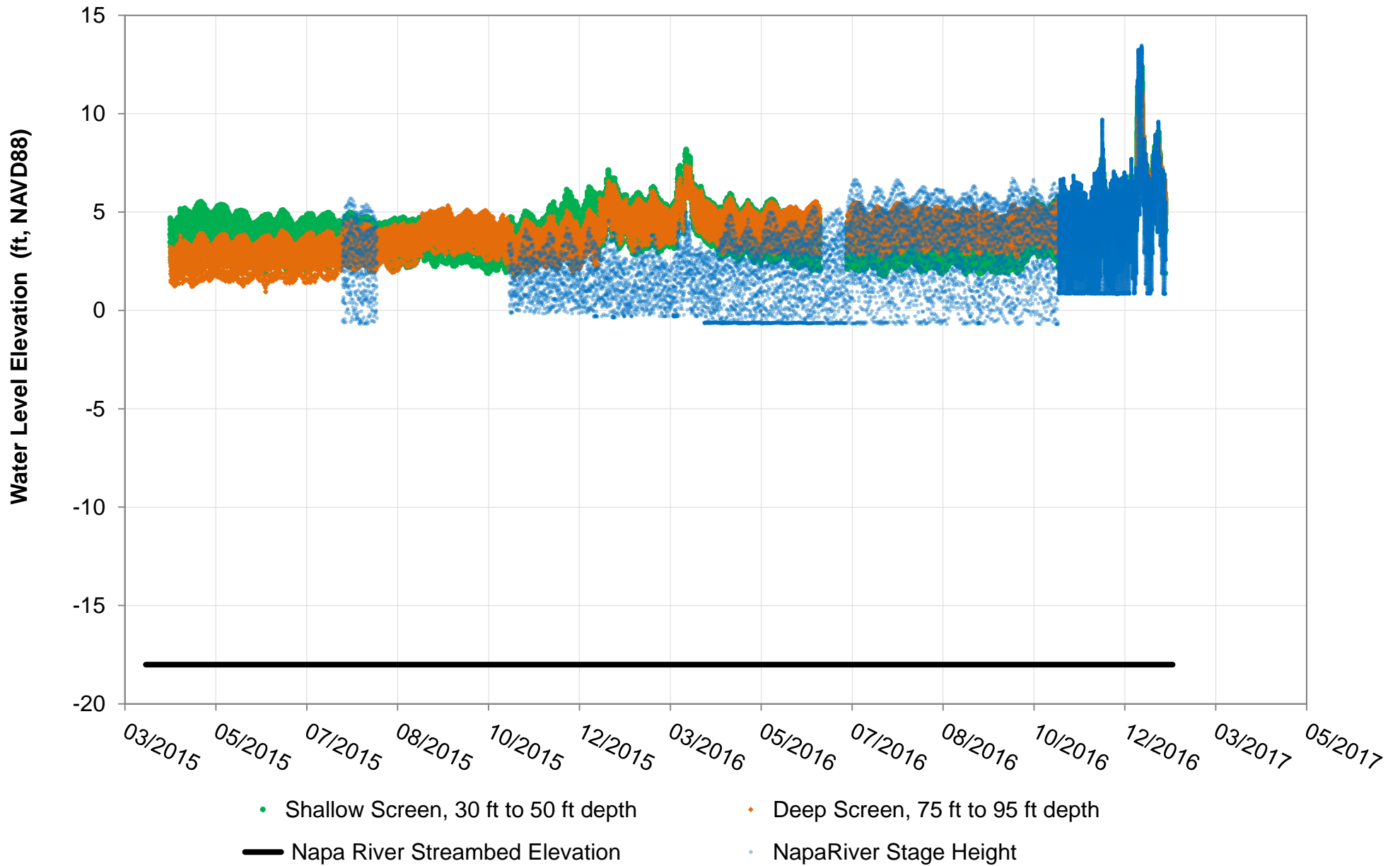
Path: X:\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\GIS\mapfiles\2016 Annual Report\5-11 HydrographNorthernMST_thru2016.mxd

FIGURE 5-11
Representative Groundwater Hydrographs Northern MST Subarea

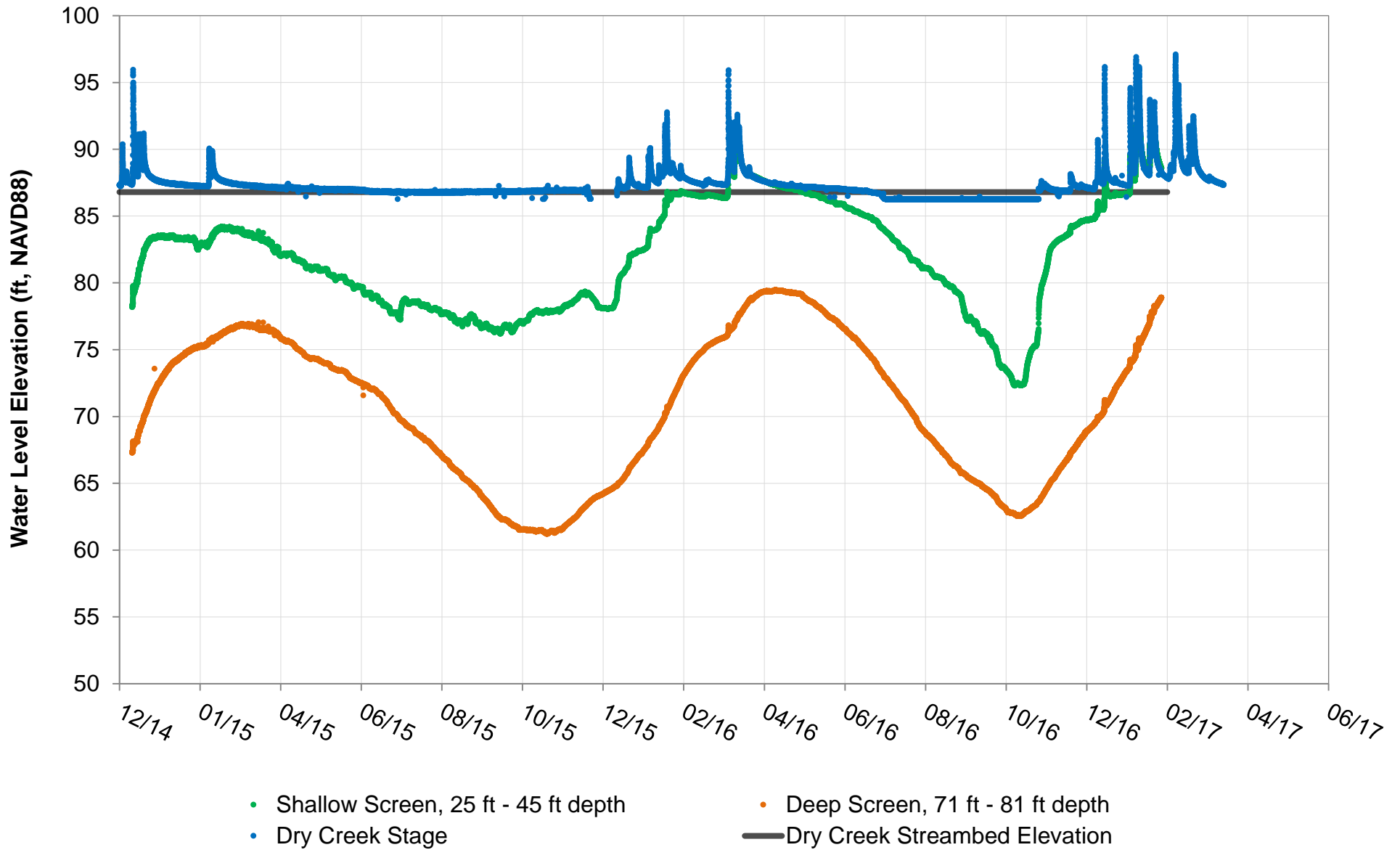


Path: X:\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\GIS\mapfiles\2016 Annual Report\5-12 HydrographsSouthernMST_thru2016.mxd

FIGURE 5-12
Representative Groundwater Hydrographs Southern MST Subarea

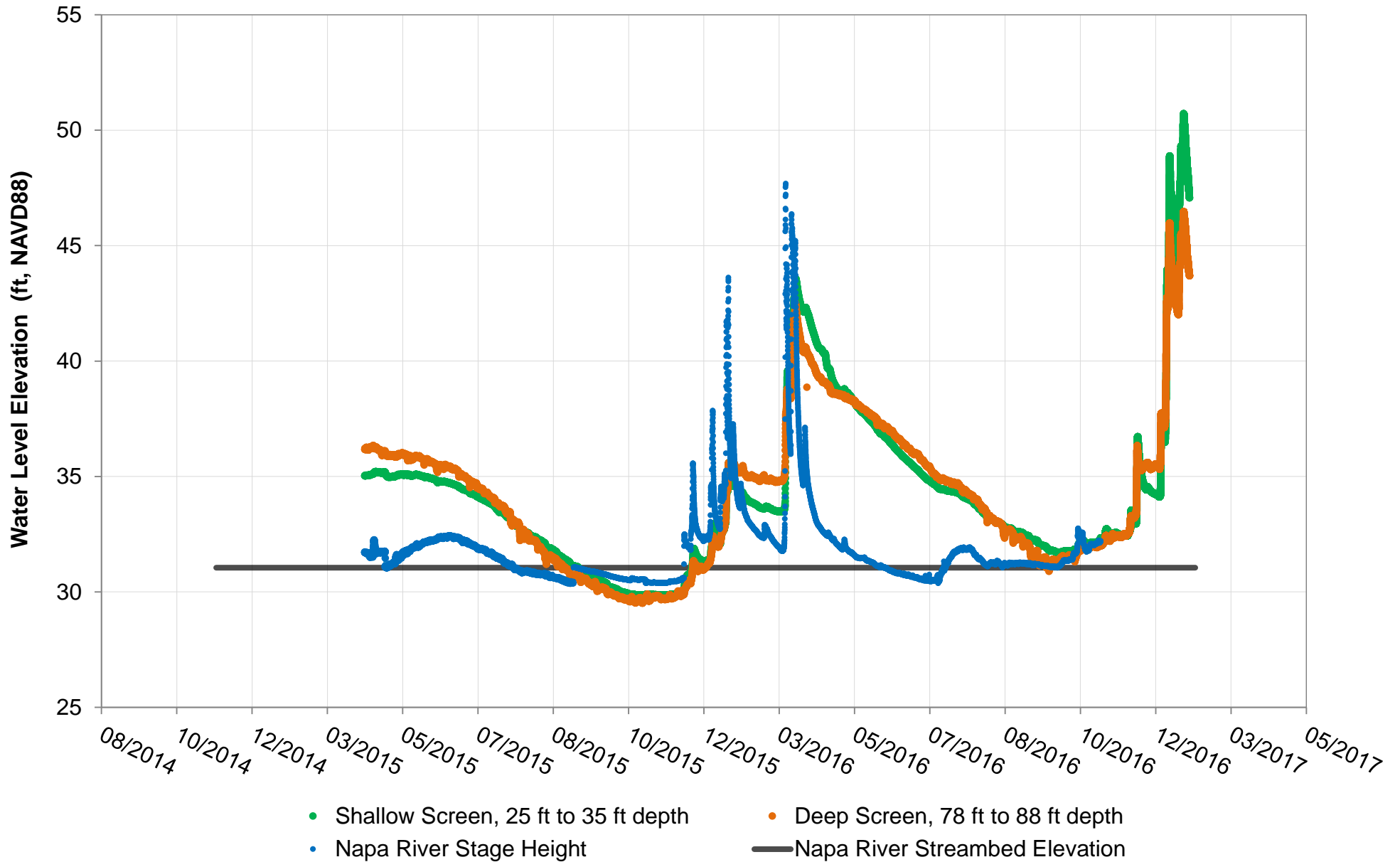


\\LSCEE\XSER\Clerical\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\DATA\DMS\DatabaseCharts_Final.xlsm

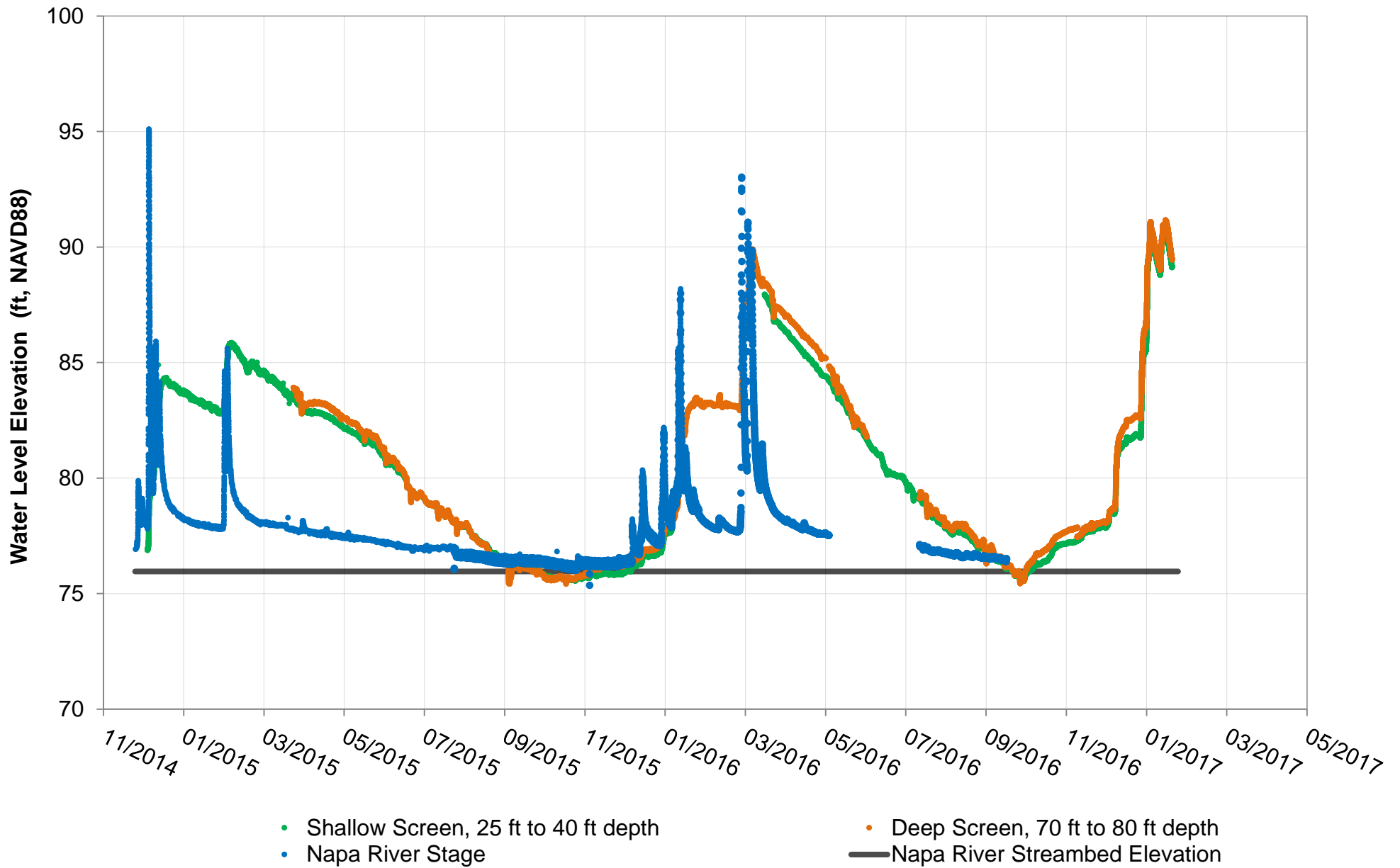


\\LSCEE\SERVER\Clerical\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\DATA\DMS\DatabaseCharts_Final.xlsxm

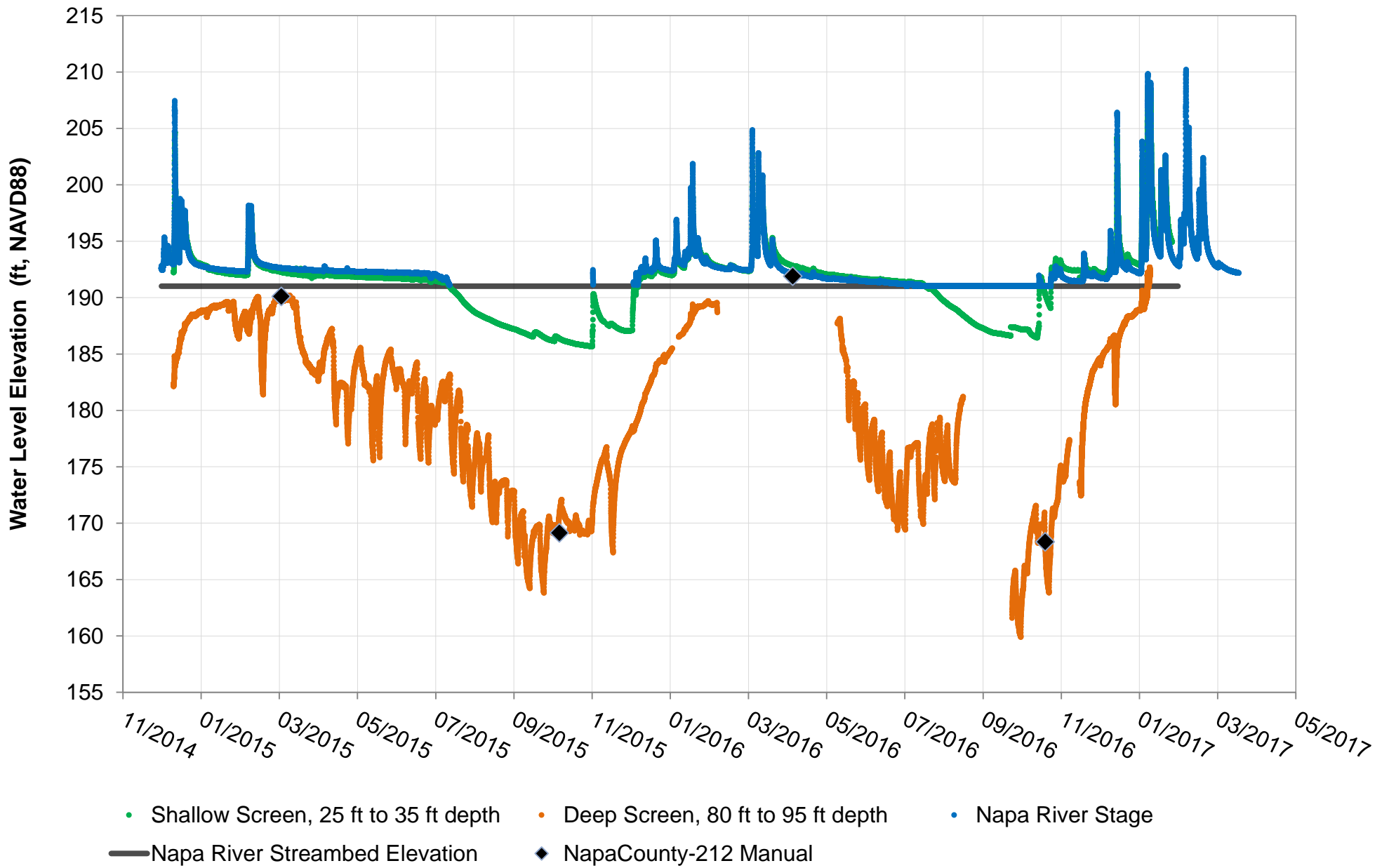
Figure 5-14
Water Level Hydrograph
Site 2: Dry Creek at Washington Street



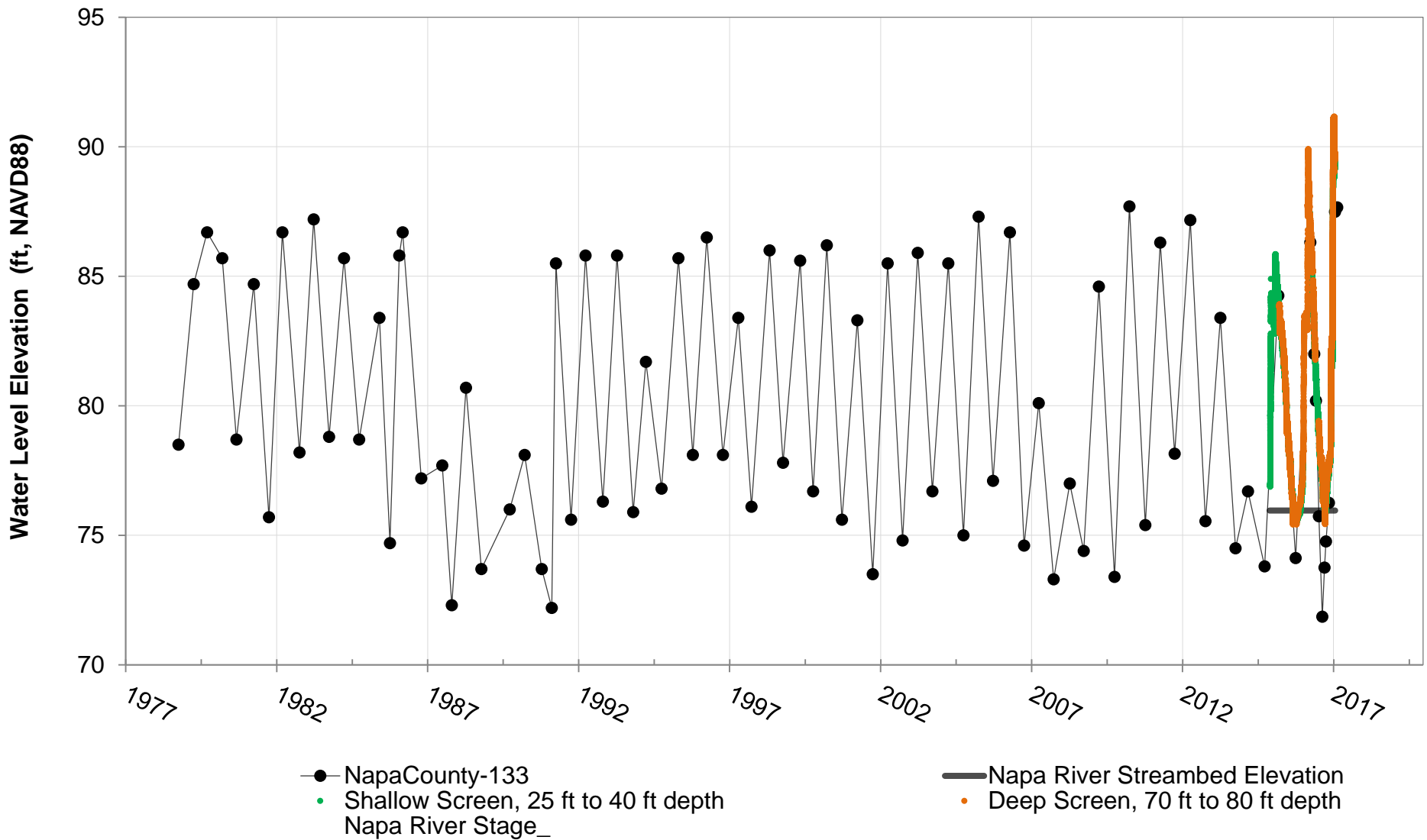
\\LSCEE\XSER\Clerical\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\DATA\DMS\DatabaseCharts_Final.xlsm



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\\LSCEE\XSER\Clerical\2016\16-079 Napa County - Groundwater Basin Sustainability Analysis\DATA\DMS\DatabaseCharts_Final.xlsm

APPENDIX A

Summary of Current Groundwater Level Monitoring Locations

WellID	SYS NO	Napa County Subarea	SWN	SRC	Monitoring Frequency	Period of Record	DWR Basin No	DWR Basin	DWR Subbasin	Aquifer Designation
08N06W10Q001M		Napa Valley Floor-Calistoga	008N006W10Q001M	DWR	Monthly	1949 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Not Defined
NapaCounty-127		Napa Valley Floor-Calistoga	009N007W25N001M	NapaCounty	Semi-Annual	1962 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-128		Napa Valley Floor-Calistoga	009N006W31Q001M	NapaCounty	Monthly	1962 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-129		Napa Valley Floor-Calistoga	008N006W06L004M	NapaCounty	Semi-Annual	1962 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-178		Napa Valley Floor-Calistoga		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	NA
NapaCounty-224		Napa Valley Floor-Calistoga		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-225		Napa Valley Floor-Calistoga		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-122		Napa Valley Floor-MST	006N004W26L00_M	NapaCounty	Semi-Annual	2001 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-149		Napa Valley Floor-MST	005N003W08E00_M	NapaCounty	Semi-Annual	2010 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-22		Napa Valley Floor-MST	005N003W08E001M	NapaCounty	Semi-Annual	2000 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
T1000008932		Napa Valley Floor-MST		Geotracker	Monthly to Quarterly	2016 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
05N04W15E001M		Napa Valley Floor-Napa	005N004W15E001M	DWR	Biennial	1949 - 1978	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
06N04W27L002M		Napa Valley Floor-Napa	006N004W27L002M	DWR	Monthly	1966 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-136		Napa Valley Floor-Napa	006N004W27N001M	NapaCounty	Monthly	1979 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-152		Napa Valley Floor-Napa	006N004W28Mx	NapaCounty	Semi-Annual	2012 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-182		Napa Valley Floor-Napa		NapaCounty	Monthly	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Tsv
NapaCounty-183		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa, Tsv?
NapaCounty-184		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Tsv, Tss/h?
NapaCounty-185		Napa Valley Floor-Napa		NapaCounty	Monthly	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-187		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Tsv?, KJgv?
NapaCounty-188		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-189		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-214s-swgw1		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-215d-swgw1		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-218s-swgw3		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-219d-swgw3		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-227		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2015 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-228		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2015 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-229		Napa Valley Floor-Napa		NapaCounty	Semi-Annual	2016 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-76		Napa Valley Floor-Napa	006N004W15R003M	NapaCounty	Semi-Annual	2000 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
SL0605536682		Napa Valley Floor-Napa		Geotracker	Monthly to Quarterly	2005 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
T0605514064		Napa Valley Floor-Napa		Geotracker	Monthly to Quarterly	2005 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
T0605547200		Napa Valley Floor-Napa		Geotracker	Monthly to Quarterly	2008 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
07N05W09Q002M		Napa Valley Floor-St. Helena	007N005W09Q002M	DWR	Monthly	1949 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Not Defined
NapaCounty-131		Napa Valley Floor-St. Helena	007N005W16L001M	NapaCounty	Semi-Annual	1963 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-132		Napa Valley Floor-St. Helena	007N005W14B002M	NapaCounty	Monthly	1962 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa, Tsvab
NapaCounty-138		Napa Valley Floor-St. Helena	007N005W16N002M	NapaCounty	Semi-Annual	1949 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-169		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-171		Napa Valley Floor-St. Helena		NapaCounty	Monthly	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-172		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-173		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-174		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-177		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-204		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-212		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2015 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-222s-swgw5		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa

WellID	SYS NO	Napa County Subarea	SWN	SRC	Monitoring Frequency	Period of Record	DWR Basin No	DWR Basin	DWR Subbasin	Aquifer Designation
NapaCounty-223d-swgw5		Napa Valley Floor-St. Helena		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
06N04W17A001M		Napa Valley Floor-Yountville	006N004W17A001M	DWR	Semi-Annual	1949 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-133		Napa Valley Floor-Yountville	007N004W31M001M	NapaCounty	Monthly	1978 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-134		Napa Valley Floor-Yountville	006N004W06L002M	NapaCounty	Semi-Annual	1963 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-135		Napa Valley Floor-Yountville	006N004W19B001M	NapaCounty	Monthly	1979 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-139		Napa Valley Floor-Yountville	006N004W17R002M	NapaCounty	Semi-Annual	1978 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-179		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	
NapaCounty-181		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2016	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Tsv
NapaCounty-216s-swgw2		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-217d-swgw2		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-220s-swgw4		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
NapaCounty-221d-swgw4		Napa Valley Floor-Yountville		NapaCounty	Semi-Annual	2014 - 2017	2-2.01	NAPA-SONOMA VALLEY	NAPA VALLEY	Qa
04N04W05D002M		Carneros	004N004W05D002M	DWR	Biennial	1951 - 1978	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-150		Carneros	004N004W05C001M	NapaCounty	Semi-Annual	2011 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-153		Carneros	004N004W05A001M	NapaCounty	Semi-Annual	2012 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	TQsb
NapaCounty-154		Carneros	005N004W31R001M	NapaCounty	Semi-Annual	2012 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	TQsb
NapaCounty-155		Carneros	004N004W06M001M	NapaCounty	Semi-Annual	2012 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	TQsb
NapaCounty-176		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-194		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-195		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-200		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-201		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-205		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-206		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-207		Carneros		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-196		Jameson/American Canyon		NapaCounty	Semi-Annual	2014 - 2016	2-2.03	NAPA-SONOMA VALLEY	NAPA-SONOMA LOWLANDS	
NapaCounty-211		Pope Valley		NapaCounty	Semi-Annual	2014 - 2016	5-68	POPE VALLEY		
NapaCounty-165		Angwin		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-166		Angwin		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-167		Angwin		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-168		Angwin		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-202		Angwin		NapaCounty	Semi-Annual	2014 - 2016		Outside		
T0605500304		Berryessa		Geotracker	Monthly to Quarterly	2002 - 2016		Outside		
L10003756160		Central Interior Valleys		Geotracker	Monthly to Quarterly	1990 - 2016		Outside		
NapaCounty-209		Central Interior Valleys		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-175		Eastern Mountains		NapaCounty	Semi-Annual	2014 - 2016		Outside		Tsv
NapaCounty-193		Eastern Mountains		NapaCounty	Semi-Annual	2014 - 2015		Outside		
NapaCounty-210		Eastern Mountains		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-208		Napa Valley Floor-Calistoga		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-10		Napa Valley Floor-MST	005N003W05M001M	NapaCounty	Semi-Annual	1979 - 2016		Outside		
NapaCounty-118		Napa Valley Floor-MST	005N003W07B00_My	NapaCounty	Semi-Annual	2001 - 2016		Outside		
NapaCounty-137		Napa Valley Floor-MST	005N004W13H001M	NapaCounty	Semi-Annual	1979 - 2016		Outside		
NapaCounty-142		Napa Valley Floor-MST	006N004W25G00_M	NapaCounty	Semi-Annual	2001 - 2016		Outside		
NapaCounty-148		Napa Valley Floor-MST	005N003W05M00_M	NapaCounty	Semi-Annual	2009 - 2016		Outside		
NapaCounty-18		Napa Valley Floor-MST	005N004W13G004M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-191		Napa Valley Floor-MST		NapaCounty	Semi-Annual	2014 - 2016		Outside		

WellID	SYS NO	Napa County Subarea	SWN	SRC	Monitoring Frequency	Period of Record	DWR Basin No	DWR Basin	DWR Subbasin	Aquifer Designation
NapaCounty-192		Napa Valley Floor-MST		NapaCounty	Semi-Annual	2014 - 2016		Outside		
NapaCounty-2		Napa Valley Floor-MST	006N004W23J001M	NapaCounty	Semi-Annual	1979 - 2016		Outside		
NapaCounty-20		Napa Valley Floor-MST	005N003W07C003M	NapaCounty	Semi-Annual	1978 - 2016		Outside		Tsvd
NapaCounty-226		Napa Valley Floor-MST		NapaCounty	Semi-Annual	2015 - 2016		Outside		
NapaCounty-35		Napa Valley Floor-MST	005N003W18D001M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-43		Napa Valley Floor-MST	006N004W23Q003M	NapaCounty	Semi-Annual	1978 - 2016		Outside		
NapaCounty-56		Napa Valley Floor-MST	006N004W26G001M	NapaCounty	Semi-Annual	1978 - 2016		Outside		Tss/h
NapaCounty-69		Napa Valley Floor-MST	006N004W35G005M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-72		Napa Valley Floor-MST	005N003W07D003M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-74		Napa Valley Floor-MST	005N003W06M001M	NapaCounty	Semi-Annual	1999 - 2016		Outside		
NapaCounty-81		Napa Valley Floor-MST	005N003W07F003M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-91		Napa Valley Floor-MST	005N003W06B002M	NapaCounty	Semi-Annual	1992 - 2016		Outside		Tsvt
NapaCounty-92		Napa Valley Floor-MST	005N003W06A001M	NapaCounty	Semi-Annual	1999 - 2016		Outside		
NapaCounty-95		Napa Valley Floor-MST	006N004W36G001M	NapaCounty	Semi-Annual	1979 - 2016		Outside		Tsvt
NapaCounty-98		Napa Valley Floor-MST	006N004W36A001M	NapaCounty	Semi-Annual	2000 - 2016		Outside		
NapaCounty-125		Napa Valley Floor-Yountville	006N004W09Q001M	NapaCounty	Semi-Annual	1979 - 2016		Outside		Tsva
NapaCounty-126		Napa Valley Floor-Yountville	006N004W09Q002M	NapaCounty	Semi-Annual	1984 - 2016		Outside		Tsva
NapaCounty-213		Western Mountains		NapaCounty	Semi-Annual	2014 - 2016		Outside		

APPENDIX B

Groundwater Level Hydrographs for Current Monitoring Locations

WellID: NapaCounty-165

Subarea: Angwin

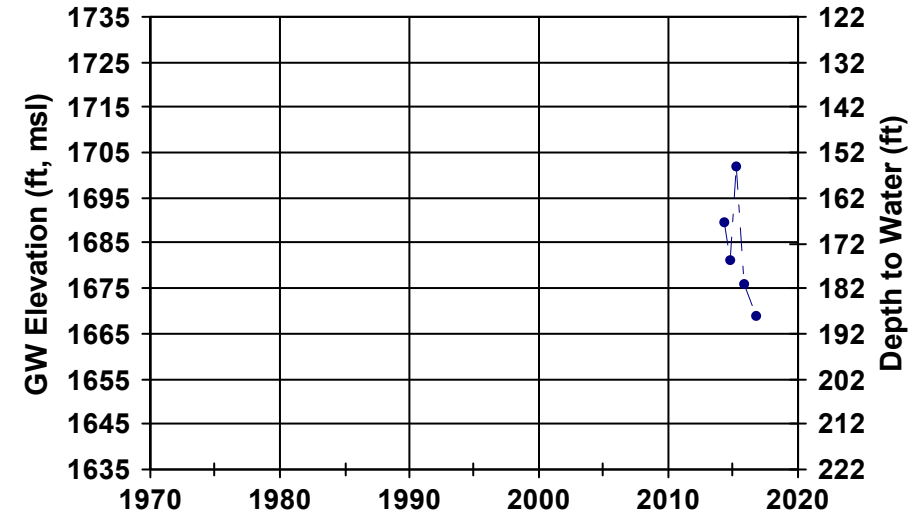
Groundwater Basin: Not within a basin

RPE: 1857 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:



WellID: NapaCounty-166

Subarea: Angwin

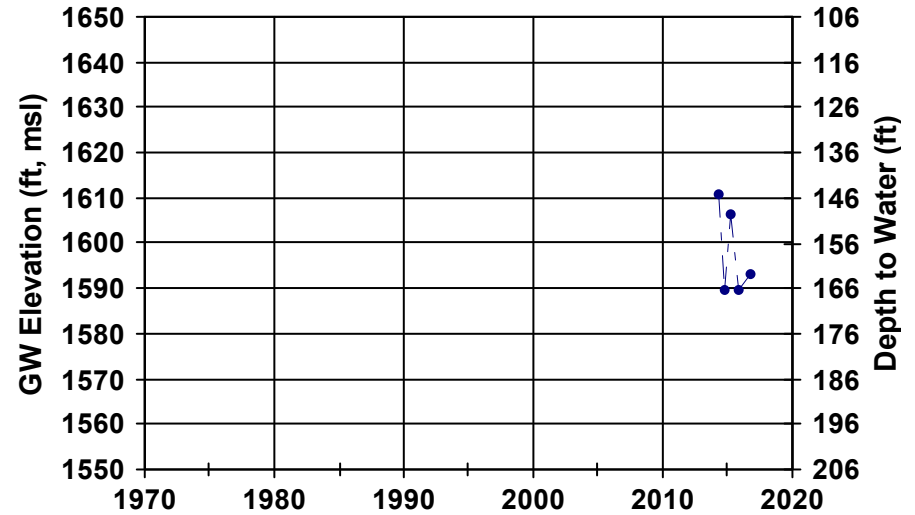
Groundwater Basin: Not within a basin

RPE: 1755.8 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:



WellID: NapaCounty-167

Subarea: Angwin

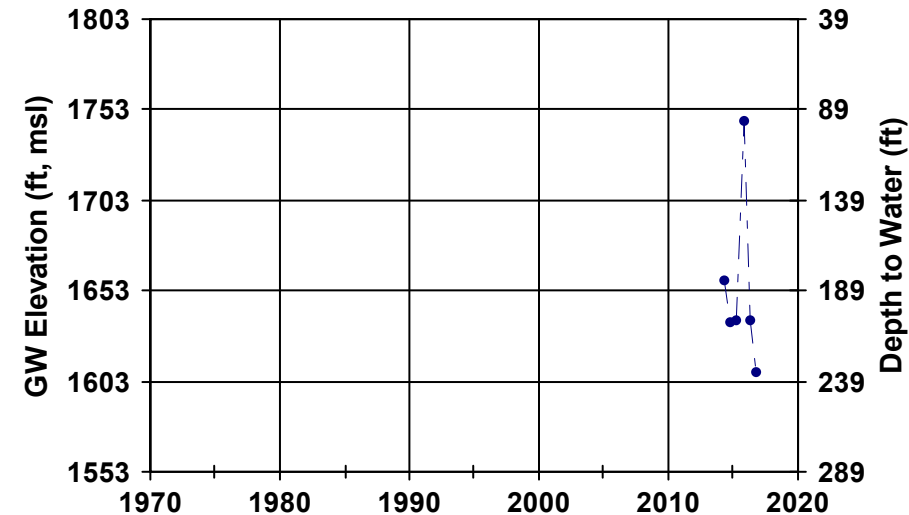
Groundwater Basin: Not within a basin

RPE: 1842.3 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:



WellID: NapaCounty-168

Subarea: Angwin

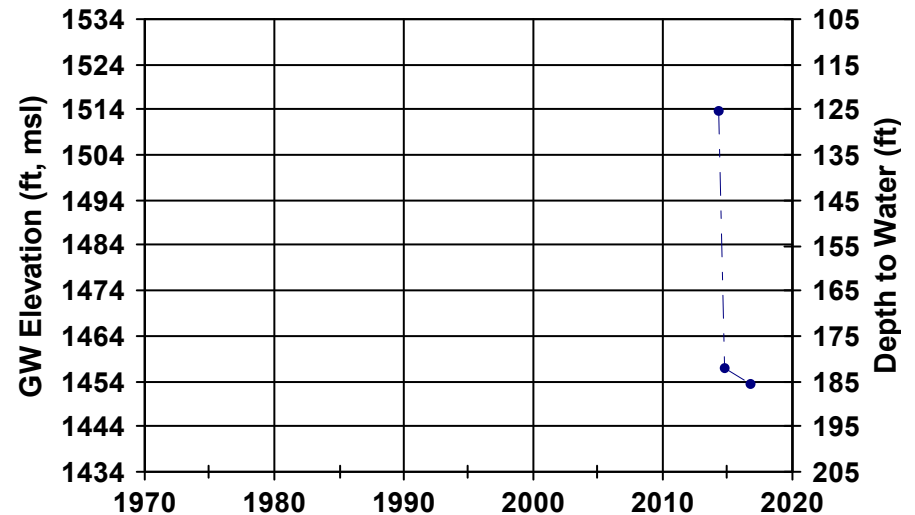
Groundwater Basin: Not within a basin

RPE: 1639 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-202

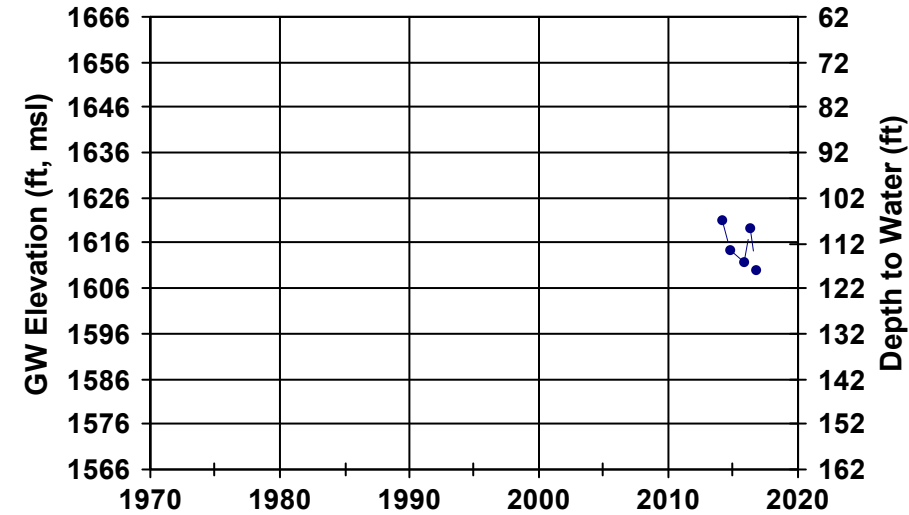
RPE: 1728.2 ft, msl SWN: Unknown

Subarea: Angwin

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: T0605500304MW-1

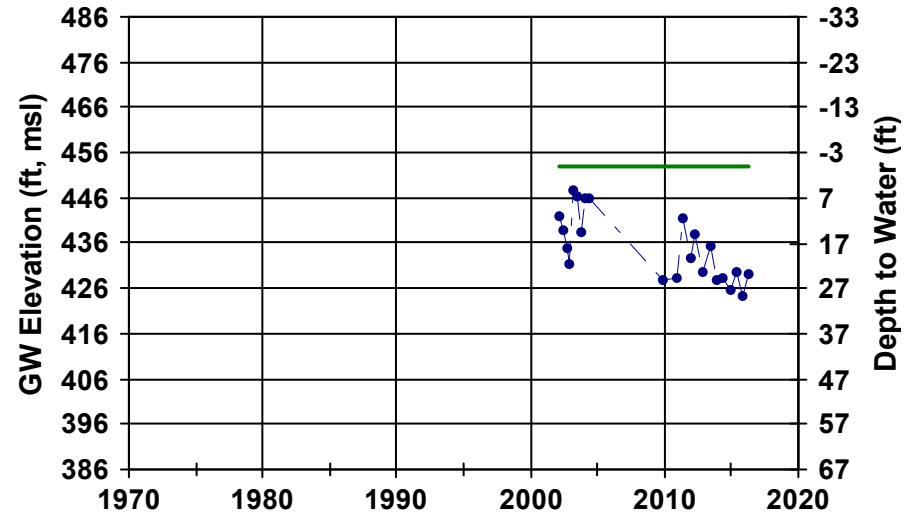
RPE: 452.82 ft, msl SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: T0605500304MW-12

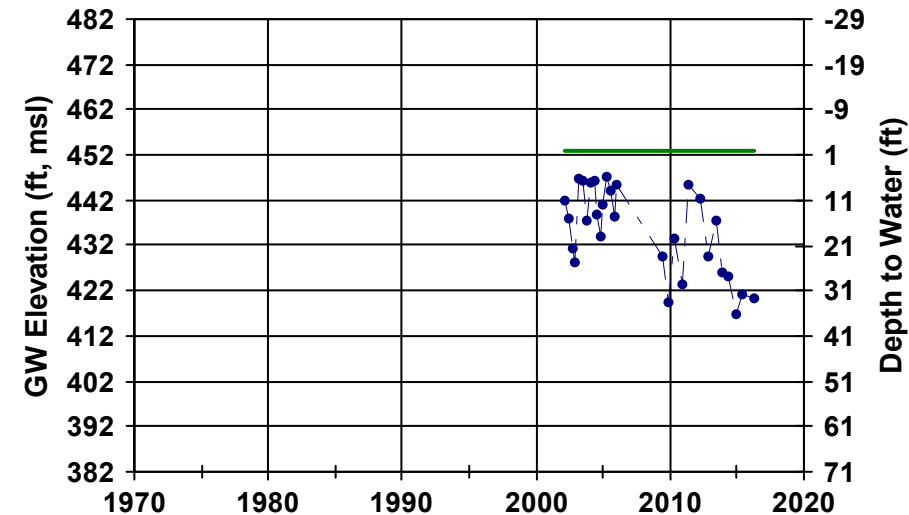
RPE: 453.06 ft, msl SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: T0605500304MW-14

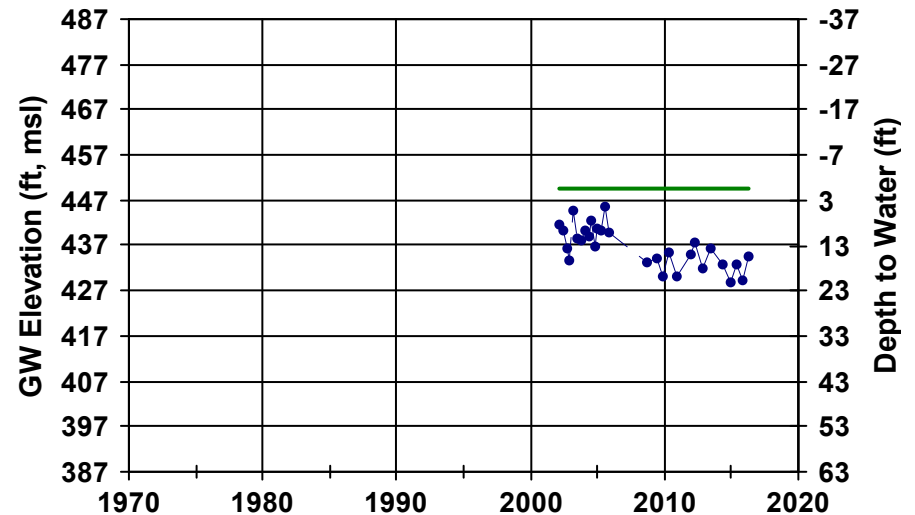
RPE: 449.75 ft, msl SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: T0605500304MW-16

RPE: 444.87 ft, msl

SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T0605500304MW-18

RPE: 467.06 ft, msl

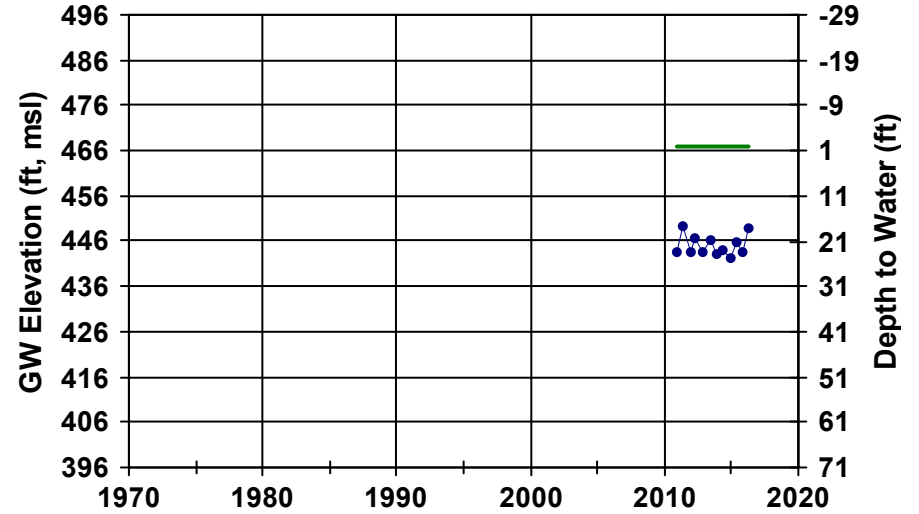
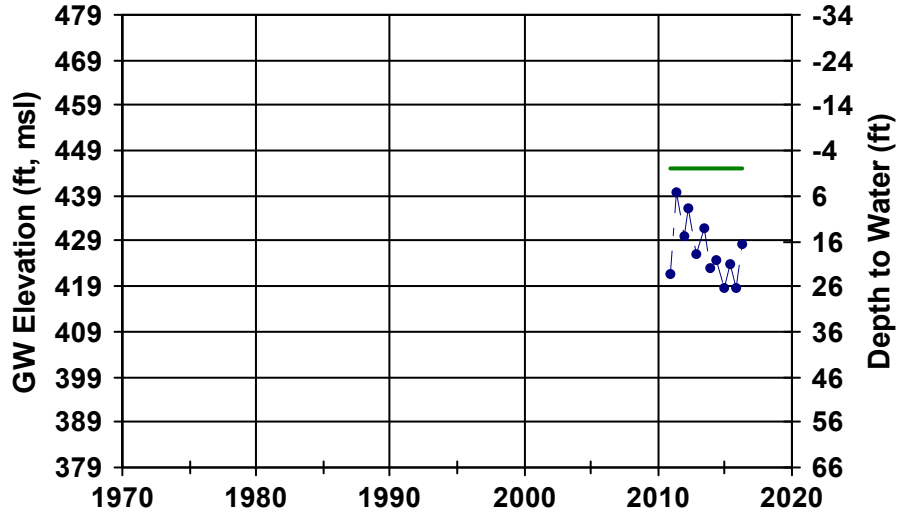
SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: T0605500304MW-19

RPE: 443.59 ft, msl

SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T0605500304MW-3

RPE: 450.99 ft, msl

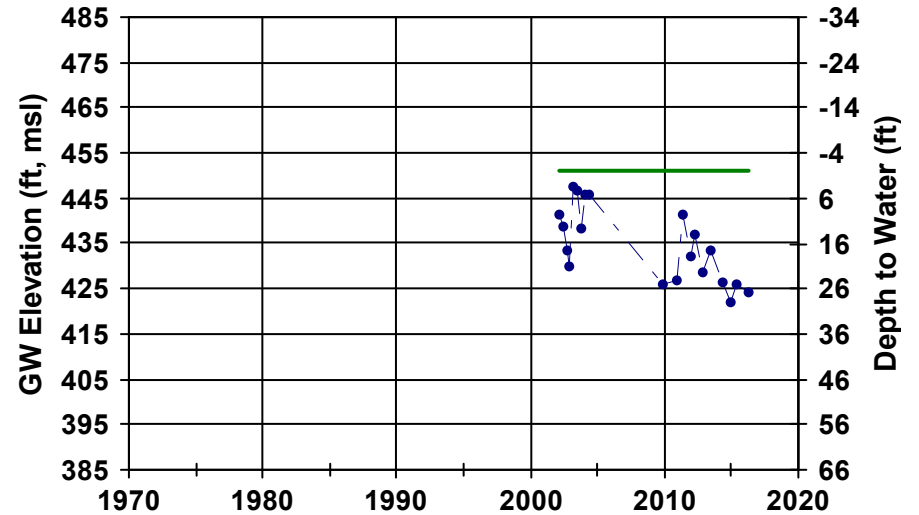
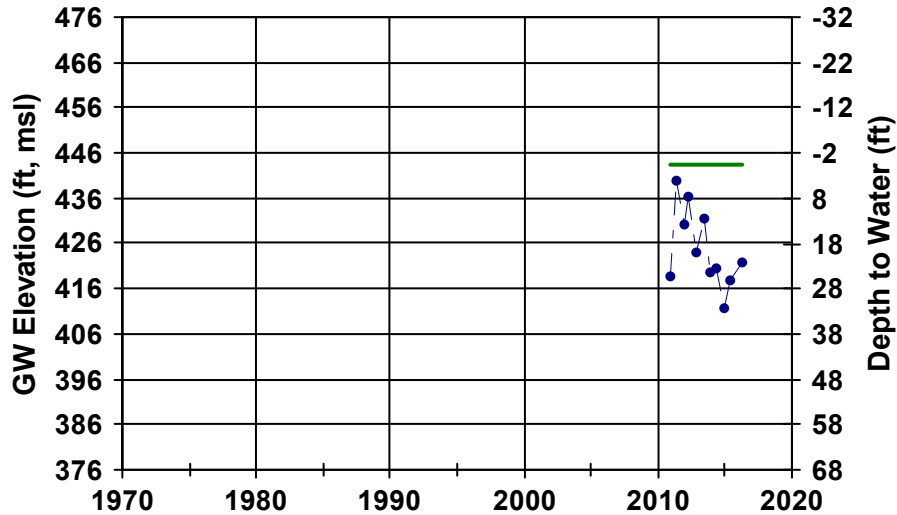
SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



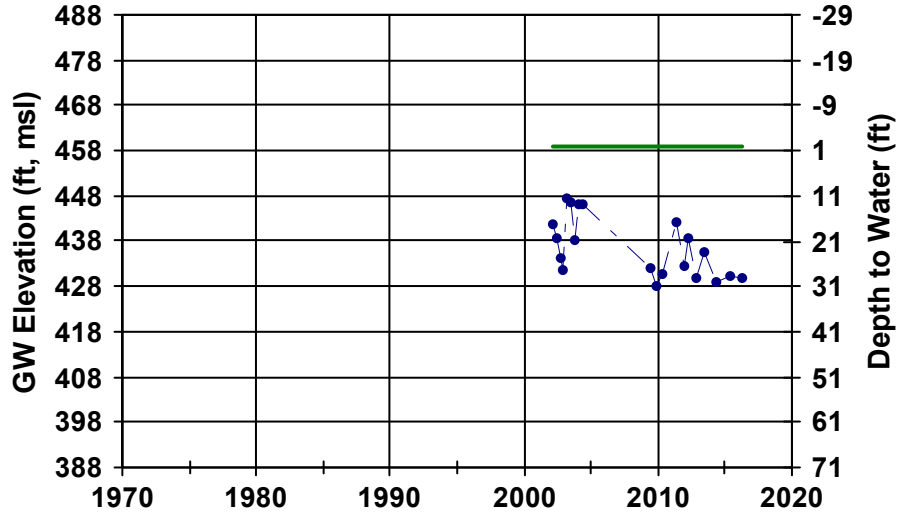
● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

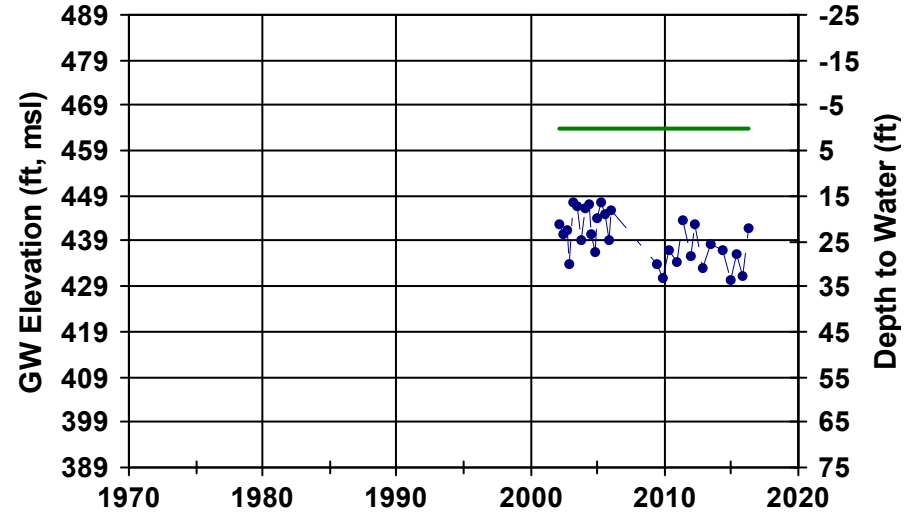
WellID: T0605500304MW-4
Subarea: Berryessa
Groundwater Basin: Not within a basin

RPE: 458.83 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:



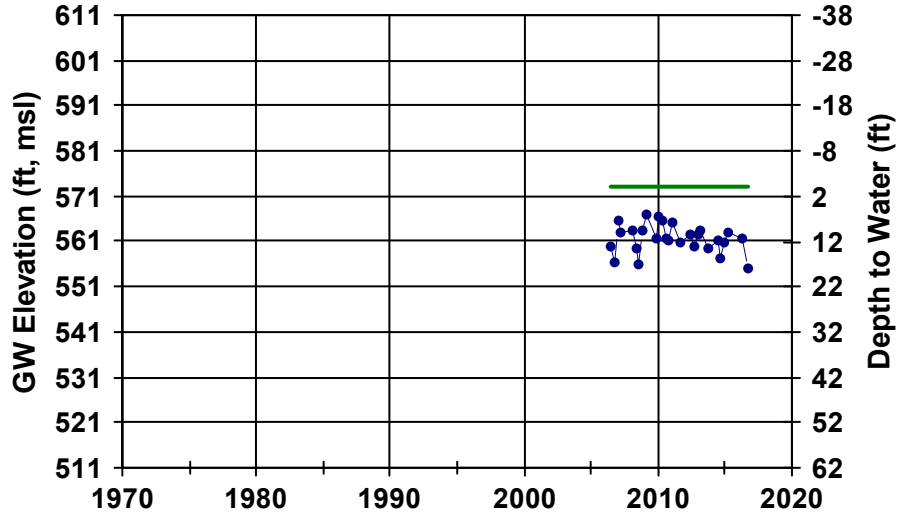
WellID: T0605500304MW-8
Subarea: Berryessa
Groundwater Basin: Not within a basin

RPE: 463.73 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:



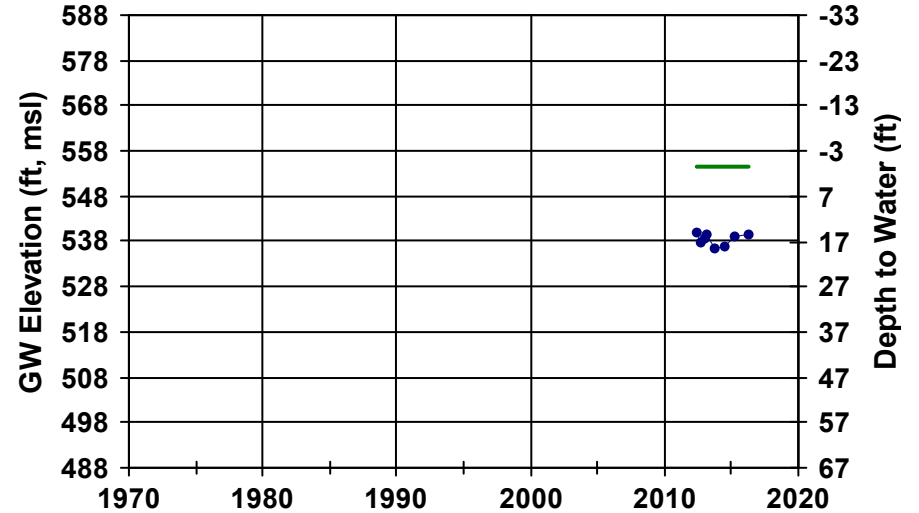
WellID: T0605591908MW-1
Subarea: Berryessa
Groundwater Basin: Not within a basin

RPE: 573.28 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:



WellID: T0605591908MW-15
Subarea: Berryessa
Groundwater Basin: Not within a basin

RPE: 554.73 ft, msl
Source: Geotracker
SWN: Unknown
Aquifer Zone:



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

WellID: T0605591908MW-16

RPE: 569.35 ft, msl

SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T0605591908MW-2

RPE: 573.08 ft, msl

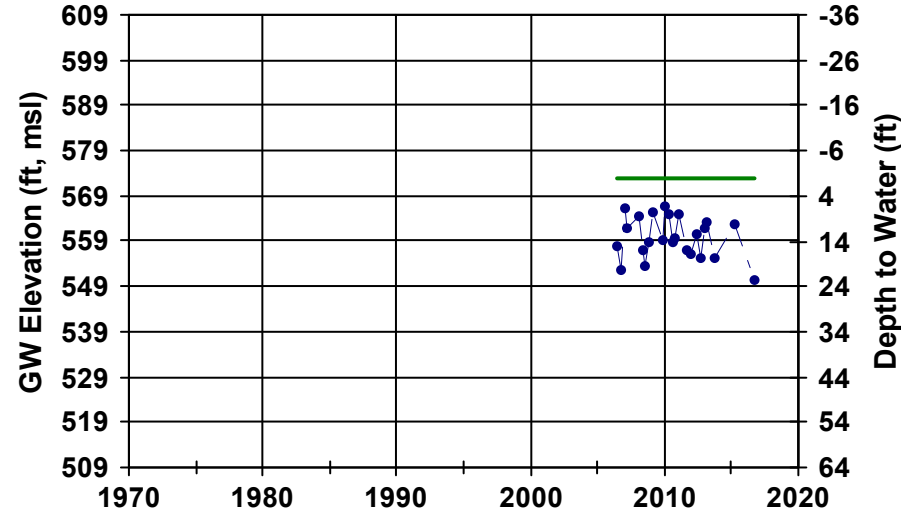
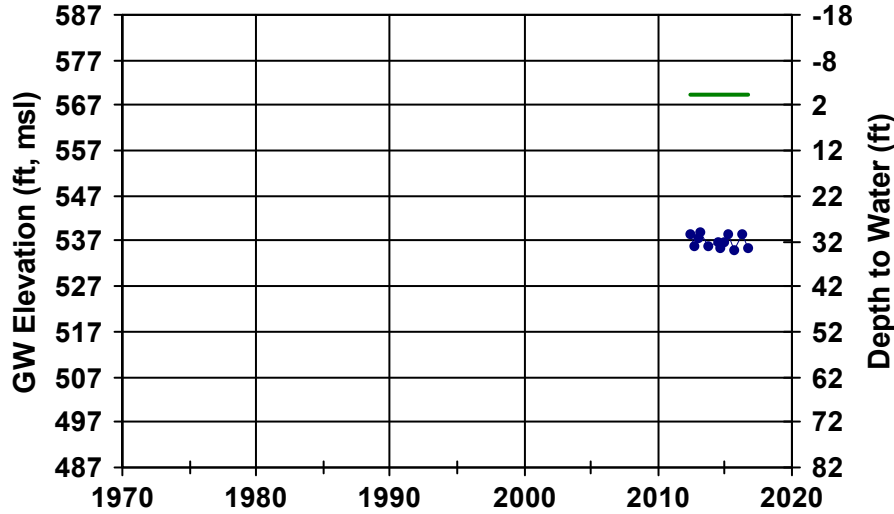
SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: T0605591908MW-3

RPE: 573.41 ft, msl

SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T0605591908MW-4

RPE: 572.75 ft, msl

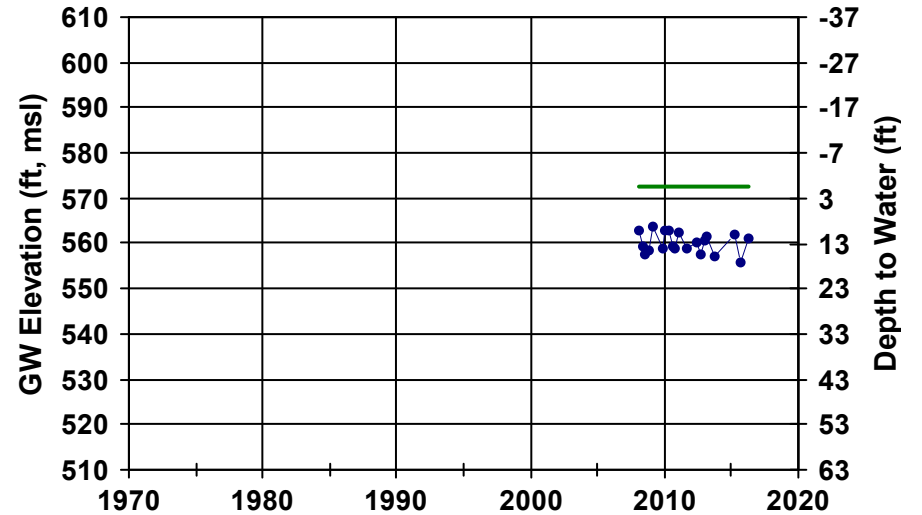
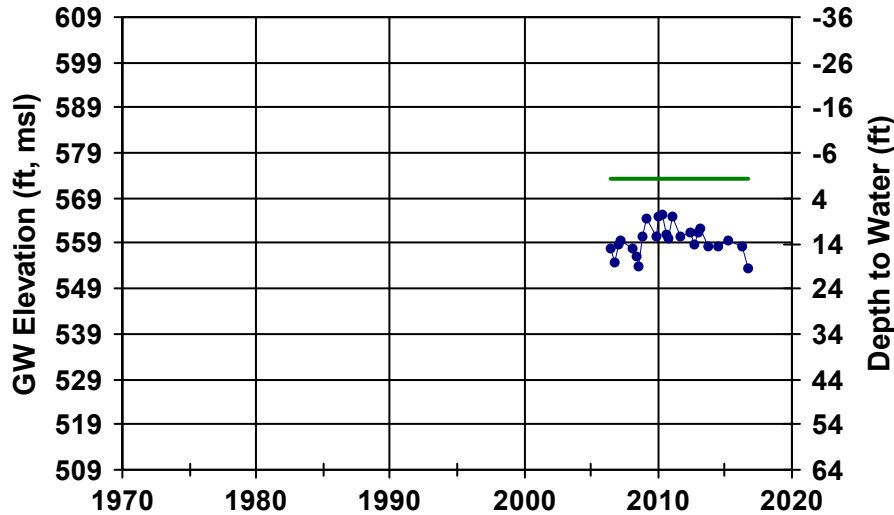
SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: T0605591908MW-5

RPE: 572.93 ft, msl

SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T0605591908MW-6

RPE: 573.3 ft, msl

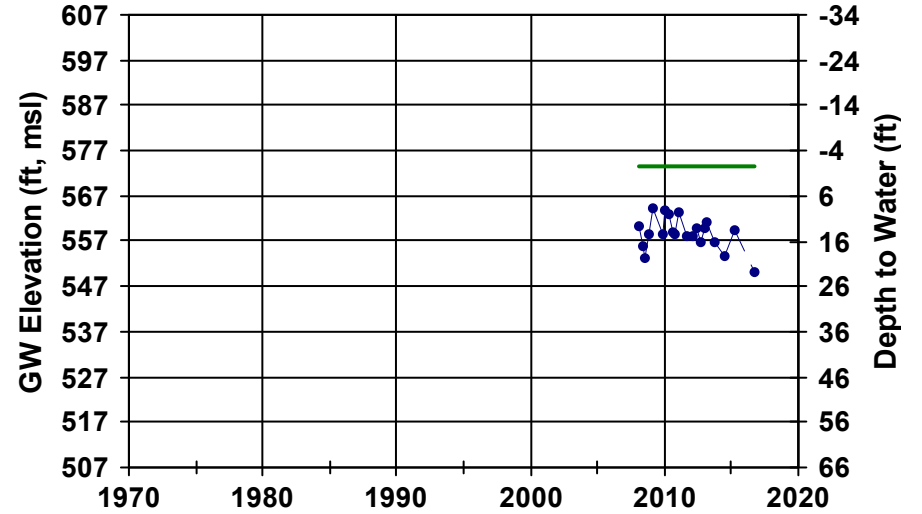
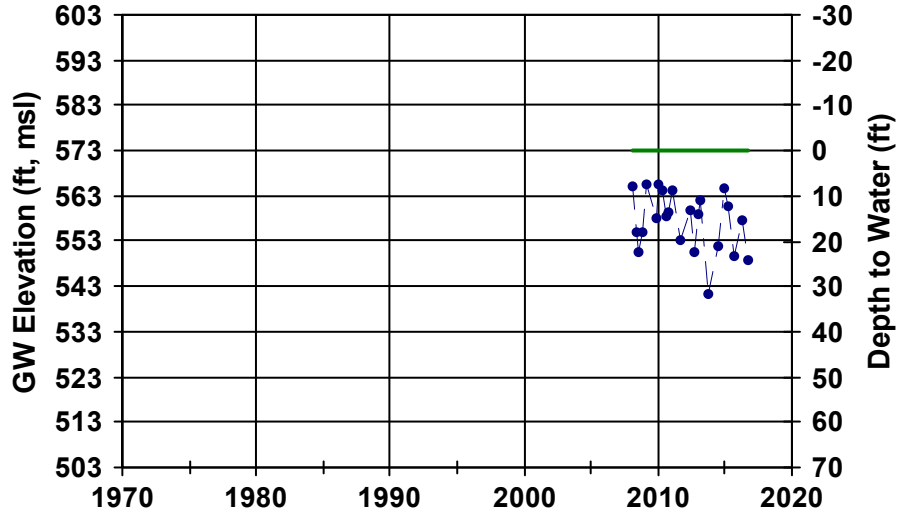
SWN: Unknown

Subarea: Berryessa

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: NapaCounty-150

RPE: 32.7 ft, msl

SWN: 004N004W05C001

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: NapaCounty-153

RPE: 47.35 ft, msl

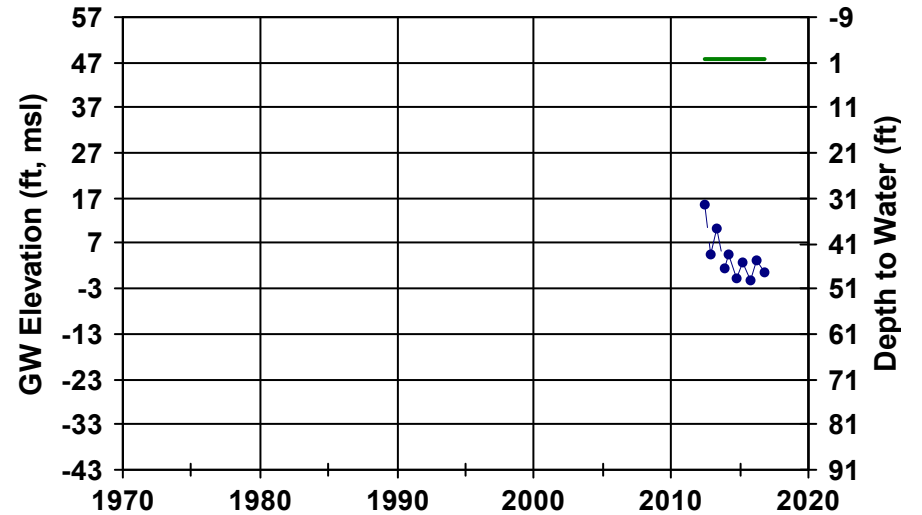
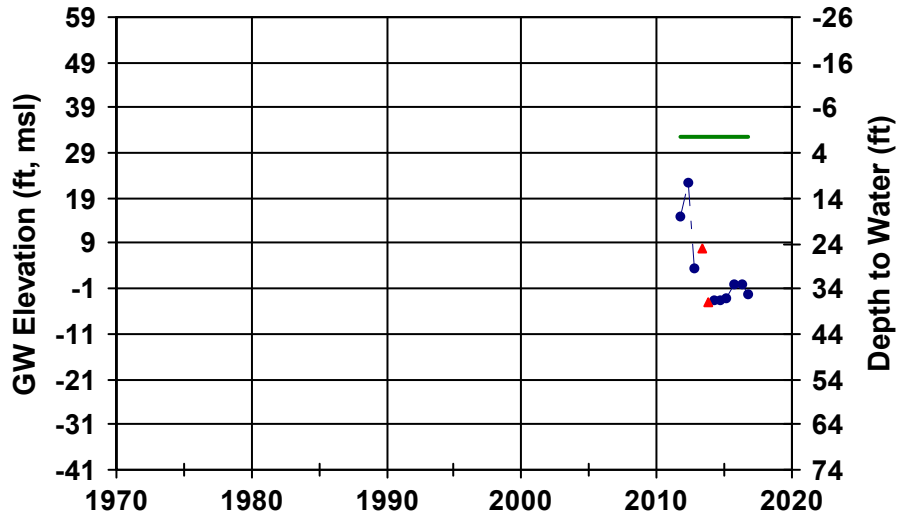
SWN: 004N004W05A001

Subarea: Carneros

Source: NapaCounty

Aquifer Zone: TQsb

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-154

RPE: 98 ft, msl

SWN: 005N004W31R001

Subarea: Carneros

Source: NapaCounty

Aquifer Zone: TQsb

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: NapaCounty-155

RPE: 25 ft, msl

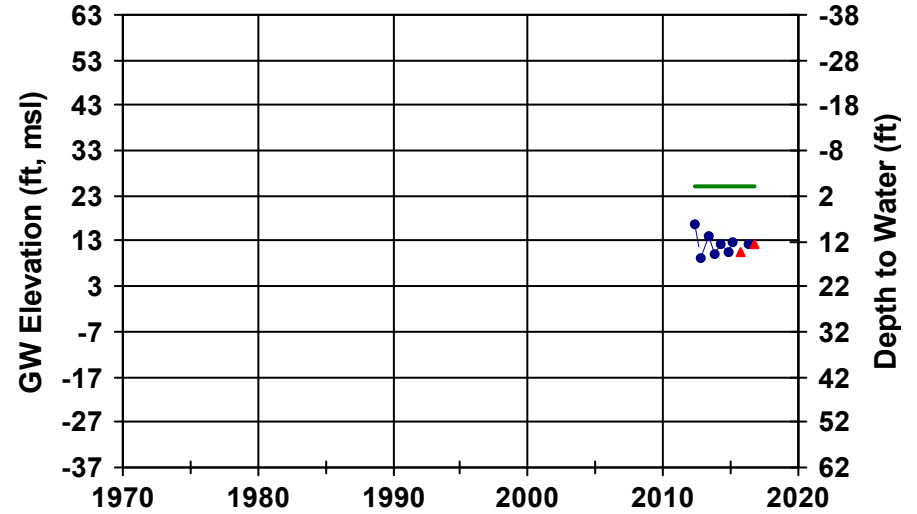
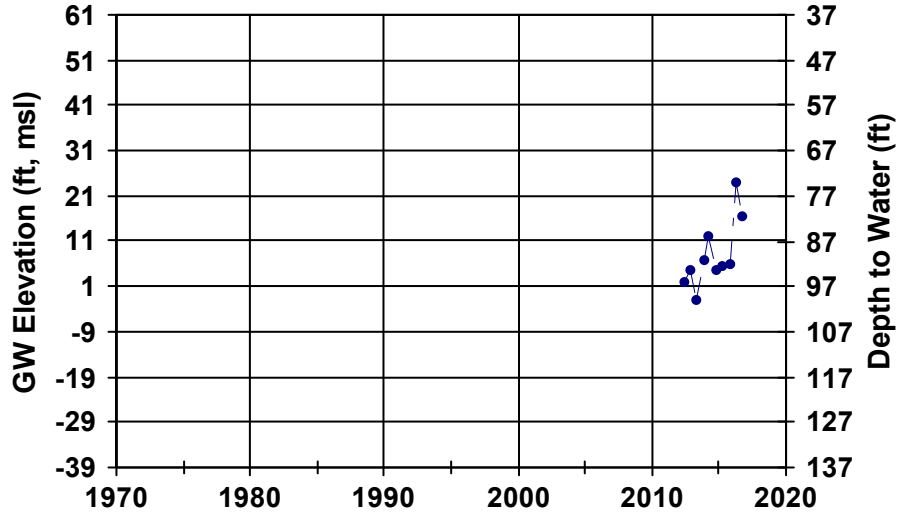
SWN: 004N004W06M001

Subarea: Carneros

Source: NapaCounty

Aquifer Zone: TQsb

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS



WellID: NapaCounty-176

RPE: 53.4 ft, msl

SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: NapaCounty-194

RPE: 75.1 ft, msl

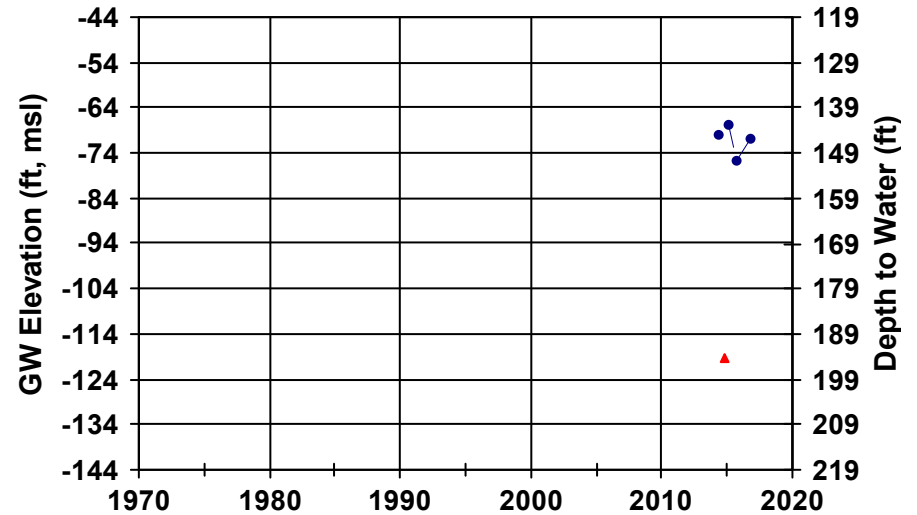
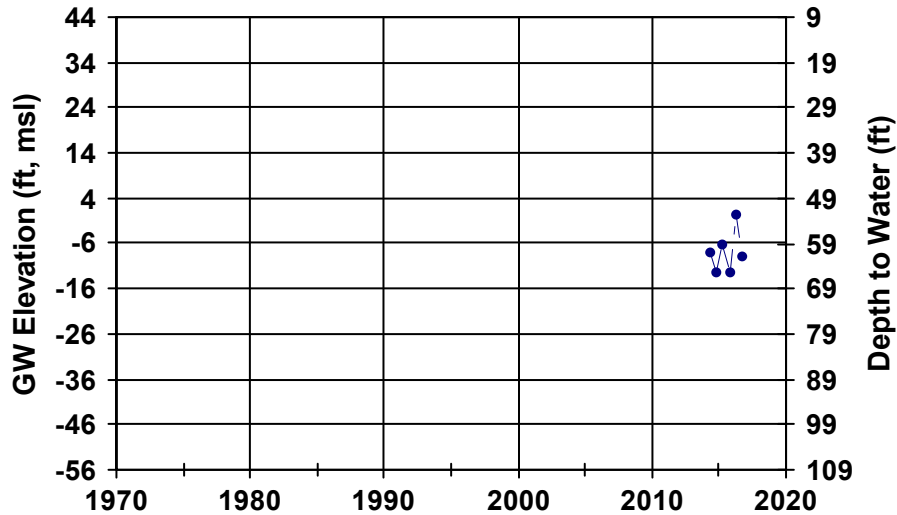
SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-195

RPE: 94.8 ft, msl

SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: NapaCounty-200

RPE: 15.7 ft, msl

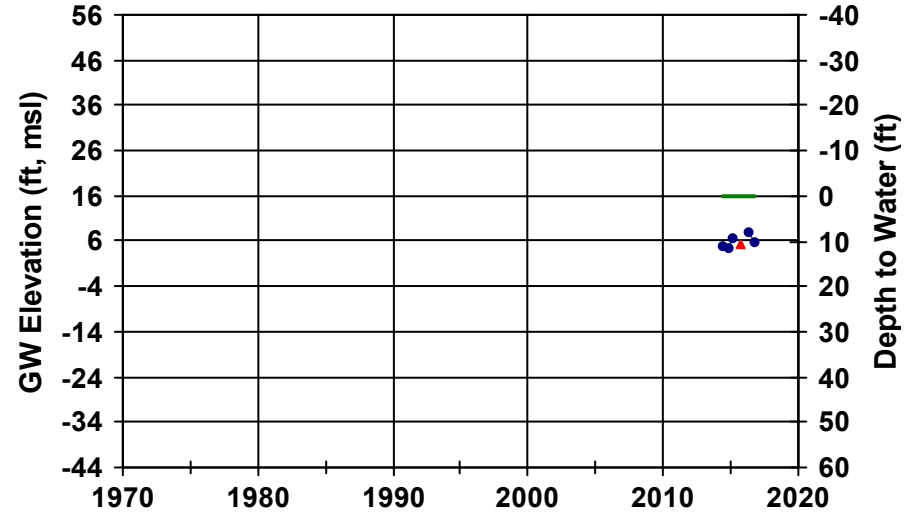
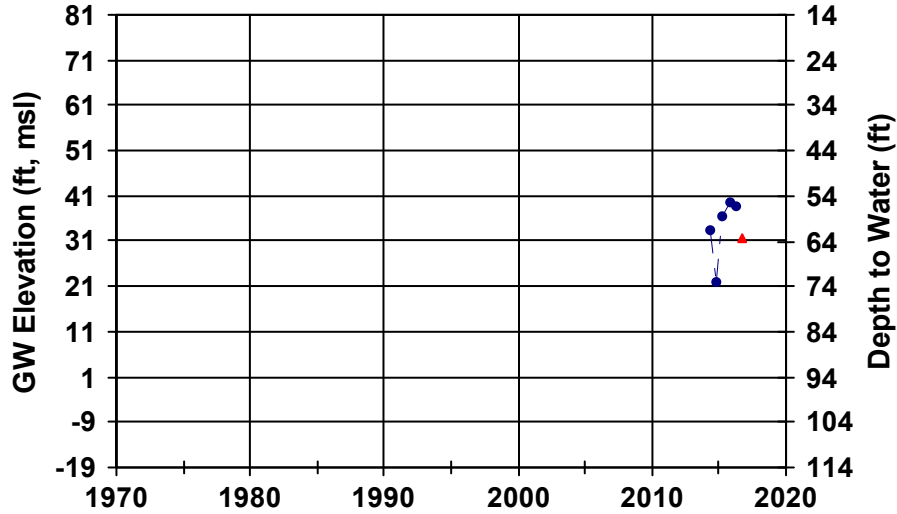
SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS



WellID: NapaCounty-201

RPE: 50.4 ft, msl

SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: NapaCounty-205

RPE: 56.8 ft, msl

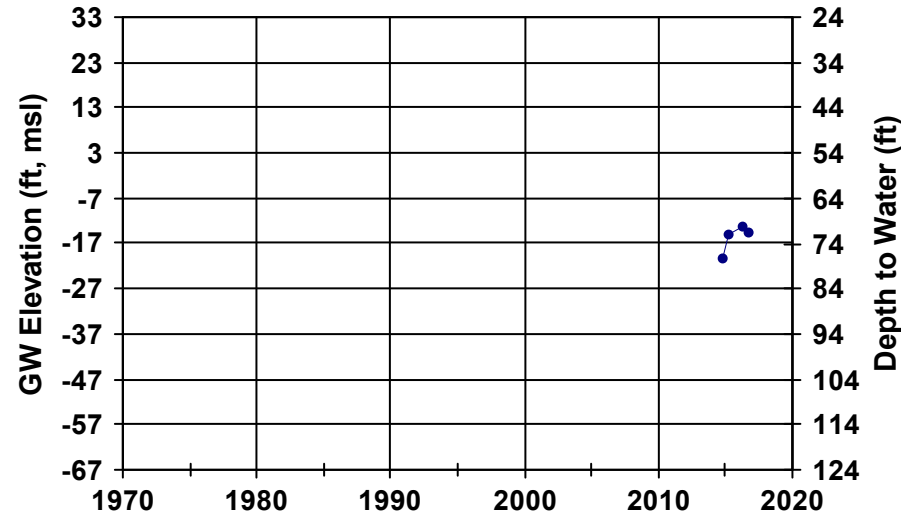
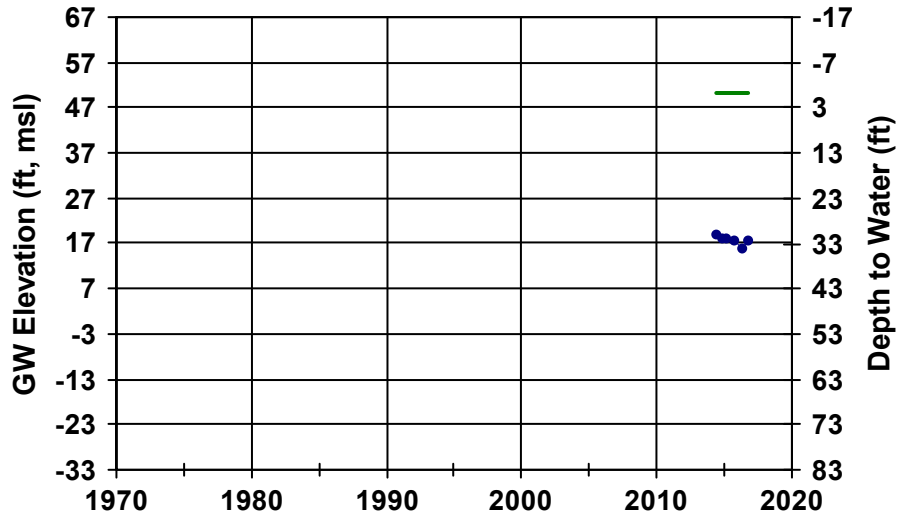
SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-206

RPE: 52.4 ft, msl

SWN: Unknown

Subarea: Carneros

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: L10003756160MW-6

RPE: 989.39 ft, msl

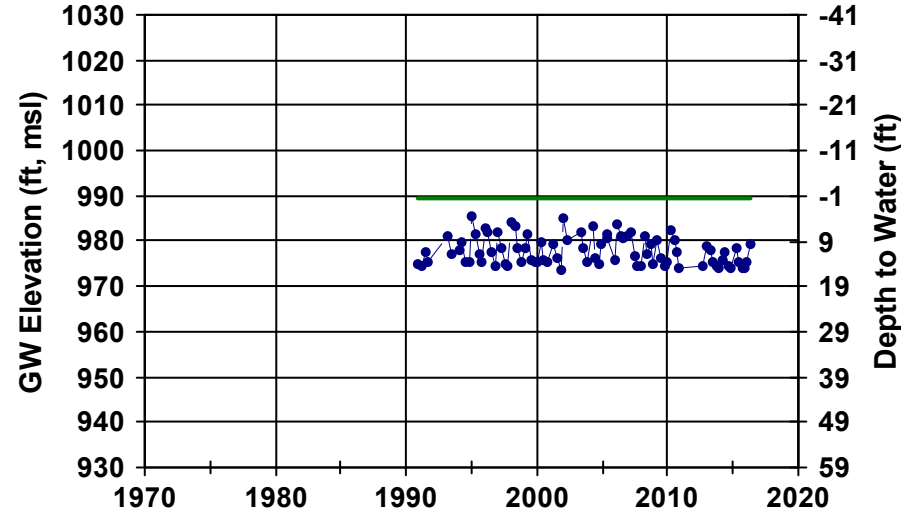
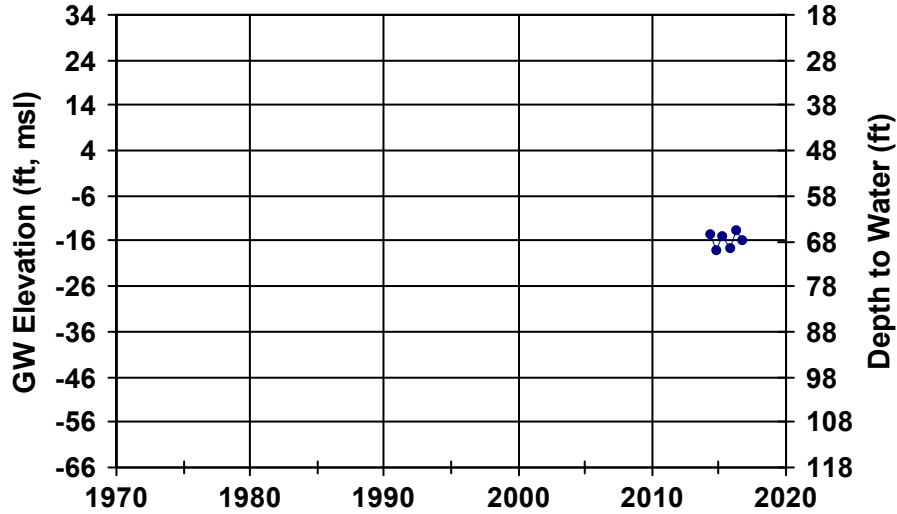
SWN: Unknown

Subarea: Central Interior Valleys

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: L10003756160MW-7

RPE: 1032.16 ft, msl

SWN: Unknown

Subarea: Central Interior Valleys

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: L10003756160MW-8

RPE: 889.03 ft, msl

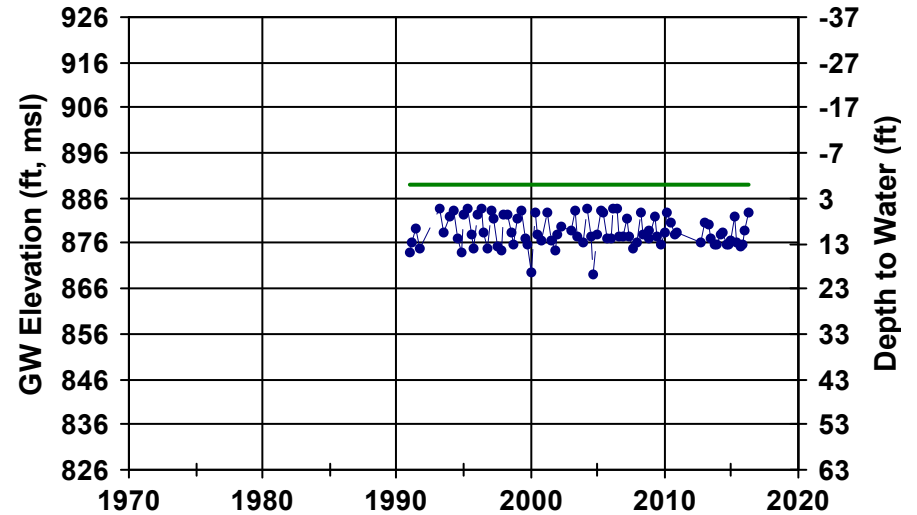
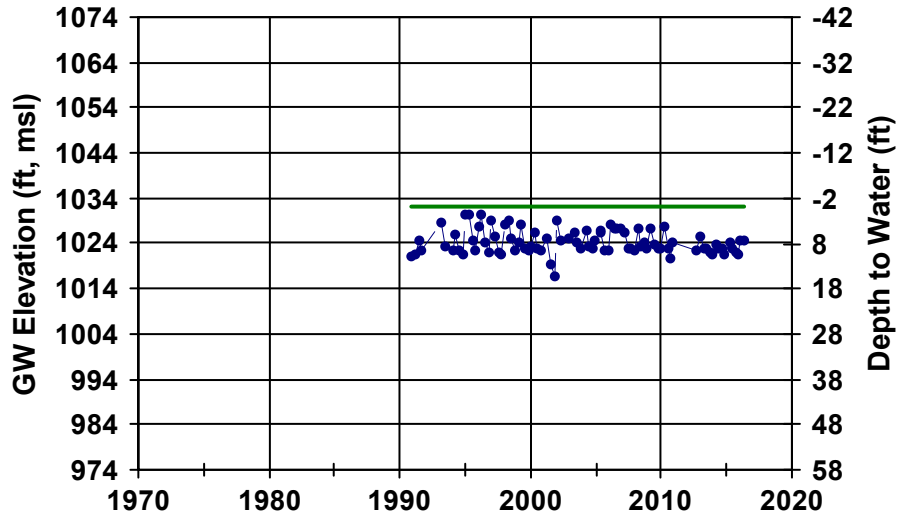
SWN: Unknown

Subarea: Central Interior Valleys

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: L10003756160MW-9

RPE: 916.87 ft, msl

SWN: Unknown

Subarea: Central Interior Valleys

Source: Geotracker

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: NapaCounty-209

RPE: 918 ft, msl

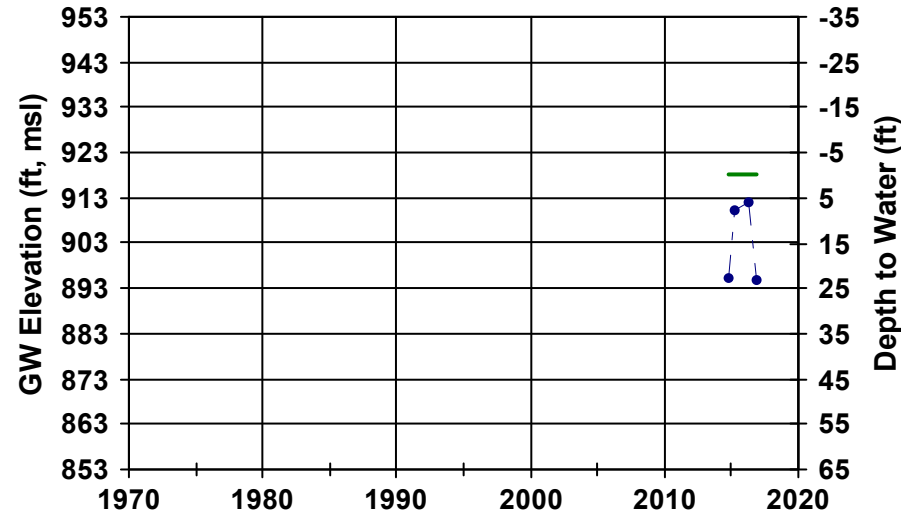
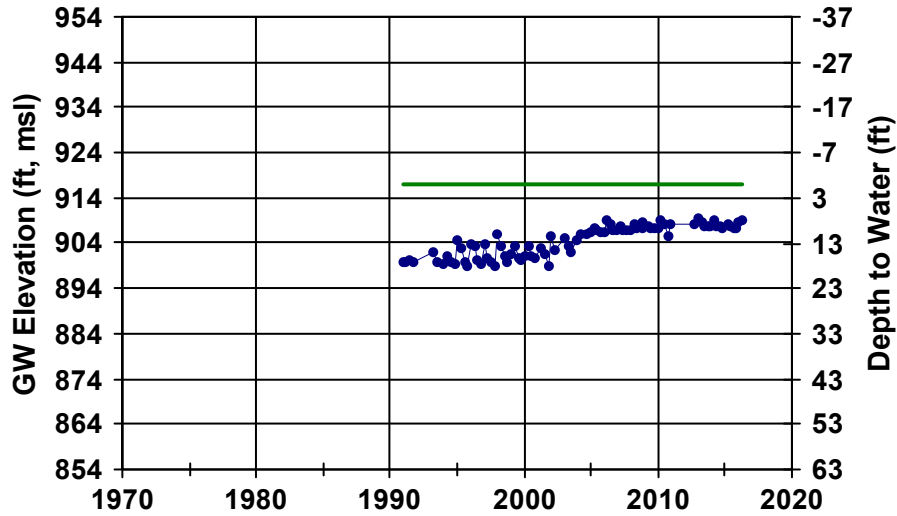
SWN: Unknown

Subarea: Central Interior Valleys

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: NapaCounty-175

RPE: 672.3 ft, msl

SWN: Unknown

Subarea: Eastern Mountains

Source: NapaCounty

Aquifer Zone: Tsv

Groundwater Basin: Not within a basin

WellID: NapaCounty-210

RPE: 1622.9 ft, msl

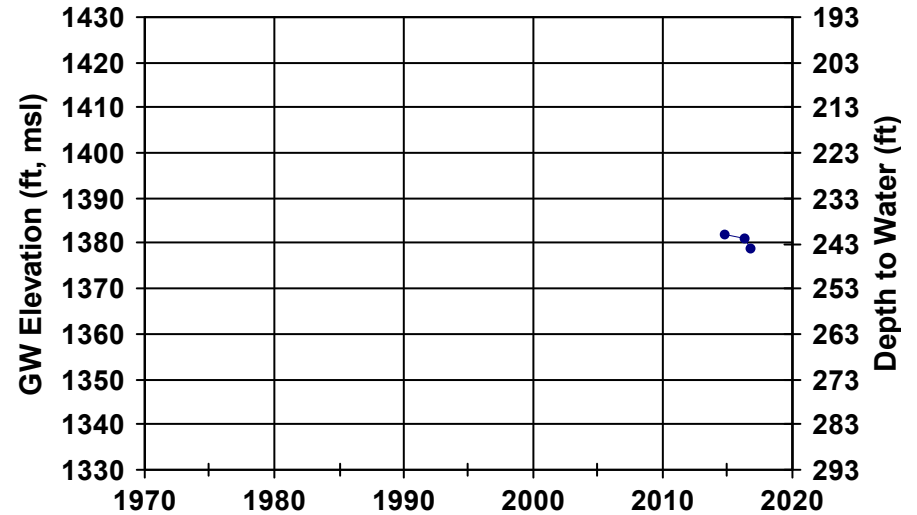
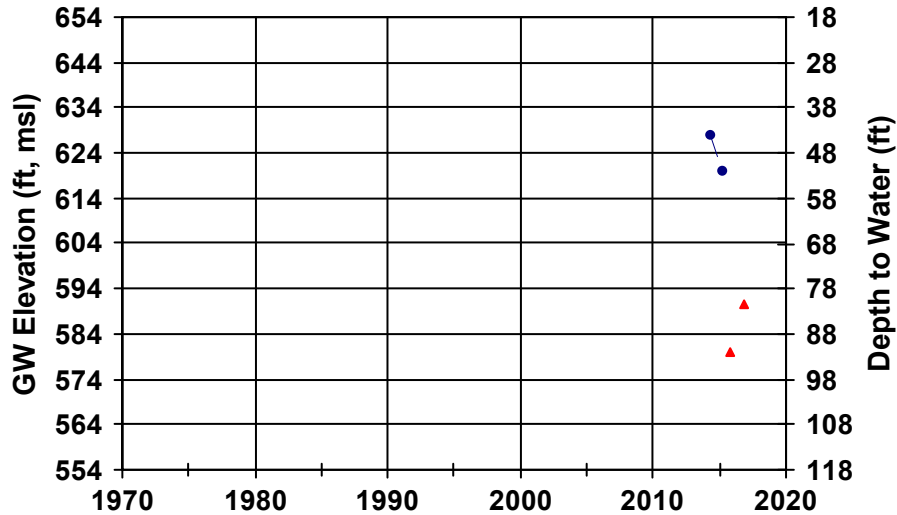
SWN: Unknown

Subarea: Eastern Mountains

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



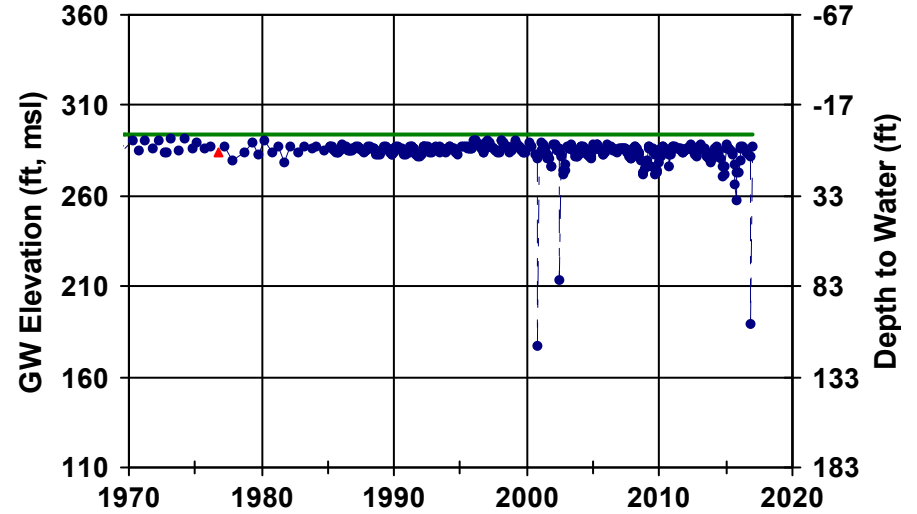
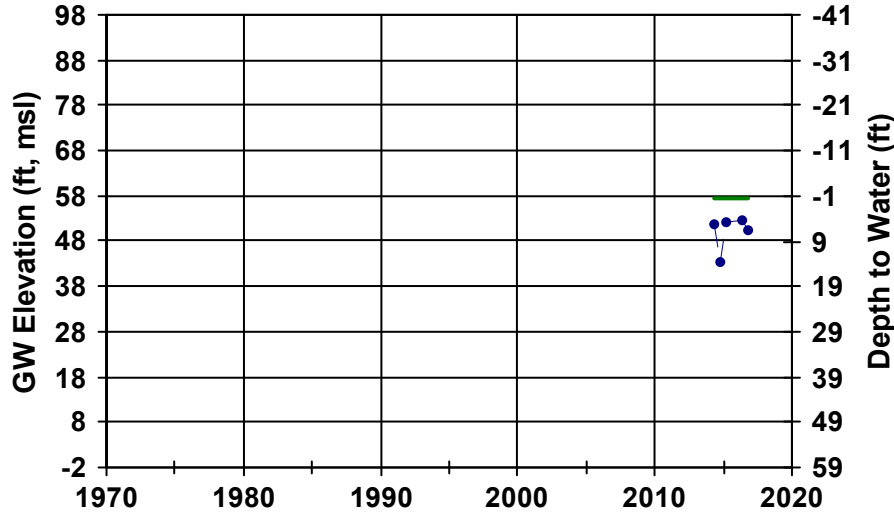
● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

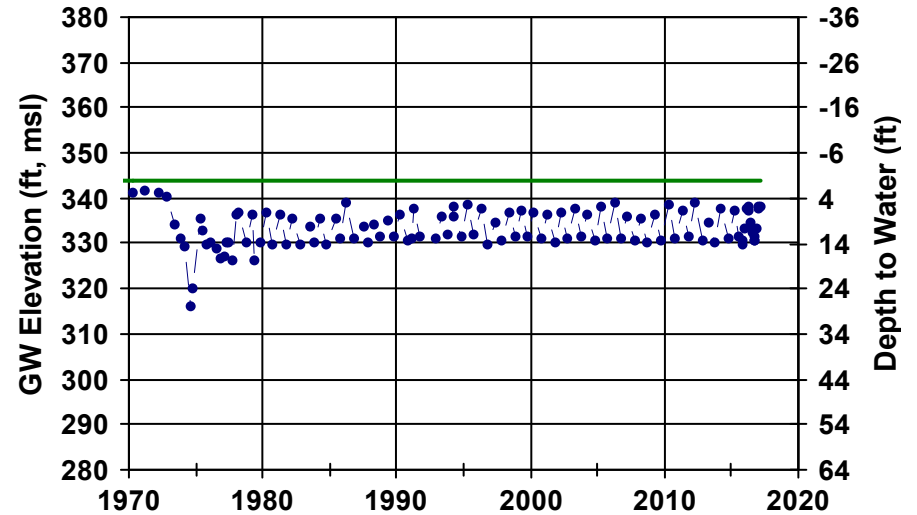
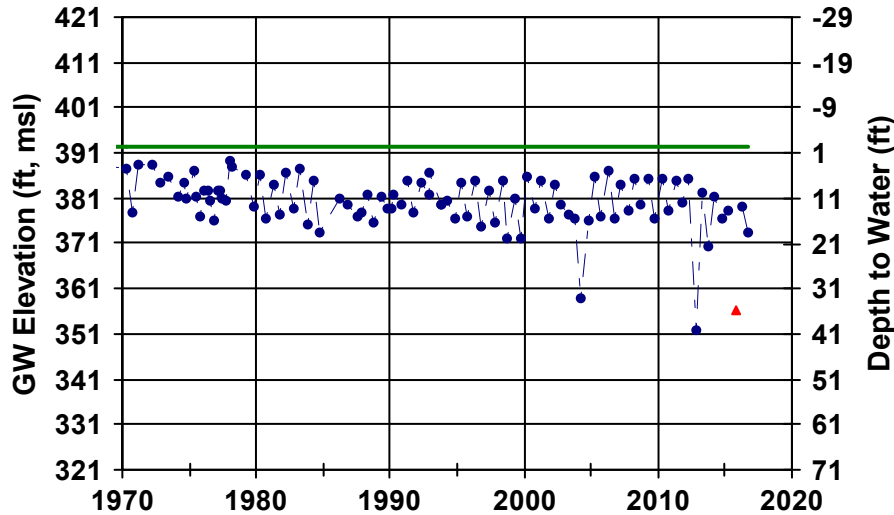
WellID: **NapaCounty-196** RPE: 57.4 ft, msl SWN: Unknown
 Subarea: Jameson/American Canyon Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA-SONOMA LOWLANDS

WellID: **08N06W10Q001M** RPE: 293.43 ft, msl SWN: 008N006W10Q001
 Subarea: Napa Valley Floor-Calistoga Source: DWR Aquifer Zone: Not Defined
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **NapaCounty-127** RPE: 392.5 ft, msl SWN: 009N007W25N001
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

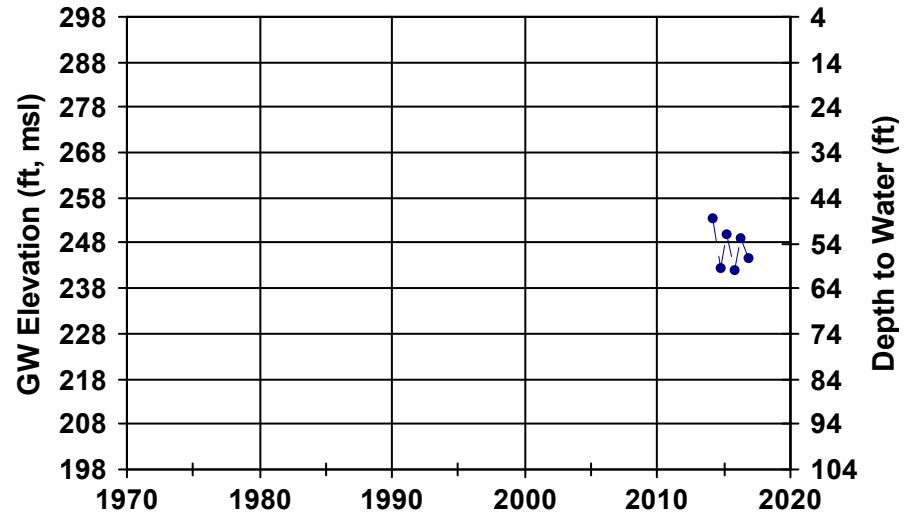
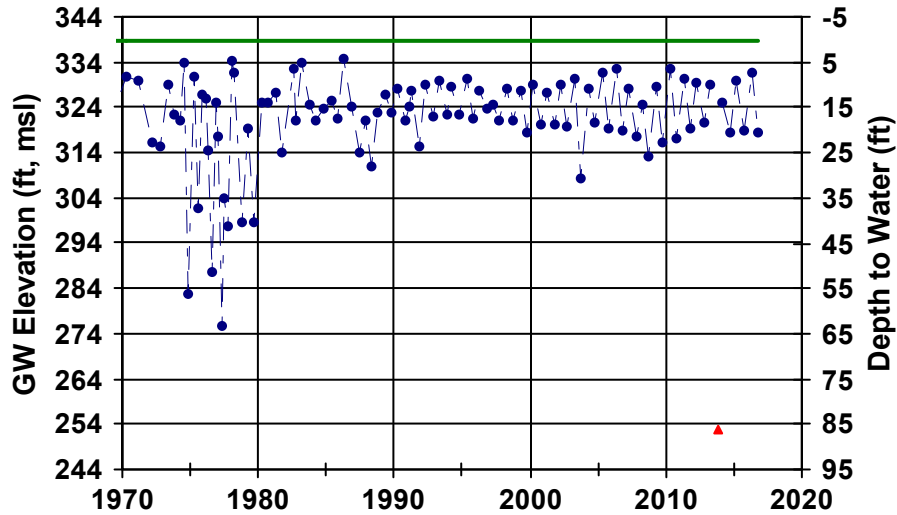
WellID: **NapaCounty-128** RPE: 343.7 ft, msl SWN: 009N006W31Q001
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

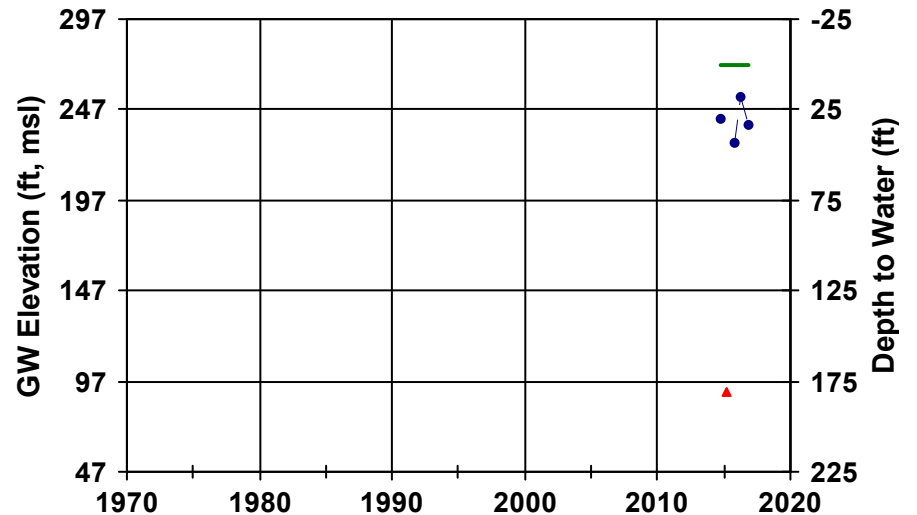
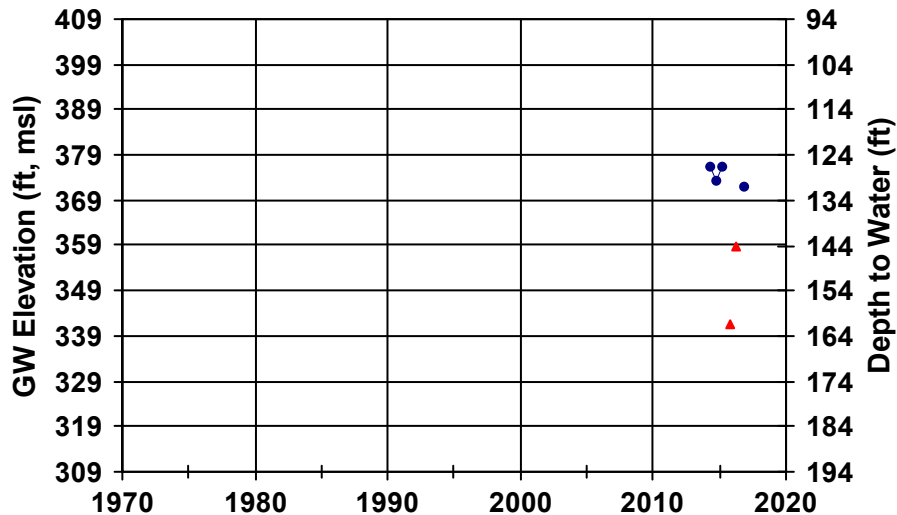
WellID: NapaCounty-129 RPE: 338.7 ft, msl SWN: 008N006W06L004
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-178 RPE: 301.5 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone: NA
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



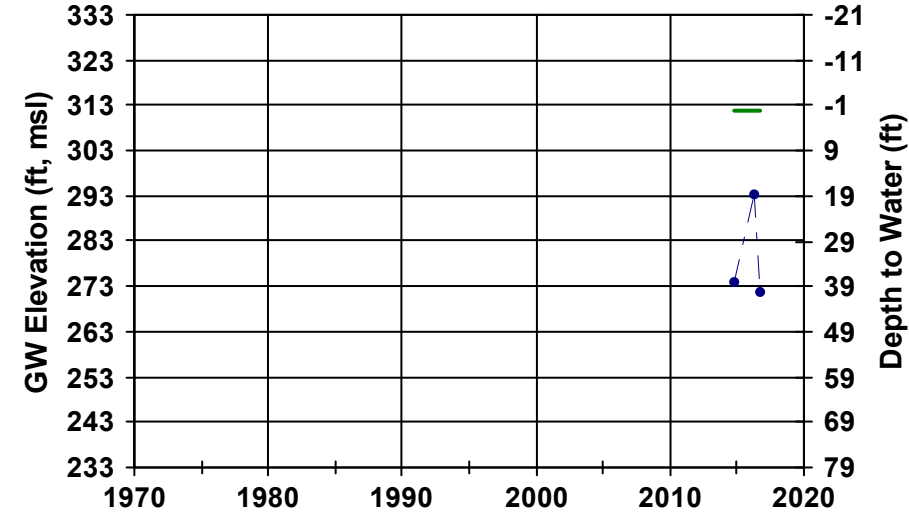
WellID: NapaCounty-208 RPE: 503.4 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin

WellID: NapaCounty-224 RPE: 272 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

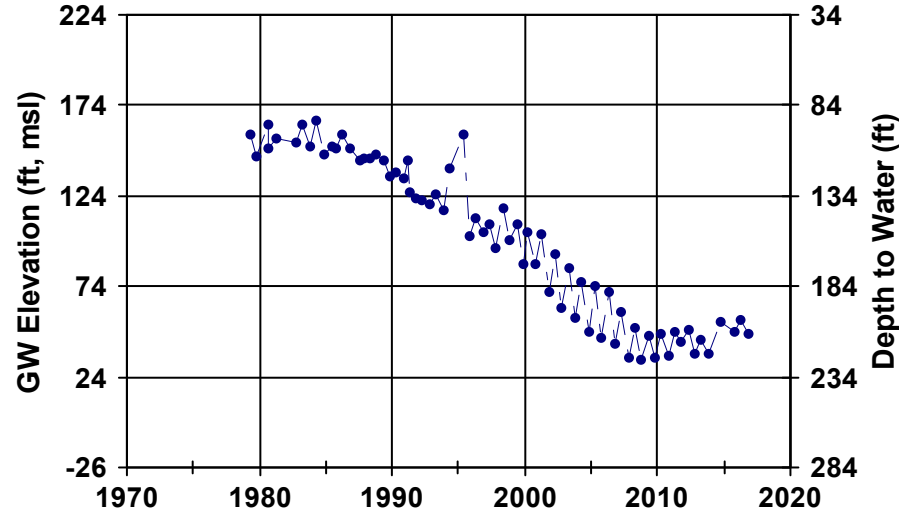


● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

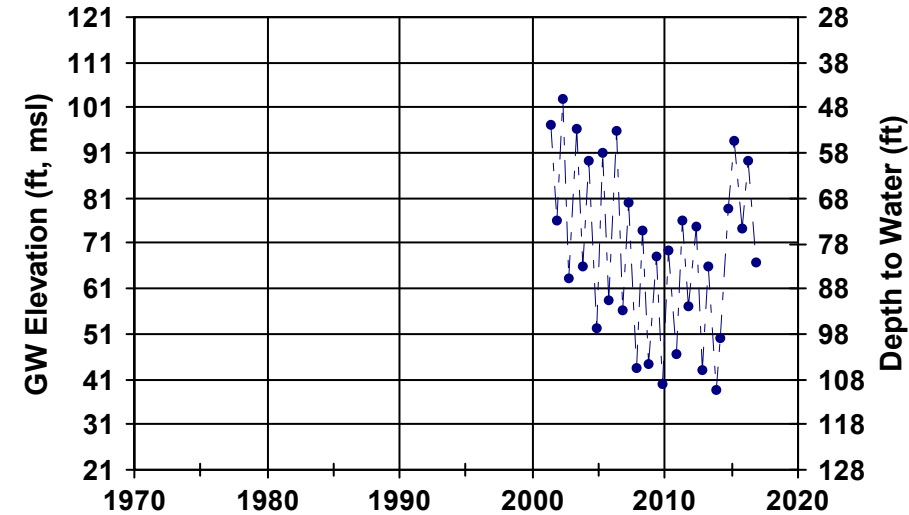
WellID: **NapaCounty-225** RPE: 311.75 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Calistoga Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



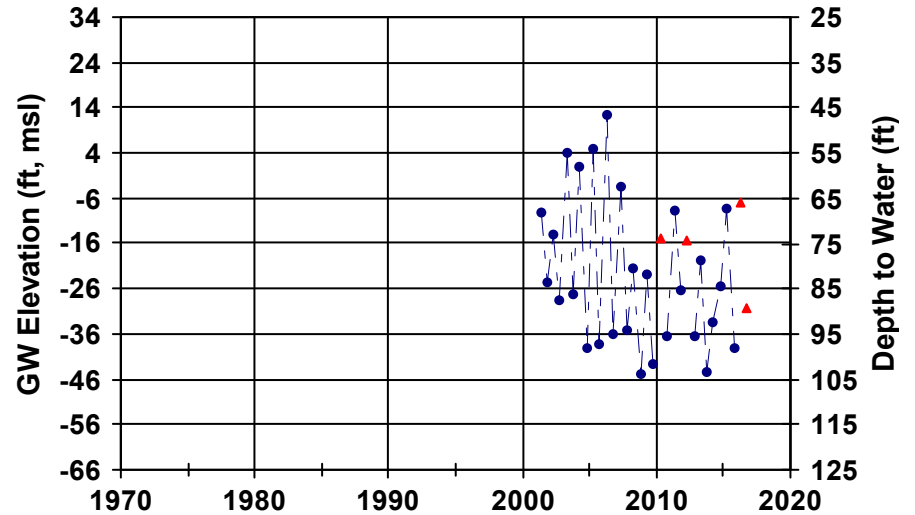
WellID: **NapaCounty-10** RPE: 258.3 ft, msl SWN: 005N003W05M001
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin



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



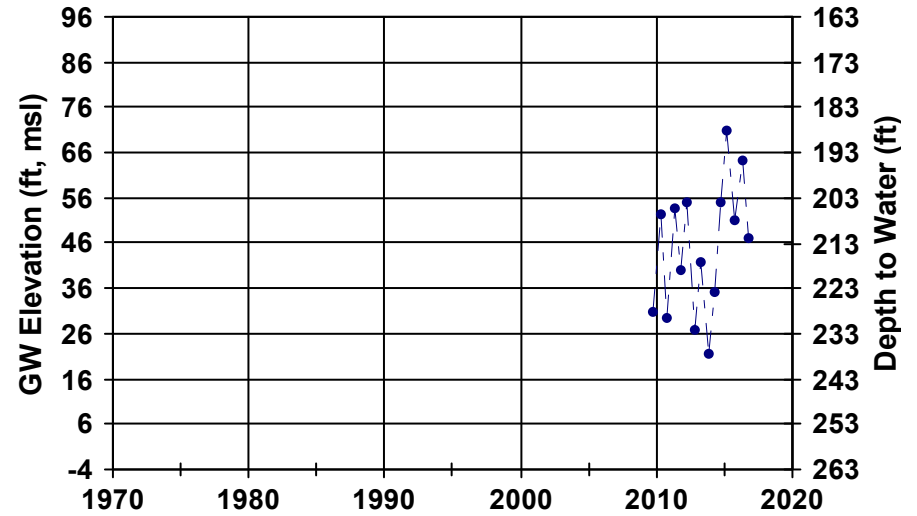
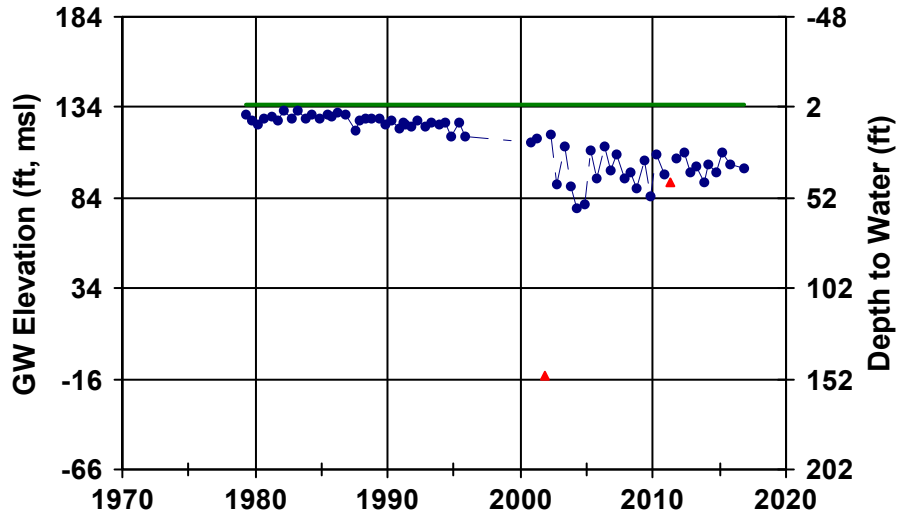
WellID: **NapaCounty-122** RPE: 59.15 ft, msl SWN: 006N004W26L00_
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

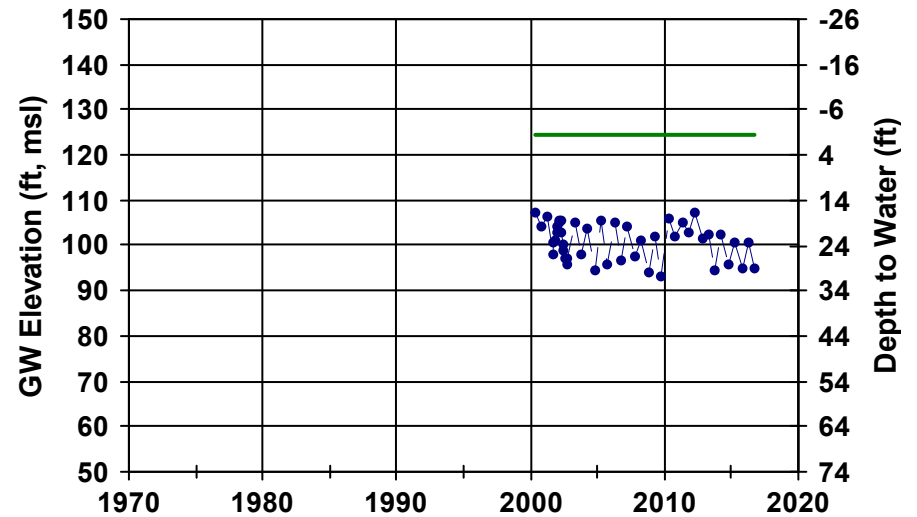
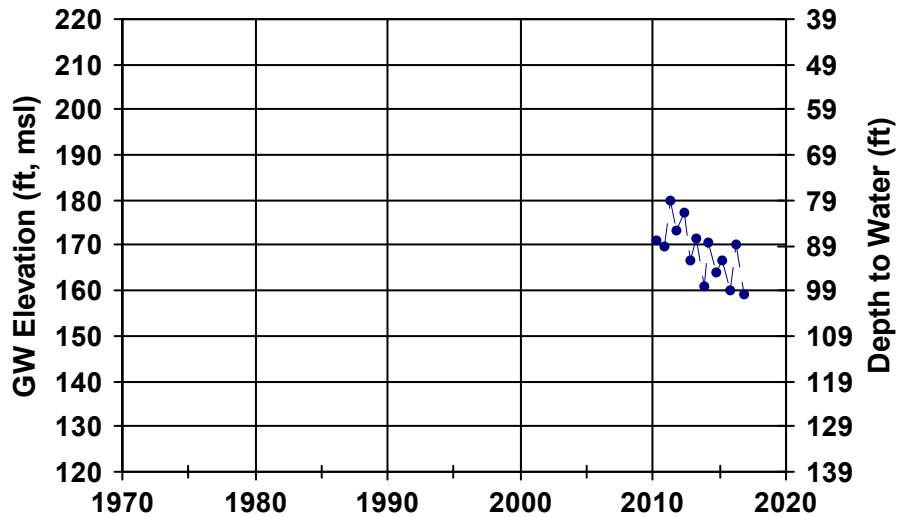
WellID: NapaCounty-137 RPE: 135.9 ft, msl SWN: 005N004W13H001
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin

WellID: NapaCounty-148 RPE: 258.6 ft, msl SWN: 005N003W05M00_
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin



WellID: NapaCounty-149 RPE: 258.9 ft, msl SWN: 005N003W08E00_
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

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



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

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

WellID: NapaCounty-192

RPE: 156.8 ft, msl

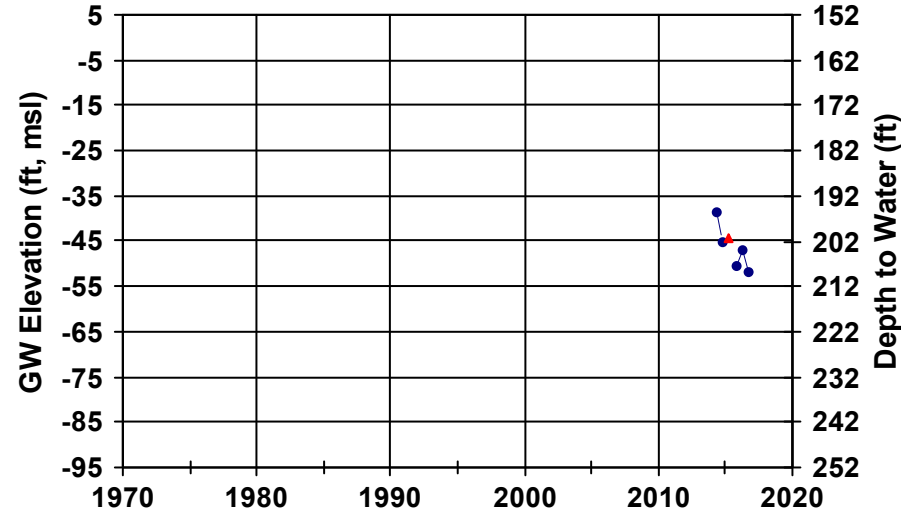
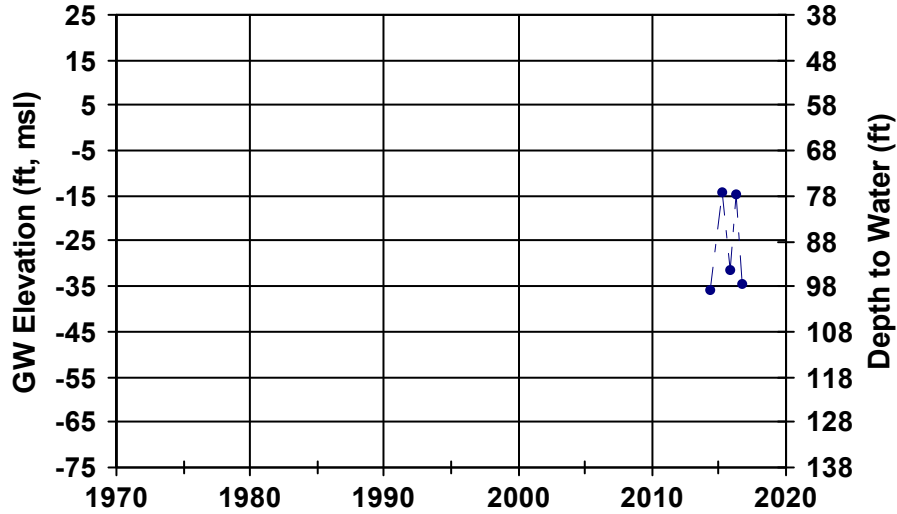
SWN: Unknown

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: NapaCounty-2

RPE: 90.5 ft, msl

SWN: 006N004W23J001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: NapaCounty-20

RPE: 134.5 ft, msl

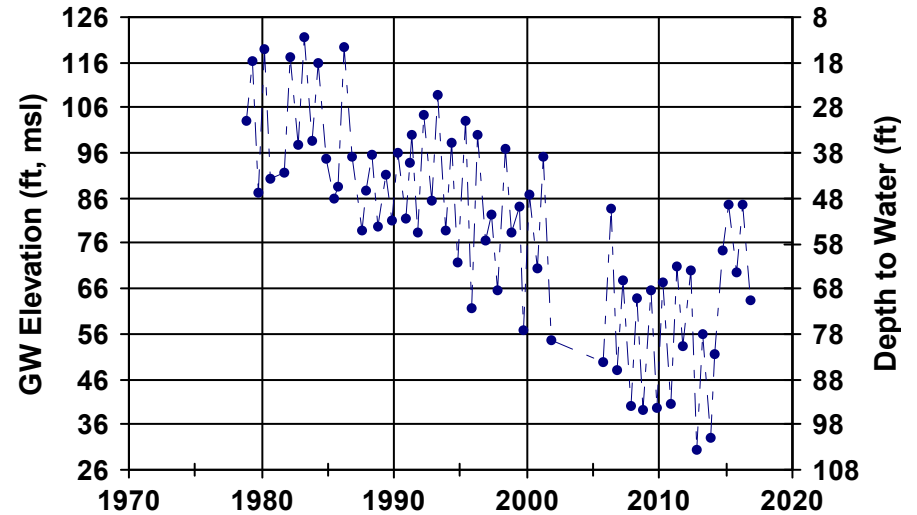
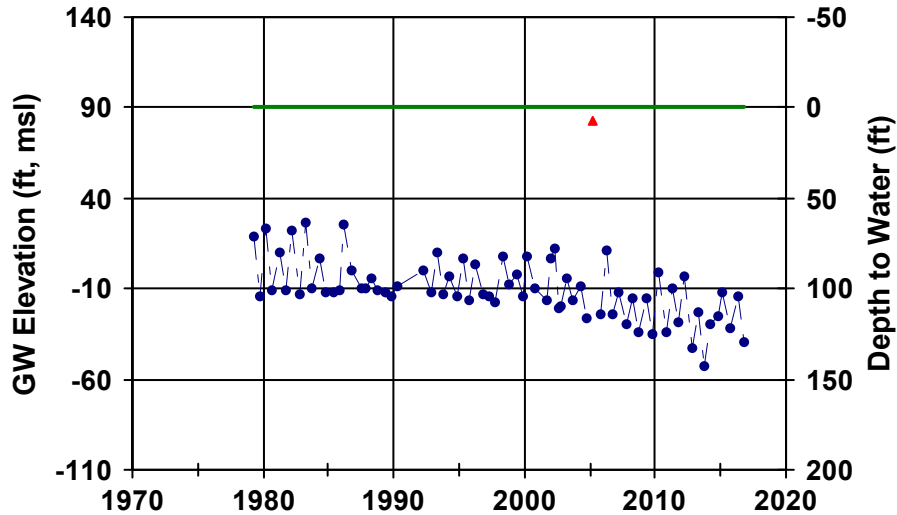
SWN: 005N003W07C003

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone: Tsud

Groundwater Basin: Not within a basin



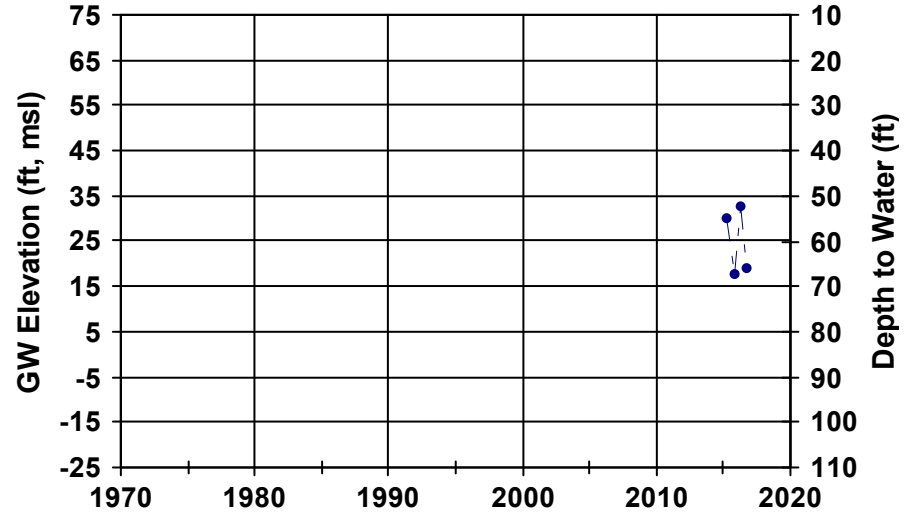
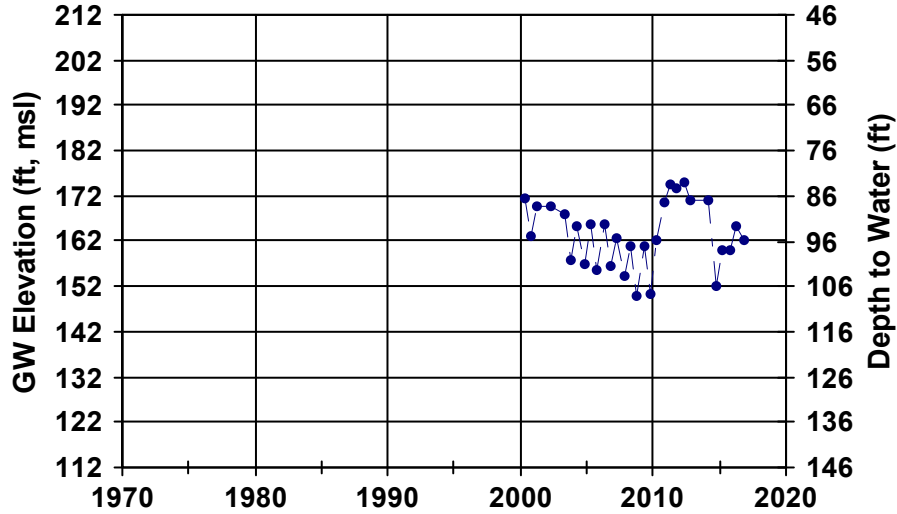
● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

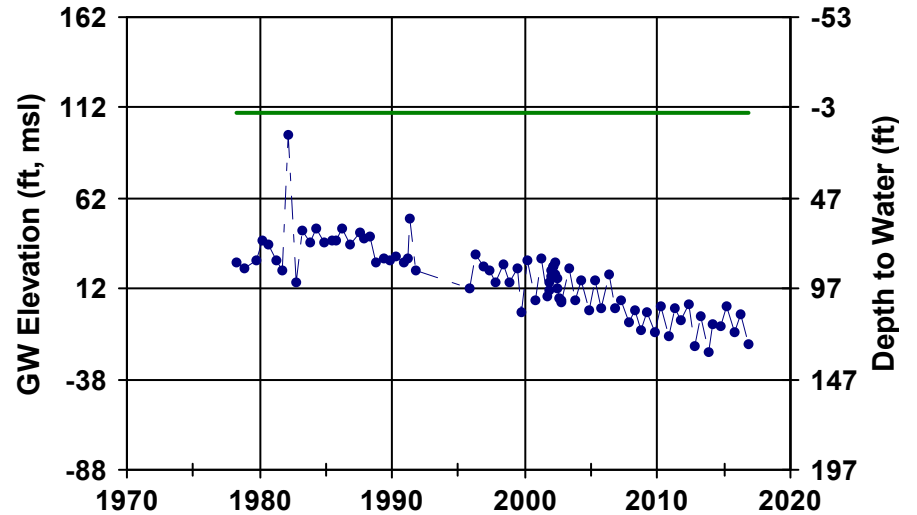
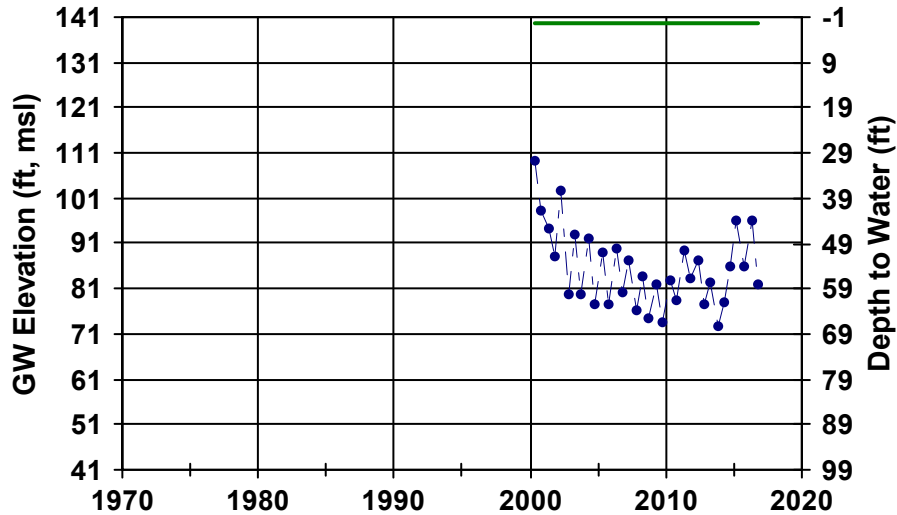
WellID: NapaCounty-22 RPE: 257.7 ft, msl SWN: 005N003W08E001
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-226 RPE: 84.9 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin



WellID: NapaCounty-35 RPE: 139.6 ft, msl SWN: 005N003W18D001
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin

WellID: NapaCounty-43 RPE: 109 ft, msl SWN: 006N004W23Q003
 Subarea: Napa Valley Floor-MST Source: NapaCounty Aquifer Zone:
 Groundwater Basin: Not within a basin



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

WellID: NapaCounty-56

RPE: 58.6 ft, msl

SWN: 006N004W26G001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone: Tss/h

Groundwater Basin: Not within a basin

WellID: NapaCounty-69

RPE: 42.1 ft, msl

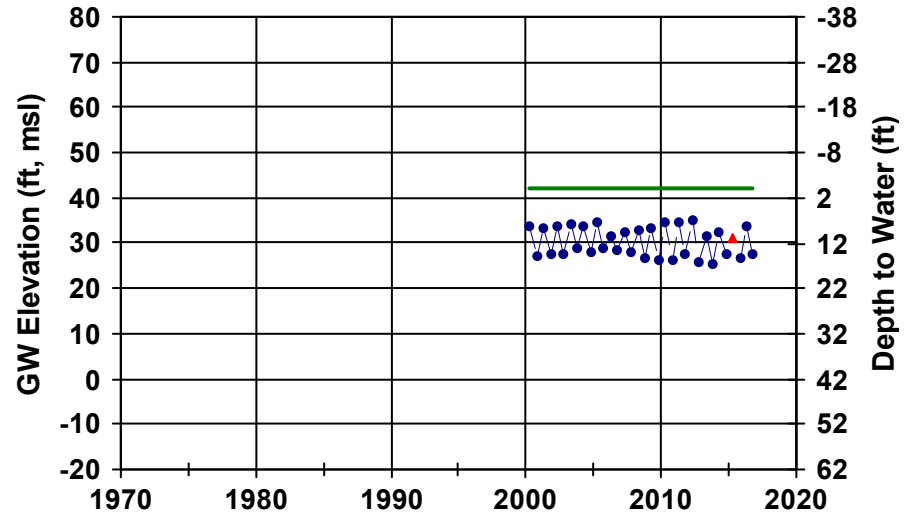
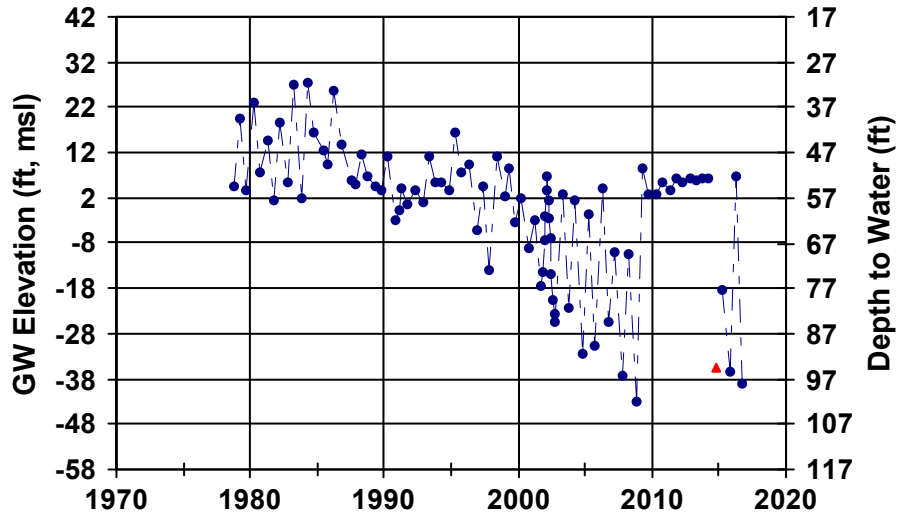
SWN: 006N004W35G005

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



WellID: NapaCounty-72

RPE: 137.1 ft, msl

SWN: 005N003W07D003

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: NapaCounty-74

RPE: 133.3 ft, msl

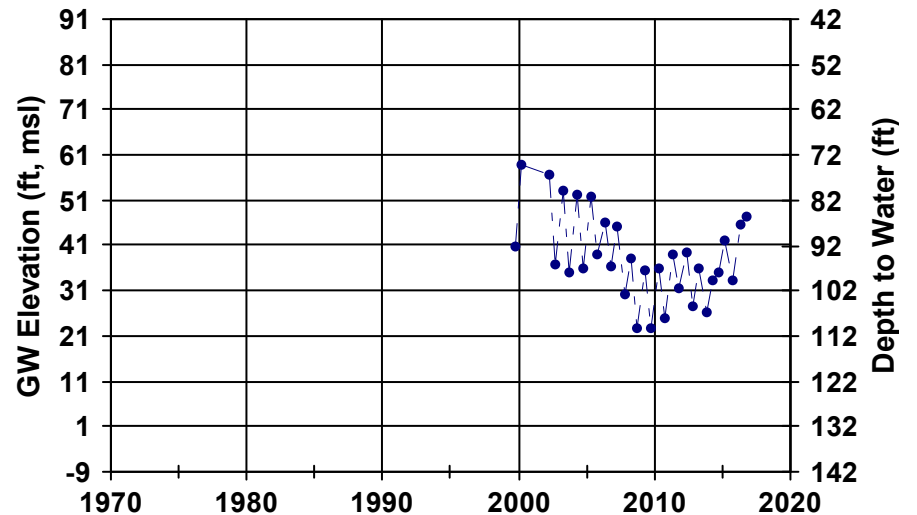
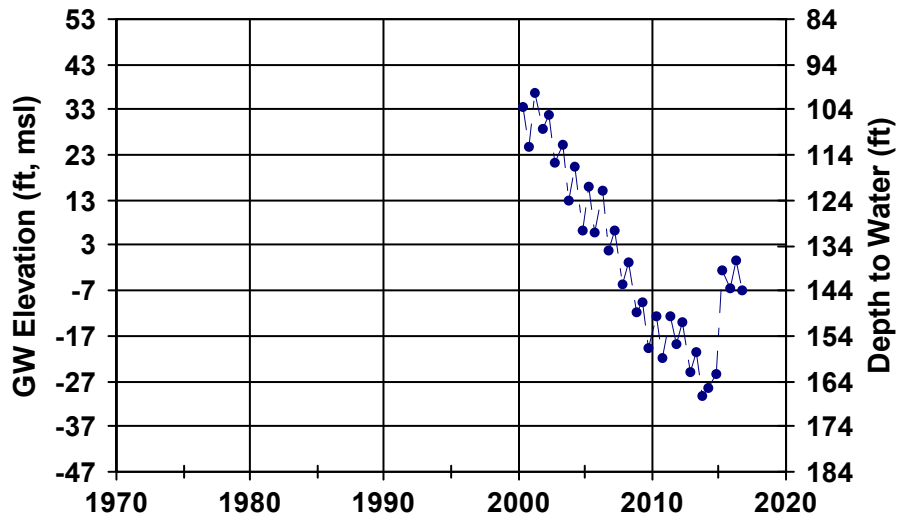
SWN: 005N003W06M001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-81

RPE: 118.6 ft, msl

SWN: 005N003W07F003

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: NapaCounty-91

RPE: 281.9 ft, msl

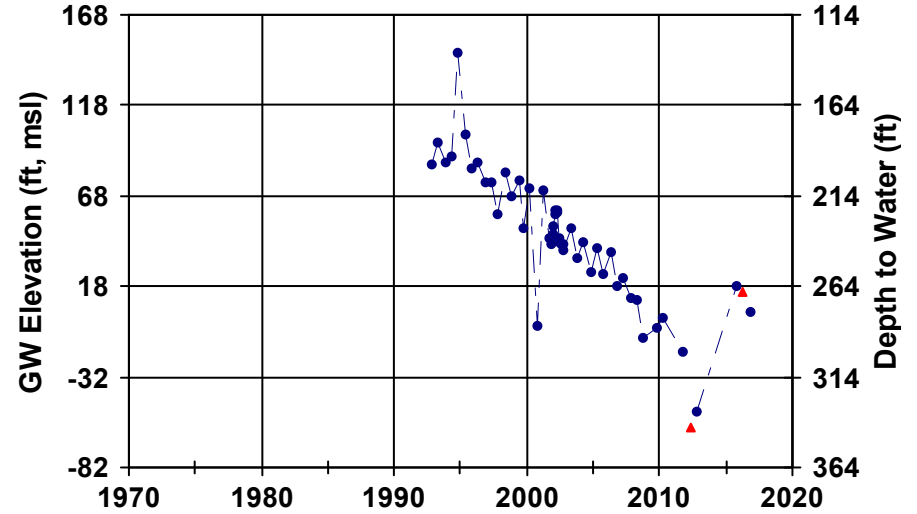
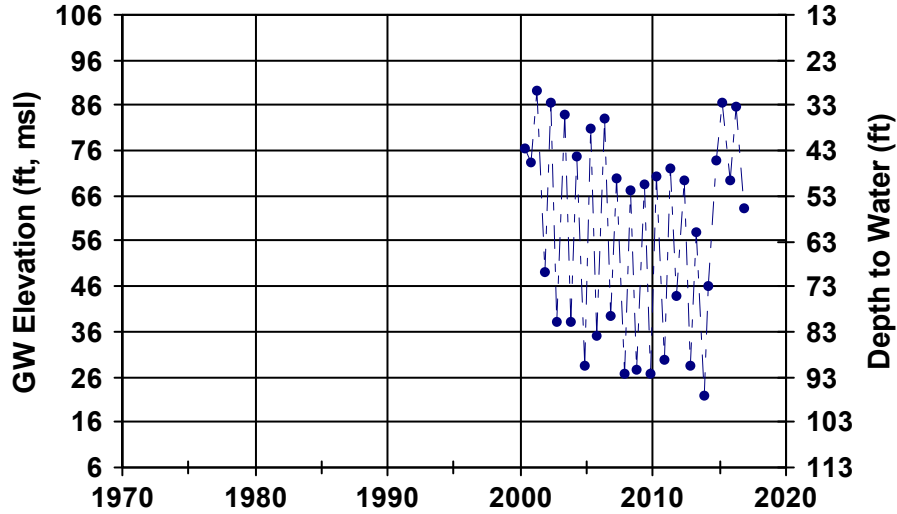
SWN: 005N003W06B002

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone: Tsvt

Groundwater Basin: Not within a basin



WellID: NapaCounty-92

RPE: 358.2 ft, msl

SWN: 005N003W06A001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: NapaCounty-95

RPE: 116.9 ft, msl

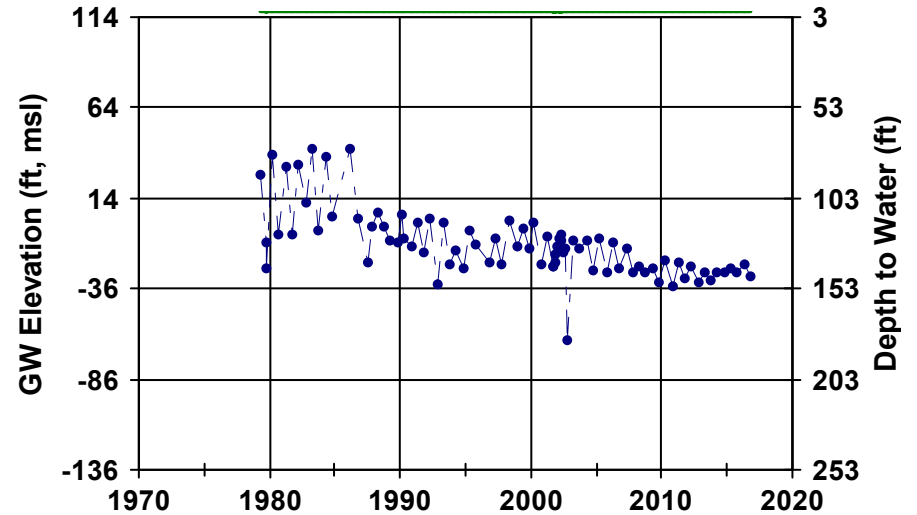
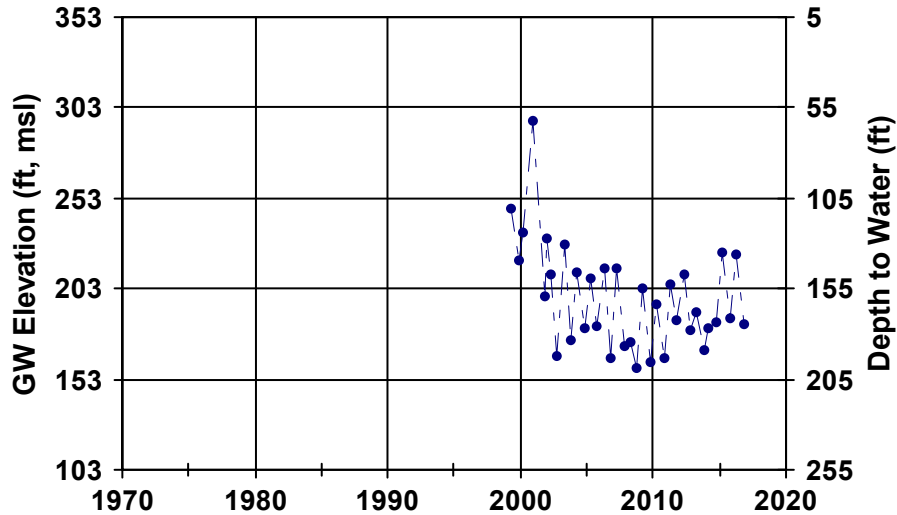
SWN: 006N004W36G001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone: Tsvt

Groundwater Basin: Not within a basin



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

WellID: NapaCounty-98

RPE: 125.7 ft, msl

SWN: 006N004W36A001

Subarea: Napa Valley Floor-MST

Source: NapaCounty

Aquifer Zone:

Groundwater Basin: Not within a basin

WellID: T10000008932MW-1

RPE: 22.22 ft, msl

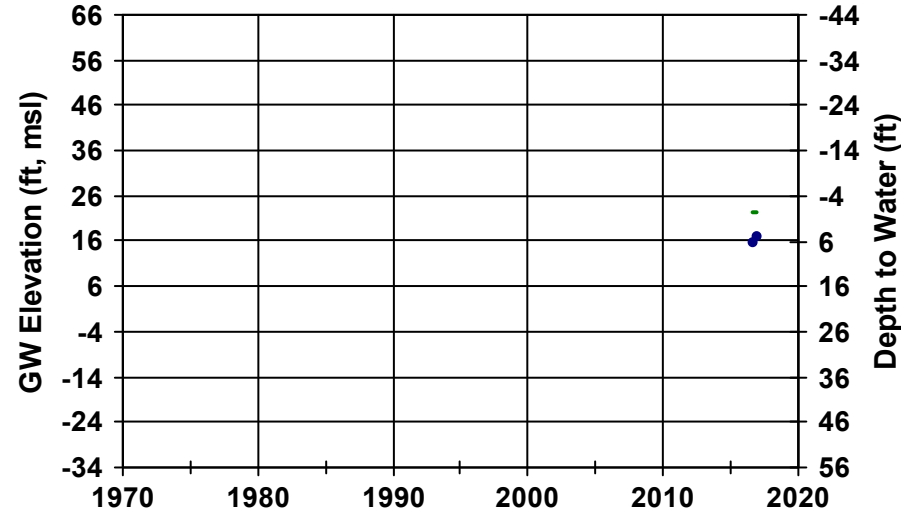
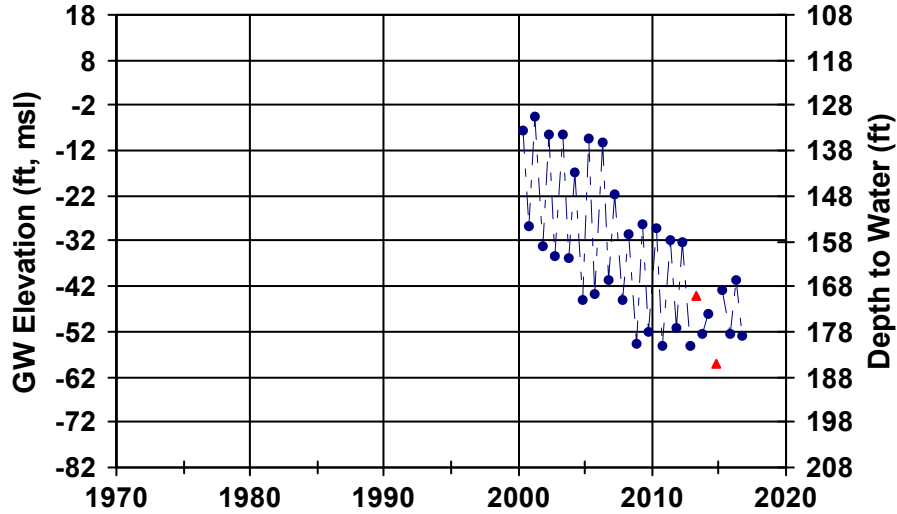
SWN: Unknown

Subarea: Napa Valley Floor-MST

Source: Geotracker

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T10000008932MW-2

RPE: 22.3 ft, msl

SWN: Unknown

Subarea: Napa Valley Floor-MST

Source: Geotracker

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T10000008932MW-3

RPE: 21.76 ft, msl

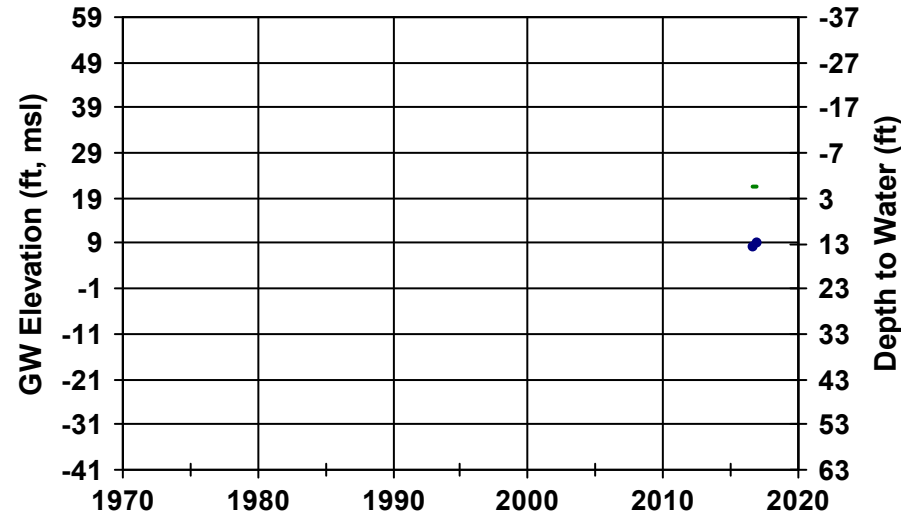
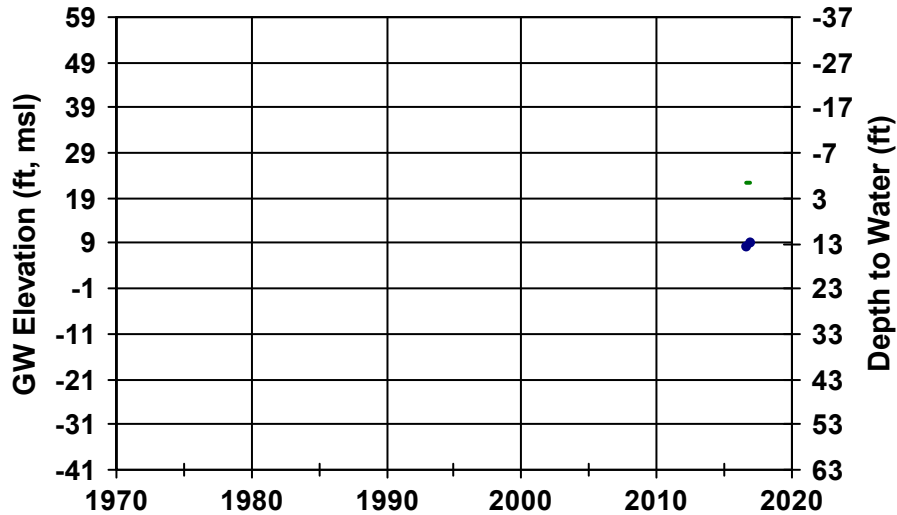
SWN: Unknown

Subarea: Napa Valley Floor-MST

Source: Geotracker

Aquifer Zone:

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



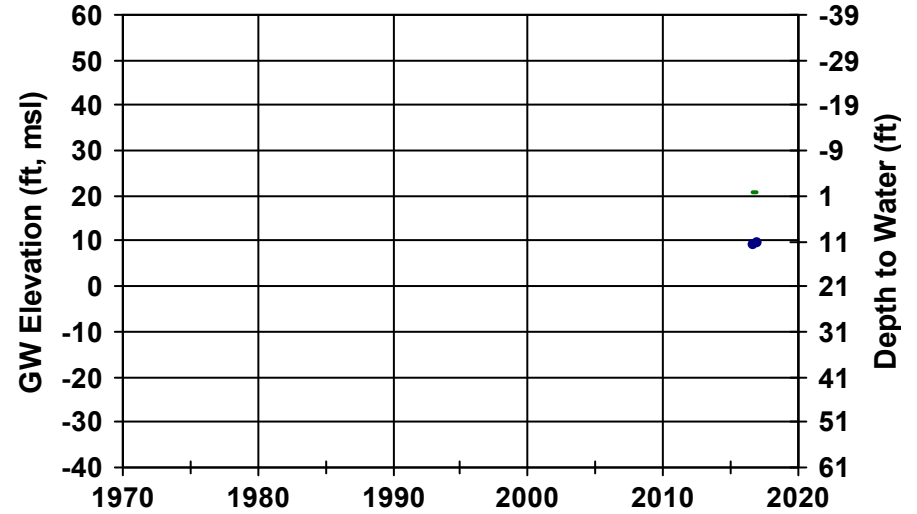
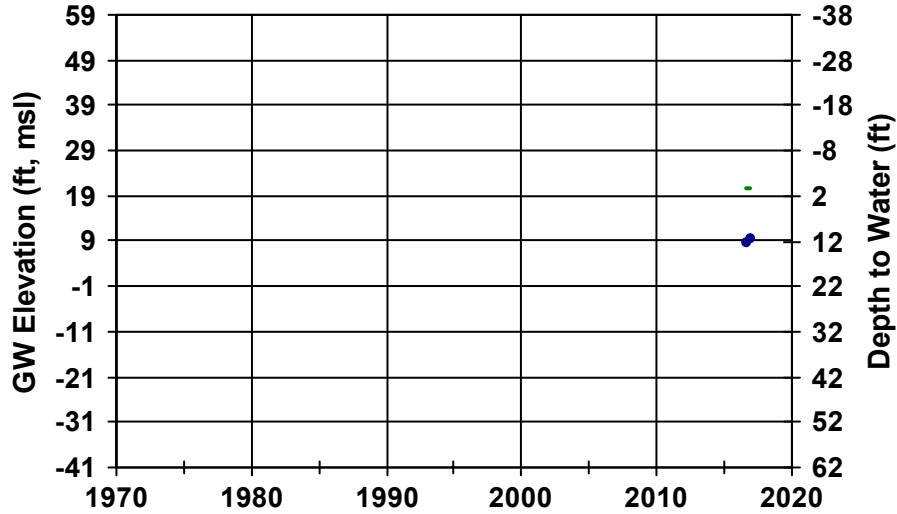
● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

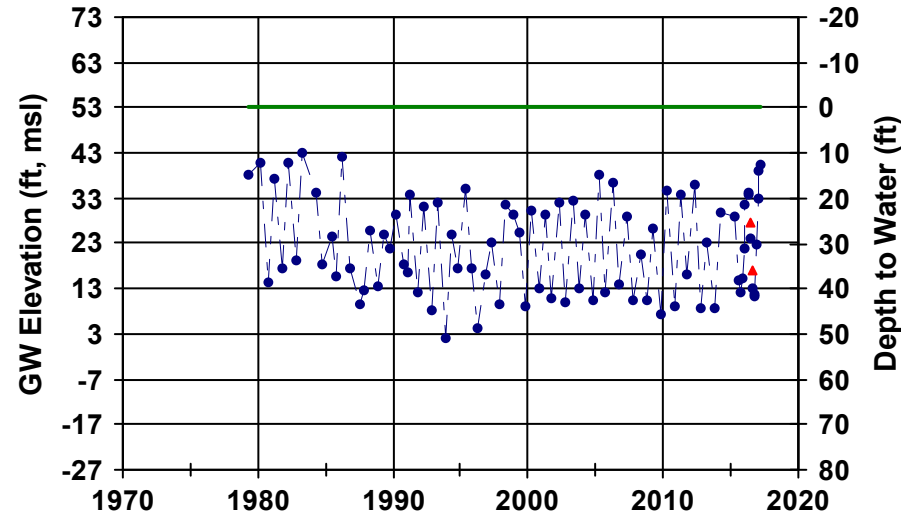
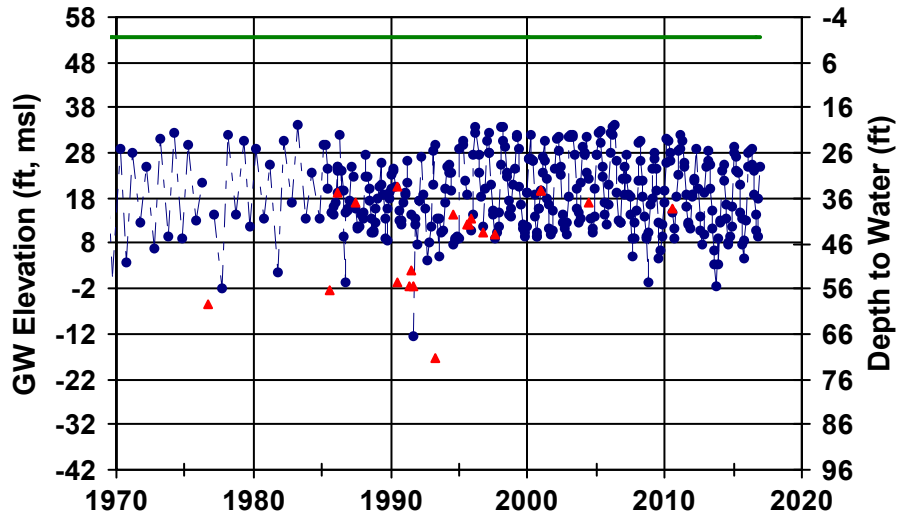
WellID: T1000008932MW-4 RPE: 20.56 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-MST Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T1000008932MW-5 RPE: 20.63 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-MST Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: 06N04W27L002M RPE: 53.6 ft, msl SWN: 006N004W27L002
 Subarea: Napa Valley Floor-Napa Source: DWR Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

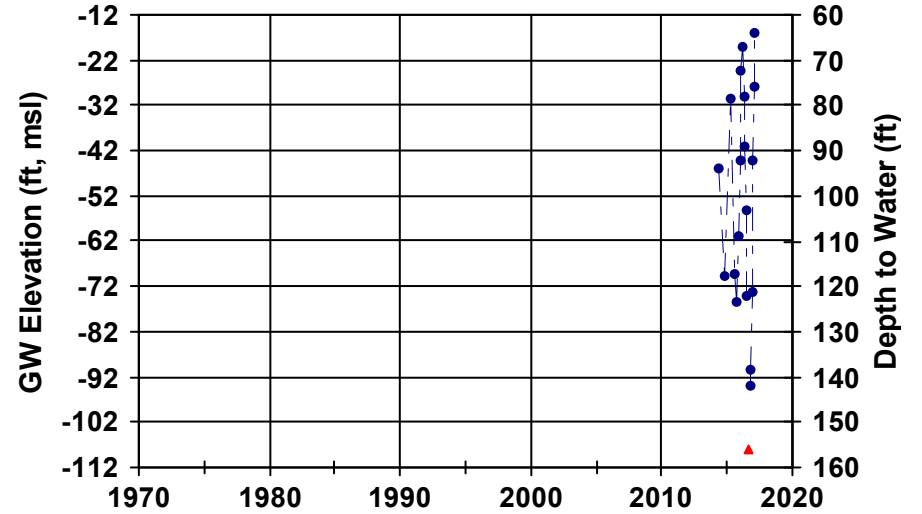
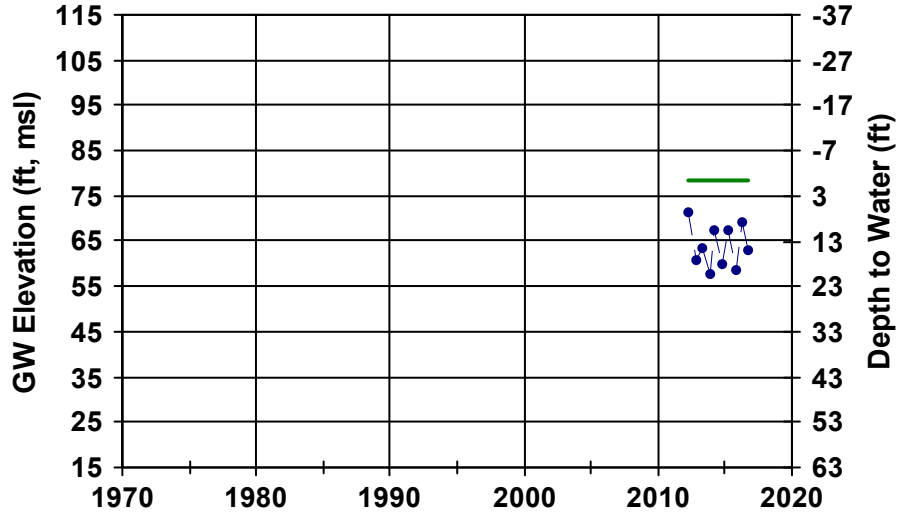
WellID: NapaCounty-136 RPE: 53.2 ft, msl SWN: 006N004W27N001
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

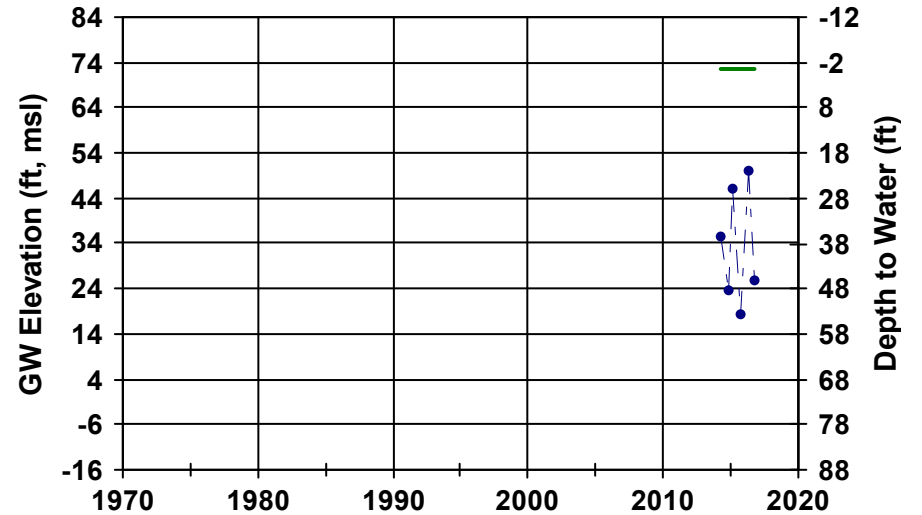
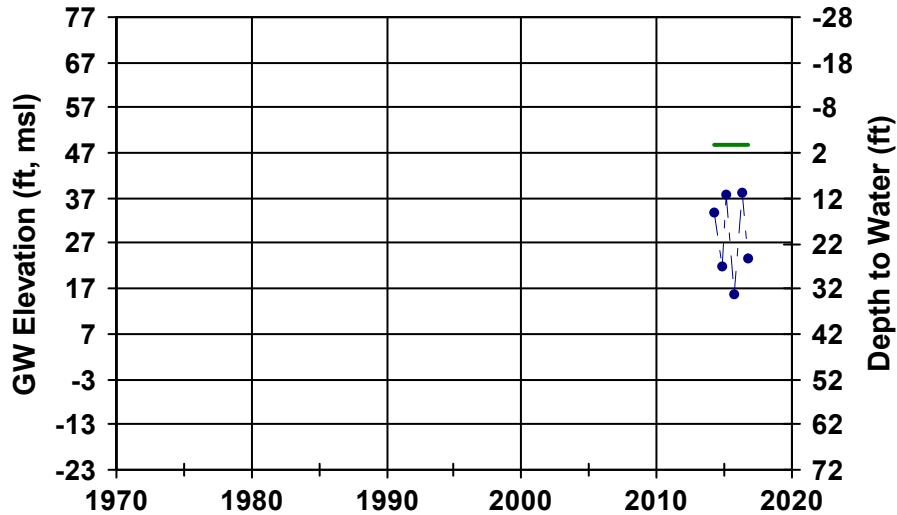
WellID: NapaCounty-152 RPE: 78.3 ft, msl SWN: 006N004W28Mx
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-182 RPE: 48.1 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



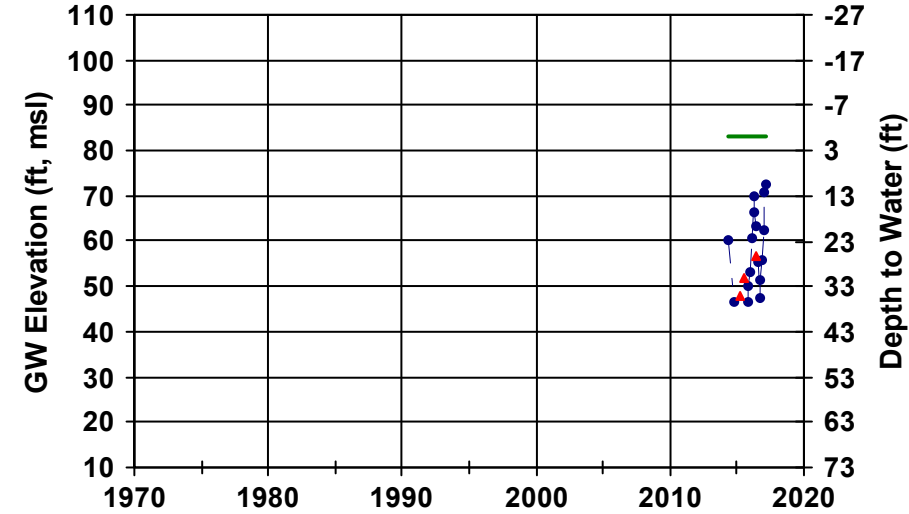
WellID: NapaCounty-183 RPE: 48.9 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa, Tsv?
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

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-SONOMA VALLEY, NAPA VALLEY

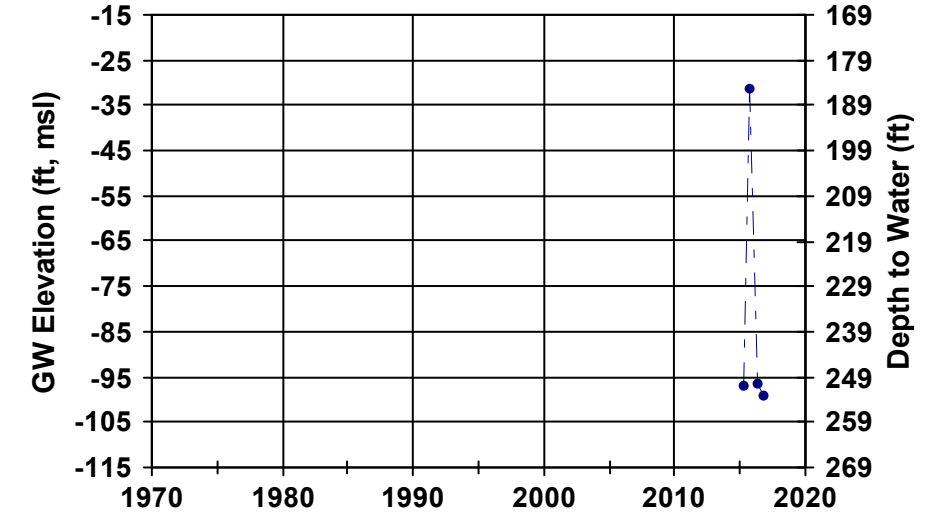


● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

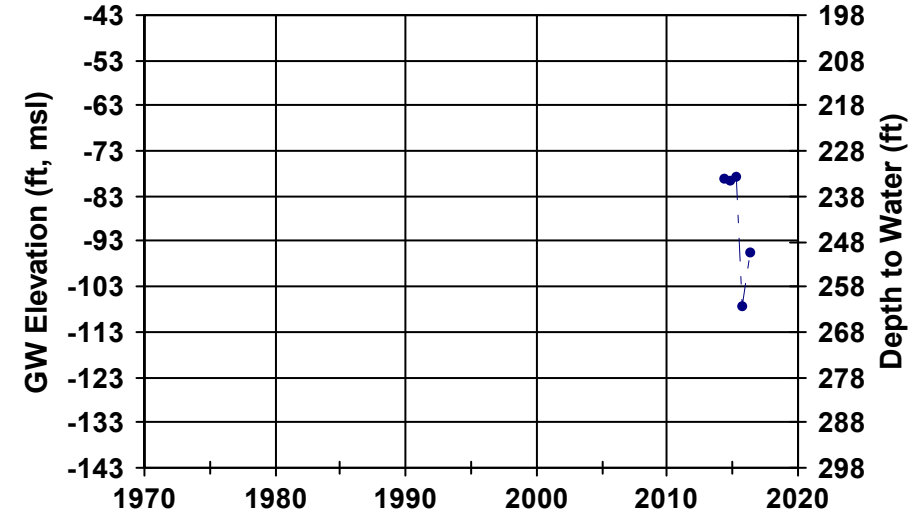
WellID: NapaCounty-185 RPE: 83 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



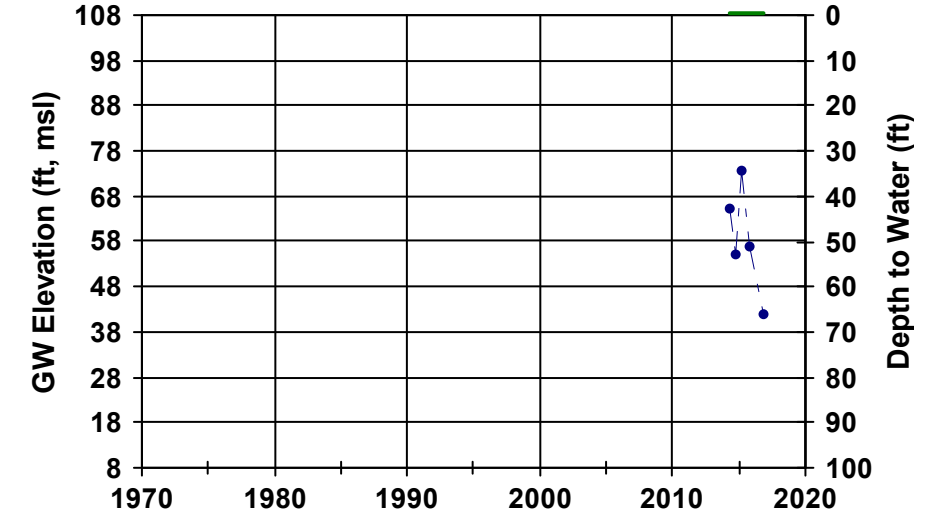
WellID: NapaCounty-187 RPE: 153.5 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Tsv?, KJgv?
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-188 RPE: 154.6 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



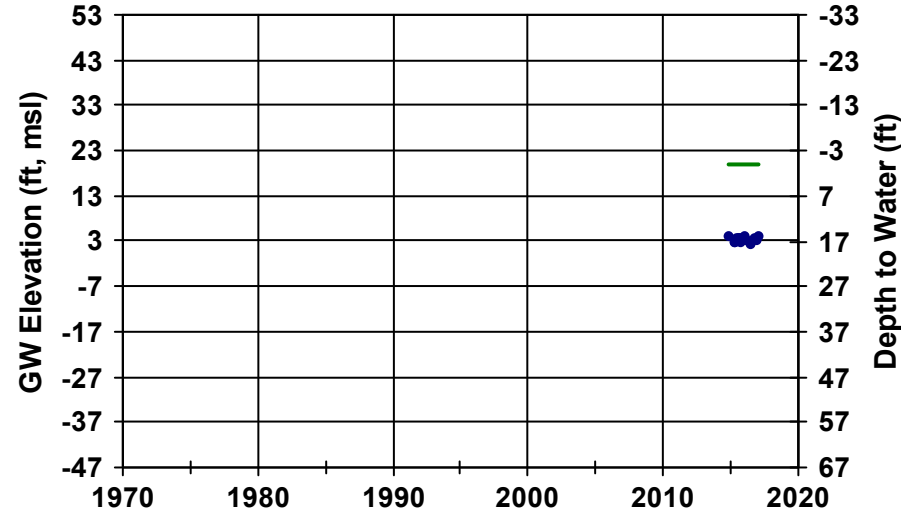
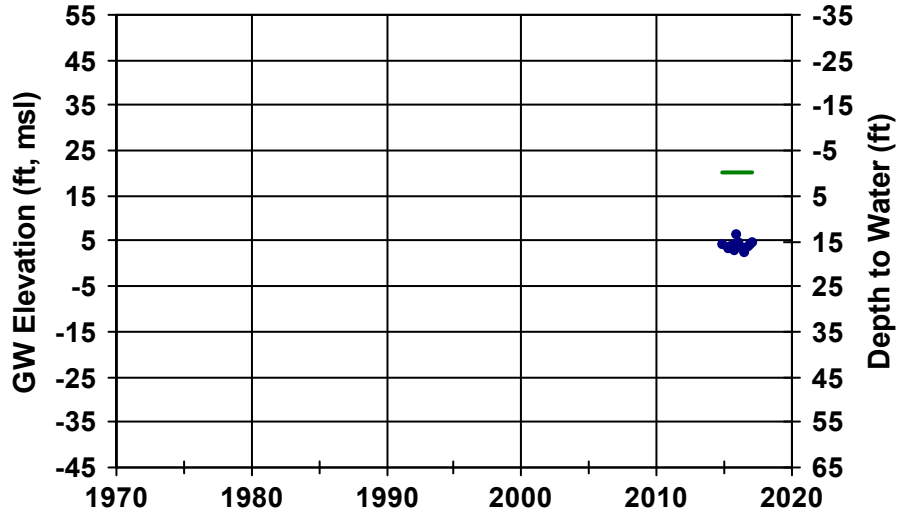
WellID: NapaCounty-189 RPE: 108.25 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

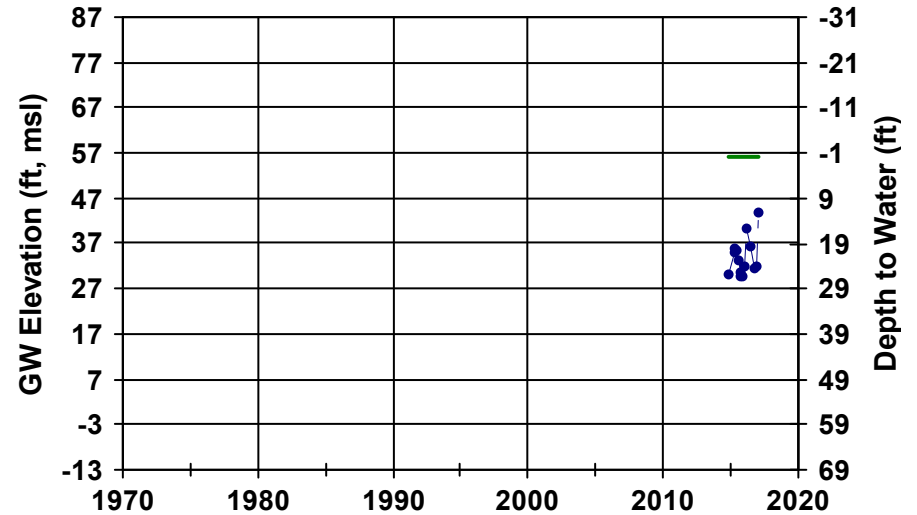
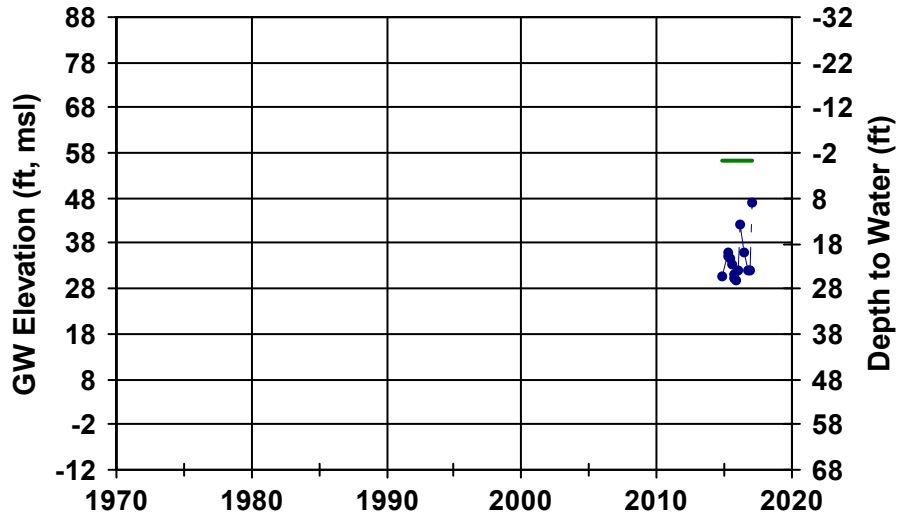
WellID: **NapaCounty-214s-swgw1** RPE: 20.12 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **NapaCounty-215d-swgw1** RPE: 20.07 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



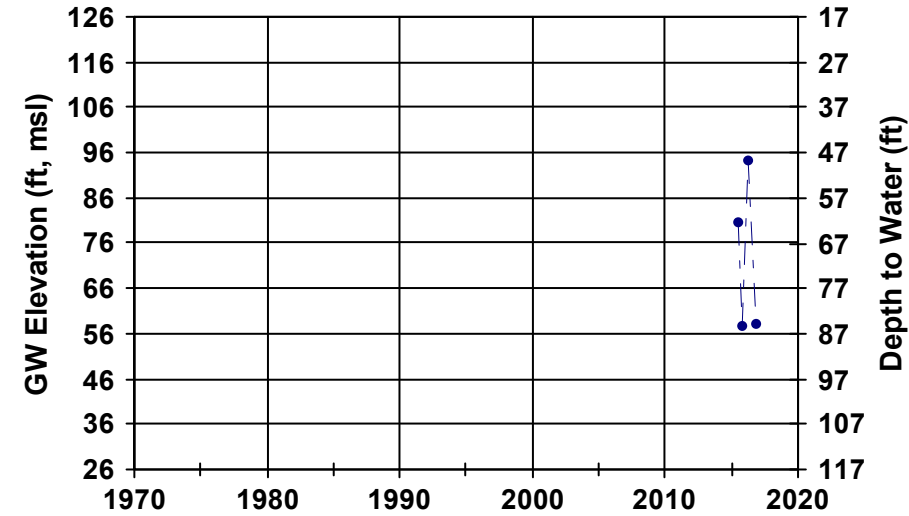
WellID: **NapaCounty-218s-swgw3** RPE: 56.12 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **NapaCounty-219d-swgw3** RPE: 56.14 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

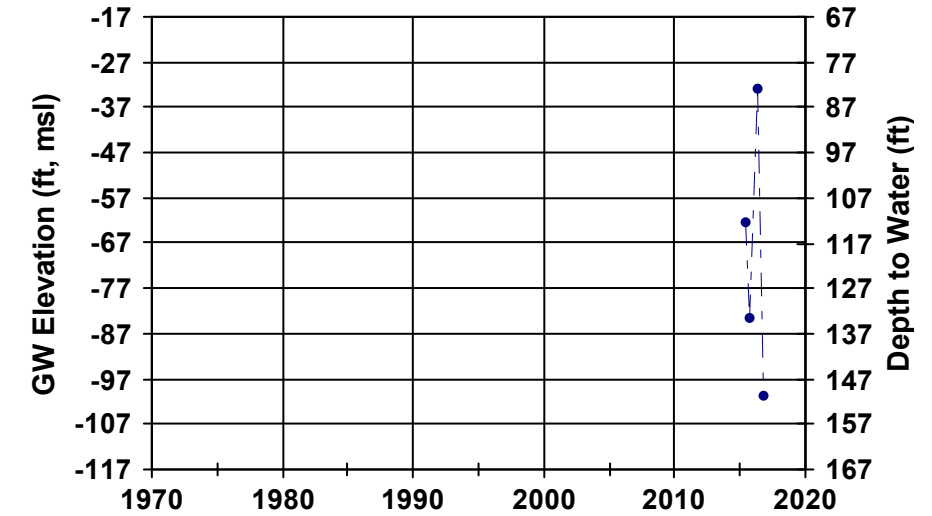


● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

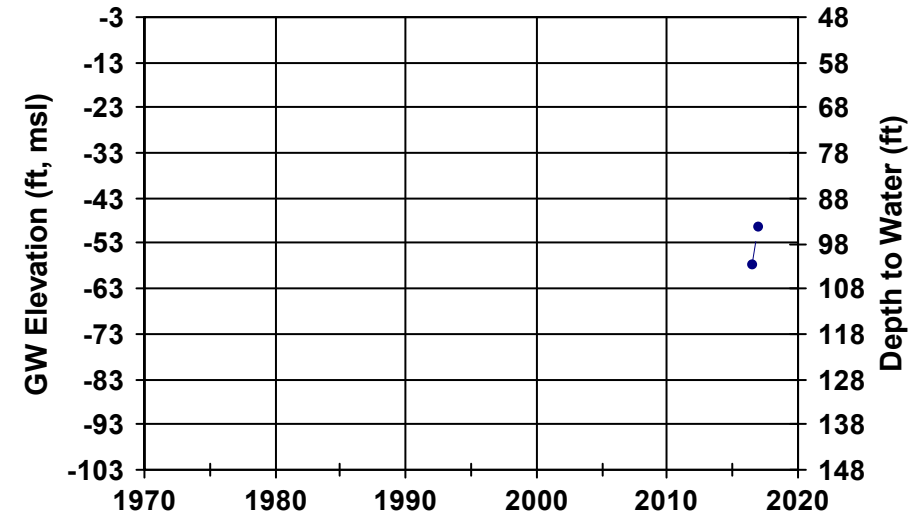
WellID: NapaCounty-227 RPE: 143.3 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



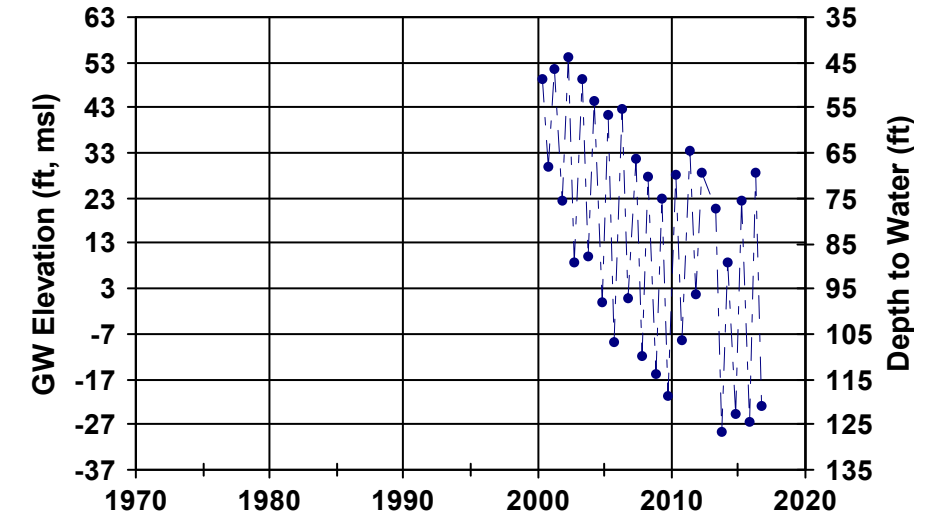
WellID: NapaCounty-228 RPE: 50.2 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-229 RPE: 45.07 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



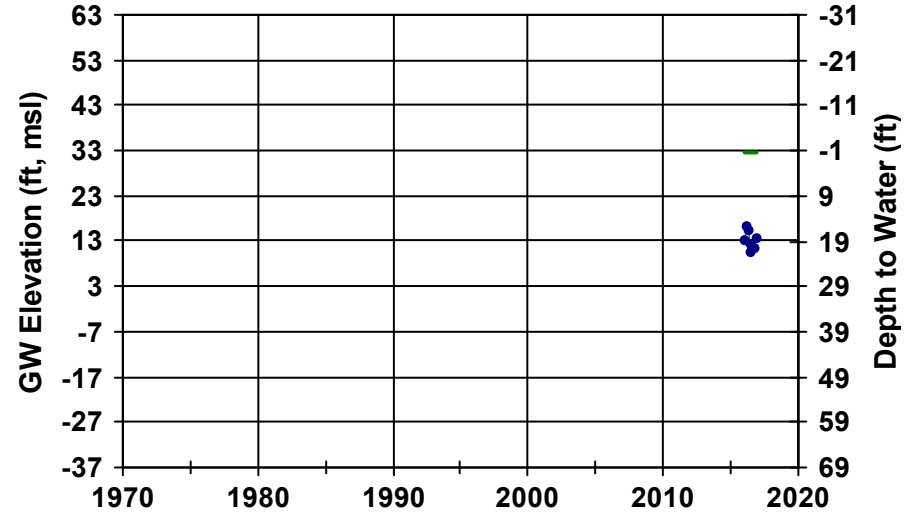
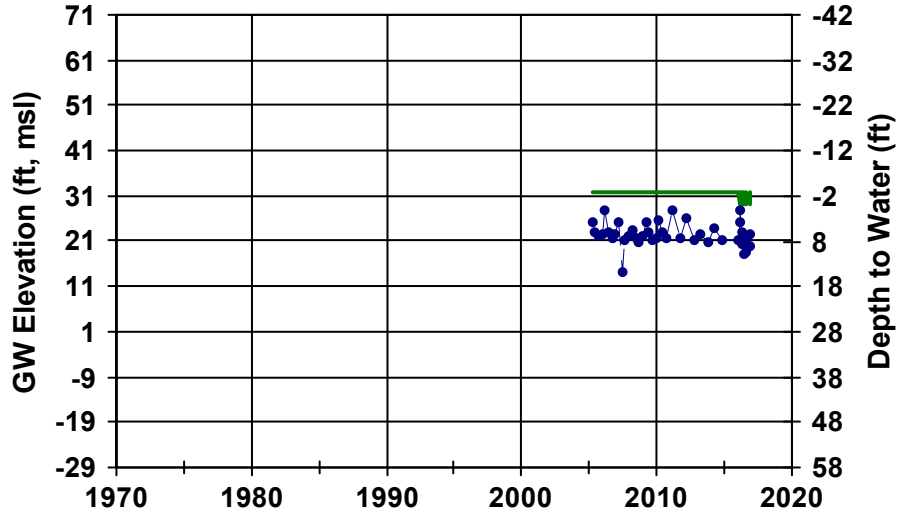
WellID: NapaCounty-76 RPE: 97.7 ft, msl SWN: 006N004W15R003
 Subarea: Napa Valley Floor-Napa Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

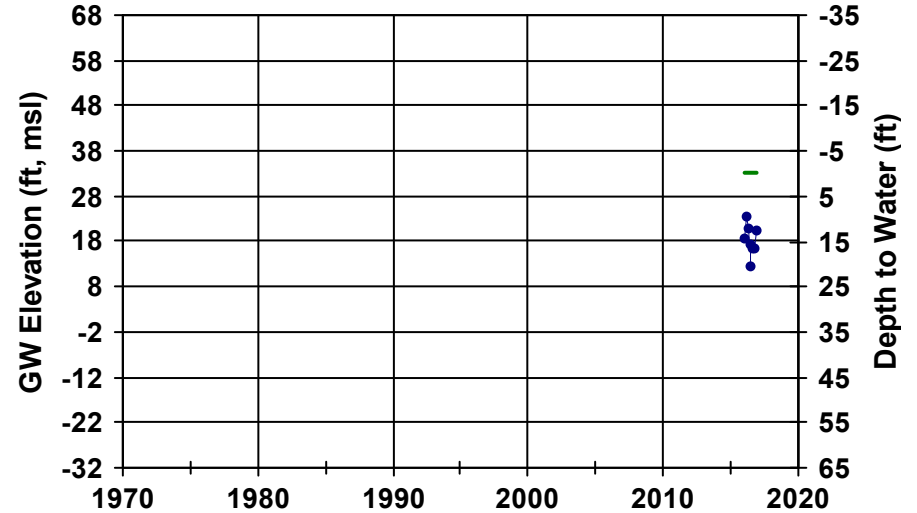
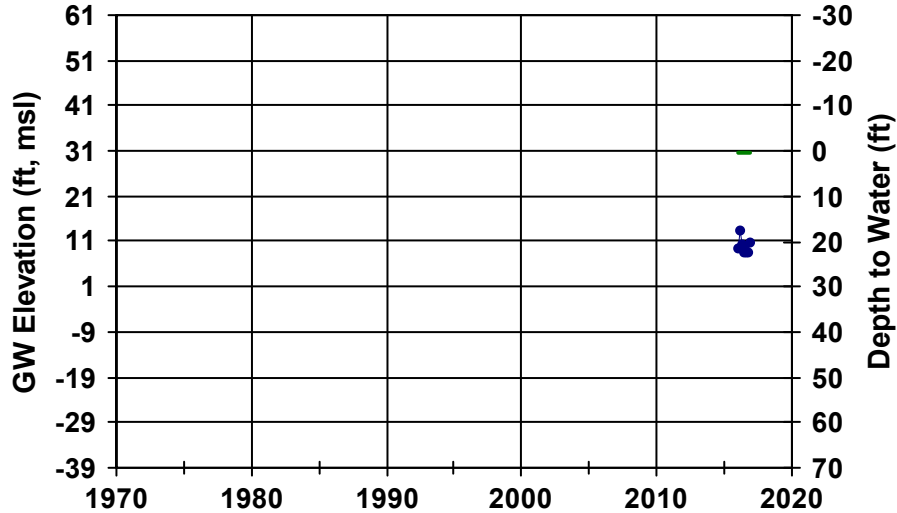
WellID: **SL0605536682MW-1** RPE: 31.63 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **SL0605536682MW-10** RPE: 32.43 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **SL0605536682MW-11** RPE: 30.71 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

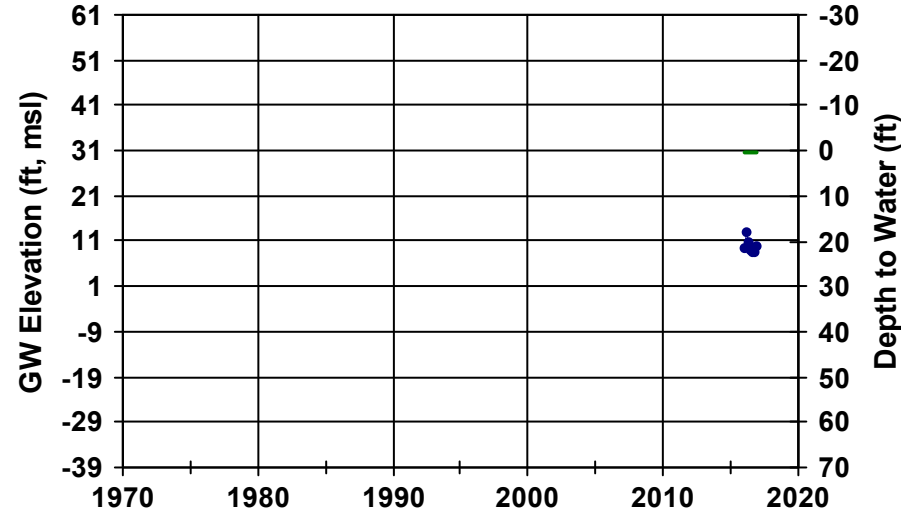
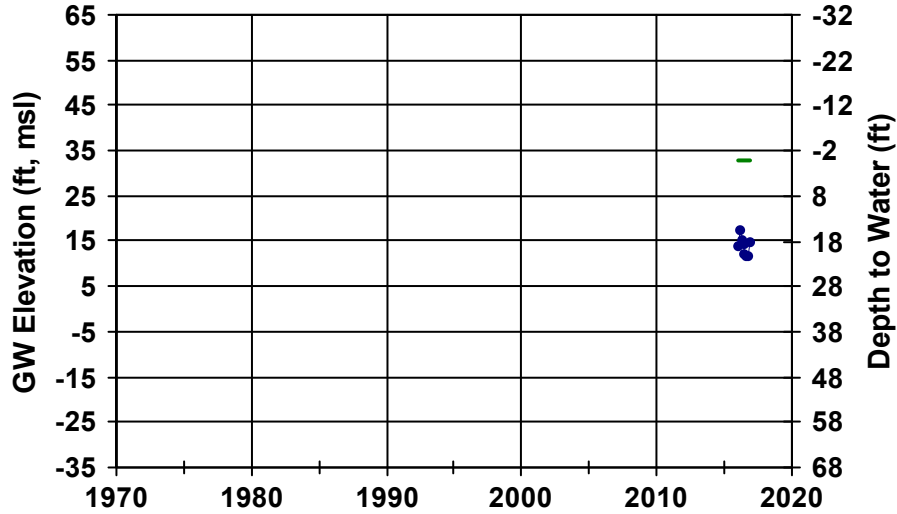
WellID: **SL0605536682MW-12** RPE: 33.26 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

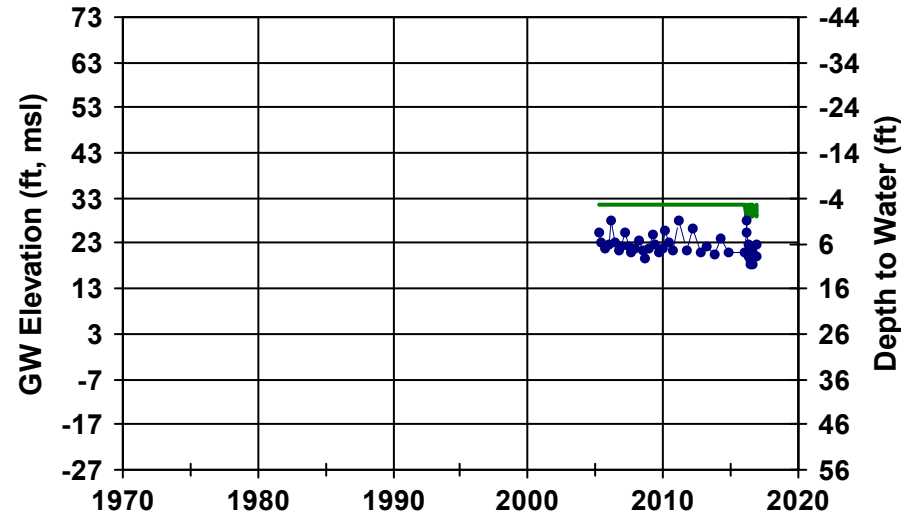
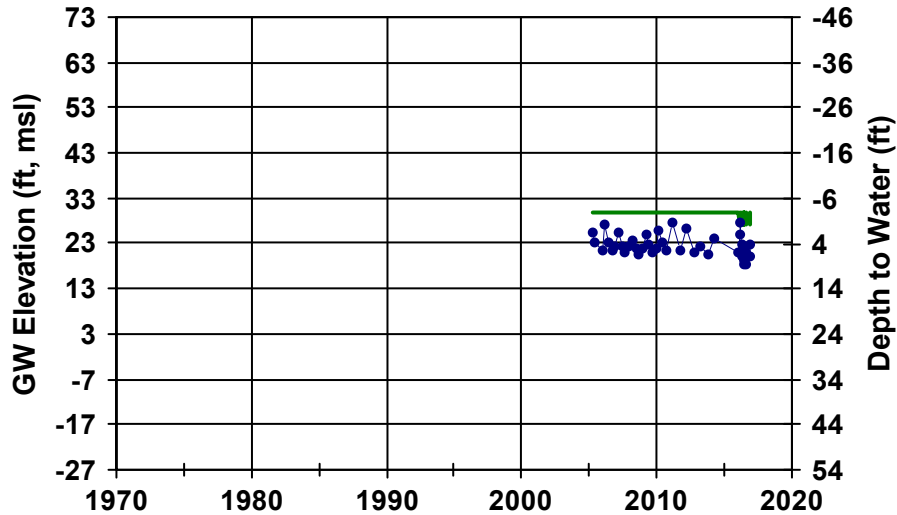
WellID: **SL0605536682MW-13** RPE: 32.95 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **SL0605536682MW-14** RPE: 30.59 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **SL0605536682MW-2** RPE: 27.24 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

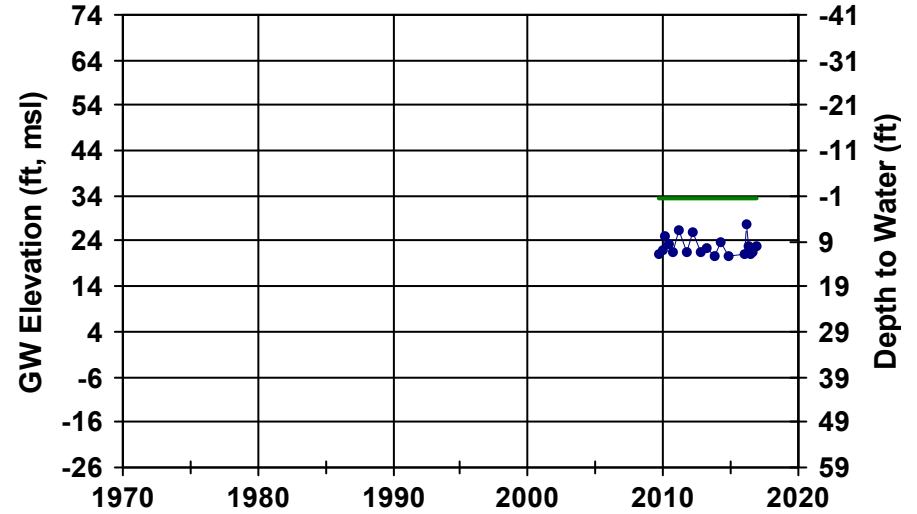
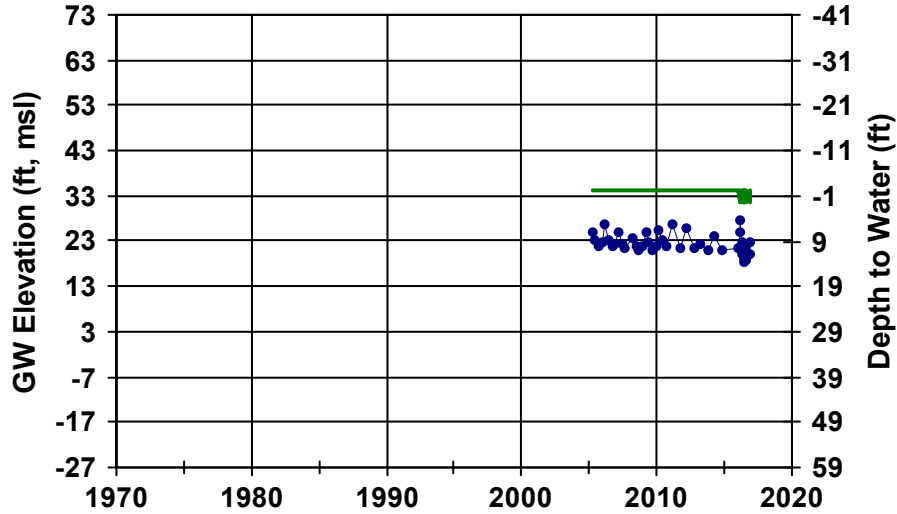
WellID: **SL0605536682MW-3** RPE: 28.86 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

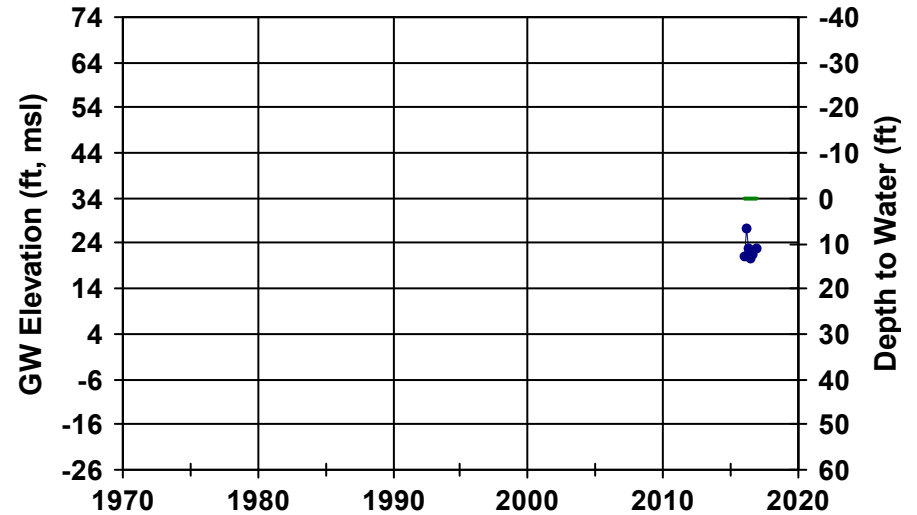
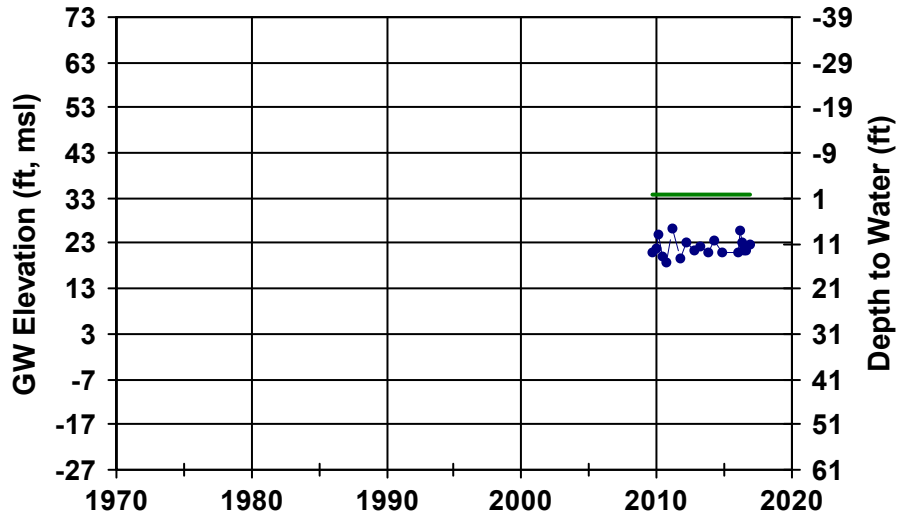
WellID: **SL0605536682MW-4** RPE: 31.59 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **SL0605536682MW-5** RPE: 33.35 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **SL0605536682MW-6** RPE: 33.75 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

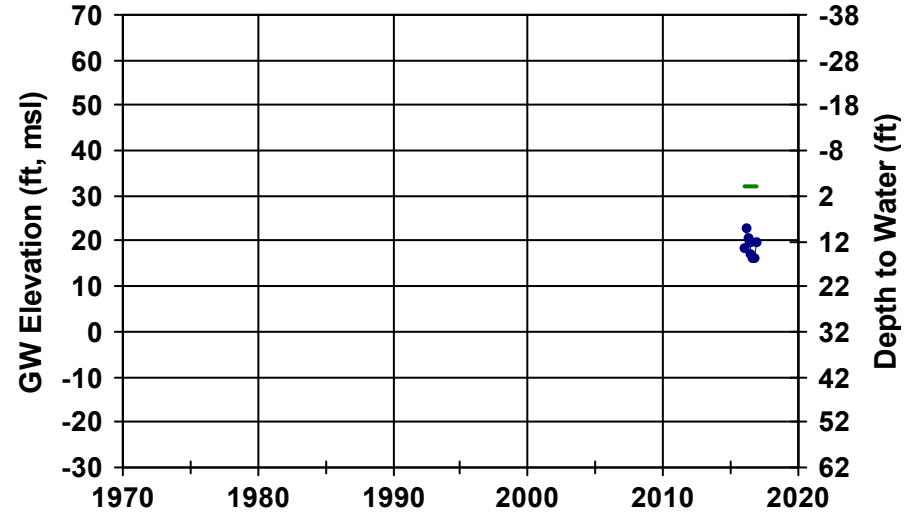
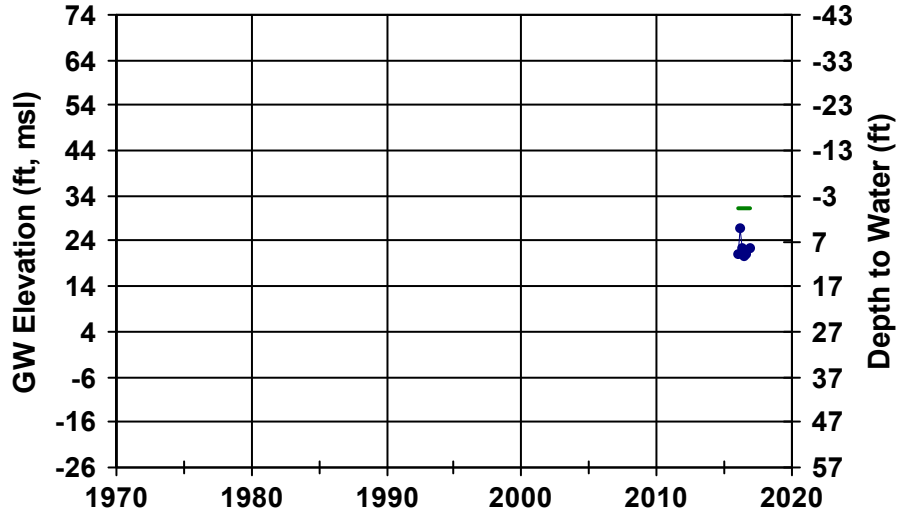
WellID: **SL0605536682MW-7** RPE: 33.89 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

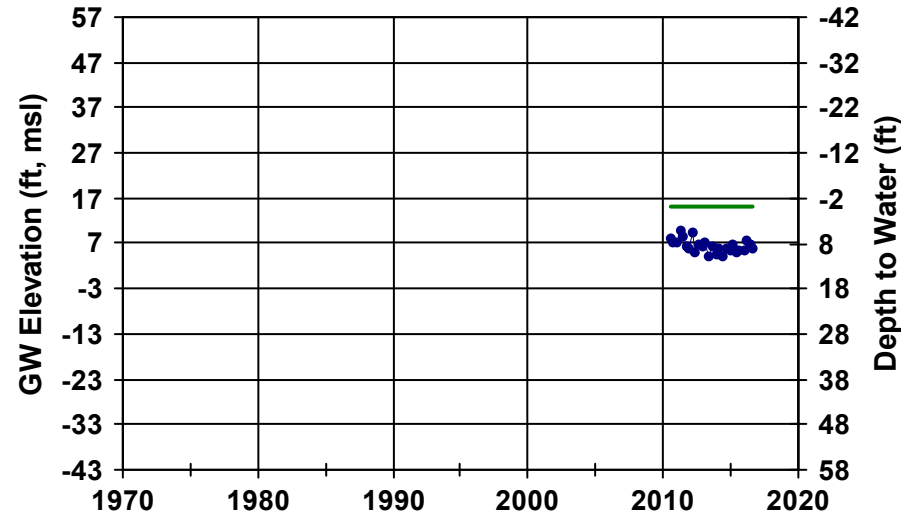
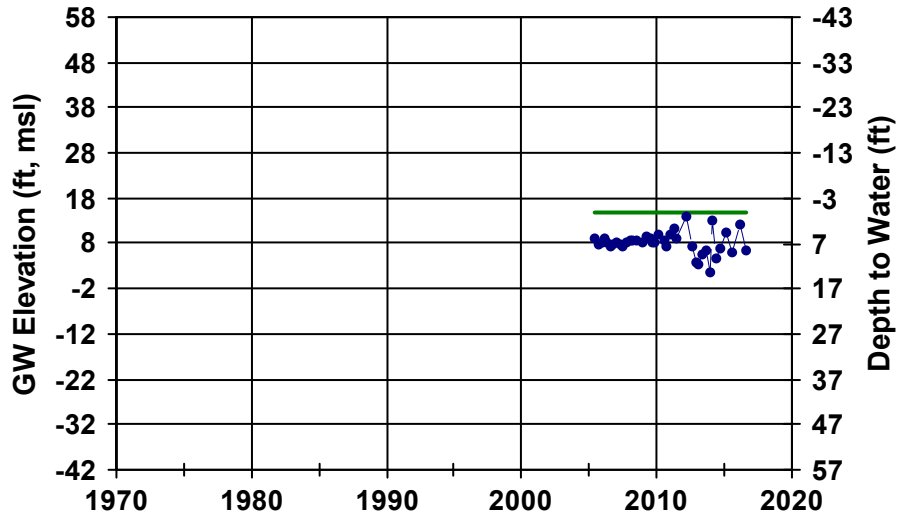
WellID: **SL0605536682MW-8** RPE: 31.12 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **SL0605536682MW-9** RPE: 32.24 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **T0605514064MW1** RPE: 14.72 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

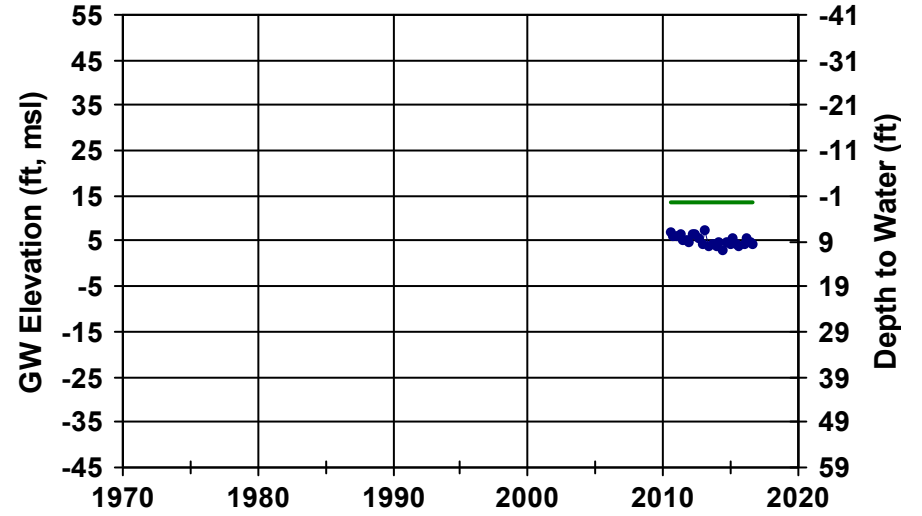
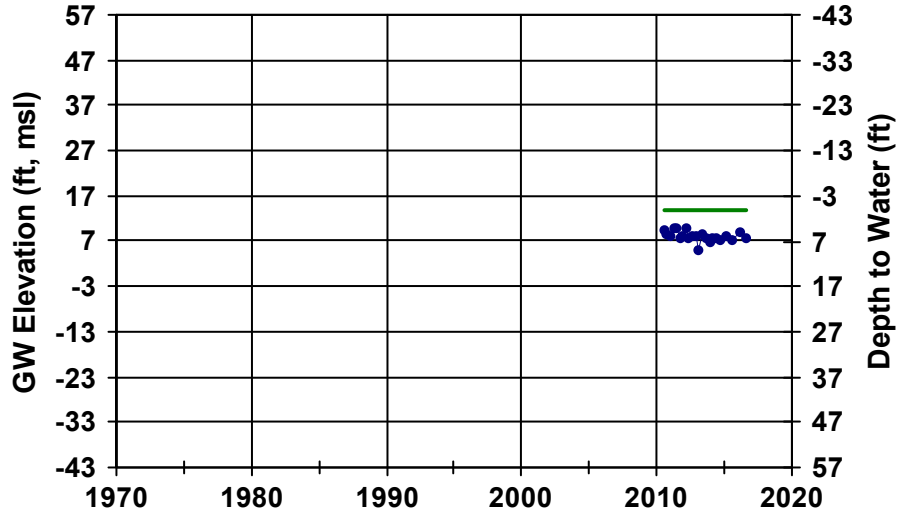
WellID: **T0605514064MW10** RPE: 15.18 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

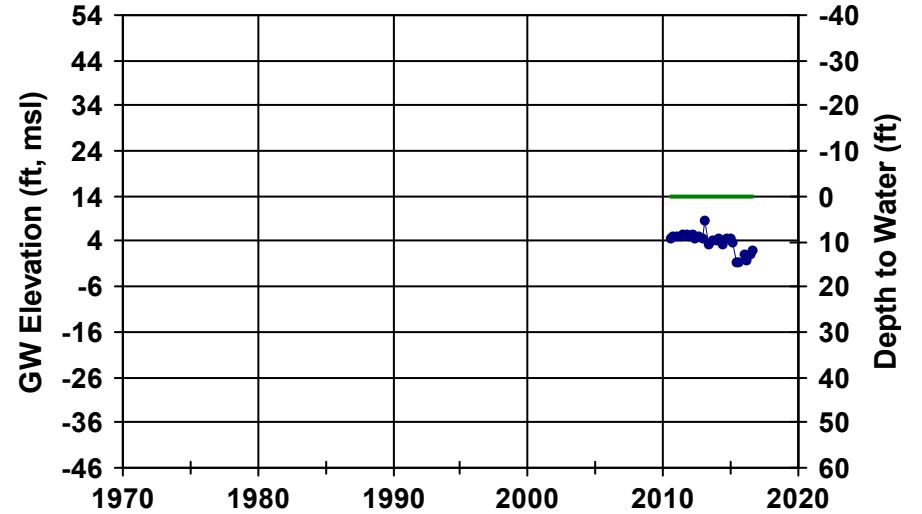
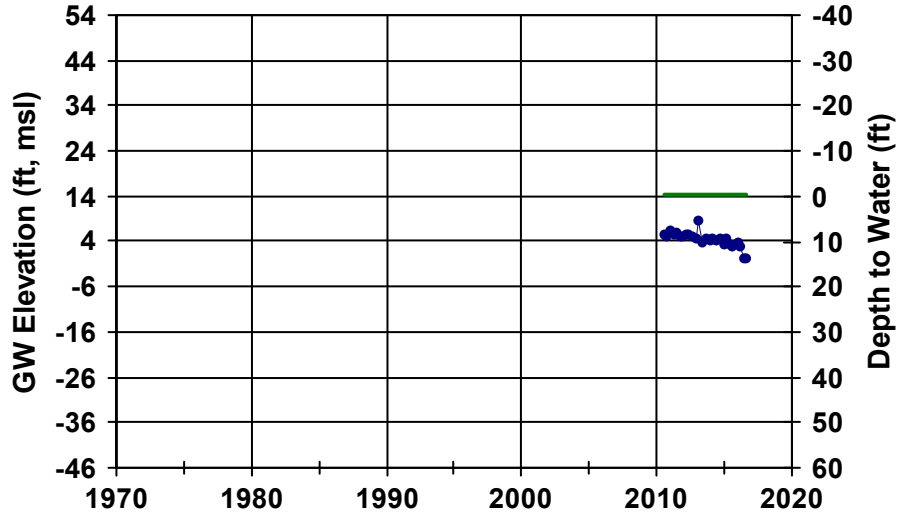
WellID: T0605514064MW11 RPE: 13.82 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064MW12 RPE: 13.71 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064MW13 RPE: 14.46 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

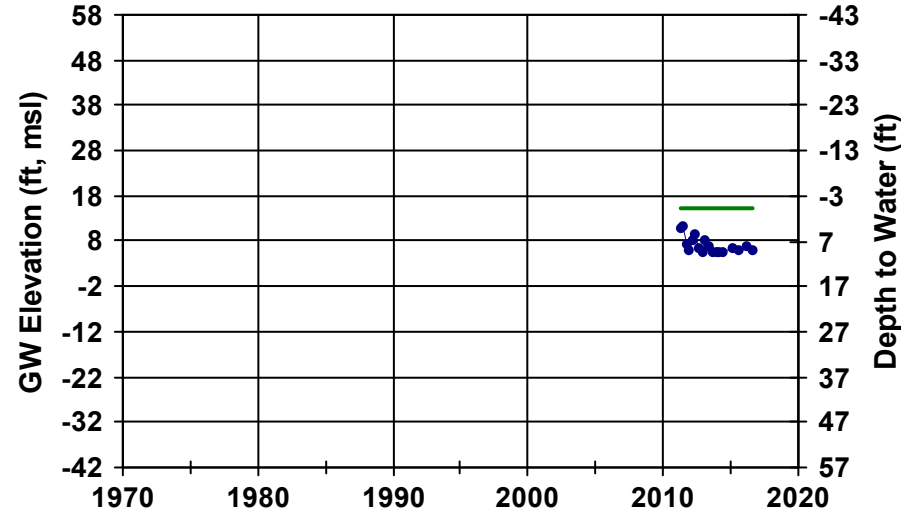
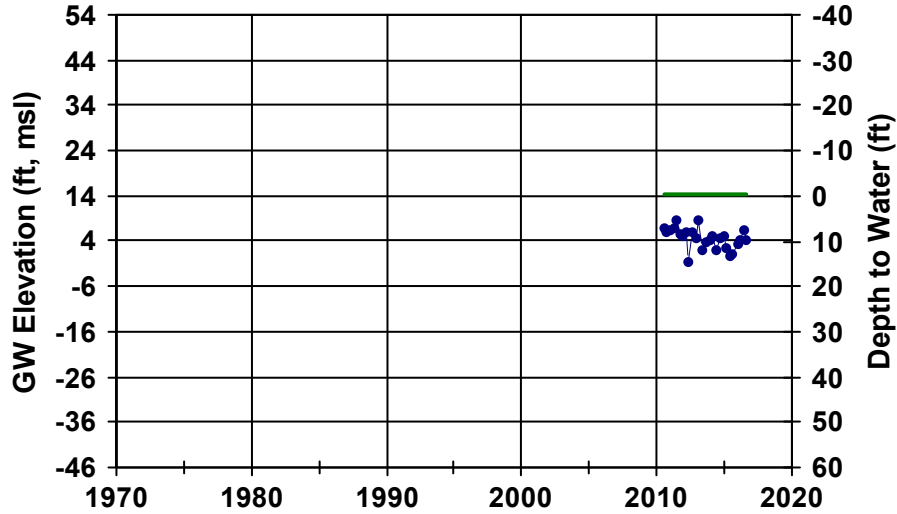
WellID: T0605514064MW14 RPE: 14 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

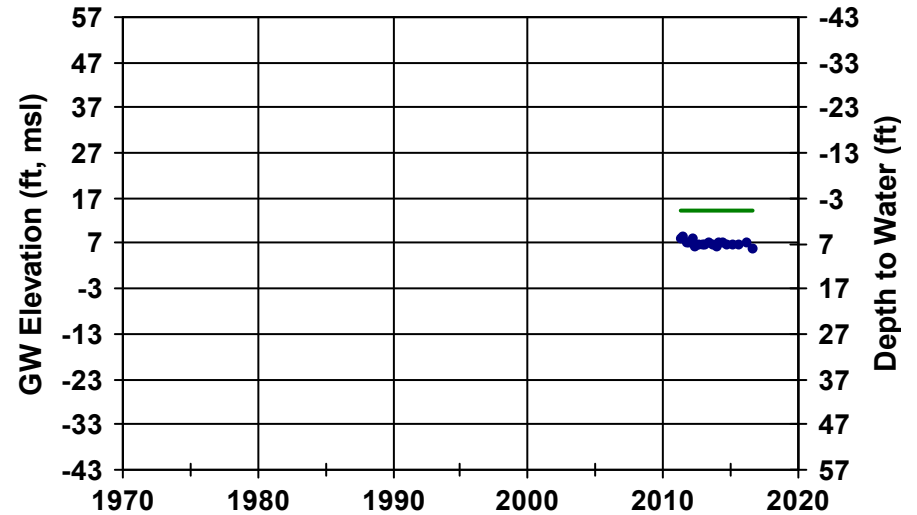
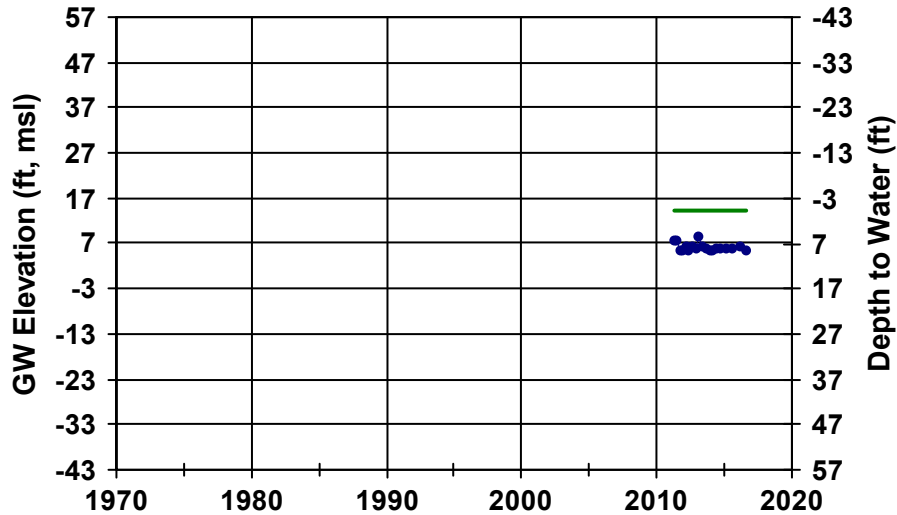
WellID: T0605514064MW15 RPE: 14.29 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064MW16 RPE: 15.22 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064MW17 RPE: 14.11 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

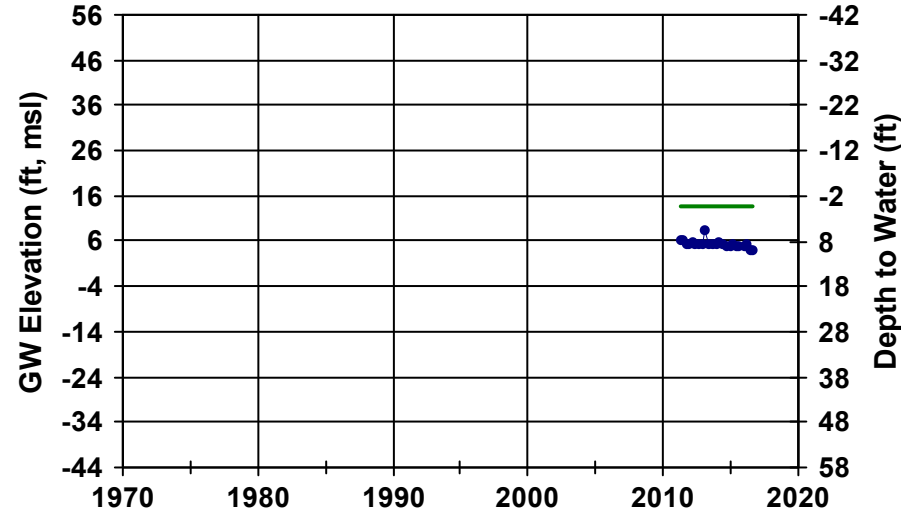
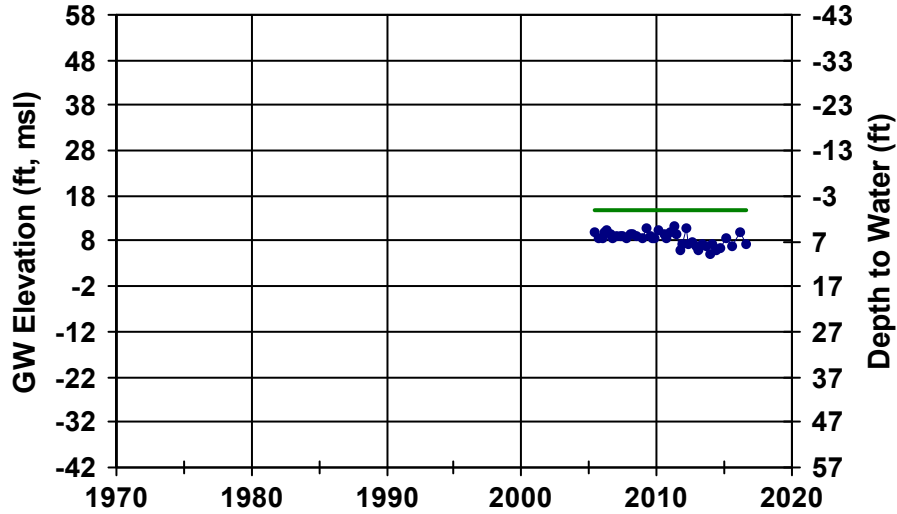
WellID: T0605514064MW18 RPE: 14.33 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

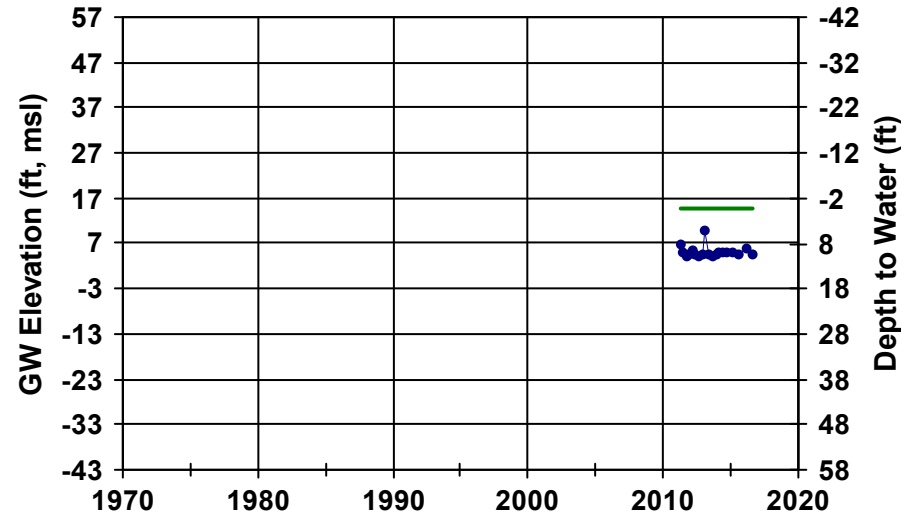
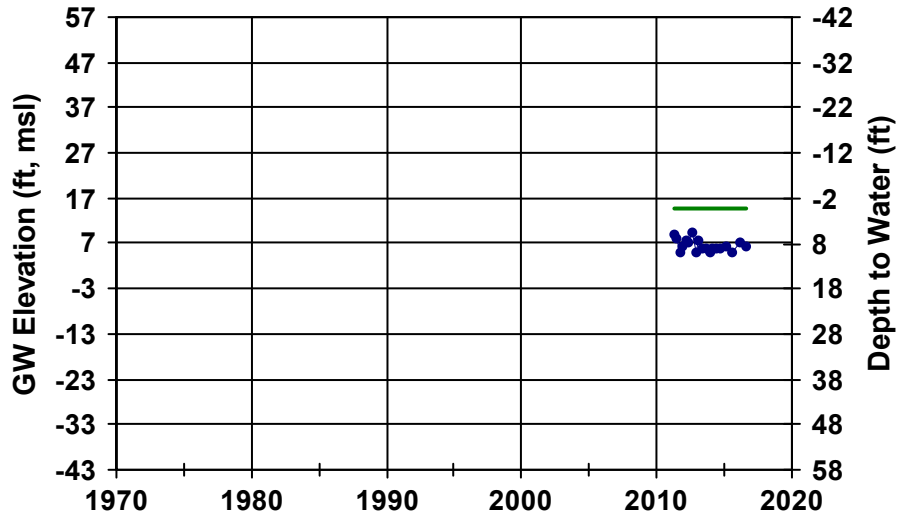
WellID: T0605514064MW2 RPE: 14.61 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064MW20 RPE: 13.91 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064MW21A RPE: 14.79 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

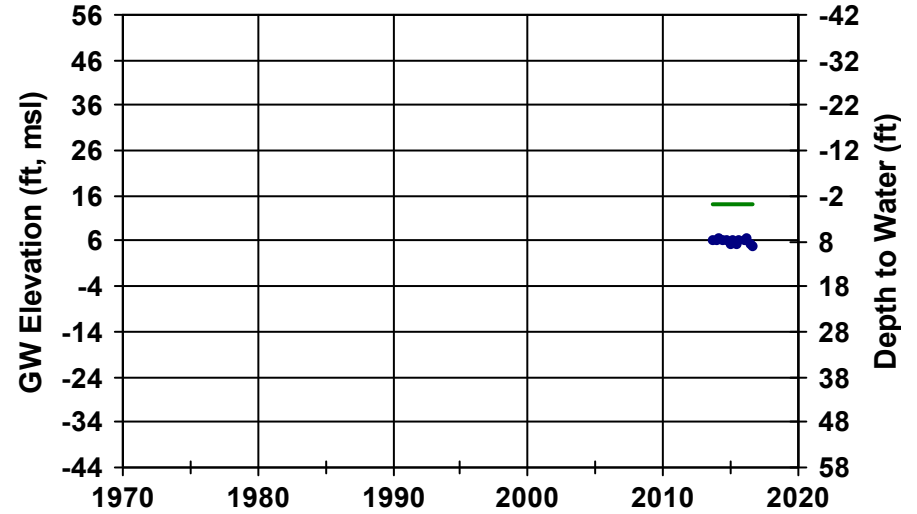
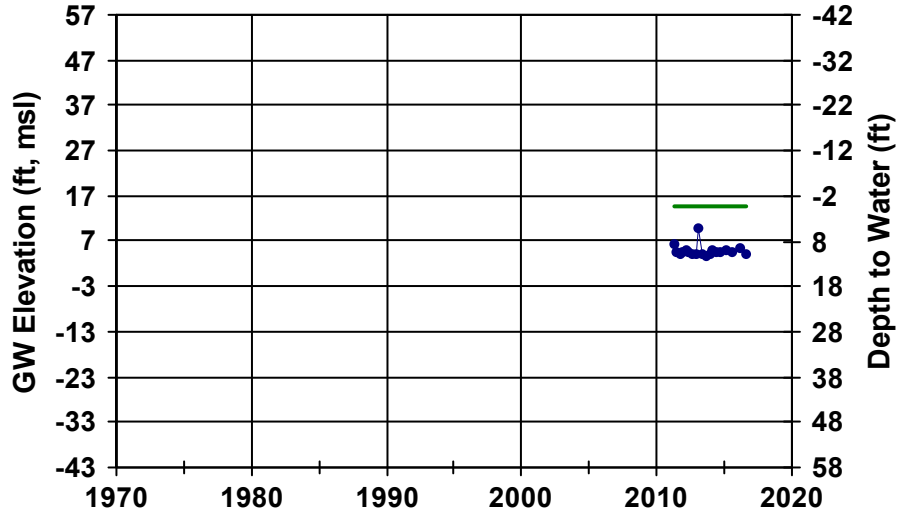
WellID: T0605514064MW21B RPE: 14.85 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

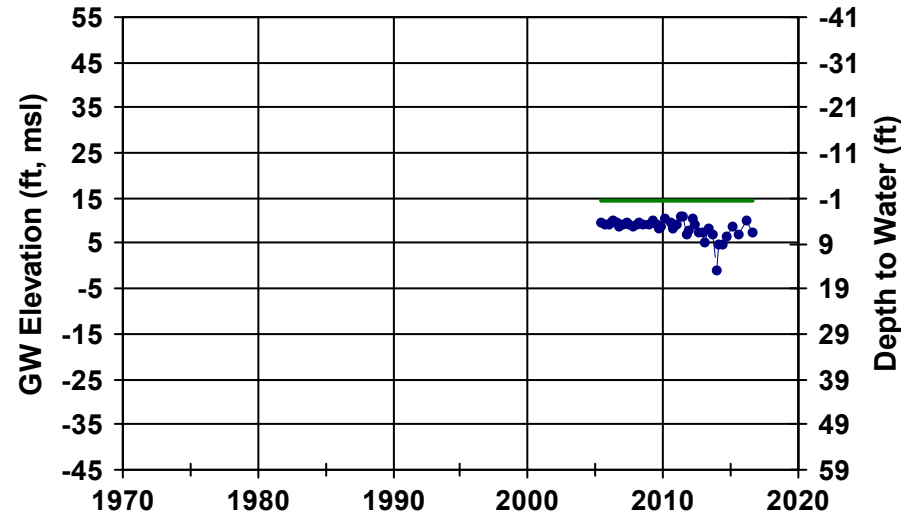
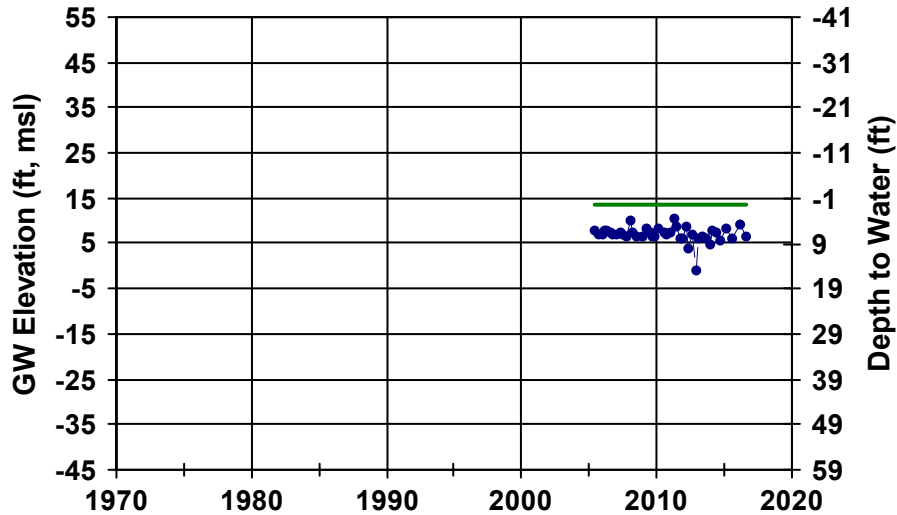
WellID: T0605514064MW21C RPE: 14.82 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064MW22 RPE: 14.29 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064MW3 RPE: 13.68 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

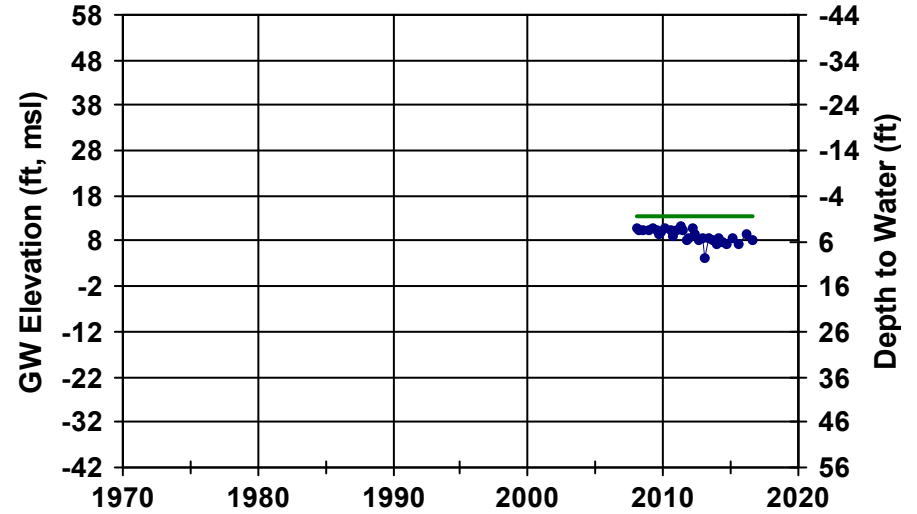
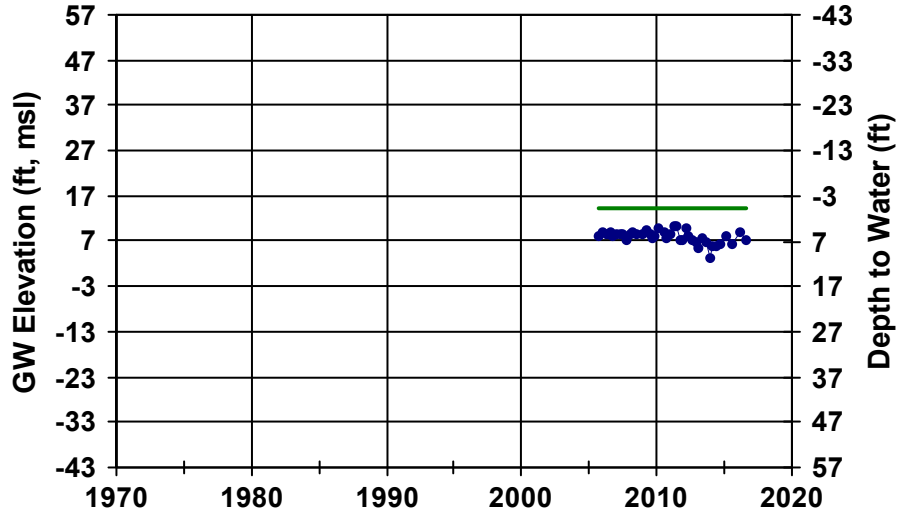
WellID: T0605514064MW4 RPE: 14.4 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

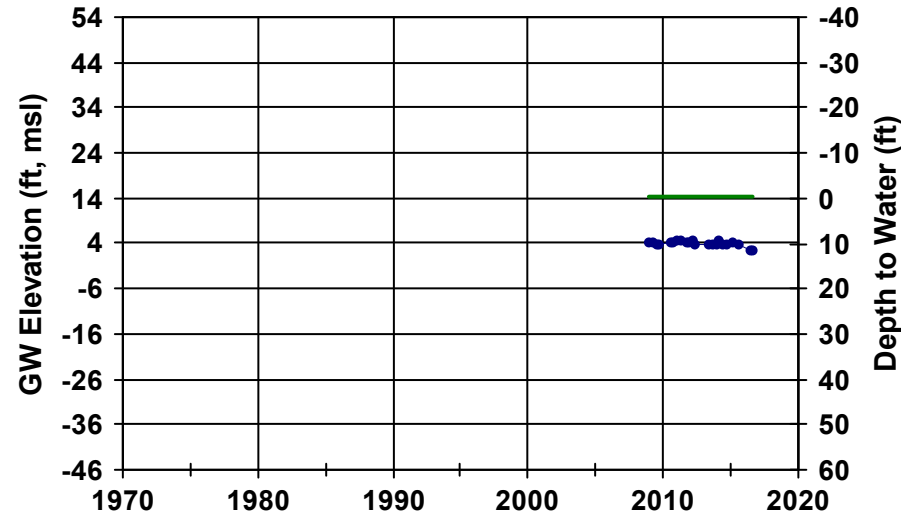
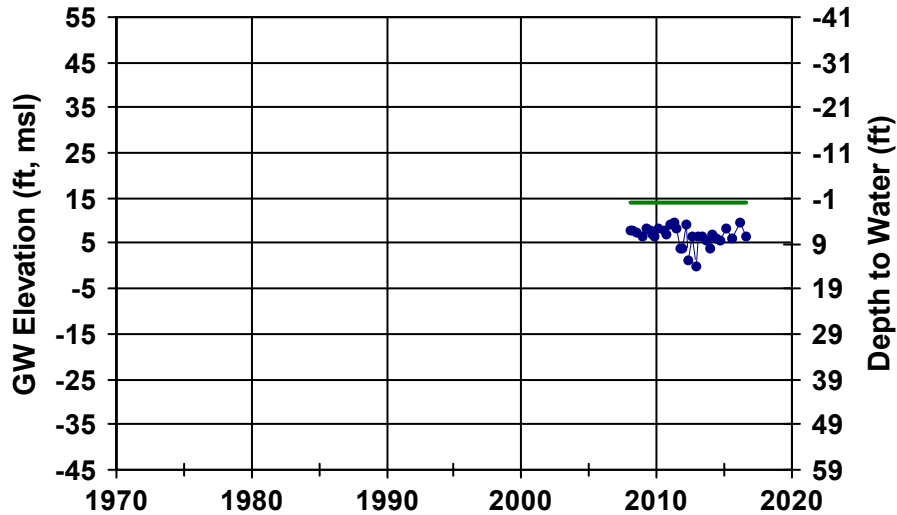
WellID: T0605514064MW5 RPE: 14.09 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064MW6 RPE: 13.65 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064MW7 RPE: 13.87 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

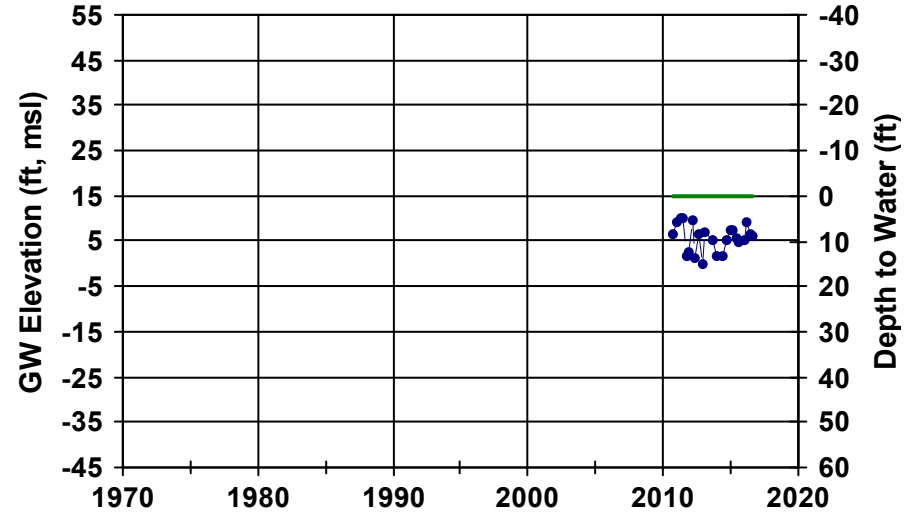
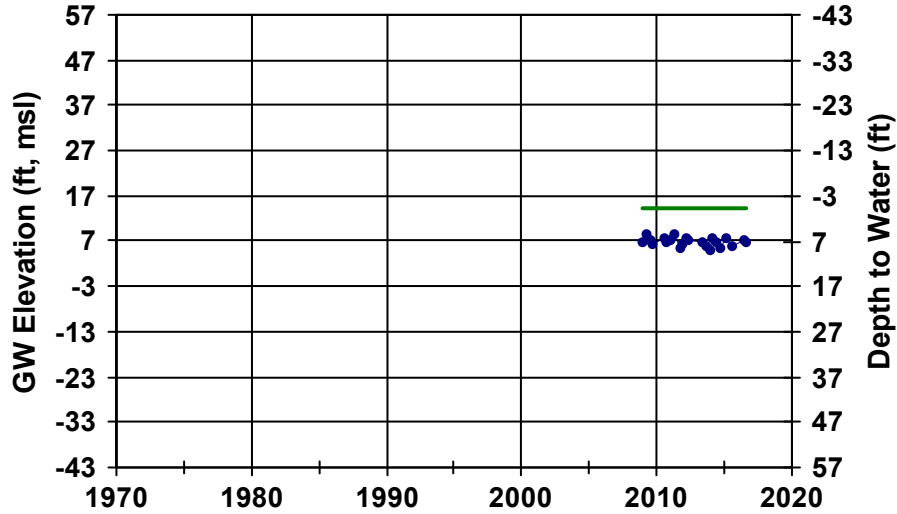
WellID: T0605514064MW8 RPE: 14.29 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

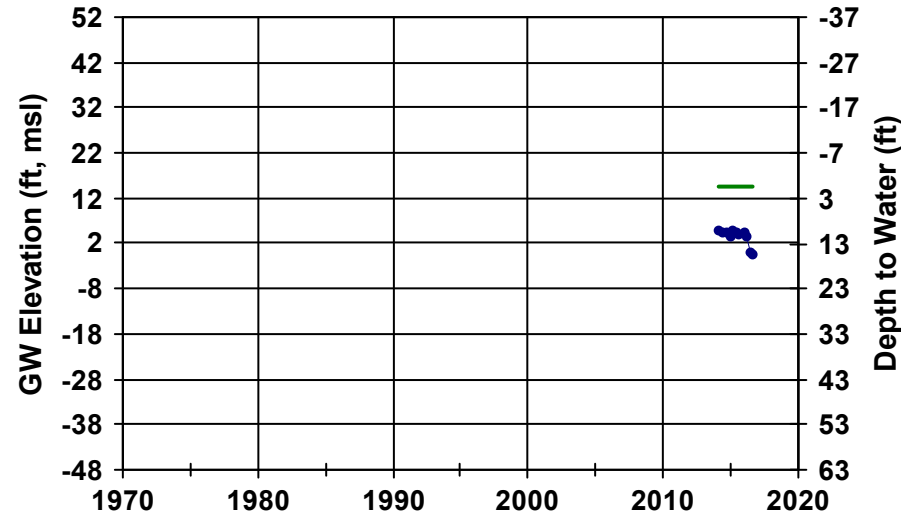
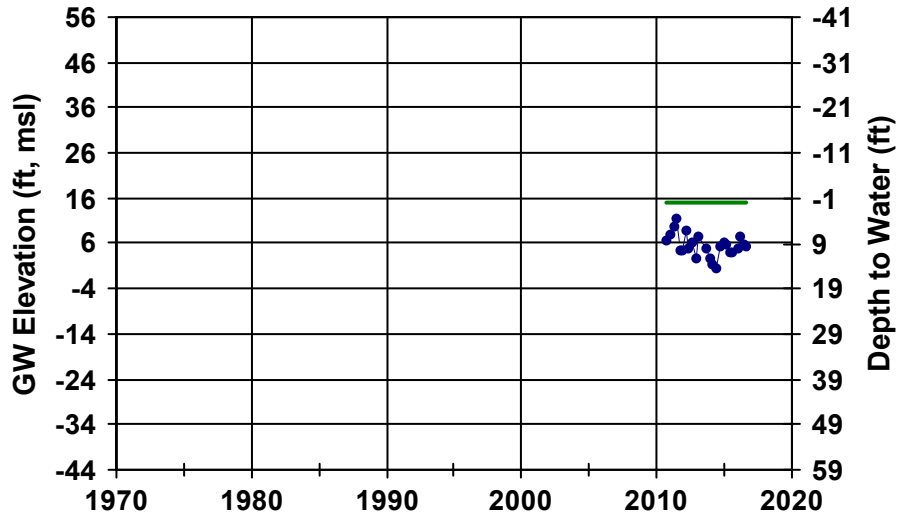
WellID: T0605514064MW9 RPE: 14.35 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064OW1 RPE: 14.73 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



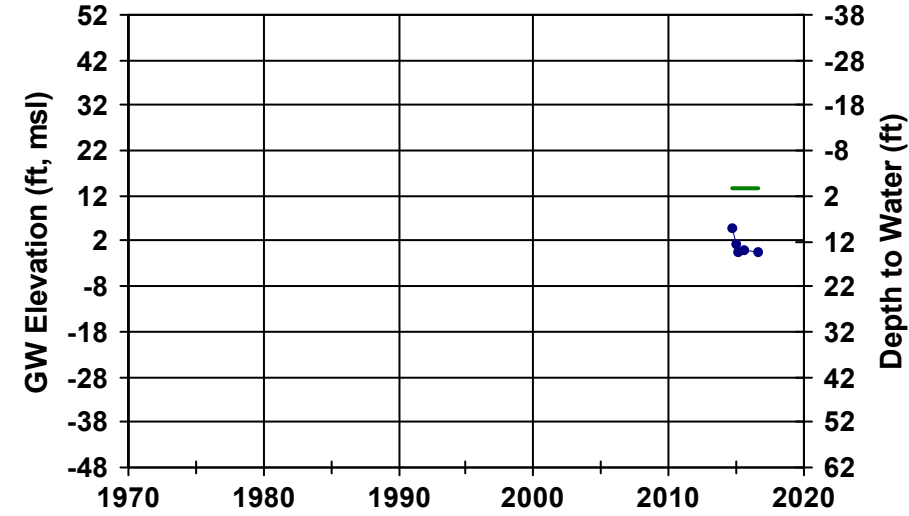
WellID: T0605514064OW2 RPE: 14.99 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605514064OW3 RPE: 14.63 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

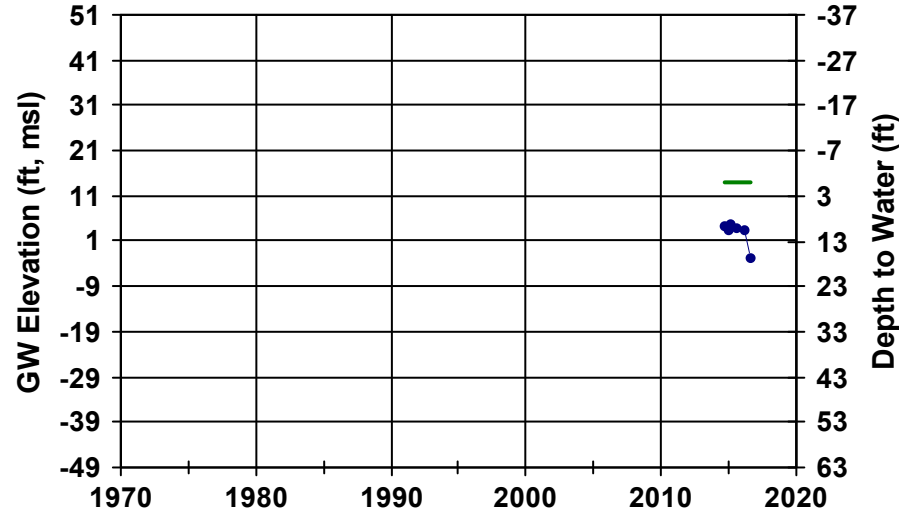


● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

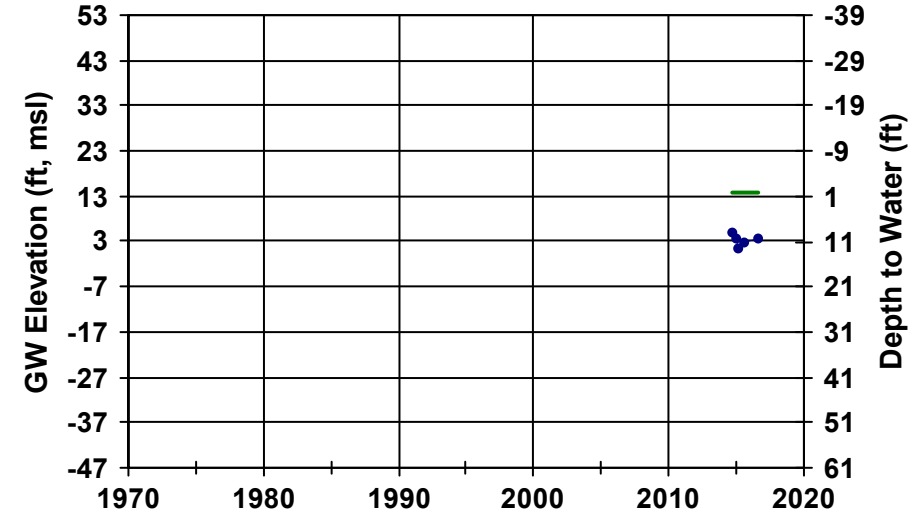
WellID: T0605514064RW1 RPE: 13.85 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



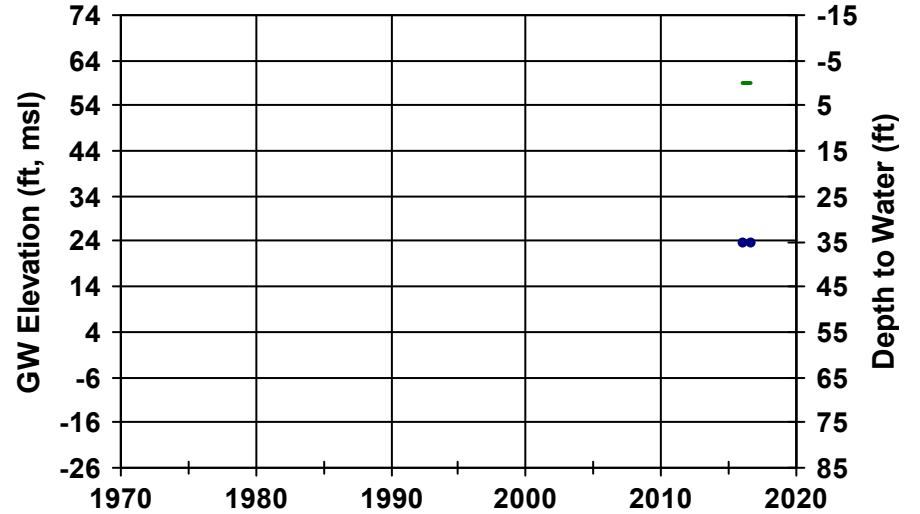
WellID: T0605514064RW2 RPE: 14.17 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605514064RW3 RPE: 13.95 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



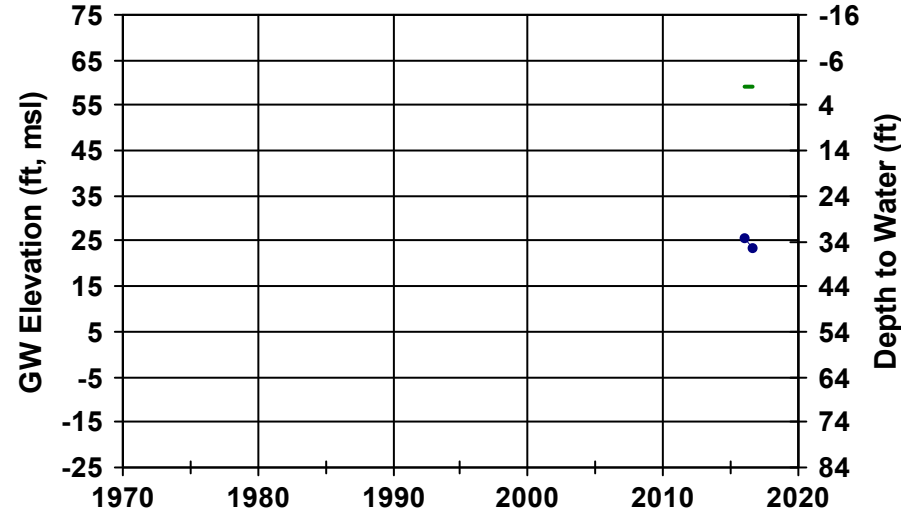
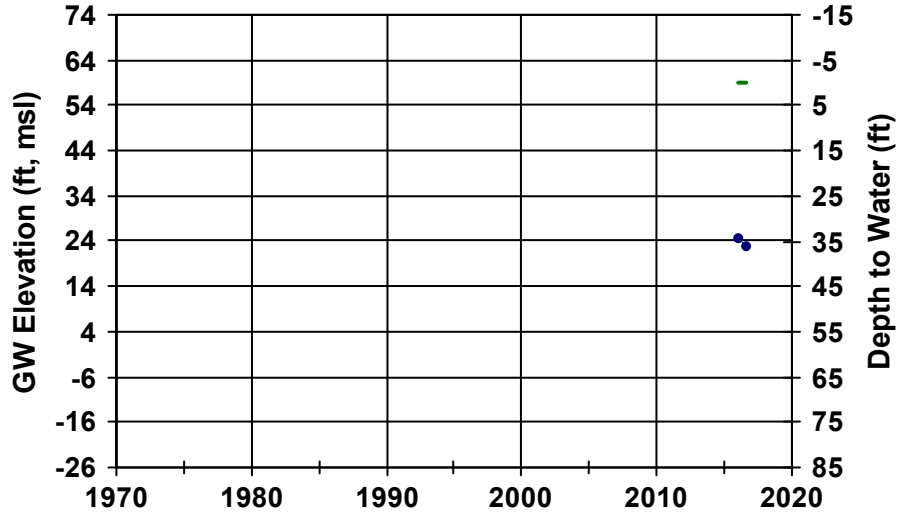
WellID: T0605547200AS-1 RPE: 59.19 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

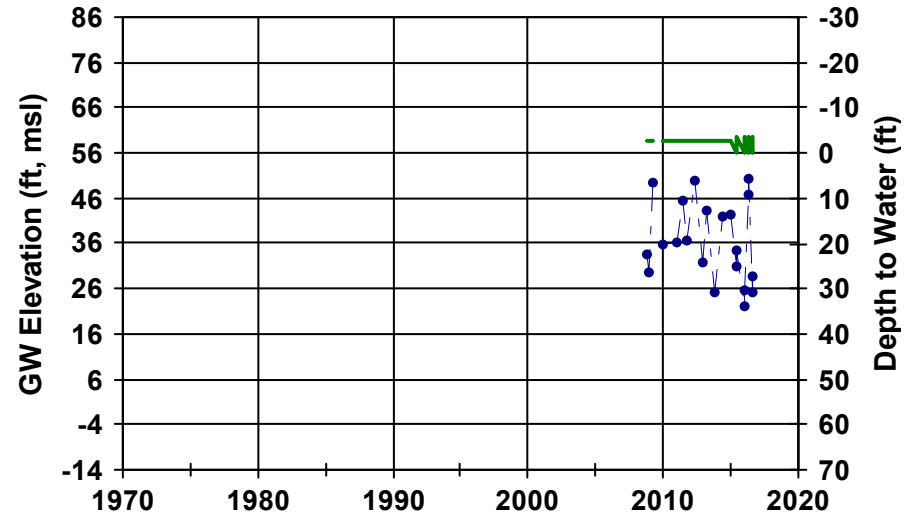
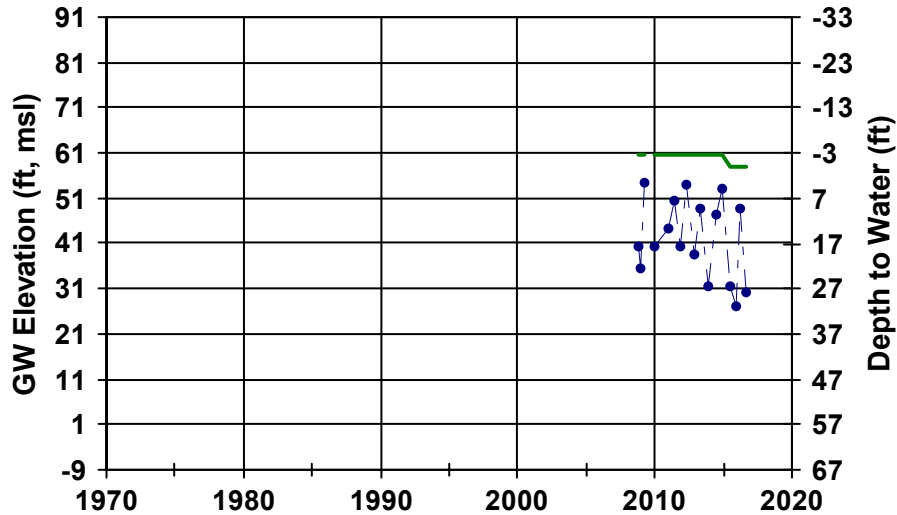
WellID: T0605547200AS-2 RPE: 58.9 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605547200AS-3 RPE: 59.02 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605547200MW-1 RPE: 60.54 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

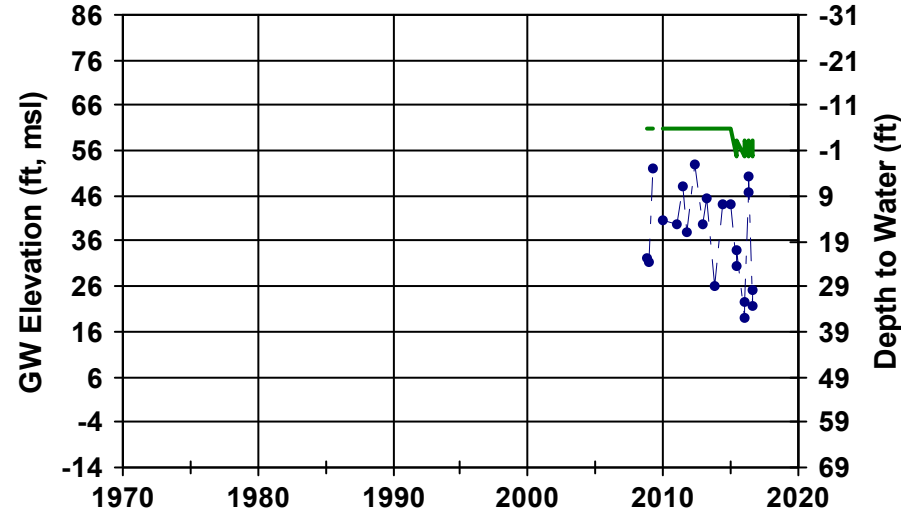
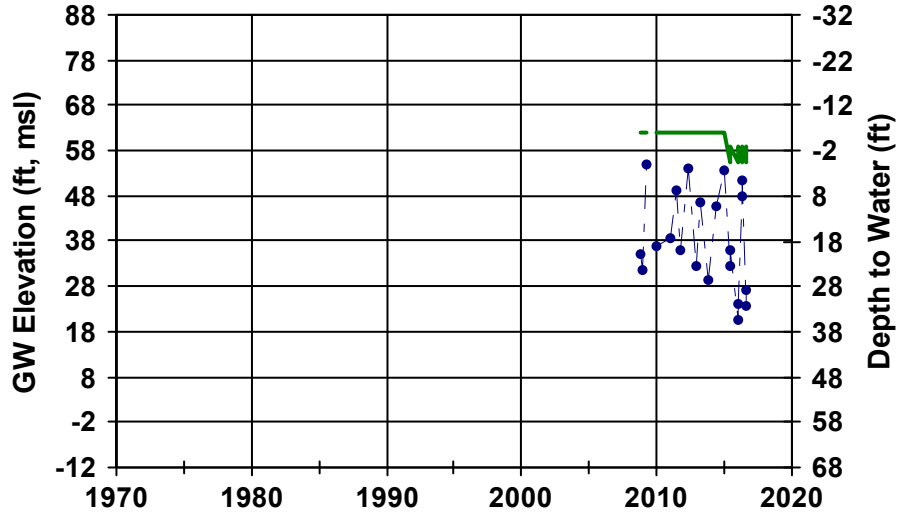
WellID: T0605547200MW-2 RPE: 55.91 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

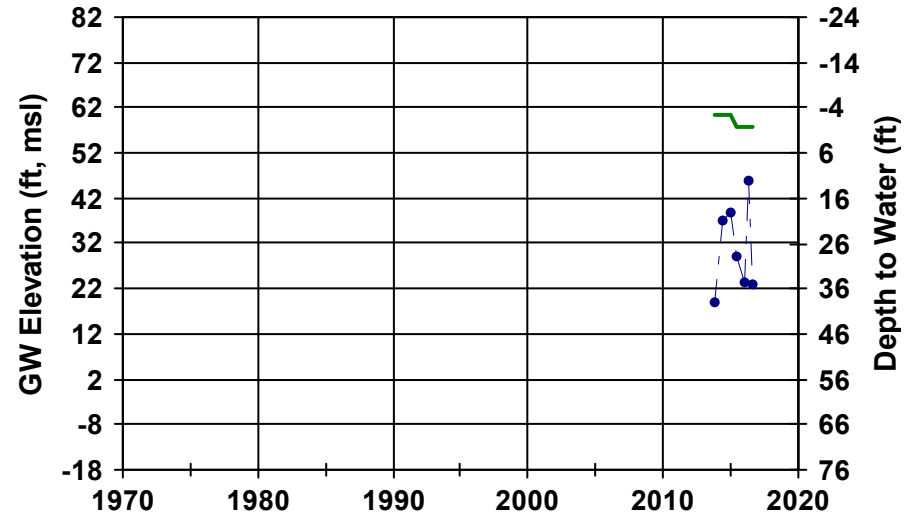
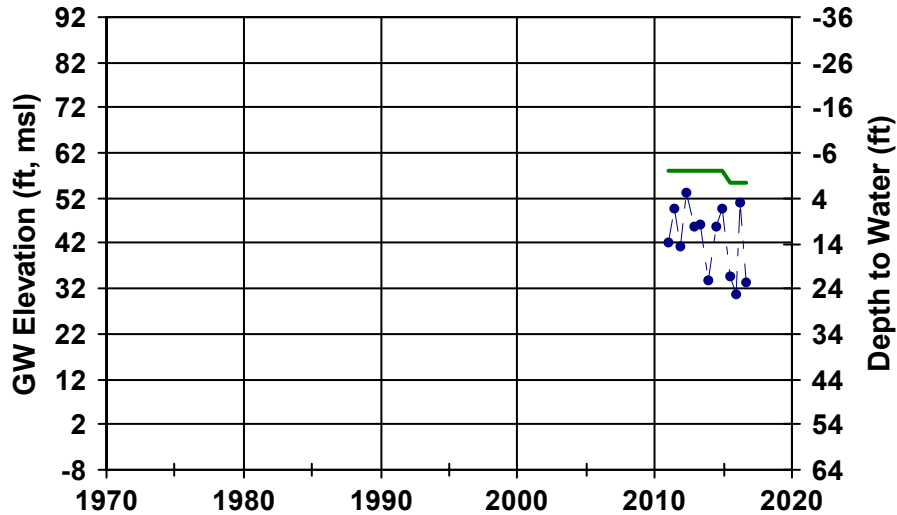
WellID: T0605547200MW-3 RPE: 55.59 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605547200MW-4 RPE: 54.8 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605547200MW-5 RPE: 55.5 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

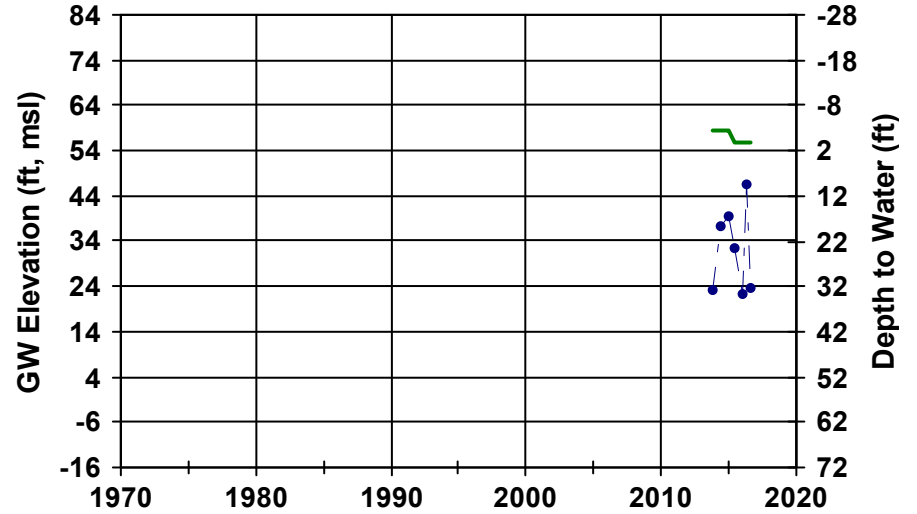
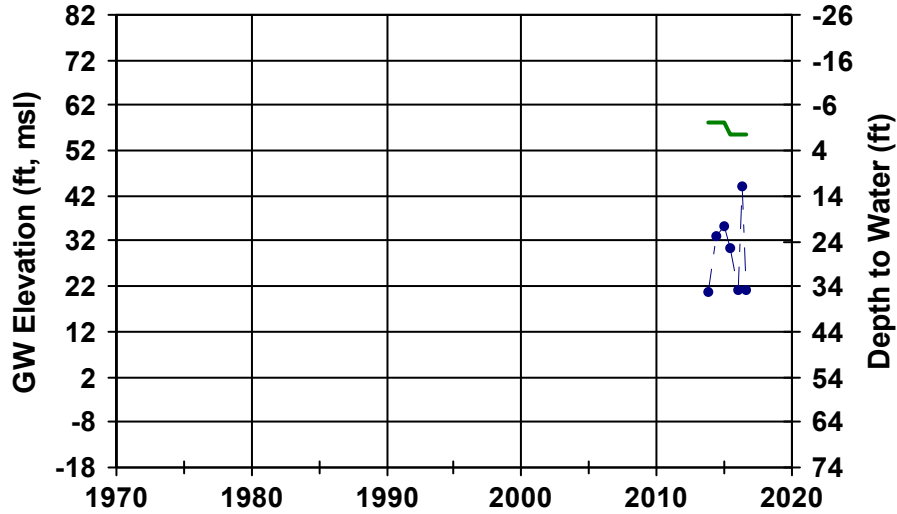
WellID: T0605547200MW-6D RPE: 57.7 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

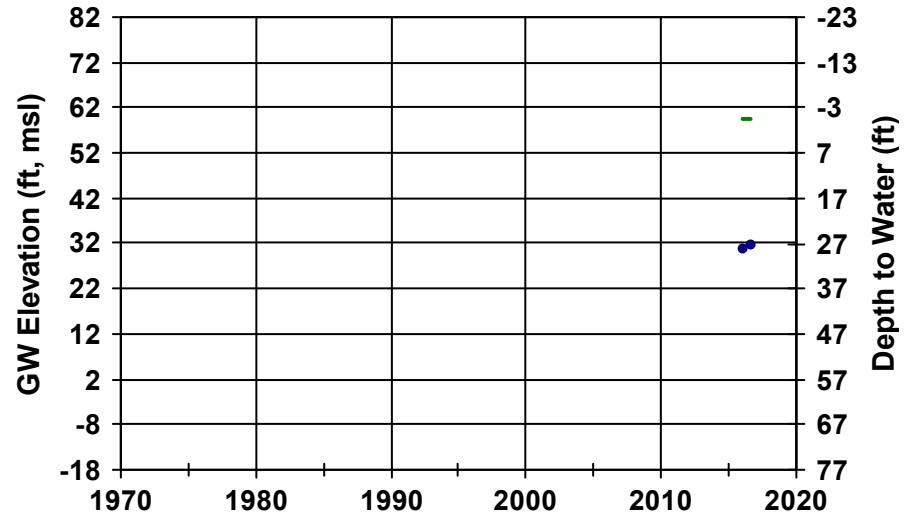
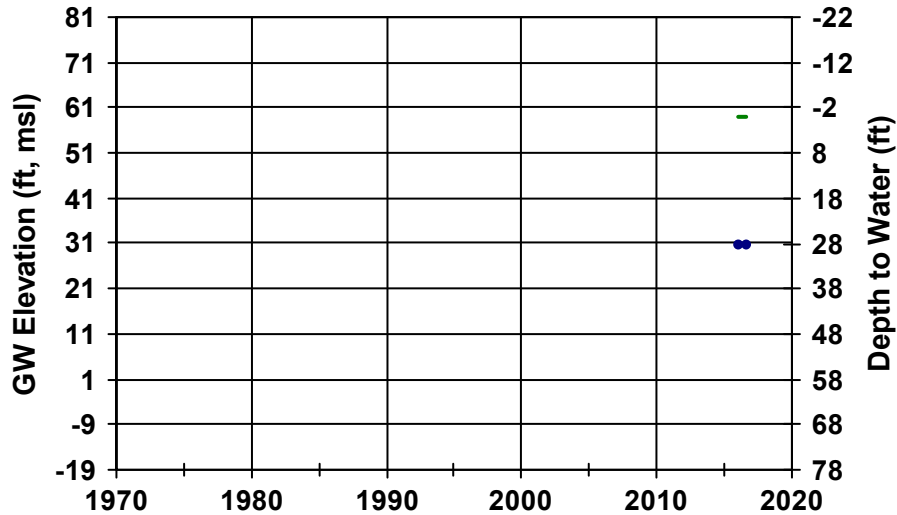
WellID: T0605547200MW-7D RPE: 55.63 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: T0605547200MW-8D RPE: 55.87 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: T0605547200SVE-1 RPE: 59.16 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

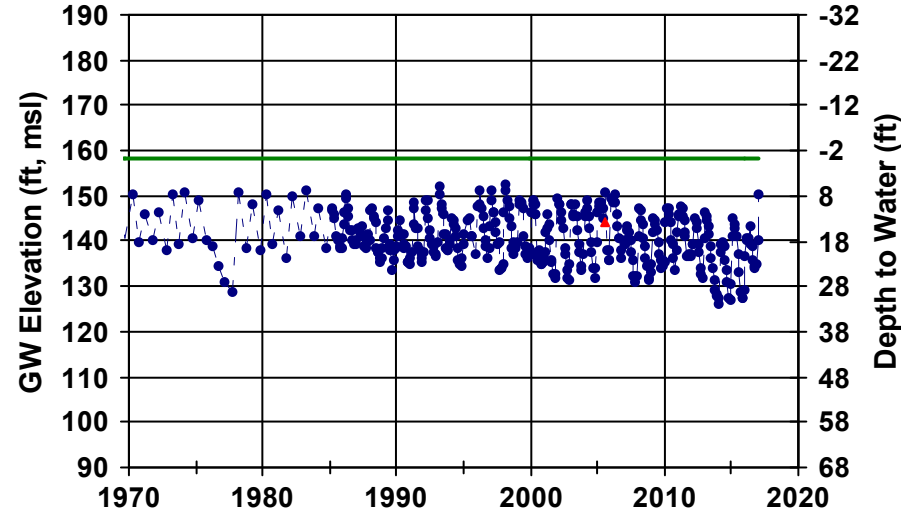
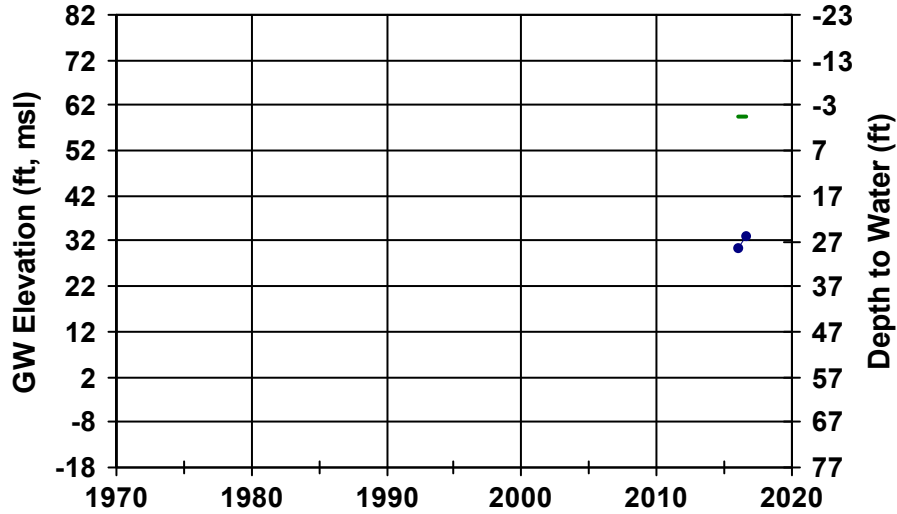
WellID: T0605547200SVE-2 RPE: 59.43 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

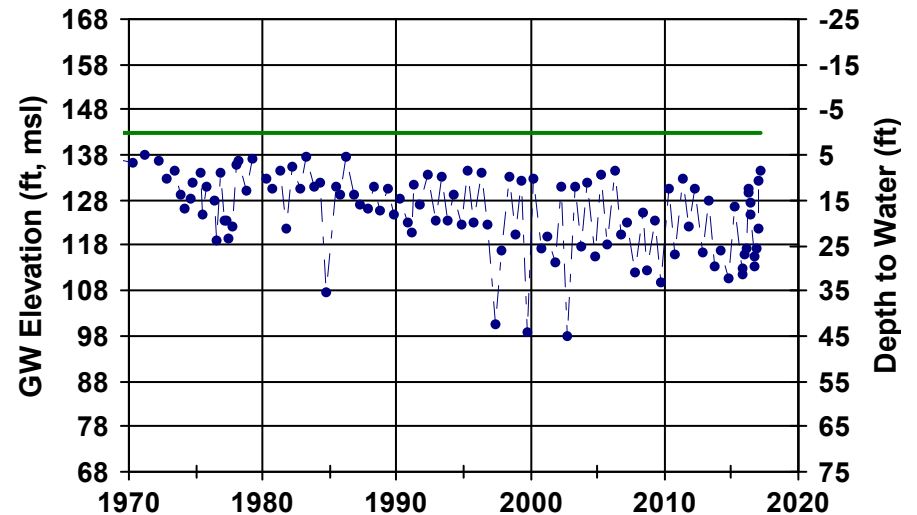
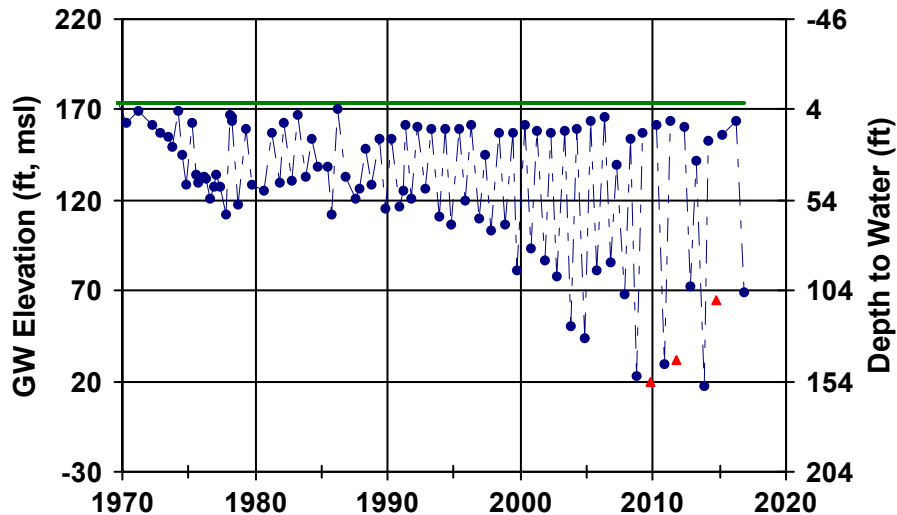
WellID: T0605547200SVE-3 RPE: 59.33 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Napa Source: Geotracker Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: 07N05W09Q002M RPE: 158.24 ft, msl SWN: 007N005W09Q002
 Subarea: Napa Valley Floor-St. Helena Source: DWR Aquifer Zone: Not Defined
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



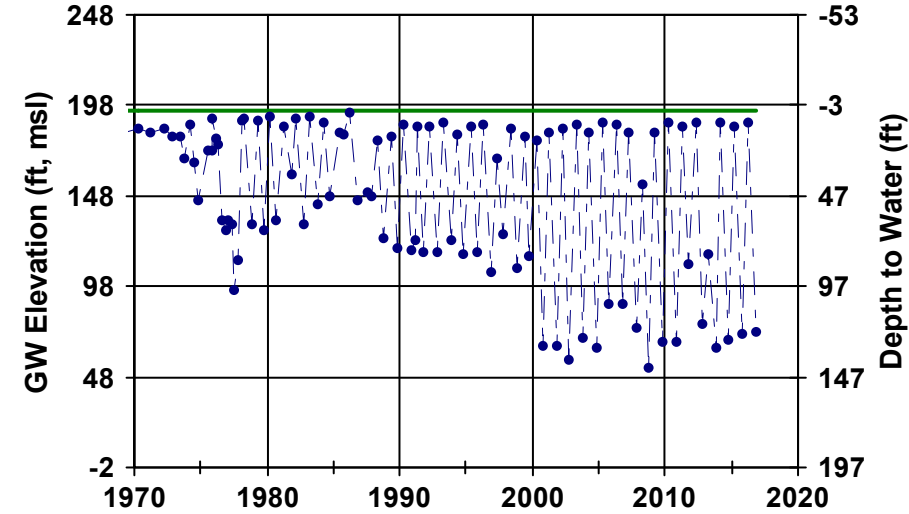
WellID: NapaCounty-131 RPE: 173.5 ft, msl SWN: 007N005W16L001
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

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-SONOMA VALLEY, NAPA VALLEY

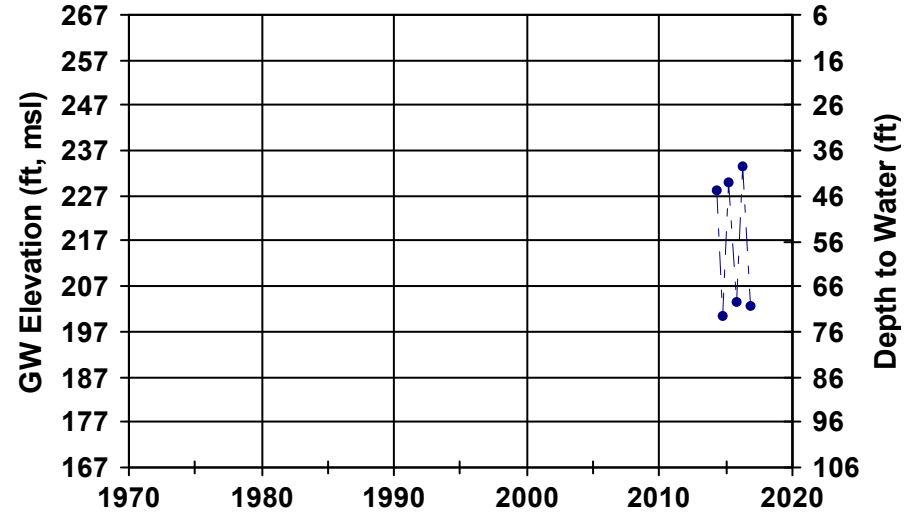


● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

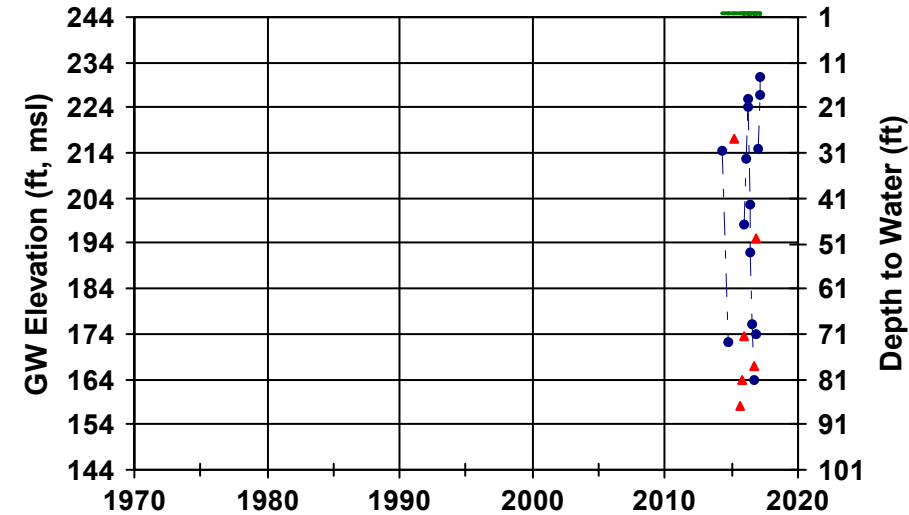
WellID: NapaCounty-138 RPE: 195.1 ft, msl SWN: 007N005W16N002
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



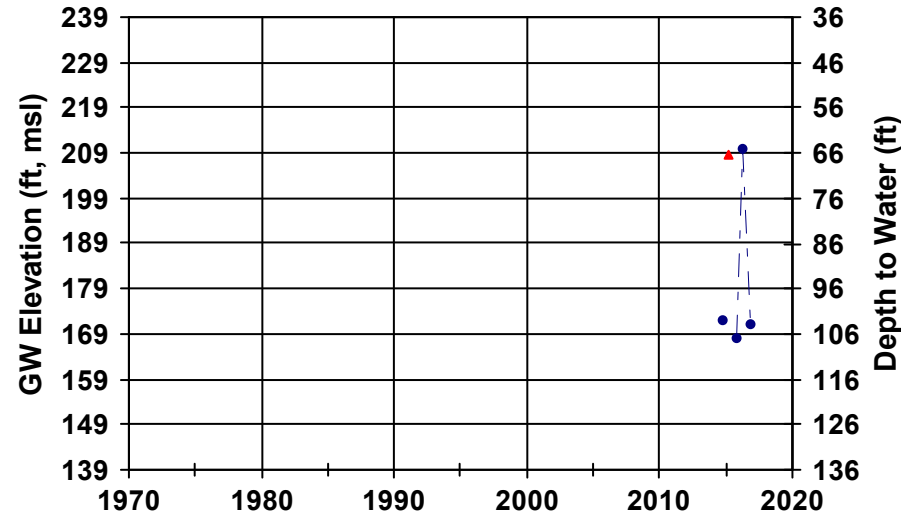
WellID: NapaCounty-169 RPE: 273.4 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-171 RPE: 245.1 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



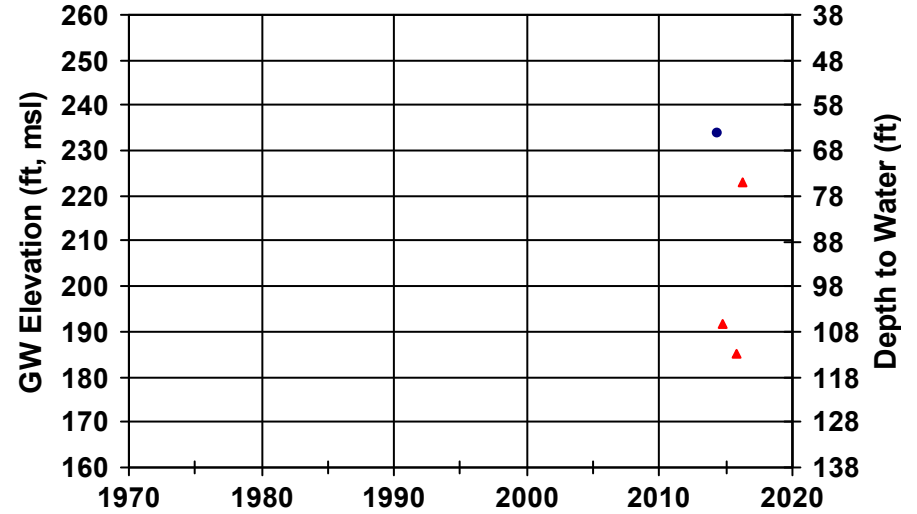
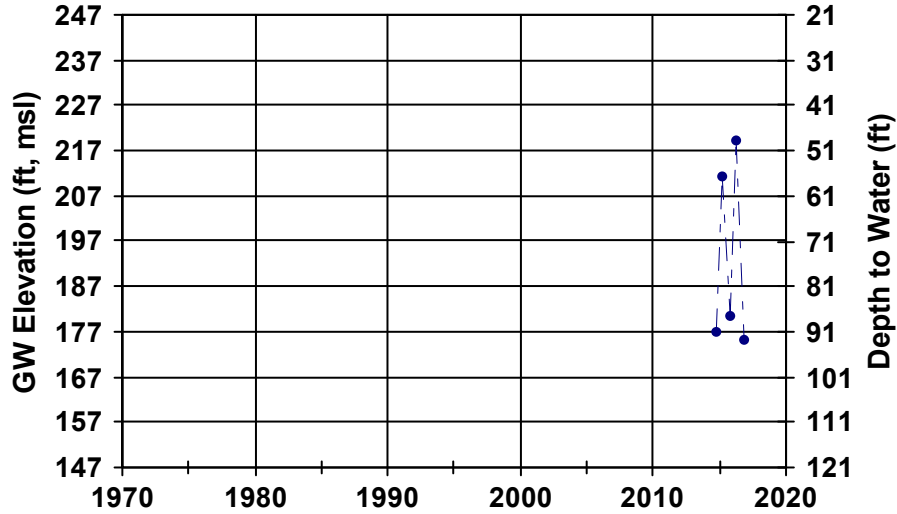
WellID: NapaCounty-172 RPE: 275.2 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

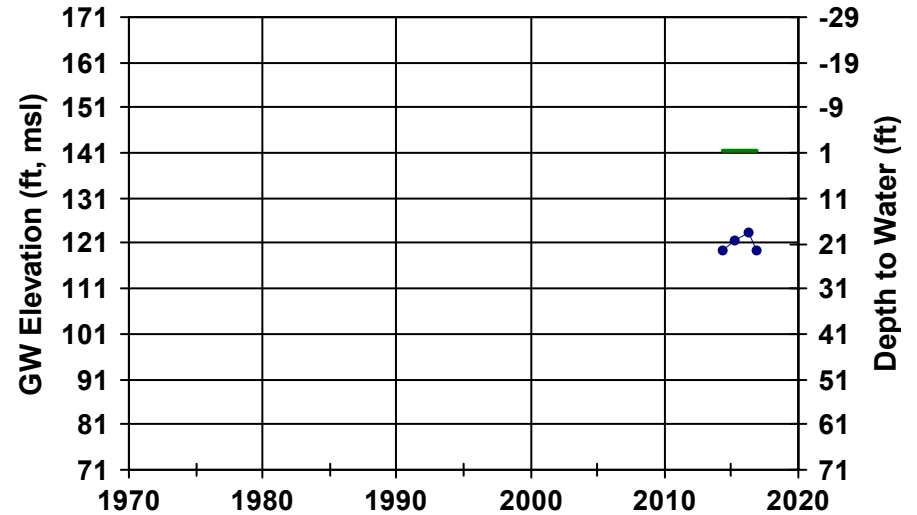
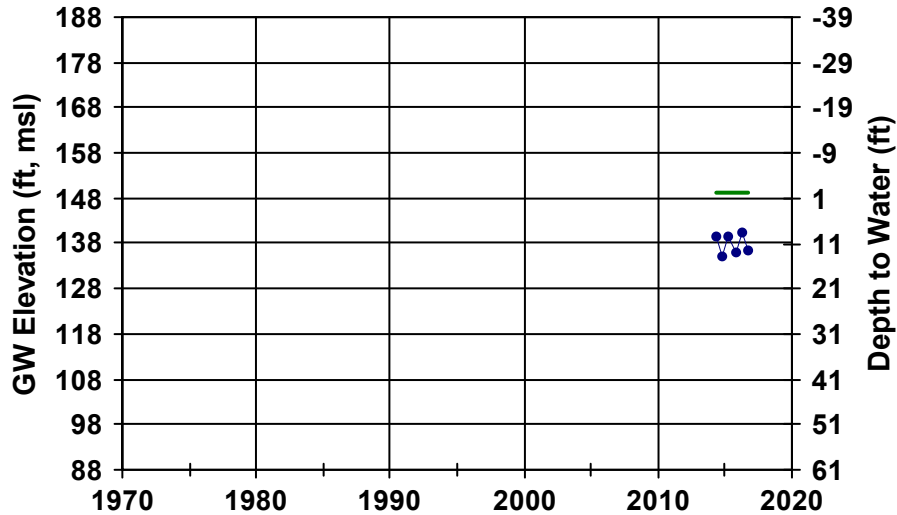
WellID: NapaCounty-173 RPE: 268.3 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-174 RPE: 298.2 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-177 RPE: 149.3 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

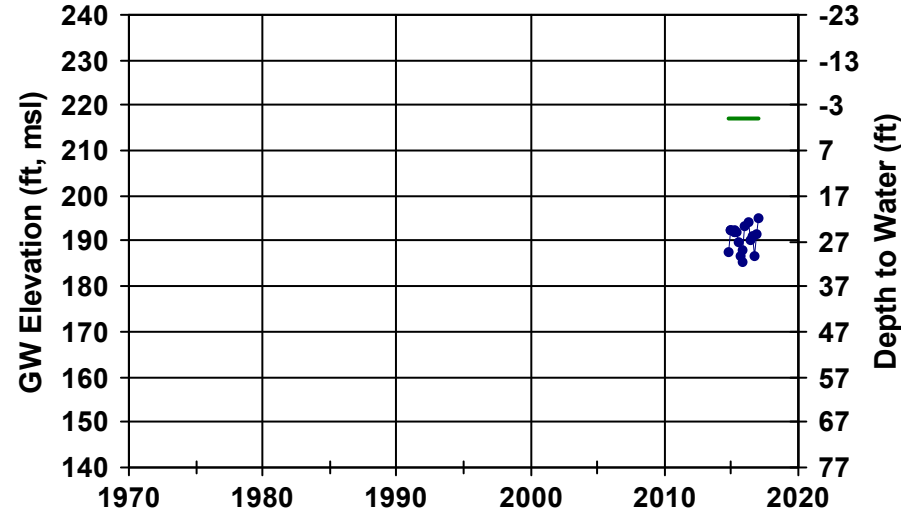
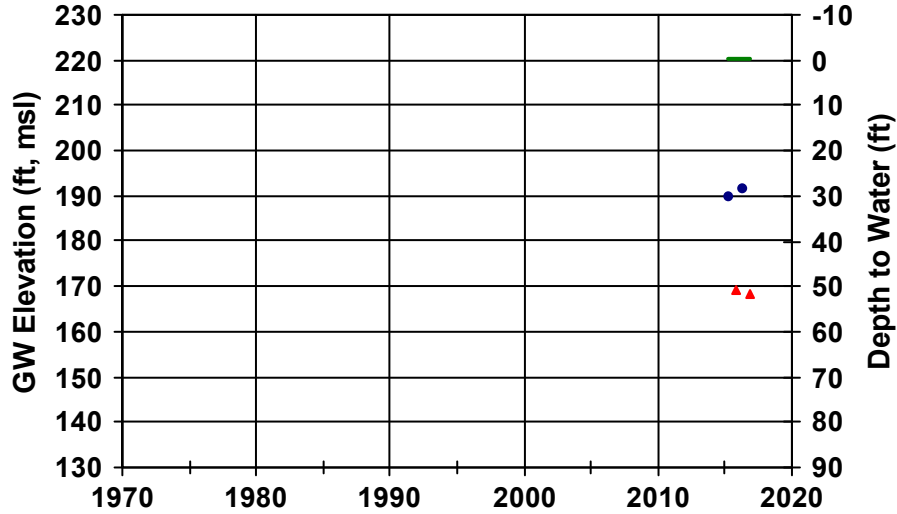
WellID: NapaCounty-204 RPE: 141.7 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

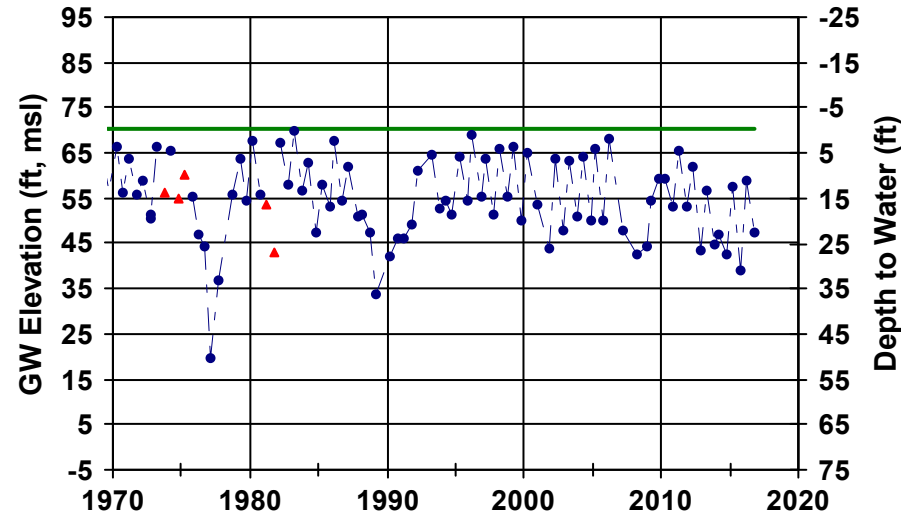
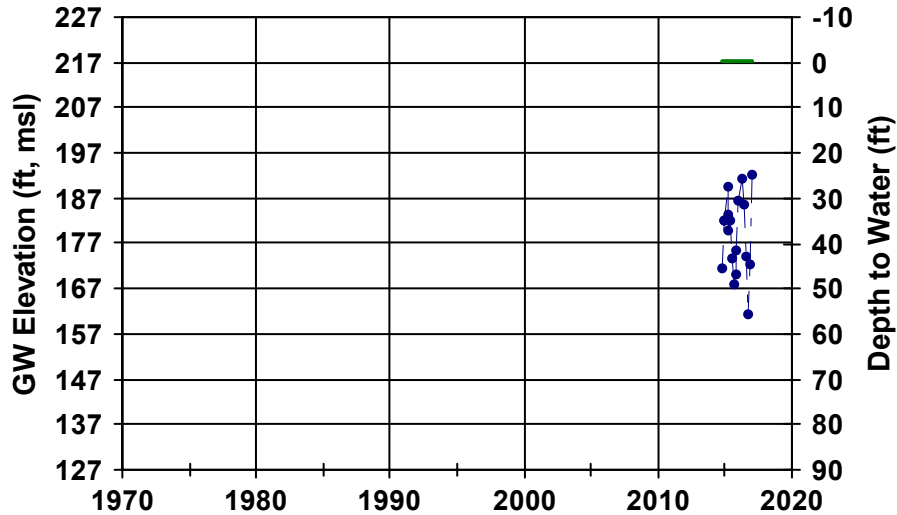
WellID: NapaCounty-212 RPE: 220.5 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-222s-swgw5 RPE: 217.07 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-223d-swgw5 RPE: 217.1 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-St. Helena Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: 06N04W17A001M RPE: 70.26 ft, msl SWN: 006N004W17A001
 Subarea: Napa Valley Floor-Yountville Source: DWR Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

WellID: NapaCounty-125

RPE: 64.6 ft, msl

SWN: 006N004W09Q001

Subarea: Napa Valley Floor-Yountville

Source: NapaCounty

Aquifer Zone: Tsva

Groundwater Basin: Not within a basin

WellID: NapaCounty-126

RPE: 66.7 ft, msl

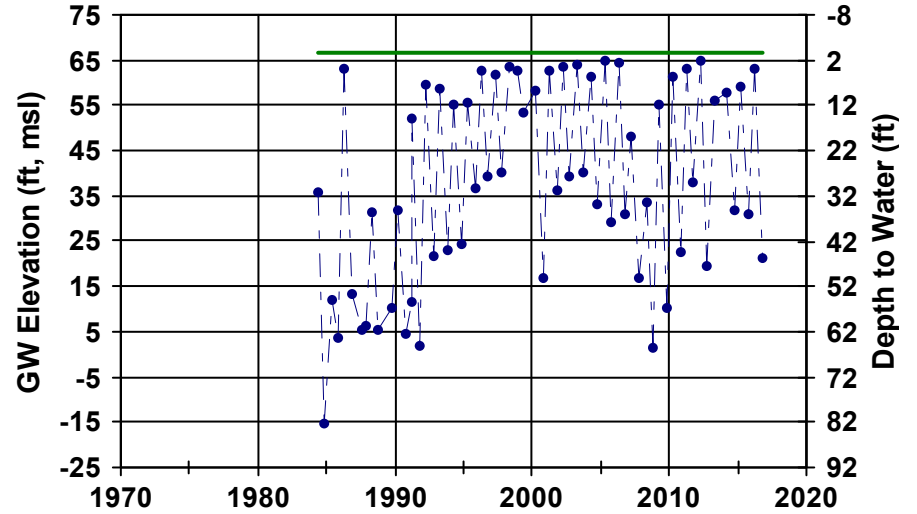
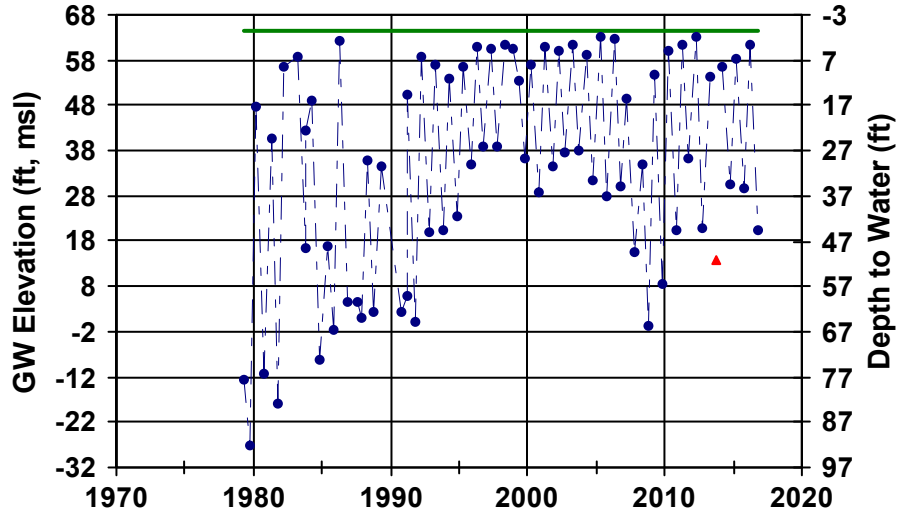
SWN: 006N004W09Q002

Subarea: Napa Valley Floor-Yountville

Source: NapaCounty

Aquifer Zone: Tsva

Groundwater Basin: Not within a basin



WellID: NapaCounty-133

RPE: 94.7 ft, msl

SWN: 007N004W31M001

Subarea: Napa Valley Floor-Yountville

Source: NapaCounty

Aquifer Zone: Qa

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-134

RPE: 83.4 ft, msl

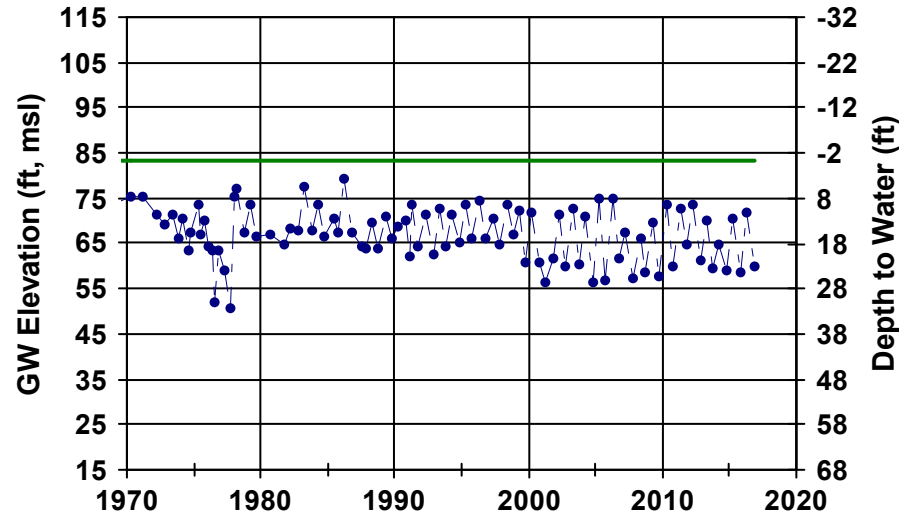
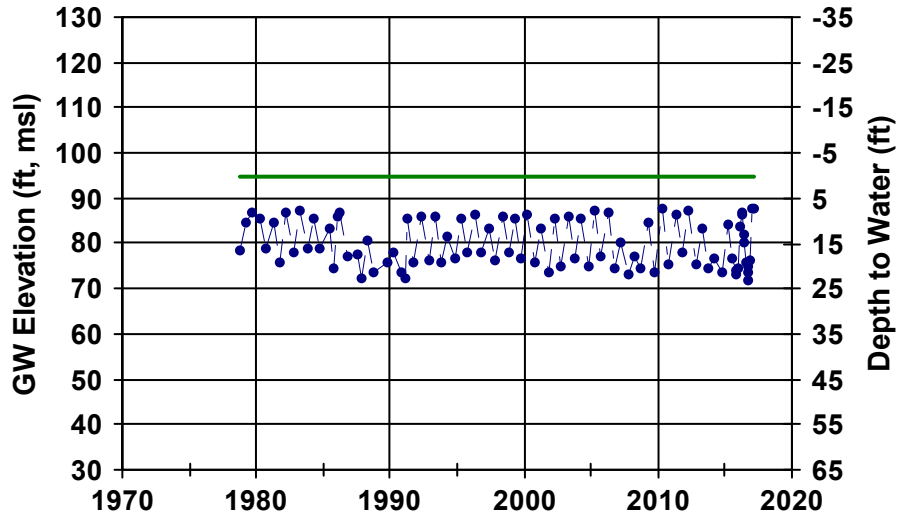
SWN: 006N004W06L002

Subarea: Napa Valley Floor-Yountville

Source: NapaCounty

Aquifer Zone: Qa

Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



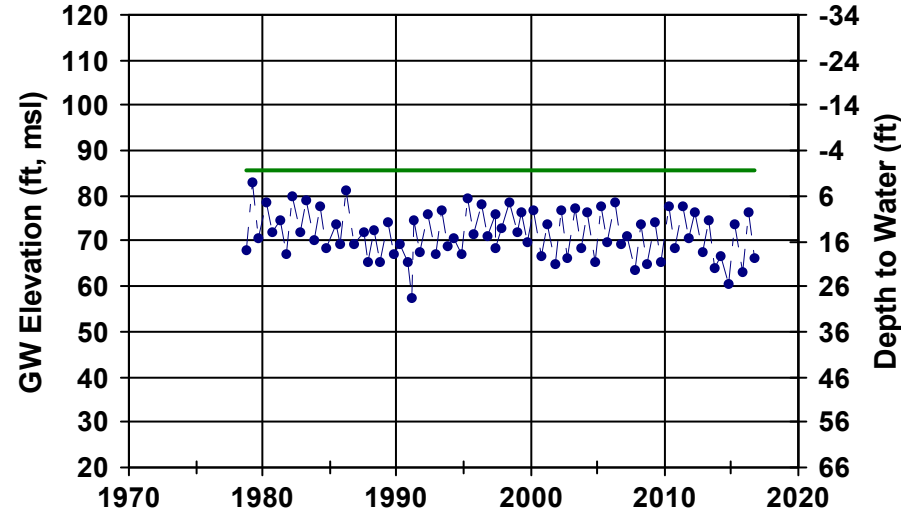
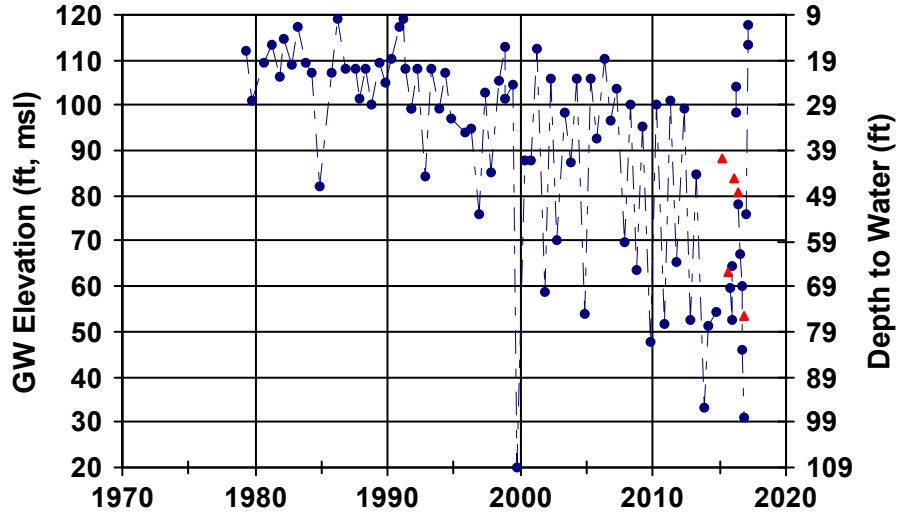
● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

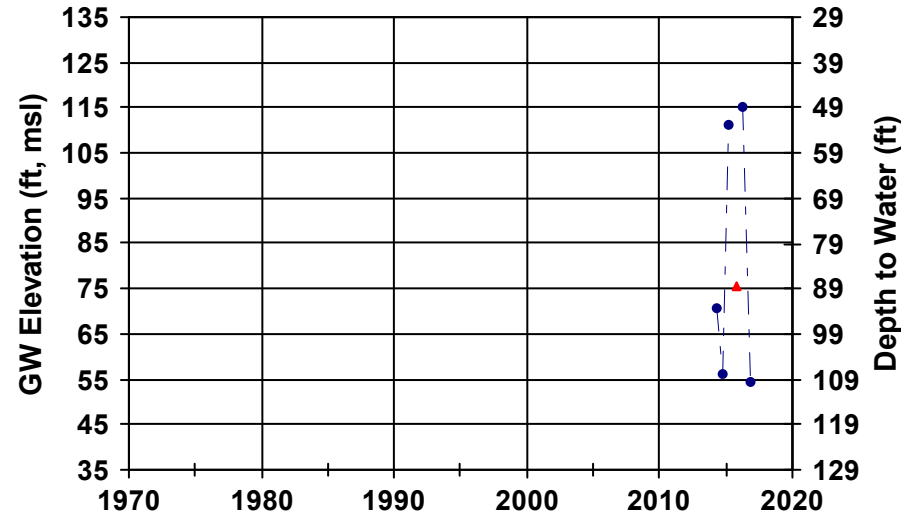
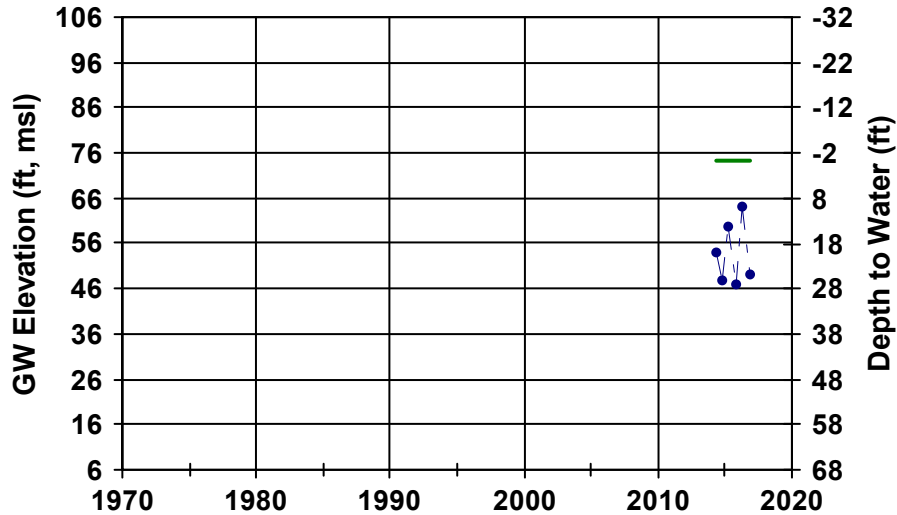
WellID: NapaCounty-135 RPE: 129.2 ft, msl SWN: 006N004W19B001
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: NapaCounty-139 RPE: 85.8 ft, msl SWN: 006N004W17R002
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: NapaCounty-179 RPE: 74.3 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone:
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

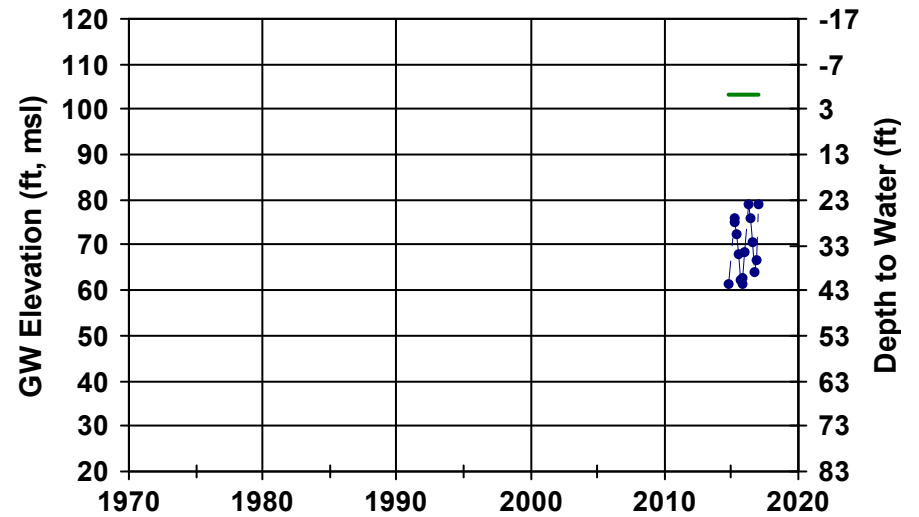
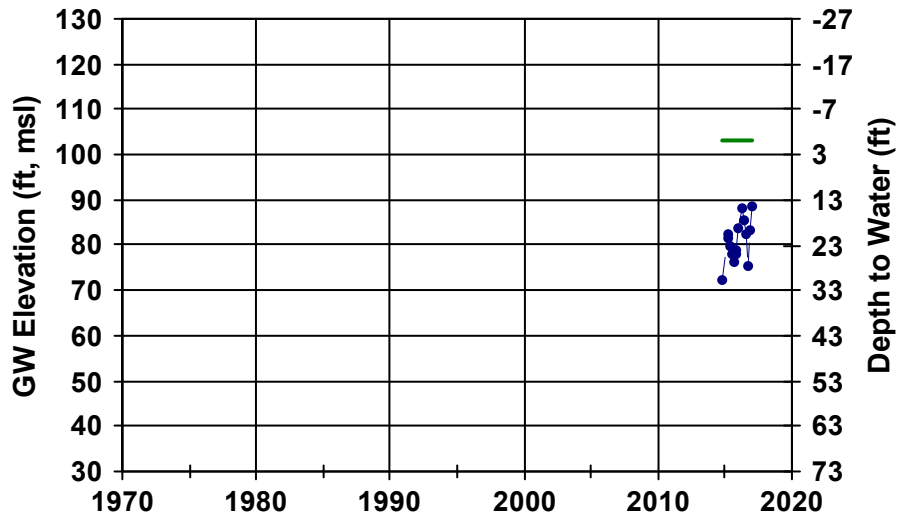
WellID: NapaCounty-181 RPE: 163.6 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Tsv
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

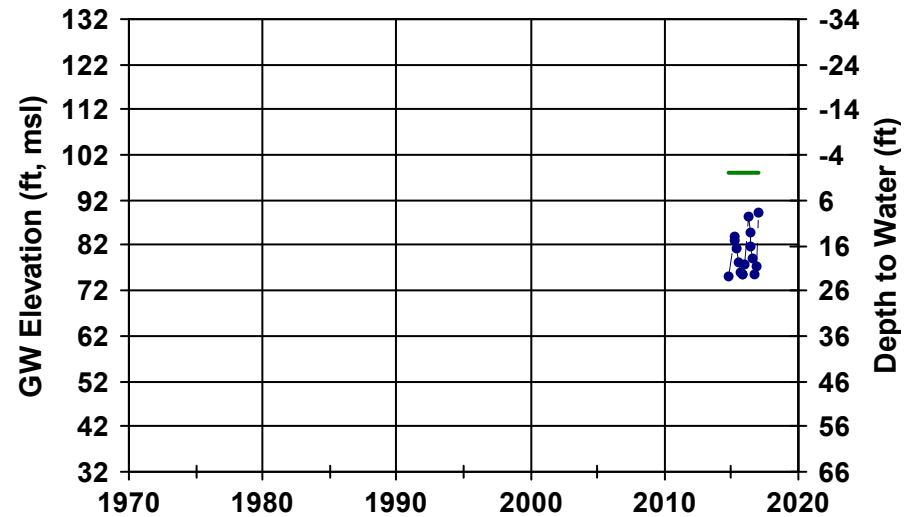
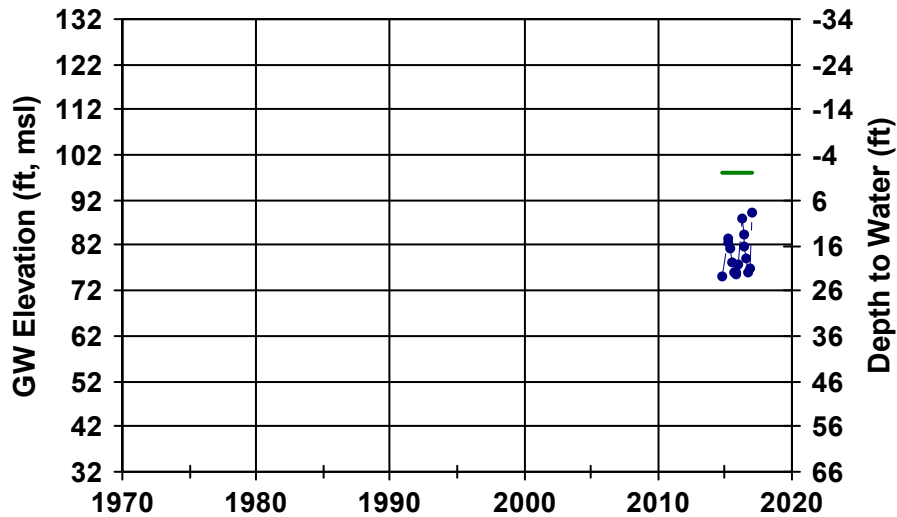
WellID: **NapaCounty-216s-swgw2** RPE: 103.1 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **NapaCounty-217d-swgw2** RPE: 103.08 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



WellID: **NapaCounty-220s-swgw4** RPE: 98.22 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY

WellID: **NapaCounty-221d-swgw4** RPE: 98.28 ft, msl SWN: Unknown
 Subarea: Napa Valley Floor-Yountville Source: NapaCounty Aquifer Zone: Qa
 Groundwater Basin: NAPA-SONOMA VALLEY, NAPA VALLEY



● Measured Water Levels ▲ Questionable Measurements — Reference Point Elevation

WellID: NapaCounty-211

Subarea: Pope Valley

Groundwater Basin: POPE VALLEY,

RPE: 708.2 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:

WellID: NapaCounty-213

Subarea: Western Mountains

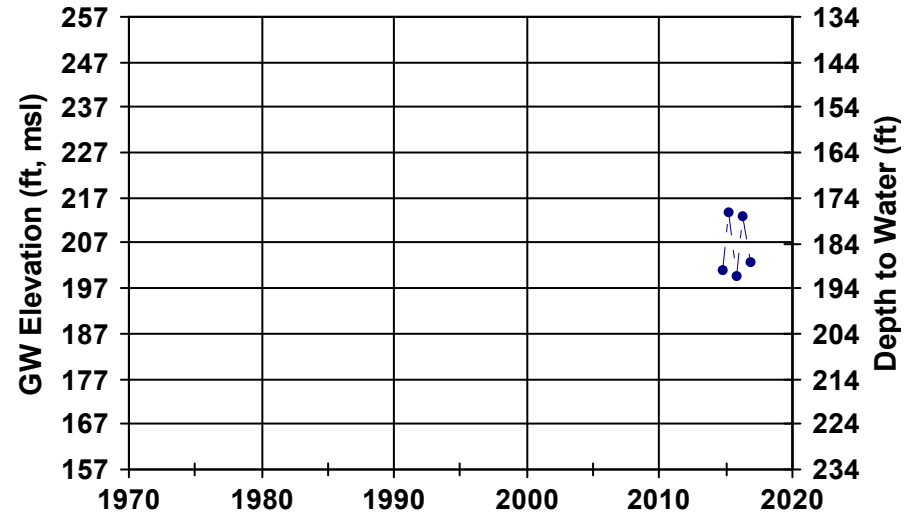
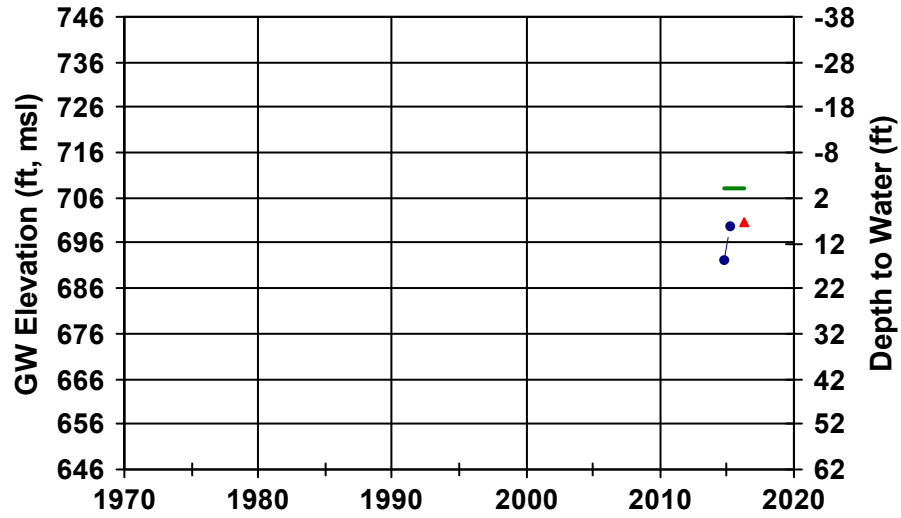
Groundwater Basin: Not within a basin

RPE: 390.8 ft, msl

Source: NapaCounty

SWN: Unknown

Aquifer Zone:



● Measured Water Levels

▲ Questionable Measurements

— Reference Point Elevation

APPENDIX C

Napa County Procedure for Measuring Groundwater Levels

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 a well is being pumped, do not measure; return later, but not sooner than 60 minutes and preferably after 24 hours (see below “Special Circumstances” 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: $\text{Depth to oil} = 37.00 \text{ feet} - 2.72 \text{ feet} = 34.28 \text{ feet}$.

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.⁸ 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 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.

⁸ 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 foot.

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)