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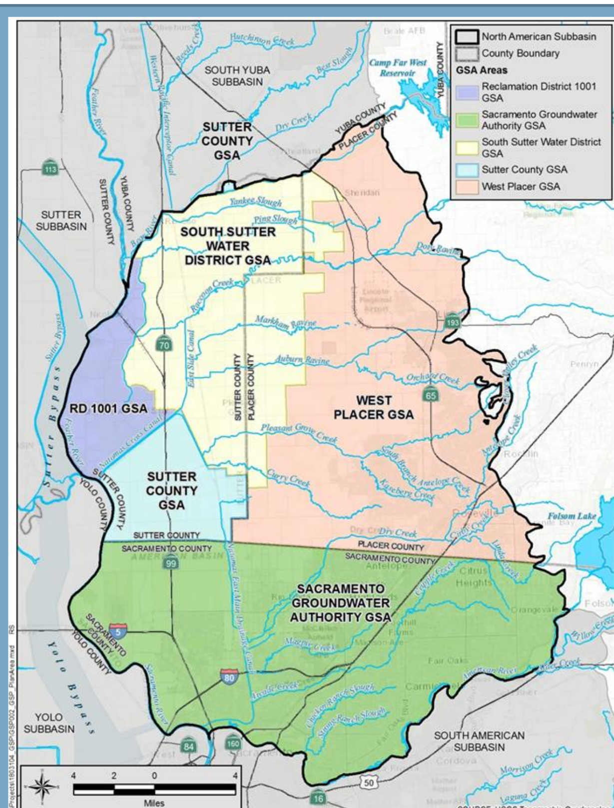
Water Year 2022
Annual Report for the North American Subbasin

April 2023



Prepared for the North American Subbasin GSAs:

- RD 1001
- Sacramento Groundwater Authority
- South Sutter Water District
- Sutter County
- West Placer

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Abbreviations and Acronyms

°F	degrees Fahrenheit
AF	acre-feet
CII	commercial, industrial, and institutional
CoSANA	Cosumnes, South American, and North American Groundwater Subbasins Integrated Water Resources Model
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
InSAR	interferometric synthetic-aperture radar
MAF	million acre-feet
msl	mean sea level
MT	minimum threshold
NASb	North American Subbasin
RD 1001	Reclamation District 1001
RMS	representative monitoring site
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act
State	state of California
Subbasin	North American Subbasin
SSWD	South Sutter Water District
SVSim	Sacramento Valley Simulation Model
TDS	total dissolved solids
WY	Water Year

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Executive Summary

Introduction

This report summarizes Water Year (WY) 2022 (October 1, 2021 – September 30, 2022) conditions and groundwater management actions and projects in the North American Subbasin (NASb or Subbasin). The NASb Groundwater Sustainability Agencies (GSAs) submitted the adopted Groundwater Sustainability Plan (GSP) for review by the California Department of Water Resources (DWR) on January 24, 2022. This report represents the second required Annual Report under the Sustainable Groundwater Management Act (SGMA) of 2014.

The Subbasin encompasses an area of about 535 square miles in portions of Placer, Sacramento, and Sutter counties. The Subbasin is managed by five GSAs comprised of the Reclamation District 1001 (RD 1001); Sacramento Groundwater Authority (SGA); South Sutter Water District (SSWD); Sutter County; and West Placer.

Hydrologic Conditions

Water Year 2022 was preliminarily classified as a critical year (hereby referred to as critically dry year) with both precipitation and runoff experiencing less than half of historical averages. Air temperatures were also higher than their averages from 2000 through 2021.

Water Supply

Water supplies, also referred to as deliveries, within the Subbasin in WY 2022 consisted of about 50 percent groundwater (292,900 acre-feet [AF]), with the remainder coming from surface water (287,500 AF) and recycled water (2,800 AF). About one-third of water supply was used by the urban/industrial sector (193,710 AF) and about two-thirds of water supply was used by the rural/agricultural uses sector (389,420 AF).

Groundwater Levels

Water level hydrographs were updated for all 41 NASb representative monitoring sites (RMS) as defined in the NASb 2021 GSP (SGA, 2021). In general, groundwater level readings for both the spring (annual high) and fall (annual low) levels in WY 2022 followed seasonal trends observed historically within the Subbasin consisting of slightly higher spring groundwater levels compared with fall levels. Groundwater level data from the NASb RMS, with use of supplemental monitoring sites, was used to create spring and fall 2022 groundwater contour maps.

Change in Groundwater Storage

The change in groundwater storage in the Subbasin was estimated through the difference of groundwater contours for both spring (annual high) and fall (annual low) for 2022 as compared to the same periods in 2021. The spring-to-spring change in storage is estimated at -67,300 AF and the fall-to-fall change in groundwater storage is estimated at -8,600 AF. Change in groundwater storage was also estimated using the regional groundwater model. The model estimated a slight positive change at the end of the WY (fall-to-fall) at about 3,600 AF.

GSP Implementation

The NASb 2021 GSP was adopted and submitted to DWR in January 2022 and the GSAs have had just a year to begin implementation of the plan. GSAs have begun to implement projects and management actions in accordance with the schedule identified in the GSP during this first year of GSP implementation. Implementation actions, along with their current status, are show in **Appendix B** of this report.

Sustainability Indicators

After the three recent and consecutive dry years (drought years), GSAs have observed some minimum threshold (MT) exceedances for the chronic lowering of groundwater, land subsidence, and depletions of interconnected stream sustainability indicators at a few NASb RMS locations. However, the Subbasin is not experiencing undesirable results for any of the sustainability indicators. Sustainability indicators, along with the Subbasins sustainable management criteria, are discussed in detail in **Chapter 8, *Sustainable Management Criteria***, of the 2021 NASb GSP (SGA, 2021).

1. Introduction

1.1 Purpose

The purpose of this report is to summarize Water Year (WY) 2022 (October 1, 2021 – September 30, 2022) conditions and groundwater management in the North American Subbasin (NASb or Subbasin). The NASb Groundwater Sustainability Agencies (GSAs) submitted the adopted Groundwater Sustainability Plan (GSP) for review by the California Department of Water Resources (DWR) on January 24, 2022. This report represents the second required Annual Report under the Sustainable Groundwater Management Act (SGMA) of 2014.

1.2 North American Subbasin

The NASb is identified by DWR in Bulletin 118 as Subbasin No. 5-021.64 (DWR, 2003). The Subbasin is part of the greater Sacramento Valley region of California. The location of the Subbasin and surrounding subbasins are shown in **Figure 1-1.** The Subbasin encompasses an area of about 342,516 acres (535 square miles) in Sacramento, Placer, and Sutter counties. The NASb is bounded on the north by the Bear River, on the south by the American River, to the west by the Feather and Sacramento rivers, and on the east by the Sierra Nevada foothills (**Figure 1-1**).

1.3 North American Subbasin GSAs

The Subbasin is managed by five GSAs that cover the entire Subbasin (**Figure 1-1**) and is comprised of:

- Reclamation District 1001 (RD 1001)
- Sacramento Groundwater Authority (SGA)
- South Sutter Water District (SSWD)
- Sutter County
- West Placer

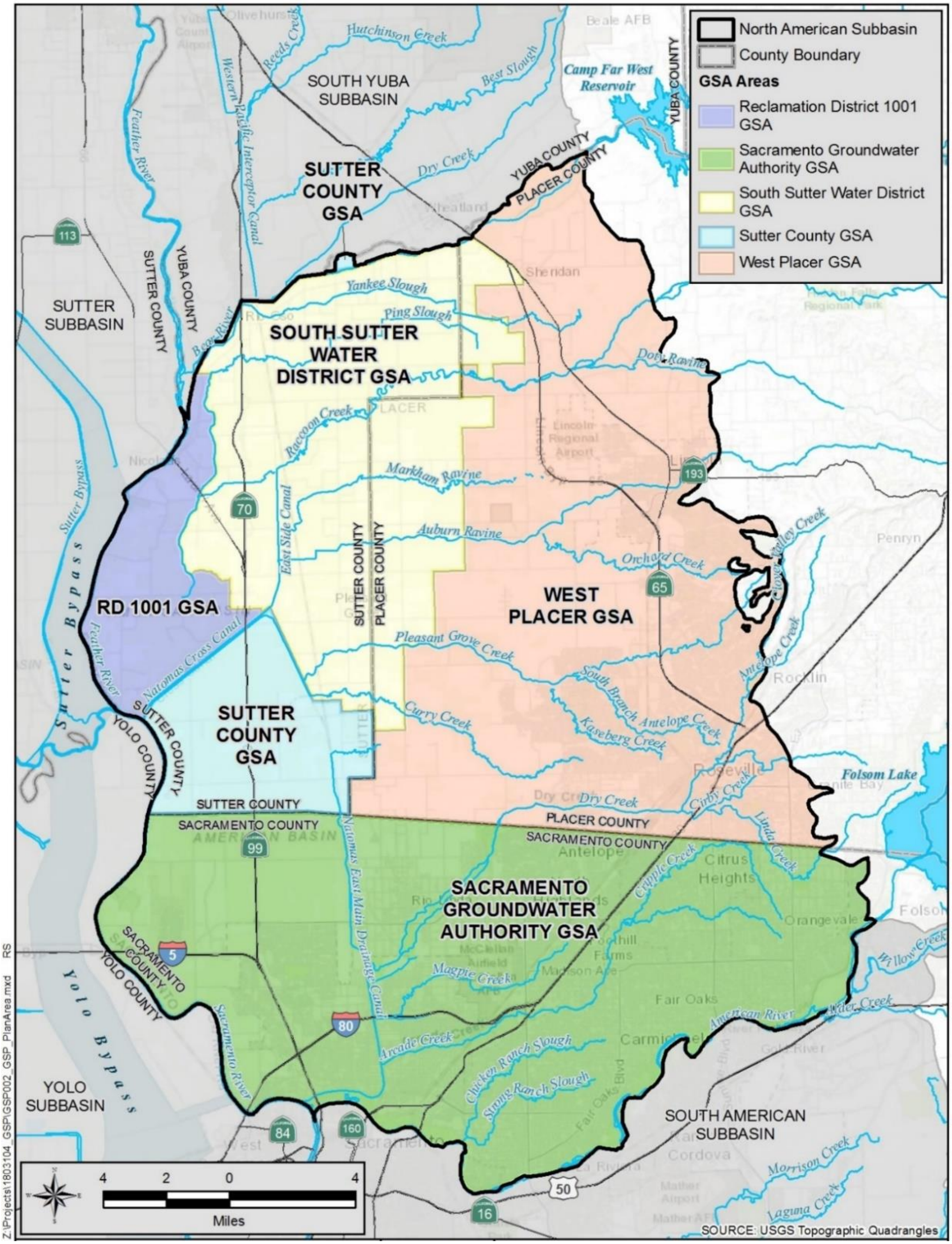
1.4 Organization of this Report

The requirements of an Annual Report are provided in the California Water Code § 10728 and further defined in California Code of Regulation, Title 23, Division 2, Chapter 15., Subchapter 2., § 356.2. Organization of this report is meant to follow the regulations where possible to assist in the review of the document. Sections of the WY 2022 Annual Report include the following:

- **Section 1. Introduction:** a brief background of the Subbasin GSAs and a location map.
- **Section 2**. **Hydrologic Conditions:** a summary of WY 2022 precipitation, runoff, and temperature.
- **Section 3. Water Supply:** a summary of the sources and uses of supply/delivery.

- **Section 4. Groundwater Levels:** a summary of groundwater levels at individual monitoring wells in response to hydrologic supply and demand conditions, including contour maps of annual highs and lows.
- **Section 5. Change in Groundwater Storage:** a description of the methodologies and presentation of changes in groundwater storage.
- **Section 6. GSP Implementation:** a summary of progress toward implementing management activities and projects and management actions since adoption of the GSP.
- **Section 7. Sustainability Indicators:** a summary of the status of adopted sustainability indicators for the Subbasin.
- **Section 8. References.**

Figure 1-1. North American Subbasin



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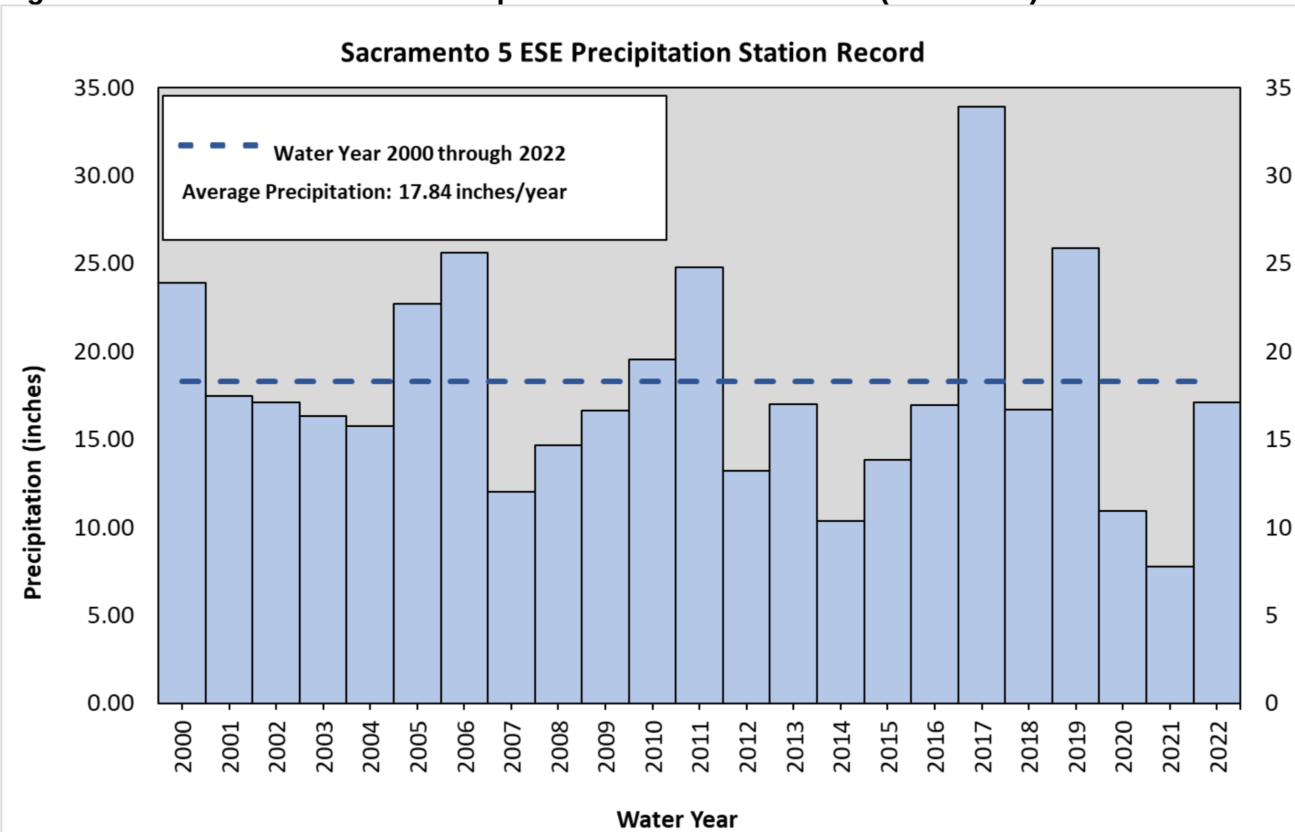
2. Hydrologic Conditions

This section provides a brief description of the Subbasin hydrologic conditions in WY 2022. In the last three years, the NASb, the state of California (State), and other western states have been experiencing abnormally dry hydrologic conditions. In WY 2021, the Governor of California issued multiple proclamations of a state of emergency related to drought which included the April 21, 2021, proclamation (Executive Department State of California, 2021a) that added three counties located within the NASb to the drought emergency (e.g., Placer, Sacramento, and Sutter). On October 19, 2021, the Governor expanded prior drought emergency proclamations to include the remaining counties thus extending the drought emergency to cover all 58 counties within the State (Executive Department State of California, 2021b).

2.1 Precipitation

In the beginning of WY 2022, the northern portion of the State experienced a Category 5 atmospheric river storm in October. The storm set a new daily precipitation record in Sacramento, which is located within the Subbasin, of 5.40 inches. Sacramento also set a record earlier in the month of October for 212 consecutive days with no precipitation (DWR, 2022). The State also experienced very high levels of snowfall in parts of the Sierra Nevada's in December, with the University of California's Central Sierra Snow Laboratory near Donner Pass recording more than 16 feet of snow, and its driest January through April on record (DWR, 2022). Overall, WY 2022 received about 76 percent of average precipitation, which is an increase from WY 2021's average statewide precipitation of 50 percent (DWR, 2022). Precipitation is measured at 29 stations in the Subbasin, although many of the stations do not have a long period of record. The closest station to the Subbasin with a long period of record, dating back into the 1880s, is the Sacramento 5 ESE station, which is just south of the Subbasin, but is representative due to its relative close geographic location. The average precipitation at the Sacramento 5 ESE station, using recent years that may be more representative of current and potentially future conditions with climate change (e.g., WYs 2000 through 2021), is 17.84 inches. During WY 2022, annual precipitation was 17.10 inches, less than 1 inch under average precipitation (**Figure 2-1**).

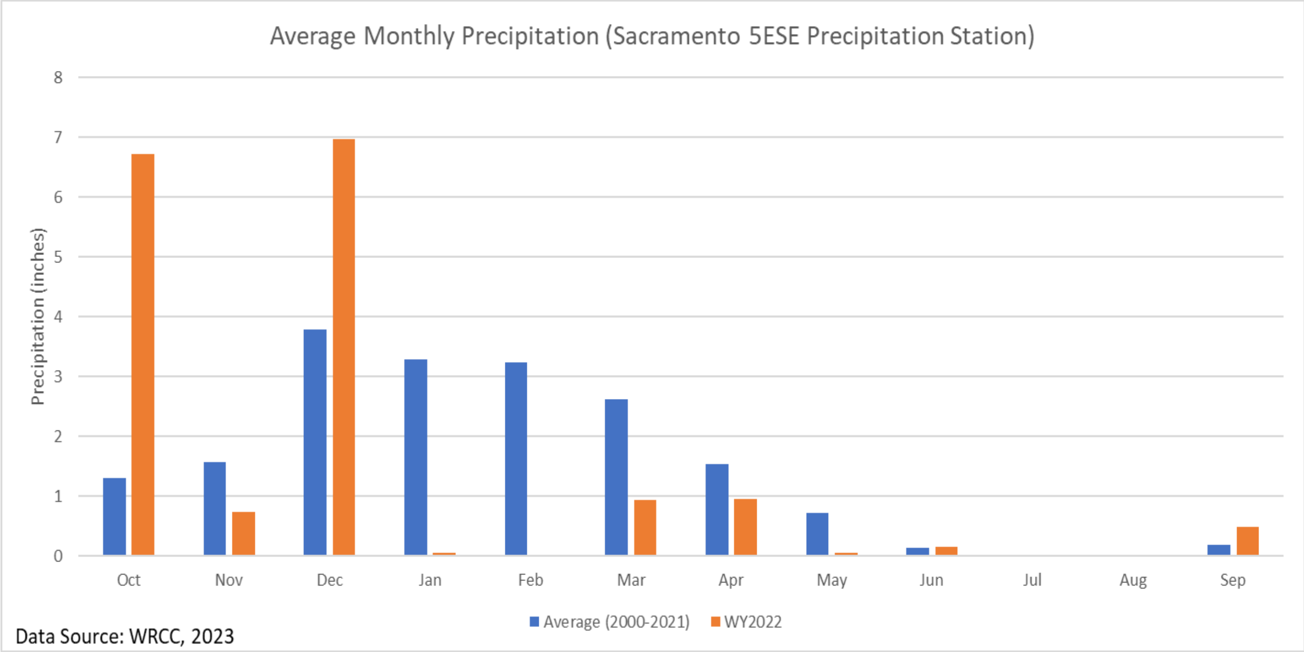
Figure 2-1. Sacramento 5 ESE Precipitation Station Water Year (2000-2022) Record



Source: WRCC, 2023

As shown in **Figure 2-2** below, 6 of the 12 months in WY 2022 (e.g., November, January, February, March, April, and May) were below the monthly precipitation average and 4 months (e.g., October, December, June, and September) were above the monthly average for WYs period 2000 through 2021. The remaining 2 months (e.g., July and August) in WY 2022 had no precipitation, similar to their monthly average for this period.

Figure 2-2. Sacramento 5 ESE Precipitation Station Monthly Record



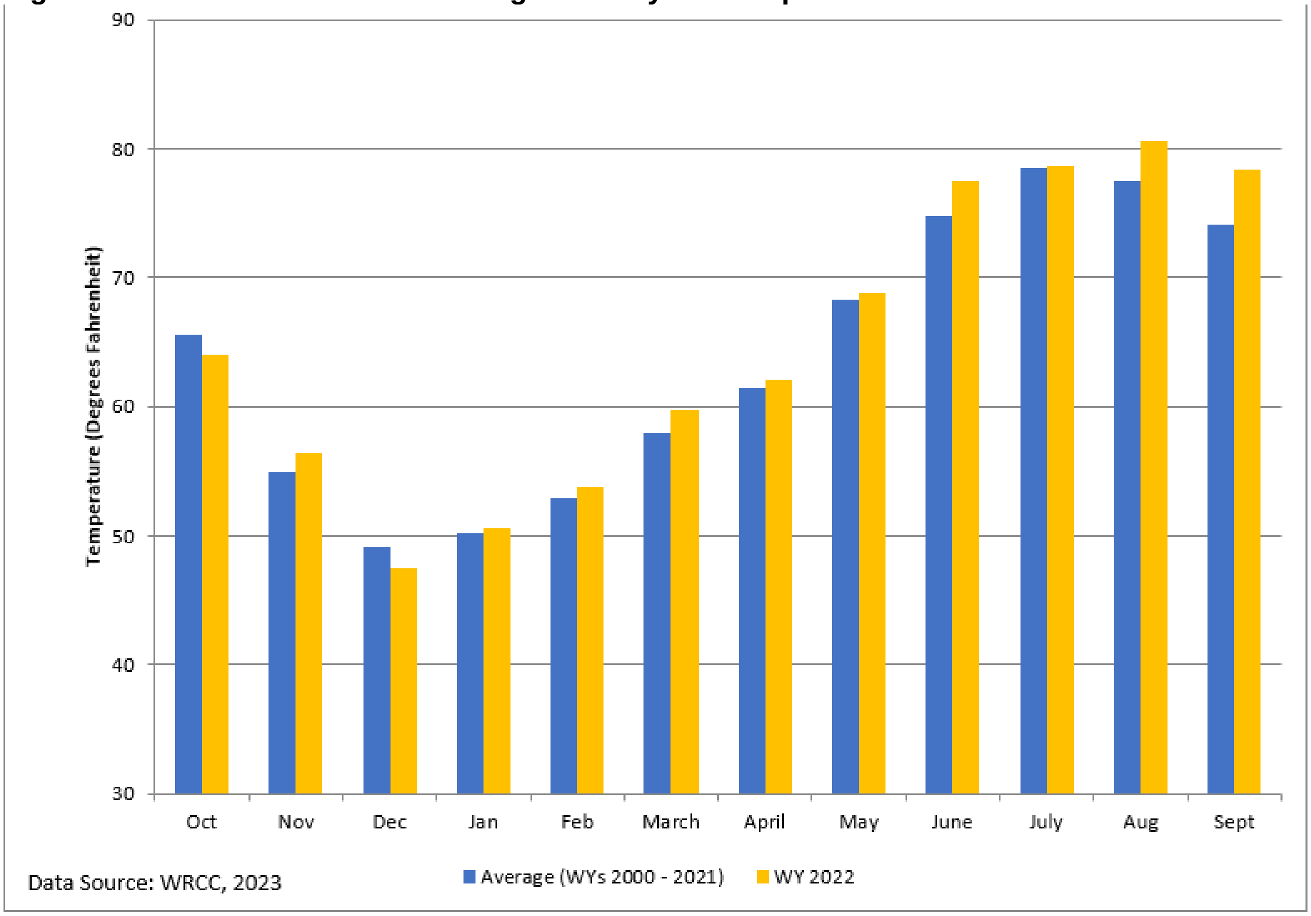
2.2 Runoff

Water Year 2022 was below average based on statewide runoff; this was preceded by WY 2021, which was California's second driest year on record. The Sacramento Valley Water Year Index is calculated by DWR on a WY basis. Water Year 2022 has been preliminarily classified as a critical water year (hereby referred to as critically dry year), with only 4.55 million acre-feet (MAF) of runoff compared to a 1991 to 2021 average of 7.90 MAF.

2.3 Temperature

The average annual air temperature at the Sacramento 5 ESE station in WY 2022 was approximately 0.05 degrees Fahrenheit (°F) warmer than the 2000 through 2021 average (63.83 compared to 63.88 °F, respectively). Ten of the 12 months in WY 2022 exceeded the 2000 through 2021 average temperature for the same month as shown in **Figure 2-3**.

Figure 2-3. Sacramento 5 ESE Average Monthly Air Temperature



3. Water Supply

This section describes the total water supply, also referred to as deliveries, by source and the total water use by sector. In addition, this section provides a description of groundwater recharge and recycled water.

3.1 Water Supply by Source

Total water supply for WY 2022 was determined from a few sources including metered surface water deliveries, metered and estimated (modeled) groundwater production which are discussed in detail below.

3.1.1 Surface Water Supply

On a monthly basis, metered surface water deliveries were reported by public water suppliers and for agriculture by SSWD, Pleasant Grove-Verona Mutual Water Company, Natomas Central Mutual Water Company, Nevada Irrigation District, and Placer County Water Agency. Smaller riparian diversions for private use and tailwater reuse of surface water was estimated by the regional Cosumnes, South American, and North American subbasins integrated groundwater model (CoSANA). In addition to surface water supply, the cities of Roseville, Lincoln, and Placer County report metered recycled water.

3.1.2 Groundwater Supply

Metered groundwater production was reported monthly by public water suppliers. Metered groundwater remediation was also reported for the former McClellan Air Force Base and a portion of Aerojet sites with respect to remediation pumping that occurs north of the American River within the Subbasin. Agricultural groundwater pumping is conducted by private landowners and is largely unmetered.

The remaining groundwater pumping by private landowners was estimated through groundwater modeling (i.e., CoSANA). In general, to estimate the groundwater pumping in agricultural areas, water supplies (e.g., precipitation, metered groundwater pumping, and metered surface water diversions) were subtracted from the total crop evapotranspiration demands resulting in the remaining water deliveries that are estimated to be used for groundwater pumping for agriculture and agricultural-residential uses. It should be noted that for agriculture, the latest WY 2022 land use/crop type areas were not available at the time of the model run. To estimate agricultural groundwater extractions, a 2014 land use pattern was assumed because that year had a significant idling of agricultural acres due to drought conditions and limited water supply.

Estimated total water deliveries for WY 2022 are shown in **Table 3-1** below. Groundwater met about 50 percent of the total water demand in the Subbasin in WY 2022. This is comparable to the recent 10-year average[1] using the CoSANA model results for WYs 2009 through 2018. Total demand met by groundwater was about 50 percent, which represented a reduction of 10 percent when compared to last

[1] This was the recent 10-year period used to represent current conditions during development of the GSP and is used here for comparison purposes.

year's approximate 60 percent. The remaining deliveries were primarily made from surface water, with less than 1 percent of recycled water being reused for non-potable water demands in the NASb.

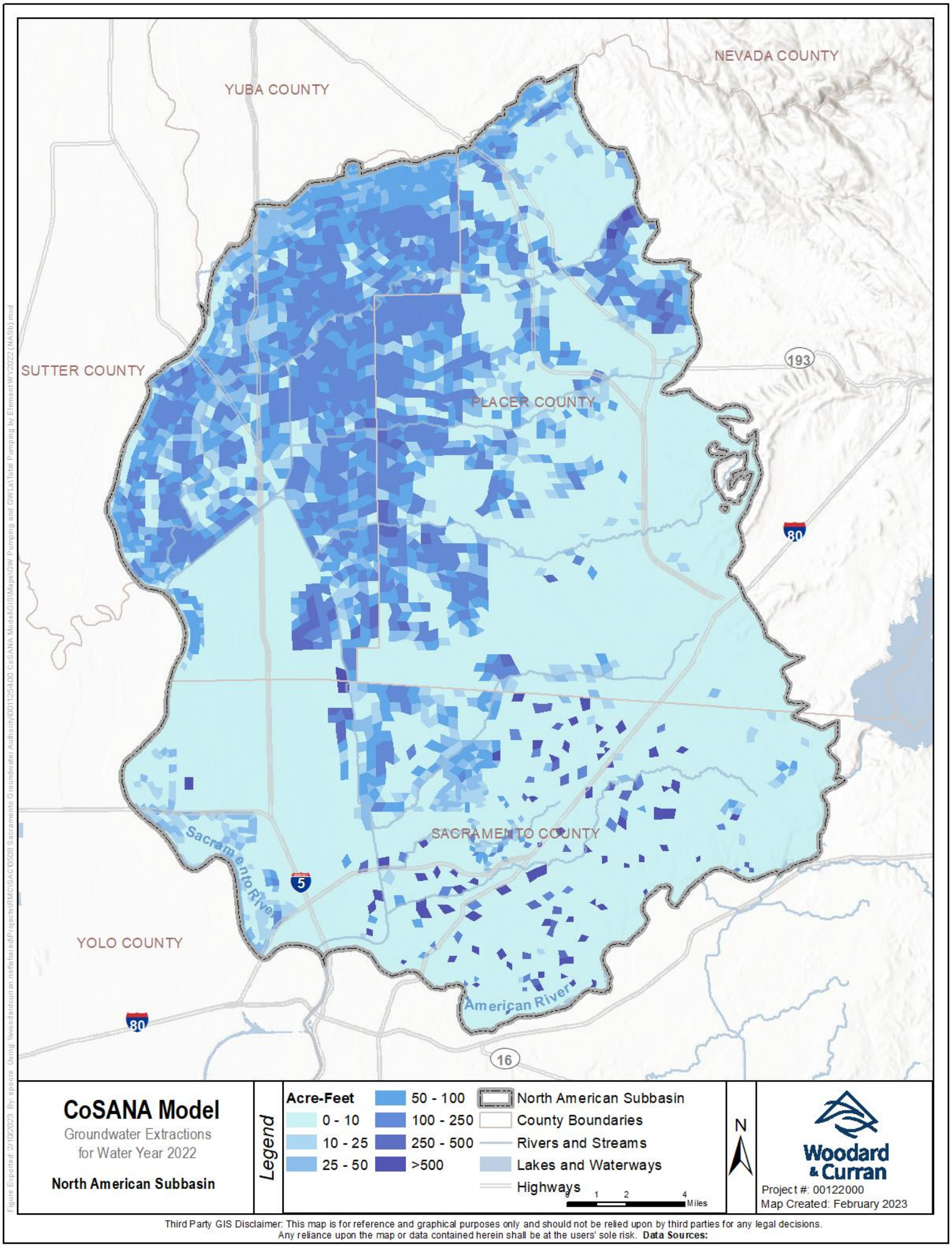
Table 3-1. Water Year 2022 Total Water Supply

Month	Groundwater (AF)	Surface Water (AF)	Remediation (AF)	Recycled Water (AF)	Total (AF)
Oct-21	14,800	12,200	600	225	27,830
Nov-21	22,100	10,400	600	12	33,110
Dec-21	10,100	6,800	700	13	17,610
Jan-22	6,500	5,900	600	13	13,010
Feb-22	9,700	6,400	600	15	16,710
Mar-22	11,000	7,900	600	169	19,670
Apr-22	20,200	17,200	600	119	38,120
May-22	49,900	51,000	600	421	101,920
Jun-22	46,500	45,800	600	543	93,450
Jul-22	43,100	53,400	600	497	97,600
Aug-22	40,400	48,900	600	398	90,300
Sep-22	18,600	21,600	600	304	41,100
Total WY 2022	**292,900**	**287,500**	**7,300**	**2,730**	**590,430**

Notes: AF = acre feet; WY = Water Year
Source: Woodard & Curran, 2023

Based on results from the CoSANA model, the general location and volume of groundwater extractions in the Subbasin are shown in **Figure 3-1** below.

Figure 3-1. Location and Volume of Groundwater Extractions



Source: Woodard & Curran, 2023

3.2 Water Use by Sector

This section summarizes the total annual groundwater and surface water used to meet urban/industrial and rural/agricultural demands, and remedial cleanup activities in the Subbasin. The total water uses in the Subbasin, by source and water use sector for WY 2022, is summarized in **Table 3-2** and includes both the method of measurement and estimated level of accuracy for each sector.

For WY 2022, urban/industrial uses accounted for about one-third of total demand in the Subbasin. These uses include residential, commercial, industrial, and institutional (CII) demands, and groundwater remediation extractions. Of the 292,900 AF of reported groundwater extraction, about 30 percent (85,200 AF) was used for urban/industrial uses, with roughly 7,300 AF of this water being pumped for remediation activities. Of the total urban/industrial water use, about 70 percent (54,000 AF) is estimated to be for residential uses, with the remaining 30 percent (23,400 AF) being for CII uses[2] and groundwater remediation. In general, nearly all urban and industrial sectors utilize direct meter measurements, with an accuracy of about 95 percent. There are some urban uses (e.g., golf courses and parks) that are not directly metered and the overall average accuracy of the urban users of groundwater is about 90 percent.

For WY 2022, rural/agricultural uses accounted for about two-thirds of total water demand in the Subbasin. These uses include agricultural, residential (domestic well owners), managed wetlands, and other rural uses. Of the 292,900 AF of reported groundwater extraction, about 70 percent (207,700 AF) was used for rural/agricultural uses. For the rural/agricultural sector, 10 percent of groundwater extractions are metered, with the remaining 90 percent being estimated by the CoSANA model. The overall estimated accuracy for groundwater use is about 80 percent. Extractions to meet managed wetland demands are included in the CoSANA model as part of the overall agricultural demand. for surface water, about 80 percent of diversions are directly measured through meters and weirs. The remaining 20 percent of surface water diversions are estimated. This results in an estimated accuracy of about 85 percent for surface water. Recycled water for use by agriculture is directly measured with a meter and the level of accuracy is estimated to be about 95 percent.

[2] This 70/30 ratio of residential to CII uses was determined by downloading monthly water conservation and production reports from the State Water Resources Control Board at: https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/conservation_reporting.html. Monthly WY 2022 data for NASb public water suppliers was filtered from the data and a weighted average for the NASb was calculated for residential uses. Non-residential uses were classified as CII.

Table 3-2. Water Year 2022 Total Water Use by Water Sector

Urban/Industrial Sector				
Month	**Groundwater (AF)**	**Surface Water (AF)**	**Recycled Water (AF)**	**Total (AF)**
Oct-2021	6,200	8,700	10	14,910
Nov-2021	5,900	5,100	10	11,010
Dec-2021	4,600	5,300	10	9,910
Jan-2022	3,900	5,900	10	9,810
Feb-2022	4,400	6,100	10	10,510
Mar-2022	5,300	7,900	10	13,210
Apr-2022	5,400	8,100	10	13,510
May-2022	7,700	10,900	20	18,620
Jun-2022	8,500	12,900	30	21,430
Jul-2022	10,700	13,100	40	23,840
Aug-2022	12,000	13,200	30	25,230
Sep-2022	10,600	11,100	20	21,720
Total WY 2022	**85,200**	**108,300**	**210**	**193,710**
Method	Metered	Metered	Metered	
Accuracy	90%	95%	95%	
Agricultural/Rural Sector				
Month	**Groundwater (AF)**	**Surface Water (AF)**	**Recycled Water (AF)**	**Total (AF)**
Oct-2021	8,600	3,500	220	12,310
Nov-2021	16,200	5,300	0	21,500
Dec-2021	5,500	1,500	0	7,000
Jan-2022	2,600	0	0	2,600
Feb-2022	5,300	300	0	5,600
Mar-2022	5,700	0	160	5,860
Apr-2022	14,800	9,100	110	24,010
May-2022	42,200	40,100	400	82,700
Jun-2022	38,000	32,900	520	71,420
Jul-2022	32,400	40,300	460	73,160
Aug-2022	28,400	35,700	370	64,470
Sep-2022	8,000	10,500	280	18,780
Total WY 2022	**207,700**	**179,200**	**2,520**	**389,420**
Method	~10% Metered ~90% Estimated	~80% Metered or Gaged ~20% Estimated	Metered	
Accuracy	80%	85%	95%	

Notes: AF = acre feet; WY = Water Year
Source: Woodard & Curran, 2023

3.3 Surface Water Used for Recharge

Several agencies in the NASb have access to both surface water and groundwater and are able to practice conjunctive use programs to adapt to changing hydrologic conditions. The SGA GSA developed a Water Accounting Framework to promote conjunctive use operations in the central SGA area. The framework provides groundwater extraction targets and tracks surface water that is used to reduce groundwater demand targets. The SGA considers surface water used for conjunctive use as in-lieu recharge within the Subbasin. For WY 2022, the SGA did not provide an updated accounting of surface water used for recharge but anticipates having updated information for the next annual report.

The city of Roseville used their Aquifer Storage and Recovery wells to recharge about 200 AF of surface water in WY 2022.

4. Groundwater Levels

This section provides groundwater level monitoring results through hydrographs and groundwater contours. Data included in this section is expressed by groundwater elevations.

Groundwater levels within the Subbasin was obtained from various entities including NASb GSAs and DWR. Additionally, reports submitted by various agencies with groundwater quality monitoring programs overseen by the Regional Water Quality Control Board were also used. Groundwater level measurements taken during WY 2022 were uploaded to the SGMA portal and are contained in the NASb data management system.

4.1 Groundwater Contours

Spring (annual high) and fall (annual low) water-level elevation contours were prepared for the principal aquifer for WY 2022 to illustrate groundwater conditions in the Subbasin. The annual low groundwater contours were developed using October 2022 groundwater level measurements, even though they are outside of the defined WY, because they represent groundwater conditions resulting from pumping during WY 2022.

Groundwater level data from 69 wells in the NASb, including all 41 GSP representative monitoring sites (RMS), were used to create the spring and fall 2022 groundwater elevation contour maps and data from the South American (4 wells) and Yuba subbasins (4 wells) were used to better align groundwater contours with adjacent subbasins. The contour maps and the locations of monitoring wells used in their creation are shown in **Figures 4-1 and 4-2** below.

Groundwater levels were generally lower in the fall than in the spring due to summer groundwater pumping. Groundwater flow direction is generally toward the center of the Subbasin where a pumping depression has been present for decades. In the spring, groundwater elevations ranged from near 200 feet above mean sea level (msl) in the eastern part of the Subbasin down to -35 feet below msl in Sacramento County near the former McClellan Air Force Base.

Figure 4-1. Spring 2022 Groundwater Elevation Contour Map

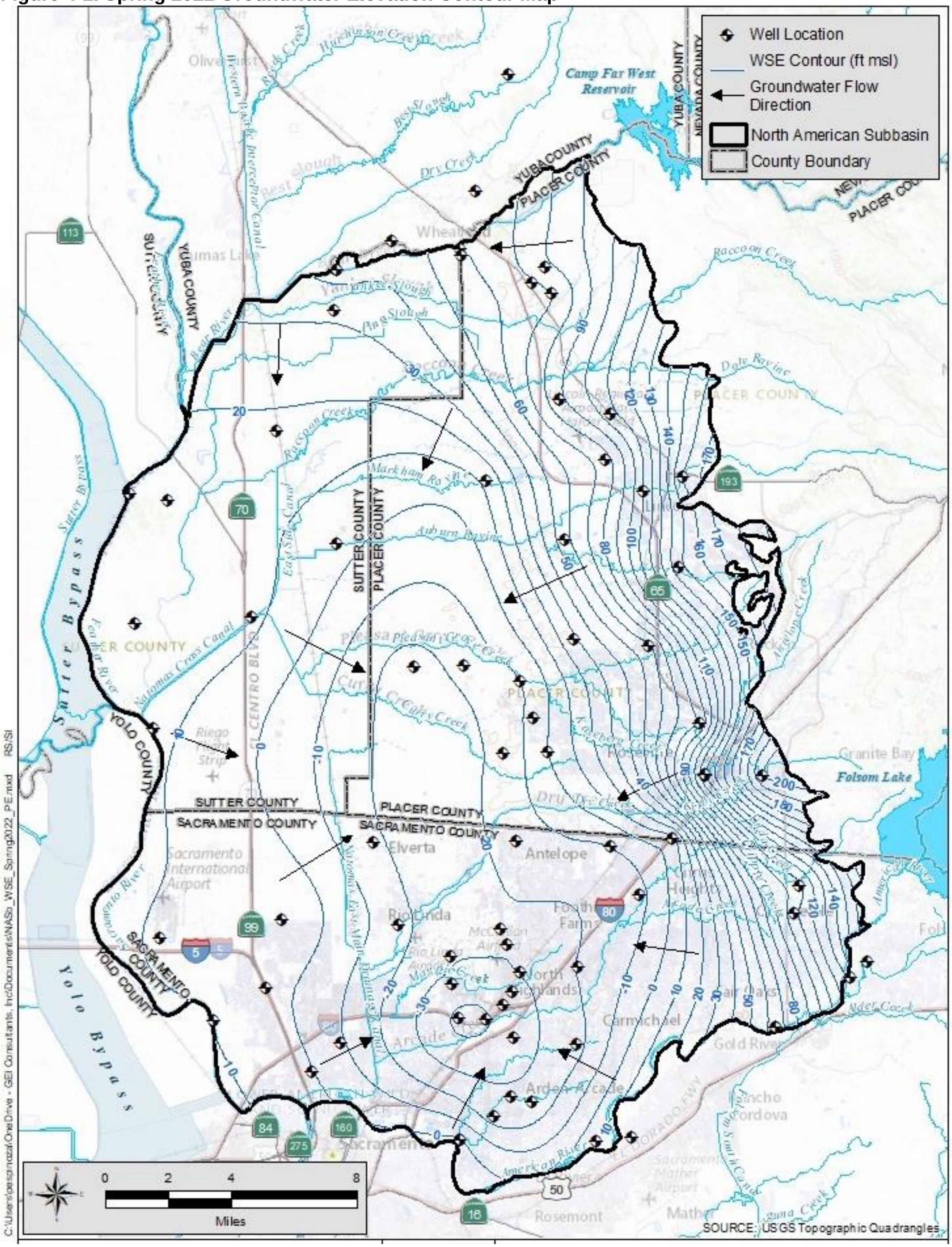
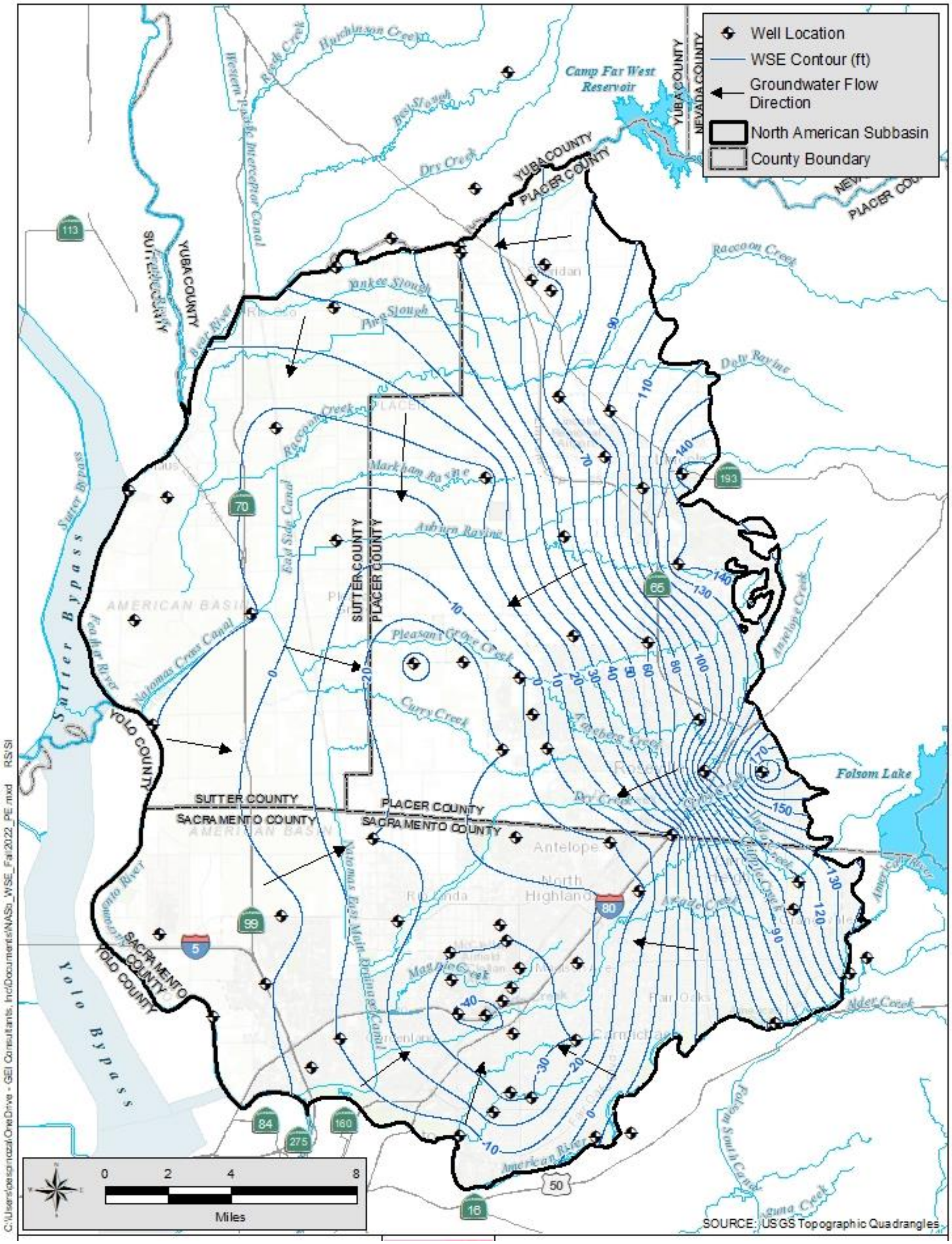


Figure 4-2. Fall 2022 Groundwater Elevation Contour Map



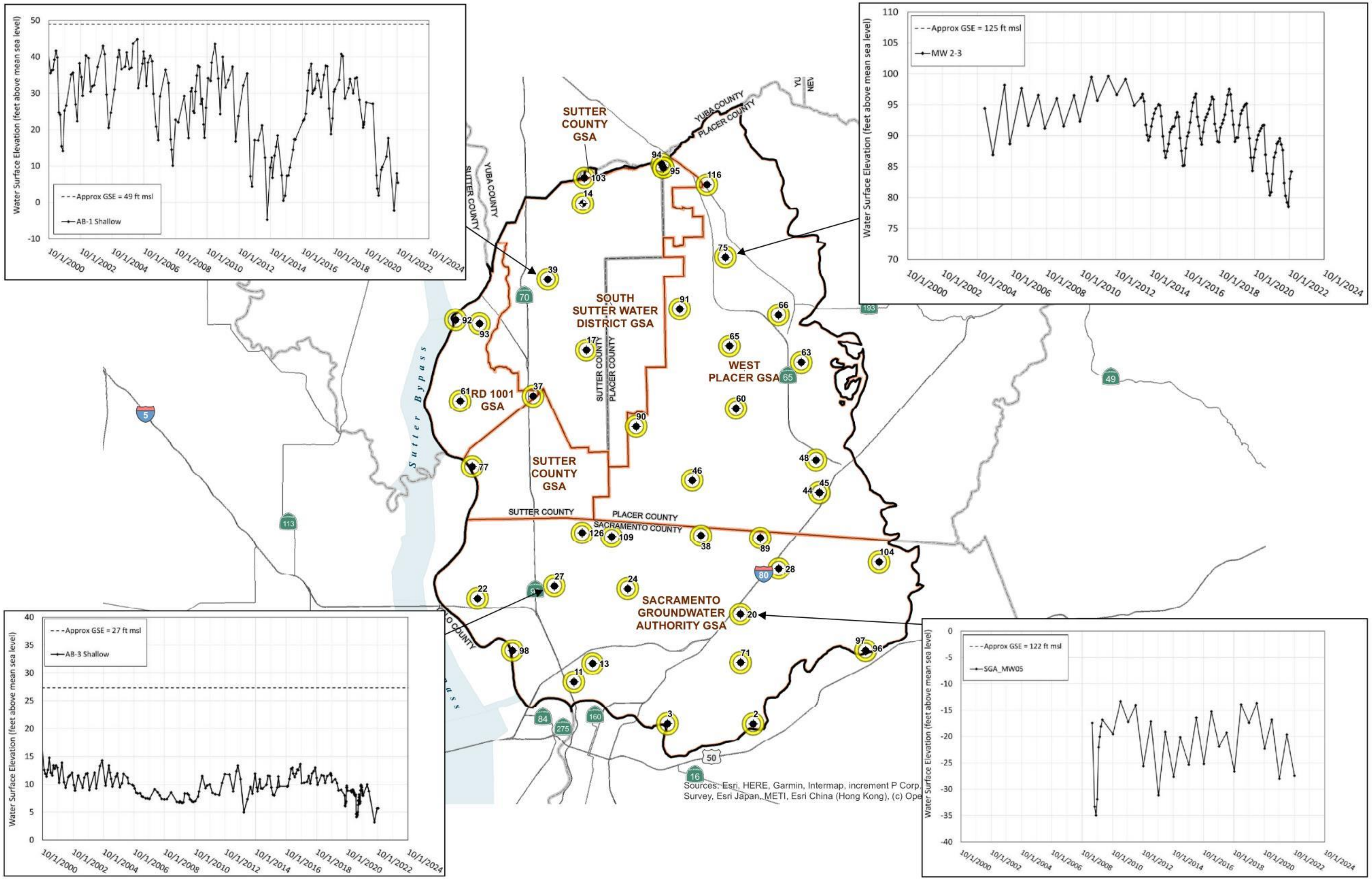
4.2 Hydrographs

Positive and negative changes in groundwater elevations from year to year are observed in various parts of the Subbasin, as has been observed historically. Seasonal trends of slightly higher spring groundwater elevations compared with fall levels are observed annually as reflected in hydrographs.

Hydrographs for all 41 GSP RMS wells and their established minimum thresholds (MTs) are shown in **Appendix A** of this report and include groundwater levels through the end of WY 2022 (generally measured in October of each year). A few of the hydrographs are shown in **Figure 4-3** below and provide a general representation of changes in groundwater levels during WY 2022 at RMS wells in different locations in the basin. Overall, the hydrographs show a downward trend in groundwater levels since 2020, when the recent drought began; however, fall 2022 levels were found to be similar to fall 2021 in large part likely a result of reduced groundwater pumping. The groundwater elevations for most of the wells remained above their respective MT through WY 2022. This is discussed further in **Section 7, *Sustainability Indicators***.

As documented in section 8 of the NASb GSP, the GSAs collect additional data when a MT is exceeded to support an investigation of potential causes and effects of that exceedance. Specifically, during late calendar year 2022, the NASb GSAs collected additional water level data from select RMS wells where MT exceedances were observed in WY 2022. Water levels were higher in all the RMS wells measured during this timeframe and likely benefited from recent rain events. This proactive adaptive management effort by the GSAs in combination with water level measurements in Spring and Fall 2023 will enable the GSAs to further understand groundwater elevation trends in these wells. It is anticipated this additional monitoring data will be provided in the WY 2023 annual report.

Figure 4-3. Regional Representative Hydrographs



Source: ESRI, 2023

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5. Change in Groundwater Storage

The change in groundwater in storage was estimated by using the following two methods: 1) comparing changes in groundwater elevation contour maps, and 2) using the CoSANA groundwater flow model. Each method and its results are described below.

5.1 Change in Storage Calculated from Groundwater Levels

Annual change in groundwater storage was determined for both the spring and fall 2022 periods by using measured groundwater levels at a consistent set of wells measured in 2021 (2022 groundwater map development is discussed in **Section 4.1, *Groundwater Contours***). For each season, a change in groundwater levels comparing 2021 to 2022 was prepared (**Figures 5-1 and 5-2**). Comparing yearly changes in groundwater level data is a useful and widely used analysis to estimate the magnitude of or change in groundwater use and combined with an estimate of aquifer conditions, it can be used to provide an estimated change in groundwater storage as described below. The difference in groundwater elevation maps was then used to calculate a weighted average change in groundwater levels throughout the Subbasin for both seasons. The average change in groundwater levels was then multiplied by the average specific yield of the Subbasin, which was estimated at 8.40 percent based on textural analysis of well driller logs as part of development of DWR's Sacramento Valley Simulation (SVSim) Model. The resulting calculated change in groundwater storage from spring 2021 to spring 2022 dropped by an estimated 67,300 AF, but the change in groundwater storage at the end of WY 2022 (fall 2021 – fall 2022) only dropped by about 8,600 AF. This information is shown in **Table 5-1**. In early 2022 due to the lack of rain, crops were planted earlier thus increasing the estimated spring groundwater pumping by about 4,200 AF in comparison to 2021. This pumping contributed to the lower levels in the spring of 2022 when compared to spring 2021. The crops also matured and were harvested earlier, which resulted in groundwater pumping being 6,800 AF less in September, prior to the October level measurement.

Table 5-1. WY 2022 Estimated Change in Groundwater Storage from Groundwater Level Difference Contours

Change in Storage Using Water Level Difference Contour Surfaces			
Basin Area (acres)	**Average Water level change (ft)**	**Average Specific Yield [1] (unitless)**	**Change in Storage (AF)[2,3]**
Spring 2021 – Spring 2022			
342,516	-2.34	0.084	-67,300
Fall 2021 – Fall 2022			
342,516	-0.30	0.084	-8,600

Notes: AF = acre feet; ft = feet
[1] Calculated average Specific Yield from DWR SVSim Model
[2] Calculated as Area x Water level change x Specific Yield
[3] The total change in groundwater storage is rounded to the nearest 100 AF

Figure 5-1. Spring 2021 to Spring 2022 Groundwater Level Difference Contours

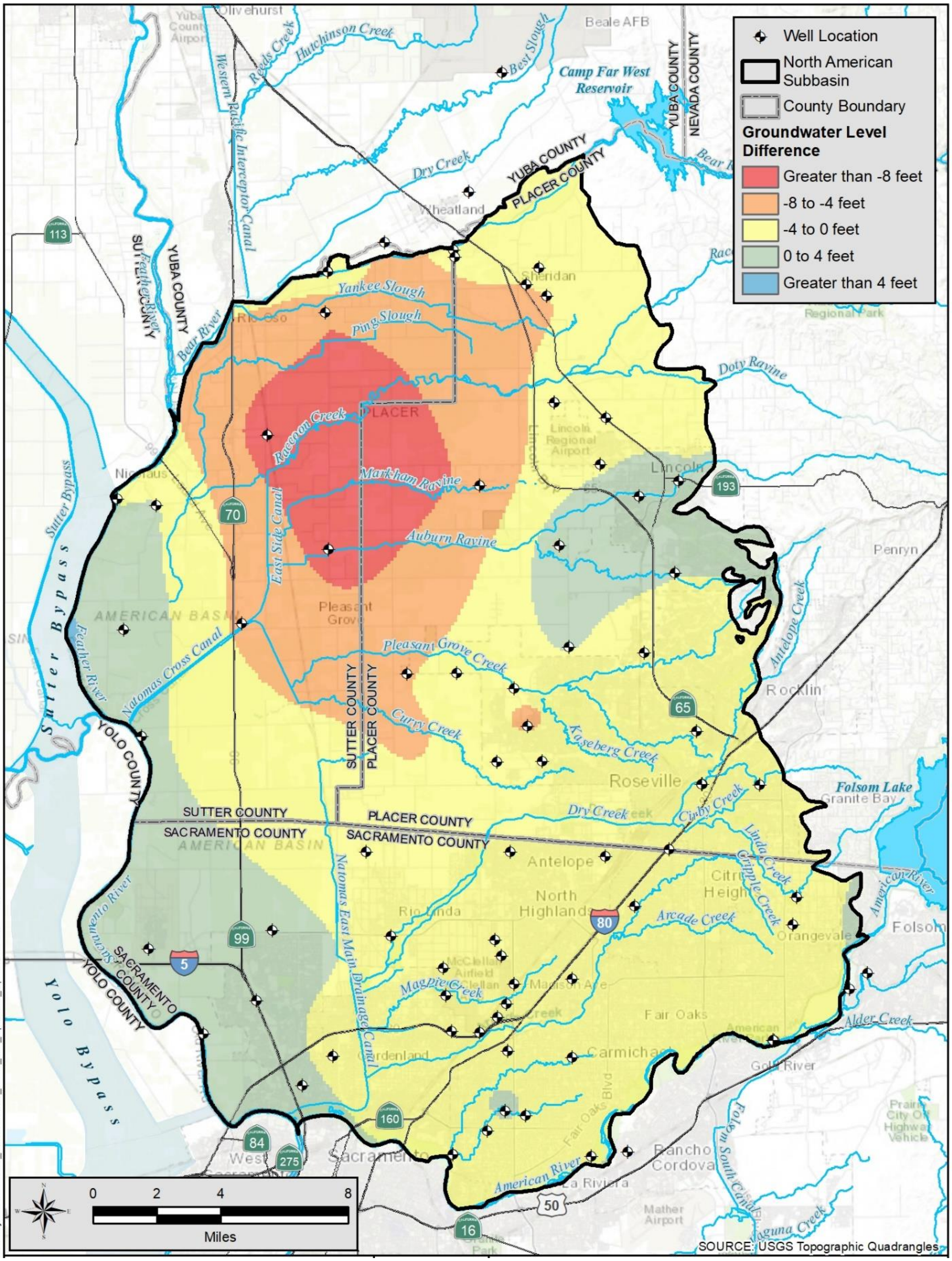
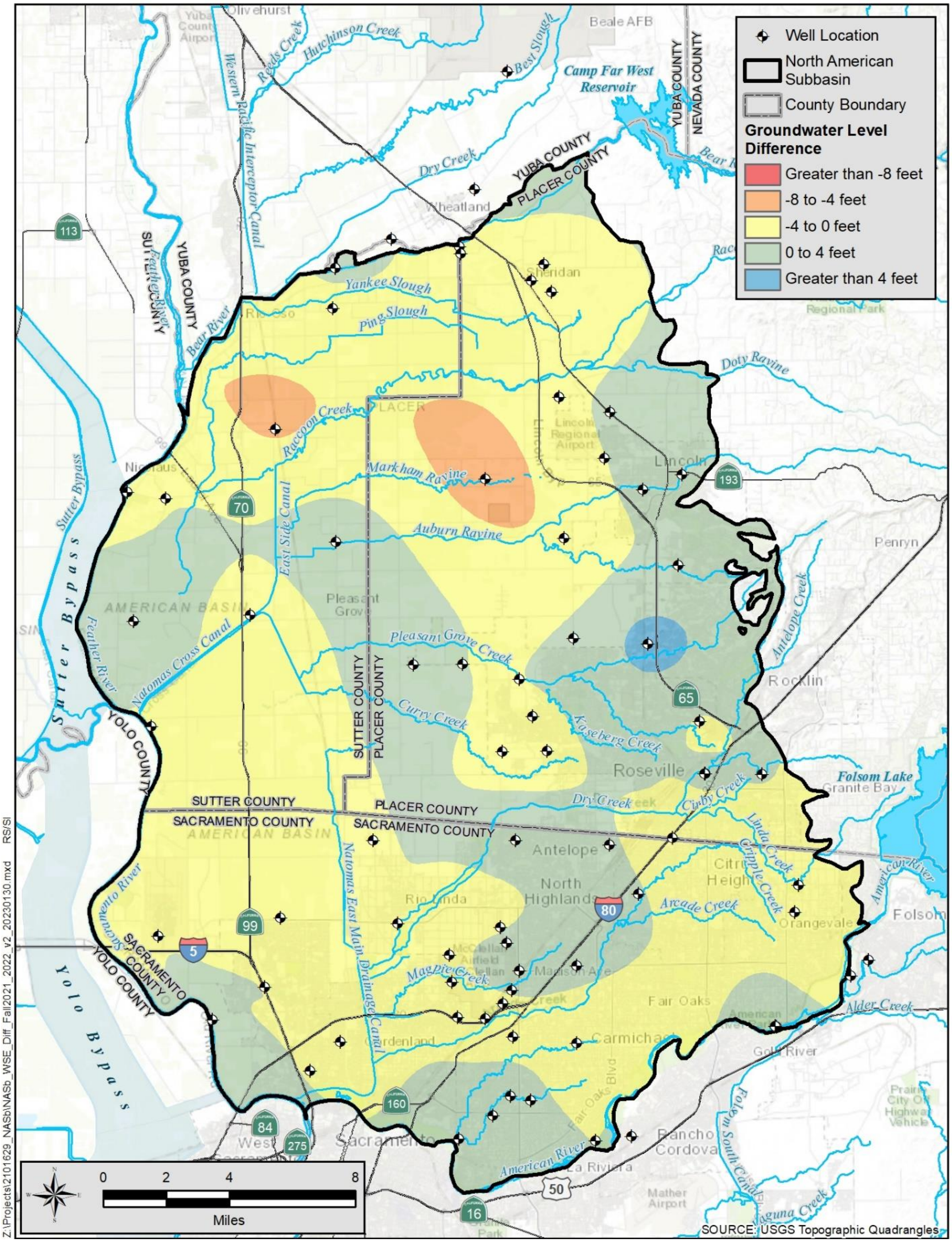


Figure 5-2. Fall 2021 to Fall 2022 Groundwater Level Difference Contours



5.2 Change in Groundwater Storage Calculated from Groundwater Model

The change in groundwater storage was estimated for the entire Subbasin using the calibrated CoSANA groundwater model. The model was used to estimate groundwater pumping for agricultural areas in the Subbasin as a residual of crop evapotranspiration minus precipitation, groundwater pumping and surface water deliveries. Subbasin-wide groundwater pumping and the change in groundwater storage for WYs 2009 through 2022[3] are shown in **Table 5-2**. For WY 2022, the Subbasin had a model estimated positive change in groundwater storage of about 3,638 AF. Over the measured period (WY 2009–2022), the Subbasin still maintains a positive cumulative change in groundwater storage of about 211,000 AF at the end of WY 2022. Some of the decreases are due to only having 3 wet years out of the last 14 years, with the remaining years being below normal to critical dry years as shown in the WY classification in **Table 5-2**.

Annual and cumulative changes in groundwater storage within the Subbasin from WYs 2009 through 2022 are shown in **Figure 5-3**. Groundwater in storage increased from WYs 2009 through 2019, by a little over 430,000 AF. Because of the drought conditions and the resulting higher reliance on groundwater in WYs 2020 and 2021, groundwater in storage was depleted by about 224,000 AF; however, in WY 2022 the changes in groundwater storage were slightly positive.

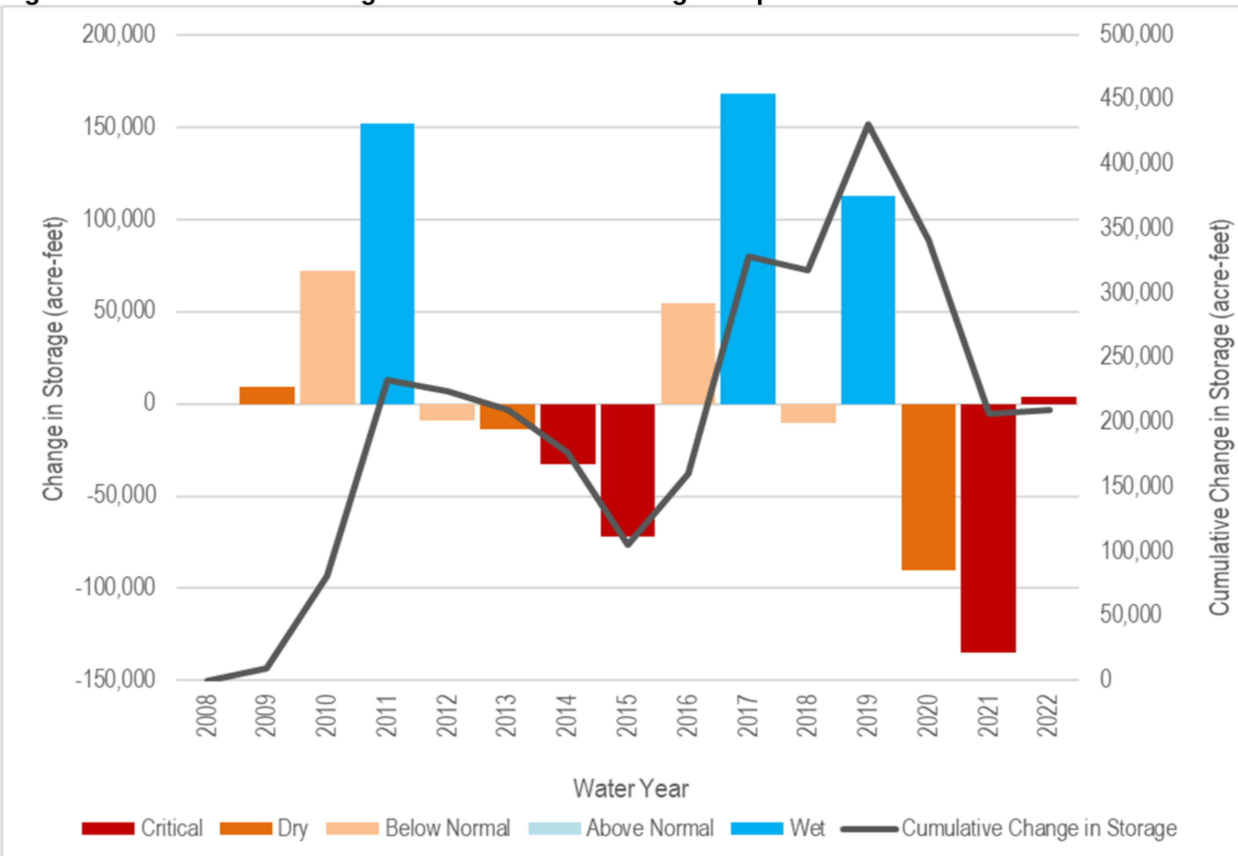
Table 5-2. Model-Estimated Annual Change in Groundwater Storage from WYs 2009–2022

Water Year	Groundwater Extraction (Acre-Feet)	Change in Groundwater Storage (Acre-Feet)	Water Year Classification[1]
2009	313,200	9,100	Dry
2010	273,800	72,400	Below Normal
2011	252,800	151,700	Wet
2012	294,700	-9,200	Below Normal
2013	299,200	-13,800	Dry
2014	302,200	-32,800	Critical
2015	357,700	-71,700	Critical
2016	279,700	54,700	Below Normal
2017	280,000	168,400	Wet
2018	307,900	-10,100	Below Normal
2019	256,900	113,000	Wet
2020	349,900	-89,900	Dry
2021	381,300	-134,200	Critical
2022	300,200	3,638	Critical
Total	4,249,500	211,200	

Notes: [1] Year Type Classification: Index based on flow in million acre-feet:
Wet = equal to or greater than 9.2; Above Normal = greater than 7.8, and less than 9.2; Below Normal = greater than 6.5, and equal to or less than 7.8; Dry = greater than 5.4, and equal to or less than 6.5; Critical = equal to or less than 5.4

[3] WYs 2009–2018 were used as the most recent 10-year period during GSP development; WY 2009 has been used as a starting point for tracking cumulative change in groundwater storage for subsequent years.

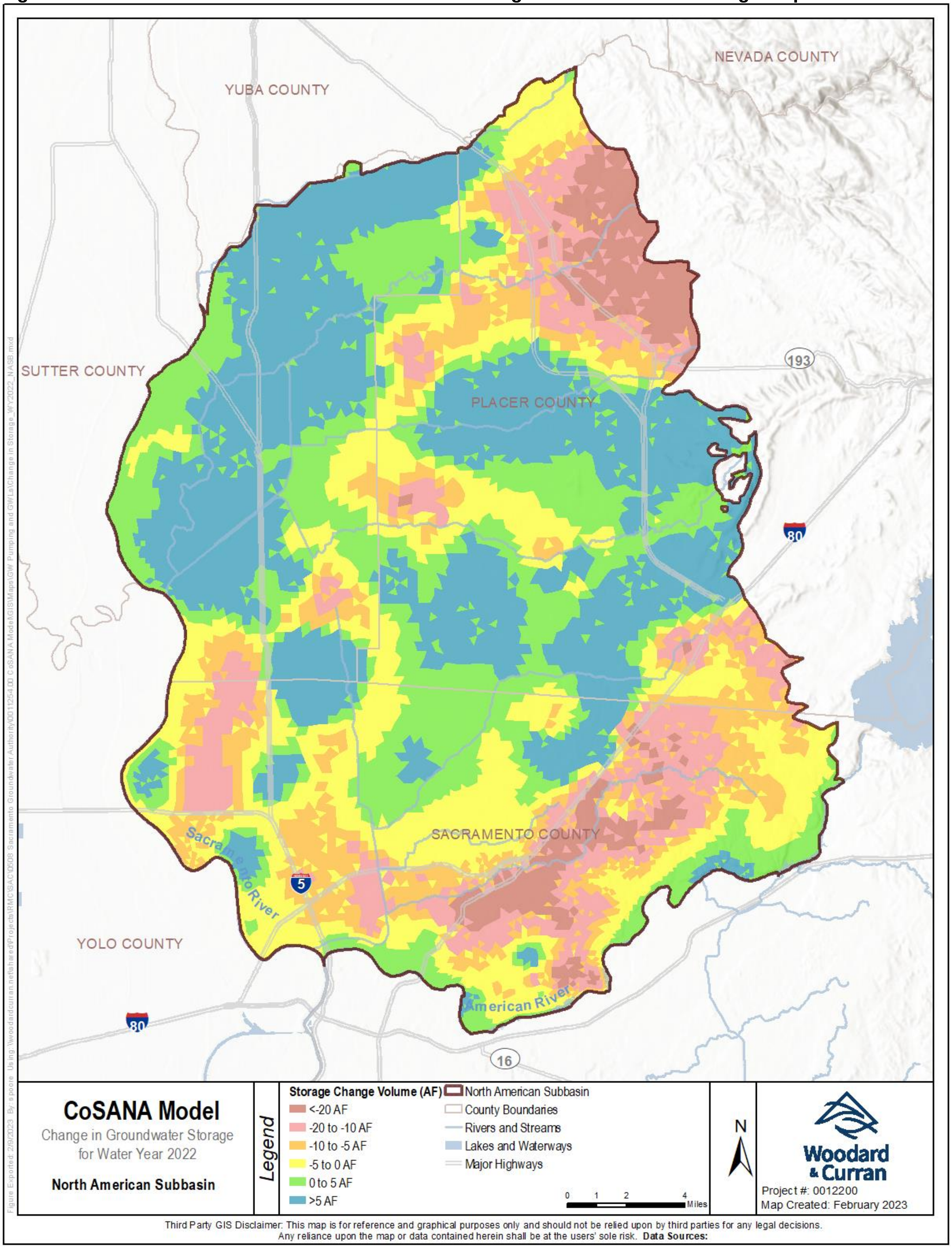
Figure 5-3. Cumulative Change in Groundwater Storage Graph from WYs 2009–2022



Source: Woodard & Curran, 2023

Based on results from the CoSANA model, relative changes in groundwater storage within the Subbasin for WYs 2009 through 2022 are shown in **Figure 5-4**. Data presented in this figure of estimated change of groundwater storage generally follows the differences in groundwater levels presented in **Figure 5-2,** thus increasing confidence of the identified estimated change in groundwater storage.

Figure 5-4. Fall 2021 to Fall 2022 Model Estimated Change in Groundwater Storage Map



Source: Woodard & Curran, 2023

6. GSP Implementation

The Subbasin GSAs agreed to work together and have signed a Memorandum of Agreement (MOA), to protect the groundwater resources of the Subbasin to meet the current and future beneficial uses in the Subbasin by adopting and submitting to DWR a GSP during WY 2022 that conforms with the requirements of SGMA. The status of each project and management action is given in tabular format below. The NASb GSP (and MOA) was submitted on January 24, 2022, to DWR and during this WY. GSAs have begun to implement projects and management actions in accordance with the schedule identified in the GSP. A summary of the progress made toward implementing the projects and management actions with activities planned in WY 2023, is provided in **Table 6-1**.

The Subbasin GSAs held their first post-GSP adoption coordination meetings on February 7, 2022 and March 14, 2022. The Subbasin GSAs held a public meeting on June 28, 2022, *via* Zoom™ after the preparation of the WY 2021 Annual Report was completed, in which basin conditions and upcoming WY 2022 activities were described. The intention of this meeting was to seek input from the public and to provide an update on the Subbasin's current conditions. The Subbasin GSAs, as part of coordination and outreach, plan to hold at least one public meeting each year following the completion of the annual report.

Additional NASb GSP implementation actions performed within the Subbasin, along with their current status, are shown in **Appendix B.**

Table 6-1. Project and Management Actions

Project or Management Action	Comments
Project #1: Regional Conjunctive Use Expansion – Phase 1	Anticipated schedule to commence in 2023 simultaneously with Management Action #1 below.
Project #2: Natomas Cross Canal Stability Berm and Channel Habitat Enhancements Project	Project is currently in progress, waiting on permits and approvals before starting work. Construction anticipated to begin in 2023.
Management Action #1: Complete Planning for Sacramento Regional Water Bank	Planning and outreach activities commenced in Spring 2022. The current target for completion of the environmental document necessary for federal acknowledgement of the Water Bank is in 2024.
Management Action #2: Explore Improvements with NASb Well Permitting Programs	Coordination meetings were held with Placer, Sacramento, and Sutter counties well permitting agencies. GSAs are developing approaches to Executive Order N-7-22, Action 9.a and 9.b, which implemented temporary improvements to well permitting programs. Technical analysis and coordination with respective well permitting programs are anticipated to take approximately 2 years to complete.
Management Action #3: Proactive Coordination with Land Use Agencies	WY 2021 Annual Report sent to respective planning agencies. In coordination with Placer County Land Use staff, a SGMA draft guide for land use agencies is in development.
Management Action #4: Domestic/Shallow Well – Data Collection and Communication Program	SGA staff is currently using DWR's well completion reports and assessor parcel number data to identify potential domestic well owners within the Subbasin. This information would be used to develop a mailing list that would be sent to high concentration areas of domestic and other shallow wells to assist with the following actions: confirm the presence of a well; establish a voluntary group of domestic well owners interested in local groundwater conditions; and, provide regular information to interested domestic well owners and NASb well permitting agencies.
Management Action #5: Groundwater Dependent Ecosystem Assessment Program	SGA staff is researching options for assessing Groundwater Dependent Ecosystems health.

Source: SGA, 2021

7. Sustainability Indicators

The NASb GSAs are committed to implementing a GSP that achieves the sustainability goal for the Subbasin and avoids undesirable results. For this reason, this section includes a detailed description of the groundwater conditions for WY 2022 (including comparisons to WY 2021 data) for each applicable GSP sustainability indicator as shown in **Table 7-1** below.

Table 7-1. Sustainability Indicators and Undesirable Results

Sustainability Indicator	Undesirable Result Definition
Chronic lowering of groundwater levels	*20% or more of all NASb RMS have MT exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Reduction of storage	*20% or more of all NASb RMS have MT exceedances for 2 consecutive Fall measurements (8 out of 41 wells)*
Depletion of surface water	*20% or more of the NASb interconnected surface water RMSs have MT exceedances for 2 consecutive Fall measurements (5 out of 21 wells)*
Land Subsidence	*The rate of inelastic subsidence exceeds 0.5 feet over a 5-year period over an area covering approximately 5 or more square miles*
Degraded groundwater quality	For public water system wells • *The basin-wide average TDS concentrations of all public water system wells exceeds 400 mg/L* *OR* • *The basin wide average nitrate (as N) concentration of all public water system wells exceeds 8 mg/L* For the shallow aquifer (i.e., domestic and self-supplied) wells *25% of the RMSs, TDS and nitrate (as N) concentrations exceed state maximum contaminant levels*

Notes: mg/L= milligrams per liter; MT = minimum threshold; NASb = North American Subbasin; RMS = representative monitoring site;
TDS = total dissolved solids
Source: SGA, 2021

7.1 Chronic Lowering of Groundwater Levels

Six representative monitoring wells out of a total 41 wells monitored (or 15 percent of the total 41 RMS wells) exceeded the MT at the end of WY 2022 (as listed in **Table 7-2**). Four of these wells had exceedances in WY 2021. One dry well was reported to DWR in 2022, about 3.5 miles from Well 91 (e.g., WPMW-11A) which exceeded the MT in 2022, but the issue was resolved by lowering the pump by 20 feet. Although, this does not constitute a defined undesirable result which would be 8 or more wells out of 41 wells for 2 consecutive fall measurements, the GSAs are in the process of trying to understand the potential causes of these exceedances. The GSAs have:

- Applied for grant funding to construct a new monitoring well in the vicinity of the dry well to better assess conditions.
- Increased the frequency of monitoring at 4 wells that had MT occurrences in both WYs 2021 and 2022 to assess if the lower groundwater levels are due to a nearby well or if this is a regional issue.

- Continued assessing potential groundwater recharge options in the portion of the Subbasin where the 4 wells with 2 years of MT exceedances occurred.

- In addition to evaluating potential causes of the MT exceedances such as whether these exceedances are resulting in negative effects. The GSAs are also evaluating whether the monitoring wells and MTs established in the NASb GSP are appropriate for evaluating those effects.

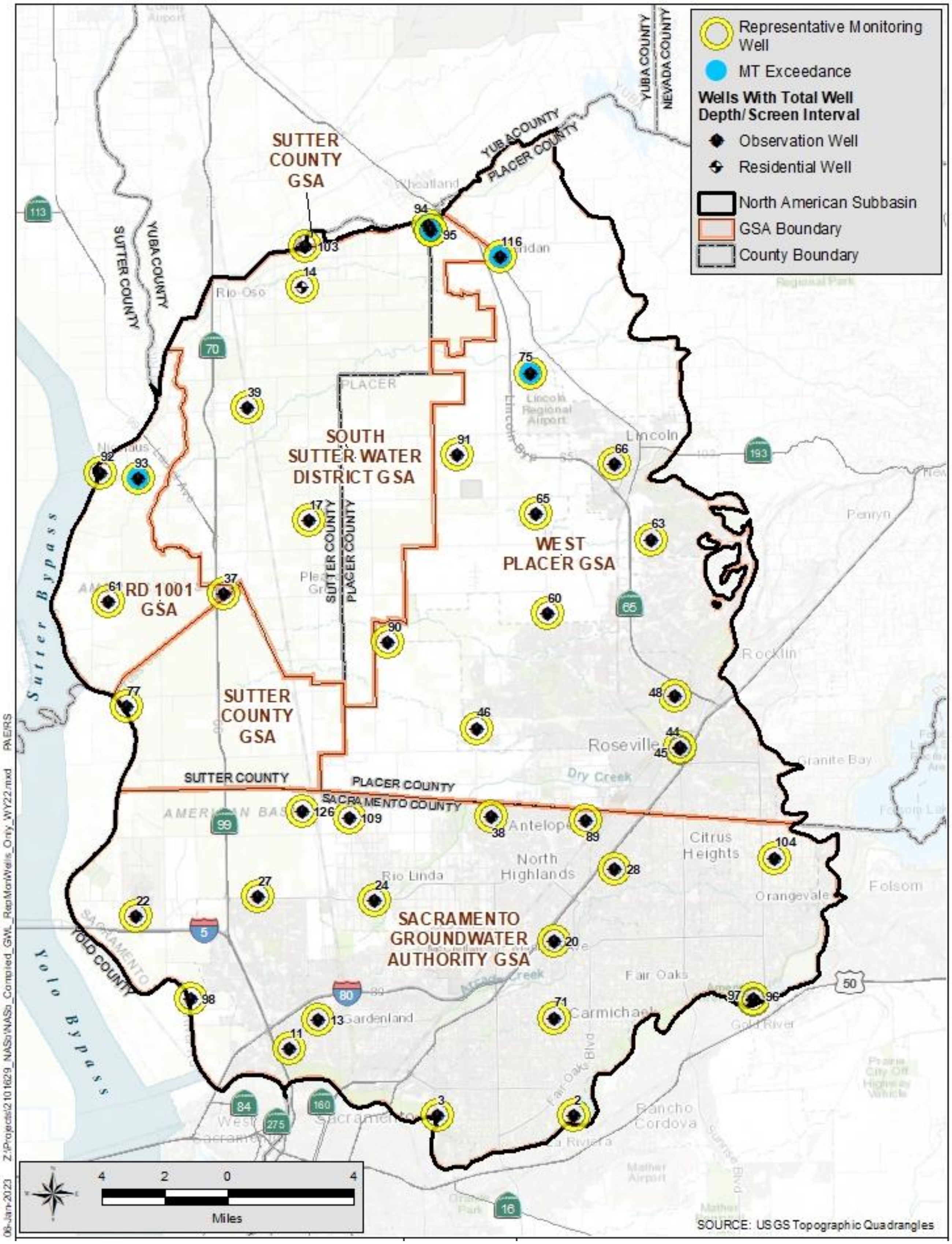
It should be noted that 4 of the 6 RMS wells with MT exceedances in 2022 had no data for the 2012 through 2016 drought and it is uncertain whether these would be normally expected levels during drought years such as the current consecutive last three WYs and/or if these RMS are truly effective locations for the purposes of establishing undesirable results for the Subbasin. As GSP implementation has just begun, the GSAs will be evaluating the effectiveness and corresponding applicability of these RMS as additional data and information is collected. A list of wells, groundwater level measurements, their MTs, and whether the MTs were exceed are shown in **Table 7-2.** The locations of wells, and those that exceeded their MTs, are shown in **Figure 7-1**.

Table 7-2. Chronic Lowering of Groundwater Levels and Minimum Thresholds

Representative Monitoring Sites (i.e. Wells)			WY 2022		2021 Fall Exceeded	2022 Fall Exceeded	Fall 2022 - MT = Difference (ft)
Map No.	Local Name	MT (ft msl)	Spring (ft msl)	Fall (ft msl)			
2	SGA_MW06	1	9.44	7.78	No	No	6.8
3	SGA_MW04	-5	0.34	-0.42	No	No	4.6
11	Bannon Creek Park	-5	0.26	-1.74	No	No	3.3
13	Chuckwagon Park	-15	-9.39	-11.34	No	No	3.7
14	13N04E23A002M	26	32.18	27.88	No	No	1.9
17	AB-2 shallow	-17	3.07	-7.69	No	No	9.3
20	SGA_MW05	-37	-19.63	-27.43	No	No	9.6
22	AB-4 shallow	-1	9.03	3.46	No	No	4.5
24	SGA_MW02	-27	-15.46	-16.91	No	No	10.1
27	AB-3 shallow	-4	8.75	5.70	No	No	9.7
28	Twin Creeks Park	-28	-12.30	-16.00	No	No	12.0
37	SUT-P1	10	16.51	12.21	No	No	2.2
38	Lone Oak Park	-27	-15.23	-16.91	No	No	10.1
39	AB-1 shallow	3	17.66	5.39	No	No	2.4
44	WPMW-10A	133	135.51	134.37	No	No	1.4
45	WPMW-9A	135	138.53	137.46	No	No	2.5
46	SVMW West - 1A	-32	-16.55	-21.25	No	No	10.8
48	WPMW-4A	75	79.19	79.07	No	No	4.1
60	WPMW-2A	22	26.10	24.70	No	No	2.7
61	Sutter County MW-5A	10	17.46	14.40	No	No	4.4
63	WPMW-3A	145	147.51	146.90	No	No	1.9
65	MW 1-3	49	57.03	54.74	No	No	5.7
66	MW 5-2	108	110.96	108.93	No	No	0.9
71	WCMSS	-40	-22.41	-29.39	No	No	10.6
75	MW 2-3	89	88.58	83.04	Yes	Yes	-6.0
77	SREL-1-27-F1	9	11.84	10.38	No	No	1.4
89	Roseview Park - 315	-22	-9.46	-11.76	No	No	10.2
90	WPMW-12A	-45	-23.08	-35.53	No	No	9.5
91	WPMW-11A	3	12.58	0.52	No	Yes	-2.5
92	RDMW-101	15	19.49	16.46	No	No	1.5
93	RDMW-102	12	15.33	11.03	Yes	Yes	-1.0
94	RDMW-103	58	60.44	50.68	Yes	Yes	-7.3
95	RDMW-104	57	58.52	51.08	Yes	Yes	-5.9
96	1516	67	69.76	69.72	No	No	2.7
97	1518	57	60.42	60.48	No	No	3.5
98	URS71000-700+00C	7	10.38	8.00	Yes	No	1.0
103	BR-1B	36	40.99	36.97	No	No	1.0
104	SGA_MW08	97	106.21	105.76	No	No	8.8
109	SGA_MW01	-33	-18.26	-20.61	No	No	12.4
116	Old Well #2	68	69.10	65.30	Yes	Yes	-2.7
126	DeWit	-25	5.30	-3.80	No	No	21.2

Note: ft msl = feet above or below mean sea level; MT = minimum threshold
Yellow highlight indicates MT exceedance.

Figure 7-1. Distribution of Wells with Chronic Lowering of Groundwater MT Exceedances



7.2 Reduction of Storage

The GSAs used groundwater levels as a proxy for defining the quantitative thresholds for this sustainability indicator as supported in the GSP regulations. As described above, the NASb is not currently experiencing an undesirable result with respect to reduction of storage.

7.3 Depletion of Surface Water

Because the depletion of interconnected surface water is directly related to the gradient between the surface water system at the groundwater interface and the groundwater Subbasin, groundwater levels are used as a proxy for this sustainability indicator. There are 24 wells at 21 locations used for evaluation purposes. At the end of WY 2022, there were 4 wells at three locations (or 16 percent of the 21 wells) that exceeded their MTs as shown in **Table 7-3**. These 4 wells also exceeded their MTs in 2021. The Subbasin is not currently experiencing an undesirable result with respect to this sustainability indicator. GSAs are evaluating potential causes of the MT exceedances and whether these could be resulting in any negative effects. The GSAs are also evaluating whether the monitoring wells and MTs established in the NASb GSP are appropriate for evaluating those effects.

Table 7-3. Depletion of Surface Water and Minimum Thresholds

Representative Monitoring Sites (i.e. Wells)			WY 2022		2021 Fall Exceeded	2022 Fall Exceeded	Fall 2022 - MT = Difference (ft)
Map No.	Local Name	MT (ft msl)	Spring (ft msl)	Fall (ft msl)			
2	SGA_MW06	1	9.44	7.78	No	No	6.8
3	SGA_MW04	-5	0.34	-0.42	No	No	4.6
11	Bannon Creek Park	-5	0.26	-1.74	No	No	3.3
13	Chuckwagon Park	-15	-9.39	-11.34	No	No	3.7
14	13N04E23A002M	26	32.18	27.88	No	No	1.9
22	AB-4 shallow	-1	9.03	3.46	No	No	4.5
27	AB-3 shallow	-4	8.75	5.70	No	No	9.7
28	Twin Creeks Park	-28	-12.30	-16.00	No	No	12.0
37	SUT-P1	10	16.51	12.21	No	No	2.2
44	WPMW-10A	133	135.51	134.37	No	No	1.4
45	WPMW-9A	135	138.53	137.46	No	No	2.5
61	Sutter County MW-5A	10	17.46	14.40	No	No	4.4
63	WPMW-3A	145	147.51	146.90	No	No	1.9
66	MW 5-2	108	110.96	108.93	No	No	0.9
75	MW 2-3	89	88.58	83.04	Yes	Yes	-6.0
77	SREL-1-27-F1	9	11.84	10.38	No	No	1.4
92	RDMW-101	15	19.49	16.46	No	No	1.5
93	RDMW-102	12	15.33	11.03	Yes	Yes	-1.0
94	RDMW-103	58	60.44	50.68	Yes	Yes	-7.3
95	RDMW-104	57	58.52	51.08	Yes	Yes	-5.9
96	1516	67	69.76	69.72	No	No	2.7
97	1518	57	60.42	60.48	No	No	3.5
98	URS71000-700+00C	7	10.38	8.00	Yes	No	1.0
103	BR-1B	36	40.99	36.97	No	No	1.0

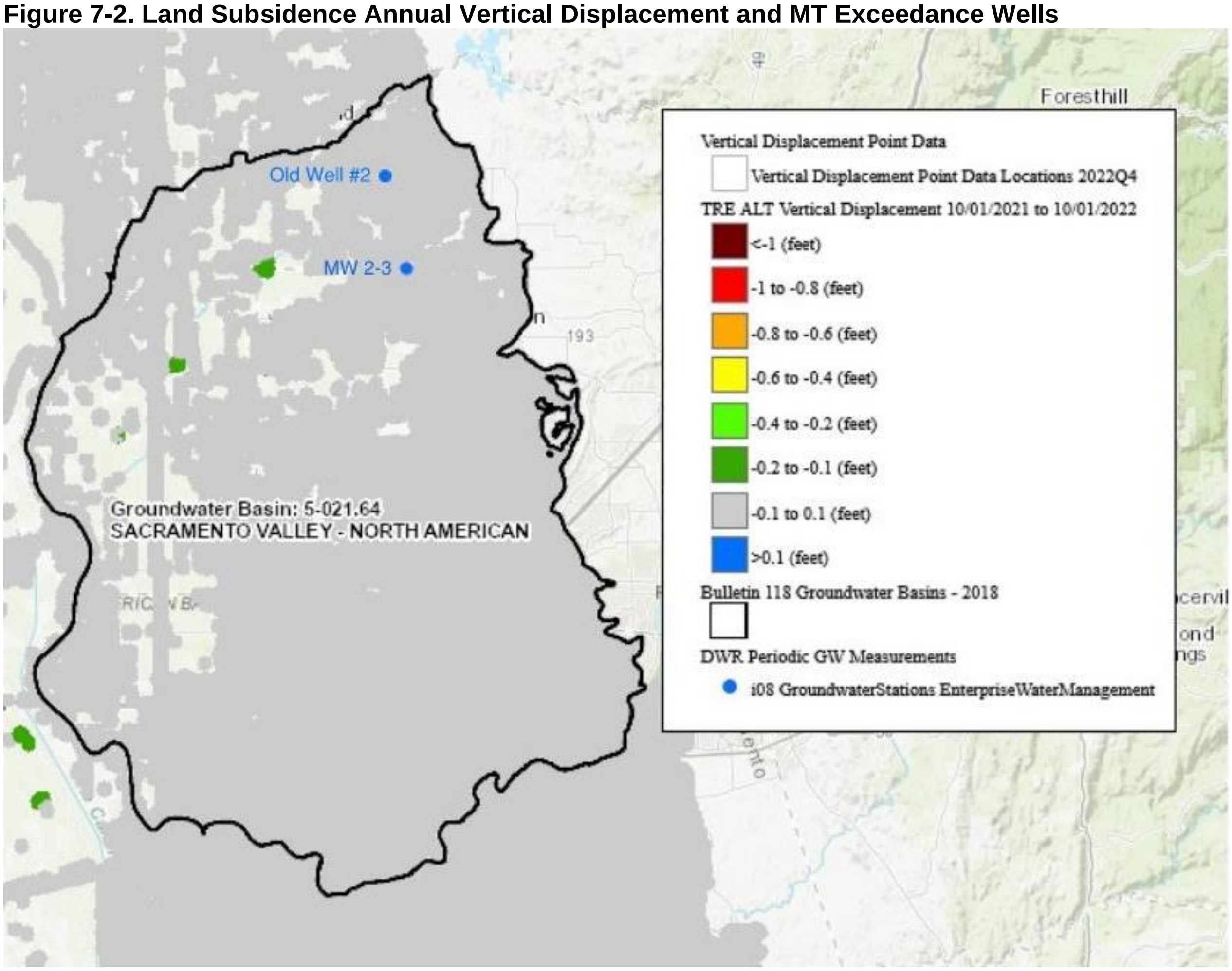
Note: ft msl = feet above or below mean sea level; MT = minimum threshold

7.4 Land Subsidence

Groundwater levels are being used as a proxy for MTs. **Table 7-4** shows the MTs as determined by the CoSANA modeled future/projected conditions, for chronic lowering of groundwater levels and the minimum measured groundwater elevation each of the designated representative monitoring wells. For WY 2022, two wells 75 and 116 (e.g., Old Well #2 and MW 2-3, respectively) exceeded their MTs. Both wells exceeded their MT by 3 feet, as shown in **Table 7-4,** but in this situation, it is unlikely to cause subsidence. The location of the 2 wells is shown on **Figure 7-2** for comparison to regional subsidence data.

The lack of subsidence in the NASb in WY 2022 is confirmed by Interferometric Synthetic-Aperture Radar (InSAR). InSAR measures ground elevation using microwave satellite imagery data. **Figure 7-2** shows InSAR measured ground surface elevations between October 1, 2021, to October 1, 2022, for the Subbasin (DWR, 2023). These data show that the rate of subsidence basin-wide was -0.10 to +0.10 foot per year in WY 2022, and a few areas showing -0.10 to -0.20 foot per year, within method estimation error for interpretation of the data. Based on the water level measurements and InSAR data, the Subbasin is not experiencing undesirable results with respect to subsidence.

Figure 7-2. Land Subsidence Annual Vertical Displacement and MT Exceedance Wells



Source: DWR, 2023

Table 7-4. Land Subsidence Groundwater Levels and Minimum Thresholds

Representative Monitoring Sites (i.e. Wells)			WY 2022		2021 Fall Exceeded	2022 Fall Exceeded	Fall 2022 - MT = Difference (ft)
Map No.	Local Name	MT (ft msl)	Spring (ft msl)	Fall (ft msl)			
2	SGA_MW06	1	9.44	7.78	No	No	6.8
3	SGA_MW04	-5	0.34	-0.42	No	No	4.6
11	Bannon Creek Park	-5	0.26	-1.74	No	No	3.3
13	Chuckwagon Park	-15	-9.39	-11.34	No	No	3.7
14	13N04E23A002M	15	32.18	27.88	No	No	12.9
17	AB-2 shallow	-21	3.07	-7.69	No	No	13.3
20	SGA_MW05	-37	-19.63	-27.43	No	No	9.6
22	AB-4 shallow	-1	9.03	3.46	No	No	4.5
24	SGA_MW02	-27	-15.46	-16.91	No	No	10.1
27	AB-3 shallow	-4	8.75	5.70	No	No	9.7
28	Twin Creeks Park	-28	-12.30	-16.00	No	No	12.0
37	SUT-P1	8	16.51	12.21	No	No	4.2
38	Lone Oak Park	-27	-15.23	-16.91	No	No	10.1
39	AB-1 shallow	-5	17.66	5.39	No	No	10.4
44	WPMW-10A	133	135.51	134.37	No	No	1.4
45	WPMW-9A	131	138.53	137.46	No	No	6.5
46	SVMW West - 1A	-32	-16.55	-21.25	No	No	10.8
48	WPMW-4A	72	79.19	79.07	No	No	7.1
60	WPMW-2A	21	26.10	24.70	No	No	3.7
61	Sutter County MW-5A	-1	17.46	14.40	No	No	15.4
63	WPMW-3A	145	147.51	146.90	No	No	1.9
65	MW 1-3	38	57.03	54.74	No	No	16.7
66	MW 5-2	104	110.96	108.93	No	No	4.9
71	WCMSS	-40	-22.41	-29.39	No	No	10.6
75	MW 2-3	86	88.58	83.04	Yes	Yes	-3.0
77	SREL-1-27-F1	9	11.84	10.38	No	No	1.4
89	Roseview Park - 315	-22	-9.46	-11.76	No	No	10.2
90	WPMW-12A	-65	-23.08	-35.53	No	No	29.5
91	WPMW-11A	-18	12.58	0.52	No	No	18.5
92	RDMW-101	14	19.49	16.46	No	No	2.5
93	RDMW-102	8	15.33	11.03	No	No	3.0
94	RDMW-103	36	60.44	50.68	No	No	14.7
95	RDMW-104	36	58.52	51.08	No	No	15.1
96	1516	67	69.76	69.72	No	No	2.7
97	1518	57	60.42	60.48	No	No	3.5
98	URS71000-700+00C	6	10.38	8.00	No	No	2.0
103	BR-1B	36	40.99	36.97	No	No	1.0
104	SGA_MW08	97	106.21	105.76	No	No	8.8
109	SGA_MW01	-33	-18.26	-20.61	No	No	12.4
116	Old Well #2	68	69.10	65.30	Yes	Yes	-2.7
126	DeWit	-25	5.30	-3.80	No	No	21.2

Note: ft msl = feet above mean sea level; MT = minimum threshold

7.5 Degraded Water Quality

The GSP identified two methods to assess if degraded water quality is occurring in the NASb. The methods included evaluation of water quality from municipal water supply wells and a network of shallow monitoring wells. The shallow monitoring wells assess potential changes in the upper portions of the aquifer, which is commonly used by domestic well owners, and the municipal wells assess changes within the deeper portions of the aquifer.

For all public water systems, or municipal wells, the California State Water Resources Control Board's Division of Drinking Water requires all active municipal wells be periodically sampled and analyzed in accordance with California Water Code Title 22 constituent standards. For the WY 2022 Annual Report, data for Total Dissolved Solids (TDS) and Nitrate (as Nitrogen) was downloaded from the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (commonly referred to as GAMA) Groundwater Information System for annual analysis of the most recent data[5] for each active public supply well. The data are summarized in **Table 7-5**. Based on the most recent data, the Subbasin is meeting its MTs with respect to public water supply water quality. Based on the municipal water quality data, the Subbasin is not experiencing undesirable results with respect to water quality.

Table 7-5. Public Supply Wells Water Quality Summary

	TDS	Nitrate (as Nitrogen)
Number of Wells Sampled	224	267
Date Range of Samples	02/20/2013-10/06/2022	08/21/2014-11/02/2022
Units	mg/L	mg/L
Minimum Concentration	5	<0.05
Maximum Concentration	650	9.10
Average Concentration (1)	256.47	1.71
Minimum Threshold (average of all wells)	400	8

Notes: mg/L= milligrams per liter; TDS = total dissolved solids
(1) For average Nitrate concentrations, values below laboratory detection levels were calculated as one-half the reporting limit.
Source: SWRCB, 2023

Based on the GSP implementation plan, water quality sampling of all wells in the shallow water quality monitoring network is planned to occur in the fall of WY 2023. A couple of shallow wells were sampled as part of a different program and are displayed in **Table 7-6** below. Groundwater samples collected and analyzed in WY 2022 from the shallow wells were all below their MTs (TDS 500 mg/L and Nitrate [as Nitrogen] 10 mg/L). Based on the shallow well water quality data, the Subbasin is not experiencing undesirable results with respect to water quality.

Table 7-6. Shallow Aquifer Water Quality Summary

Map No.	Local Name	WY 2022 TDS Reported Concentration (mg/L)	WY 2022 Nitrate as N Reported Concentration (mg/L)	TDS (Secondary MCL = 500 mg/L)	Nitrate (Primary MCL = 10 mg/L)
				Selected MTs (mg/L)	Selected MTs (mg/L)
17	AB-2 shallow	--	--	500	10
20	SGA_MW05	--	--	500	10
24	SGA_MW02	--	--	500	10
27	AB-3 shallow	--	--	500	10
37	SUT-P1	--	--	500	10
39	AB-1 shallow	--	--	500	10
46	SVMWWest1A	--	--	500	10
80	Cemetery (IRLP)	240	1.5	500	10
89	Roseview Park - 315	--	--	500	10
90	WPMW-12A	210	0.73	500	10
91	WPMW-11A	210	3.6	500	10
99	Main Well	--	--	500	10
109	SGA_MW01	--	--	500	10
133	LW-1	--	--	500	10
177	Well 22 - Northrop	--	--	500	10
298	Tinker Road Well	--	--	500	10

Note: --- = sample not acquired; mg/L = milligrams per liter

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8. References

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Appendix A Representative Monitoring Sites Hydrographs

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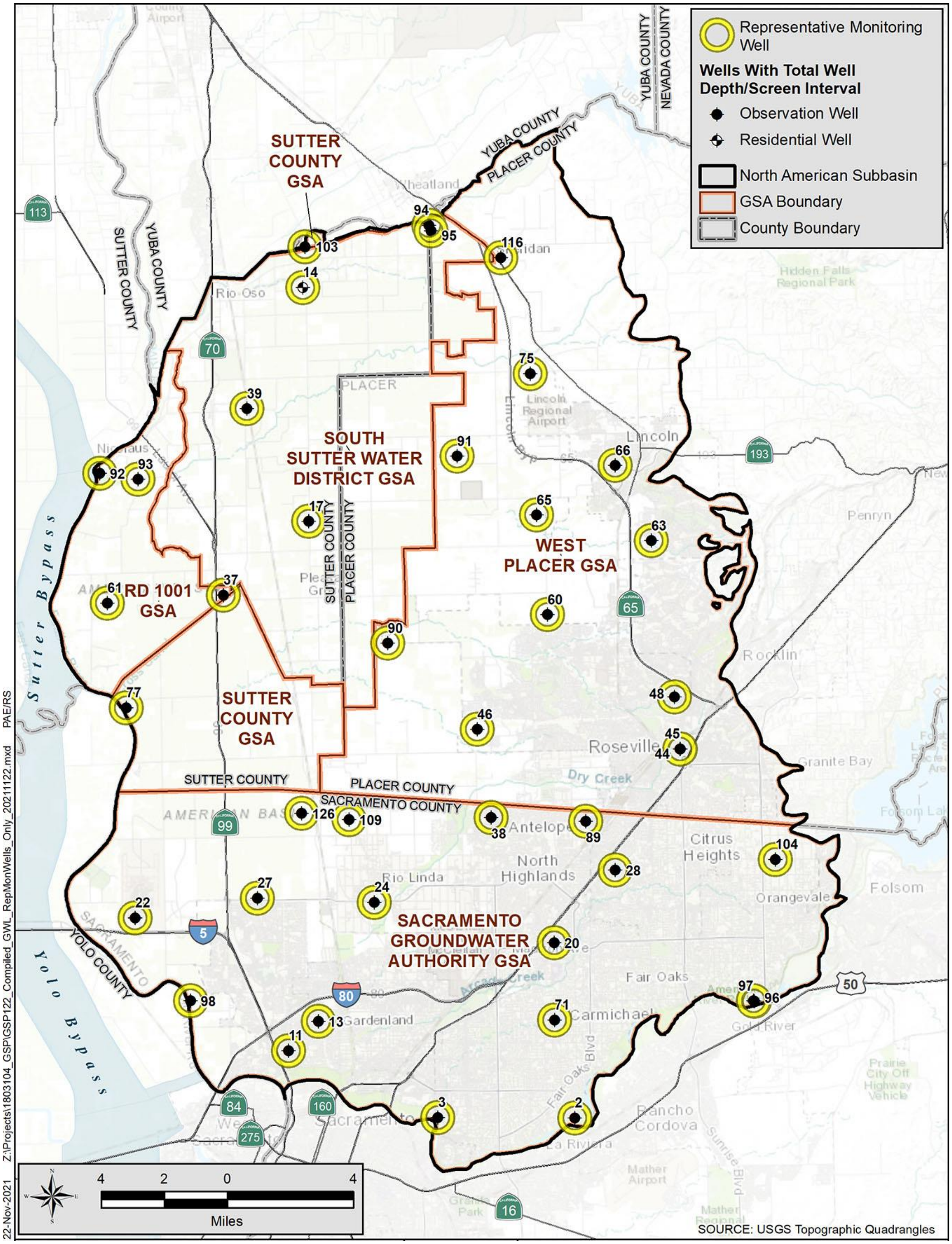


Figure A-1. Representative Groundwater Level Monitoring Wells Locations.

Table A-1. Representative Groundwater Level Monitoring Wells Information

Map No.	CASGEM ID	Local Name	Latitude	Longitude	Screened Interval (ft bgs)	Total Depth (ft bgs)
2	385828N1213385W001	SGA_MW06	38.58281	-121.33846	62-72	72
3	385841N1214185W001	SGA_MW04	38.58414	-121.41852	55-65	65
4	385947N1213985W003	MW12C	38.59472	-121.39847	590-610	615
11	386160N1215054W001	Bannon Creek Park	38.61603	-121.5054	33-48	48
13	386292N1214877W001	Chuckwagon Park	38.62921	-121.4877	27-37	52
14	389669N1214897W001	13N04E23A002M	38.9669	-121.4897	56-83	83
17	388593N1214885W003	AB-2 shallow	38.8593	-121.4885	135-145	155
20	386635N1213486W001	SGA_MW05	38.66347	-121.34859	205-215	215
22	386782N1215943W004	AB-4 shallow	38.6782	-121.5943	170-190	200
24	386836N1214536W001	SGA_MW02	38.68362	-121.45363	100-110	110
27	386864N1215222W003	AB-3 shallow	38.6864	-121.5222	190-210	220
28	386964N1213120W001	Twin Creeks Park	38.6964	-121.31203	183-193	193
37	388260N1215394W004	SUT-P1	38.826	-121.5394	110-120	120
38	387216N1213842W001	Lone Oak Park	38.72163	-121.38417	151-161	166
39	389116N1215238W003	AB-1 shallow	38.9116	-121.5238	170-180	190
44	387515N1212725W001	WPMW-10A	38.75149	-121.27251	26-36	36
45	387517N1212727W001	WPMW-9A	38.75167	-121.27266	26-36	36
46	387623N1213915W001	SVMW West - 1A	38.76232	-121.39153	120-140	145
48	387755N1212753W001	WPMW-4A	38.77554	-121.27525	120-140	145
60	388145N1213491W001	WPMW-2A	38.8145	-121.34914	215-225	230
61	388235N1216079W001	Sutter County MW-5A	38.82324	-121.60763	130-160	170
63	388476N1212872W001	WPMW-3A	38.84761	-121.28719	48-53	53
65	388604N1213544W003	MW 1-3	38.86038	-121.35438	184-204	204
66	388826N1213078W002	MW 5-2	38.88258	-121.30775	52-62	62
71	386280N1213493W001	WCMSS	38.62799	-121.34925	130-150	170
75	389255N1213566W003	MW 2-3	38.92547	-121.35663	75-85	85
77	387749N1215975W001	SREL-1-27-F1	38.77491	-121.59754	Unknown	46
89	387191N1213287W001	Roseview Park - 315	38.71912	-121.32879	295-305	315
90	388026N1214432W002	WPMW-12A	38.80264	-121.44322	260-280	300
91	388882N1214005W002	WPMW-11A	38.88816	-121.40046	132-152	162
92	388829N1216110W001	RDMW-101	38.88294	-121.61105	28-43	48
93	388798N1215885W001	RDMW-102	38.87987	-121.58853	28-43	48
94	389950N1214148W002	RDMW-103	38.99461	-121.41479	28-43	48
95	389919N1214141W002	RDMW-104	38.99195	-121.4135	28-43	48
96	386348N1212319W001	1516	38.63487	-121.23192	13-33	40
97	386351N1212323W001	1518	38.63513	-121.23231	55-75	80
98	386397N1215624W001	URS71000-700+00C	38.6397	-121.56244	Unknown	45
103	389857N1214880W001	BR-1B	38.9857	-121.488	78-98	98
104	387000N1212180W001	SGA_MW08	38.69998	-121.21795	130-140	140
109	387218N1214677W001	SGA_MW01	38.72178	-121.46771	100-110	110
116	389791N1213727W001	Old Well #2	38.97913	-121.37269	144-209	209
126	384330121293901	10N04E13F001M	38.72512	-121.49544	Unknown	50

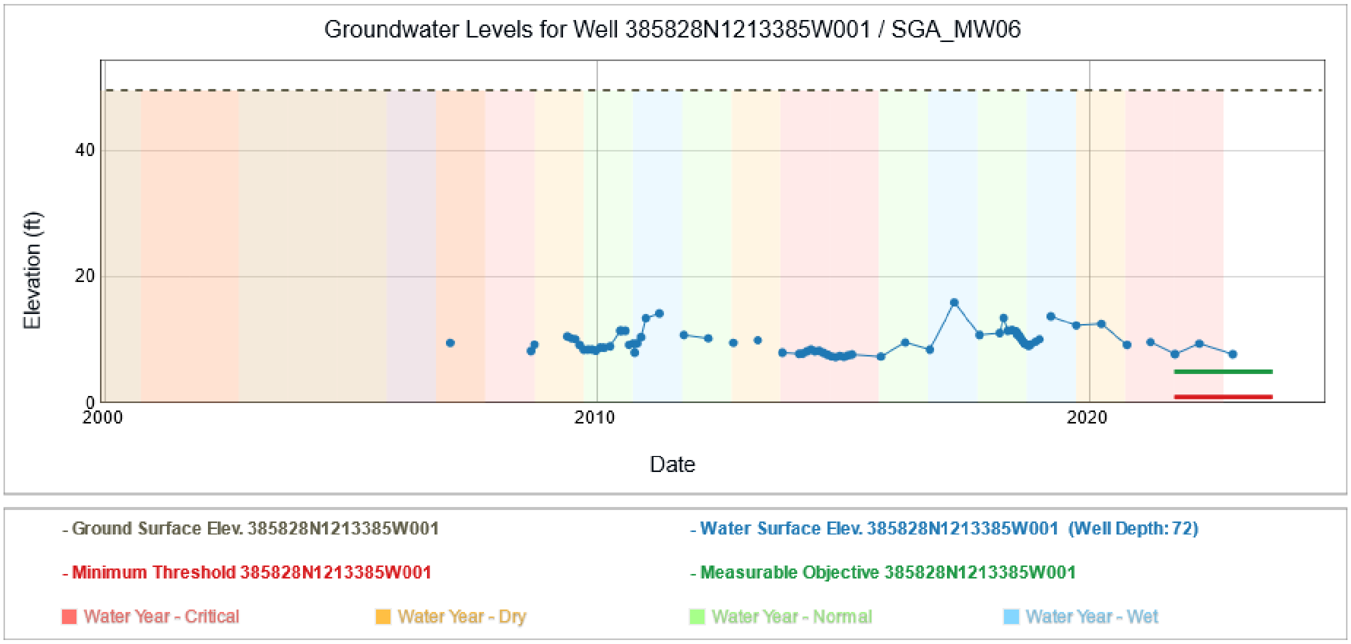


Figure A-2. SGA_MW06, Map No. 2

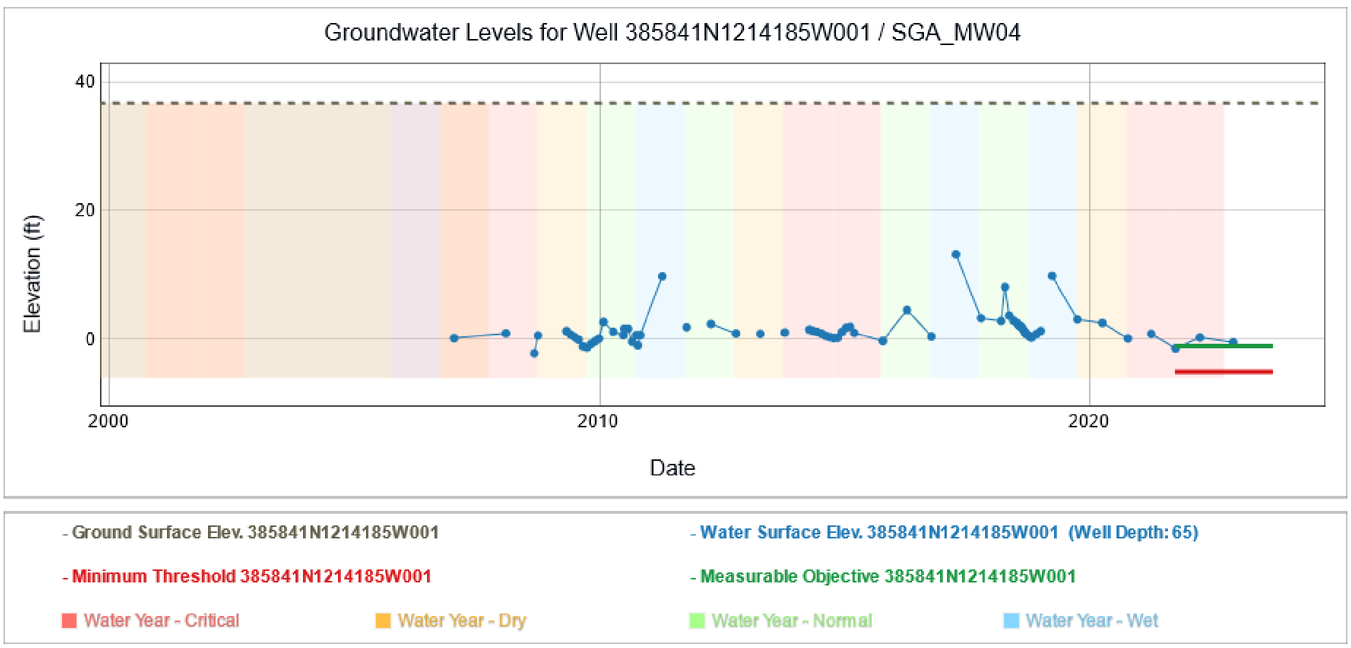


Figure A-3. SGA_MW04, Map No. 3

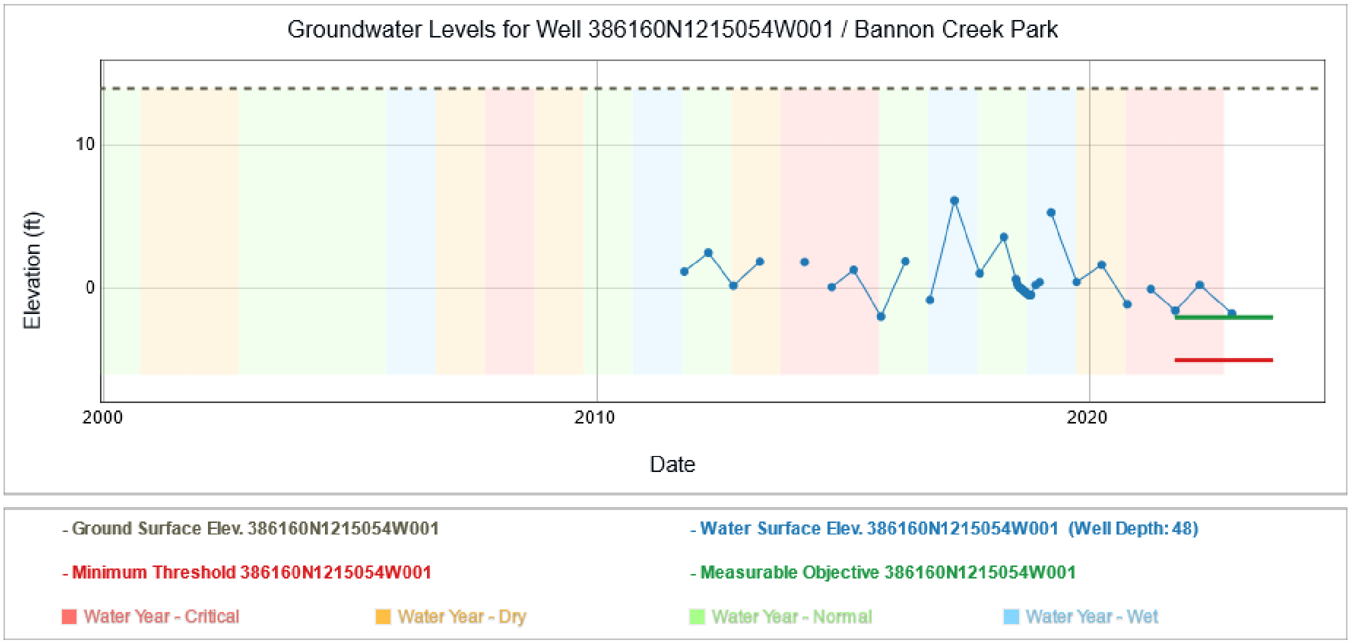


Figure A-4. Bannon Creek Park, Map No. 11

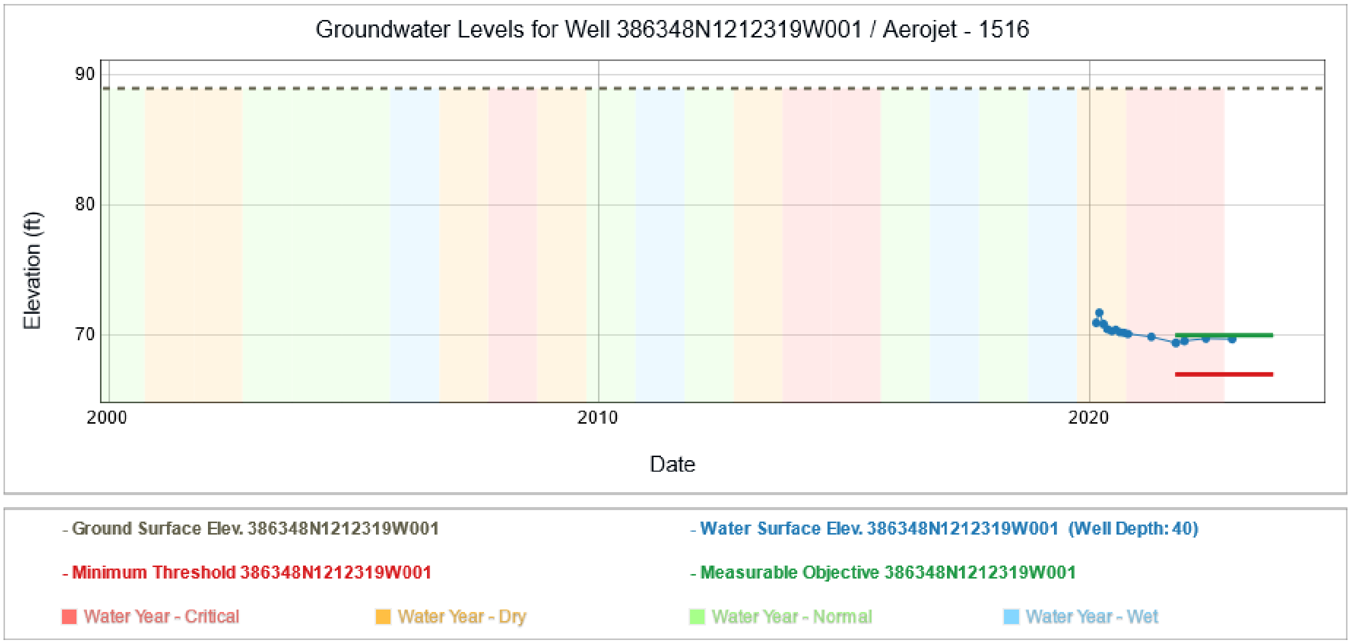


Figure A-5. Aerojet 1516, Map No. 9

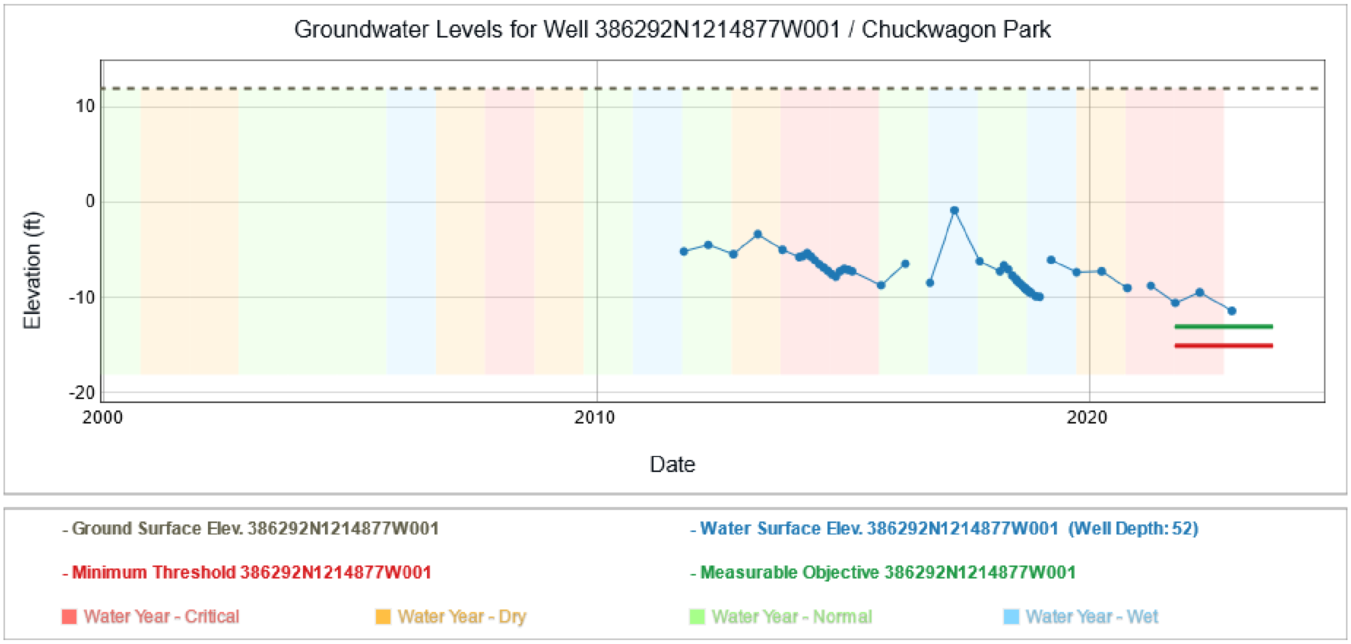


Figure A-6. Chuckwagon Park, Map No. 13

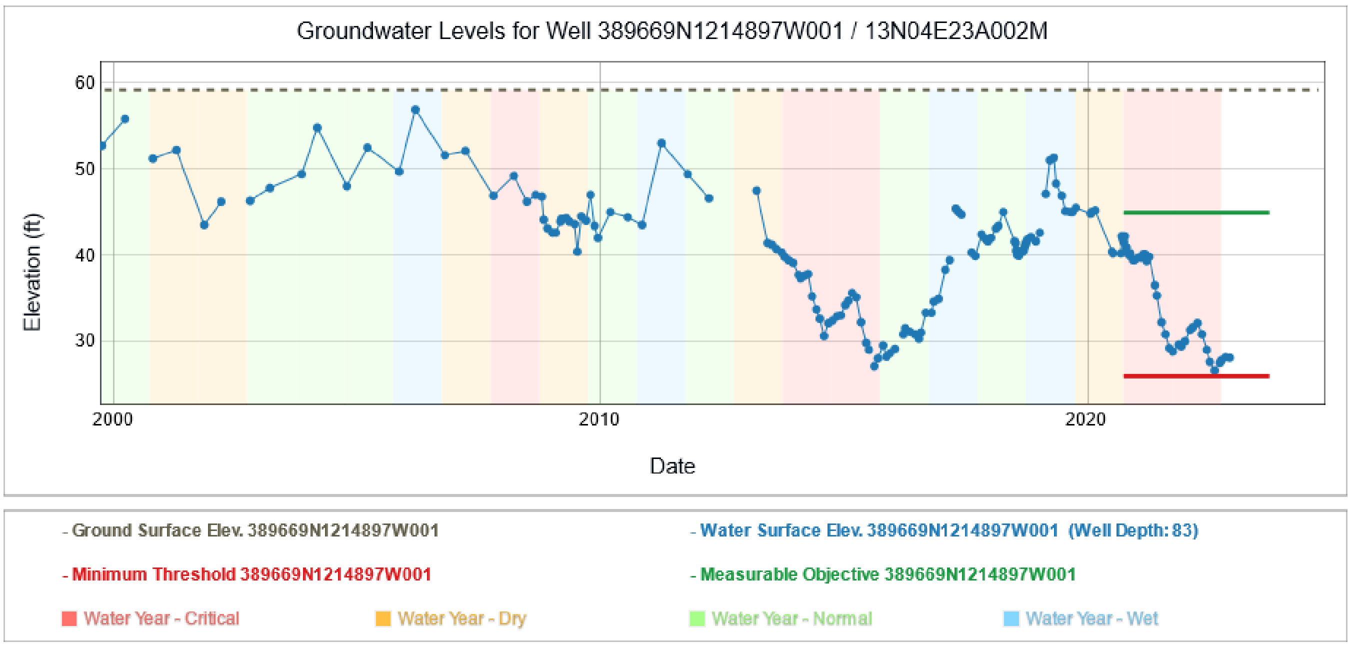


Figure A-7. 13N04E23A002M, Map No. 14

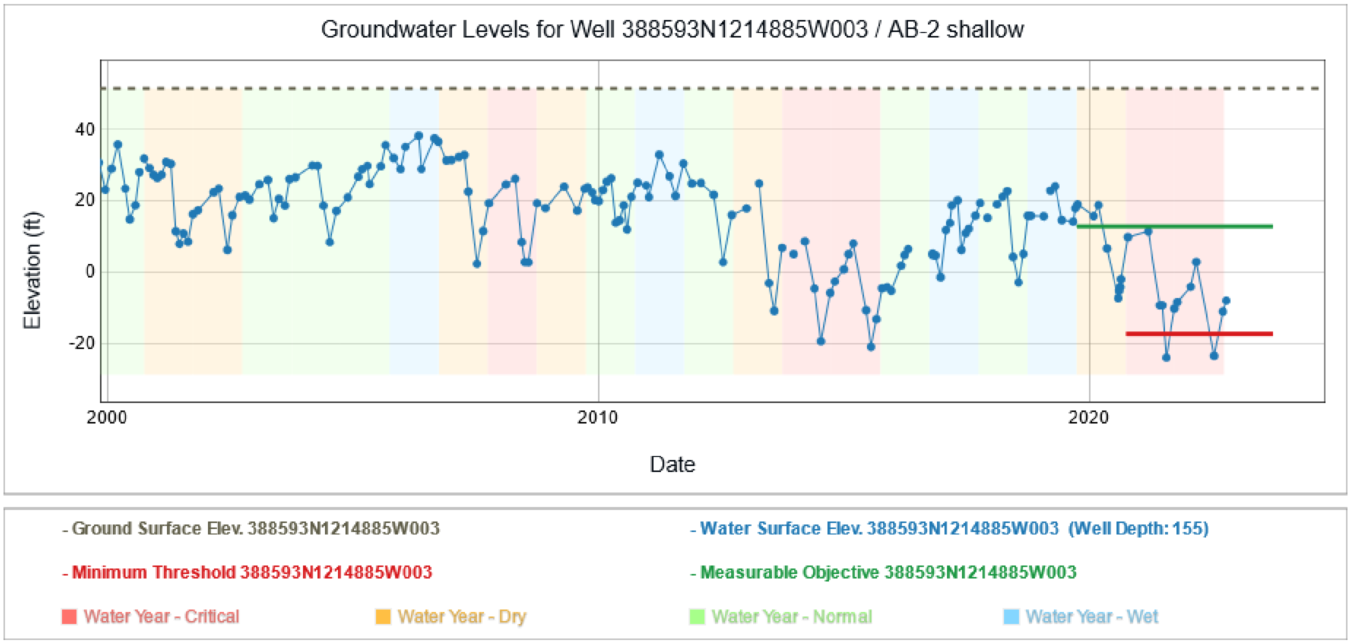


Figure A-8. AB-2 shallow, Map No. 17

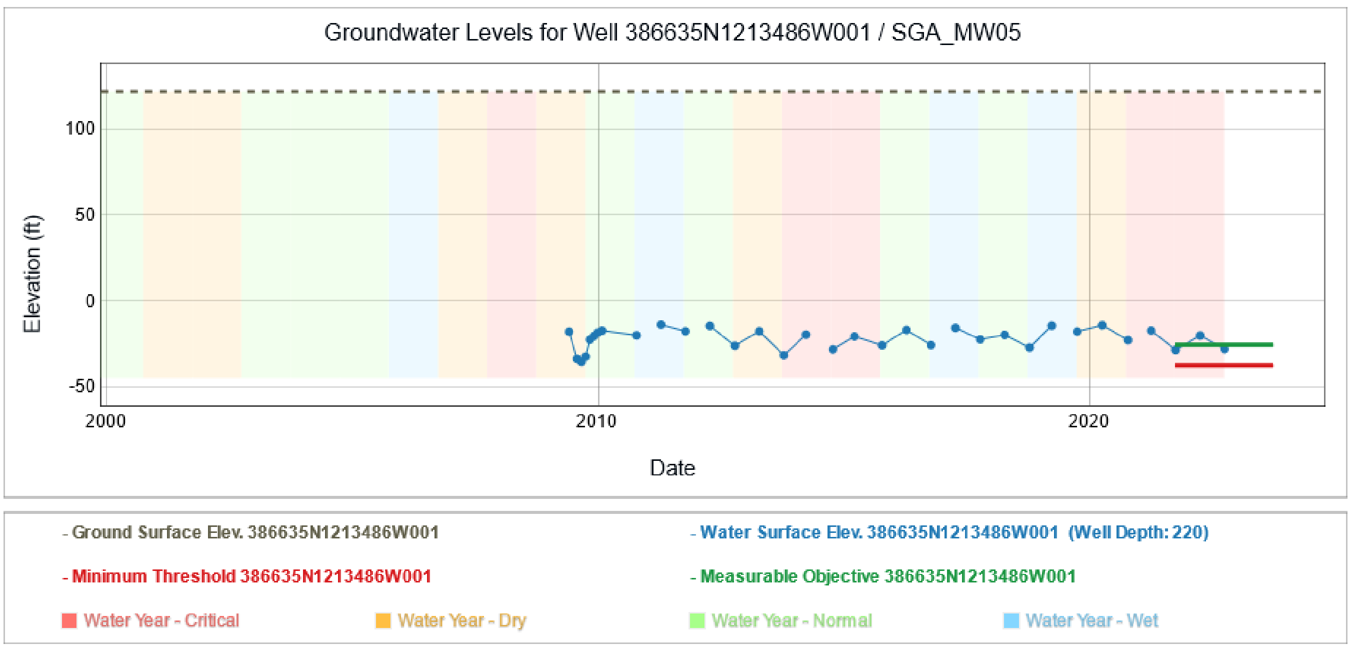
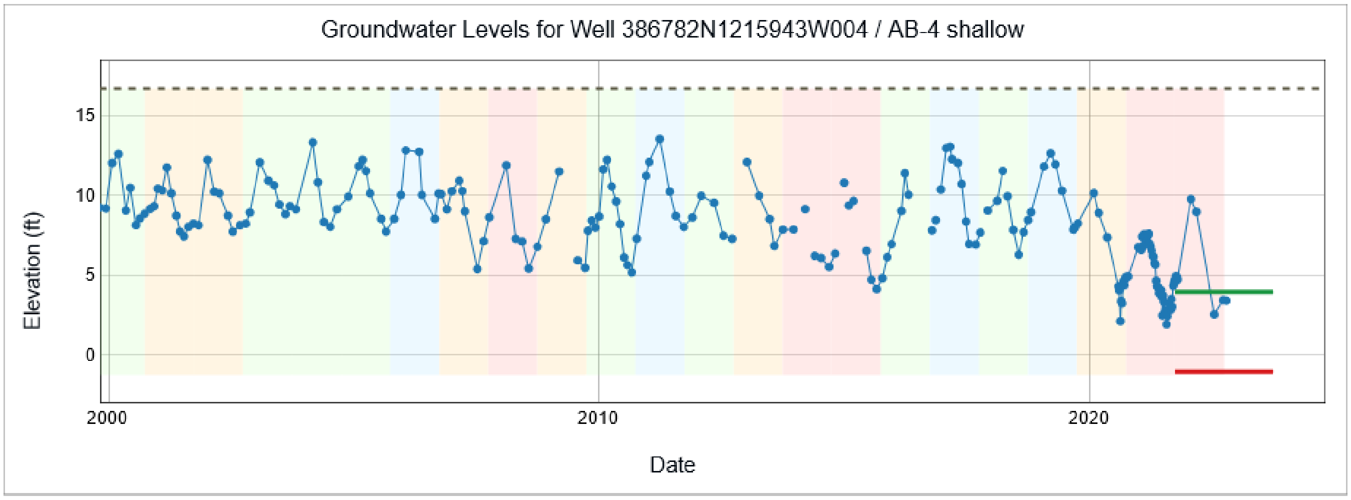


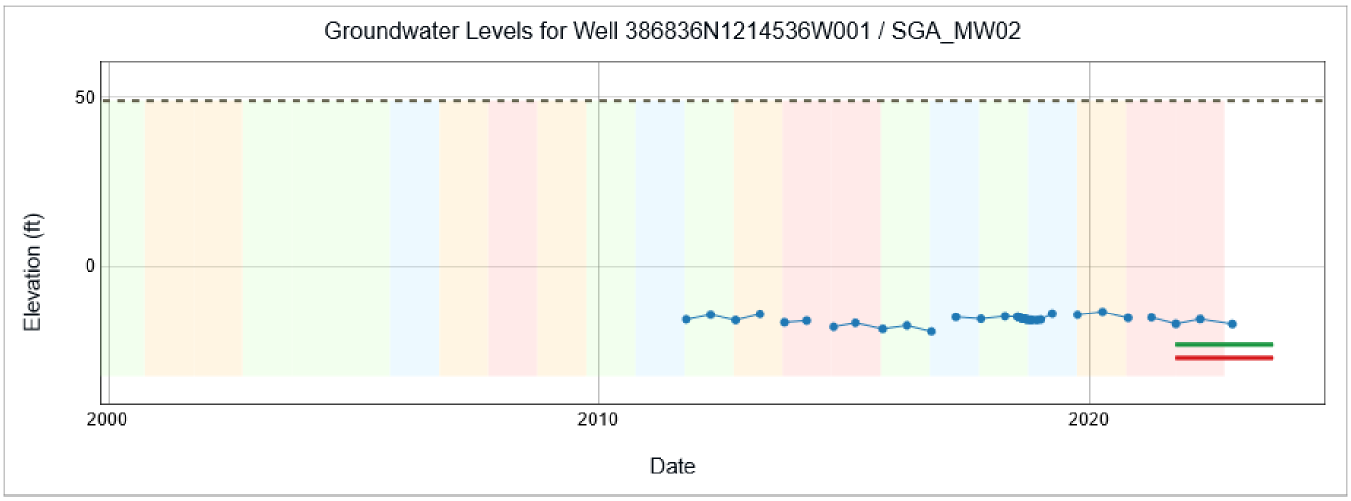
Figure A-9. SGA_MW05, Map No. 20



- Ground Surface Elev. 386782N1215943W004
- Water Surface Elev. 386782N1215943W004 (Well Depth: 200)
- Minimum Threshold 386782N1215943W004
- Measurable Objective 386782N1215943W004

Water Year - Critical | Water Year - Dry | Water Year - Normal | Water Year - Wet

Figure A-10. AB-4 shallow, Map No. 22



- Ground Surface Elev. 386836N1214536W001
- Water Surface Elev. 386836N1214536W001 (Well Depth: 110)
- Minimum Threshold 386836N1214536W001
- Measurable Objective 386836N1214536W001

Water Year - Critical | Water Year - Dry | Water Year - Normal | Water Year - Wet

Figure A-11. SGA_MW02, Map No. 24

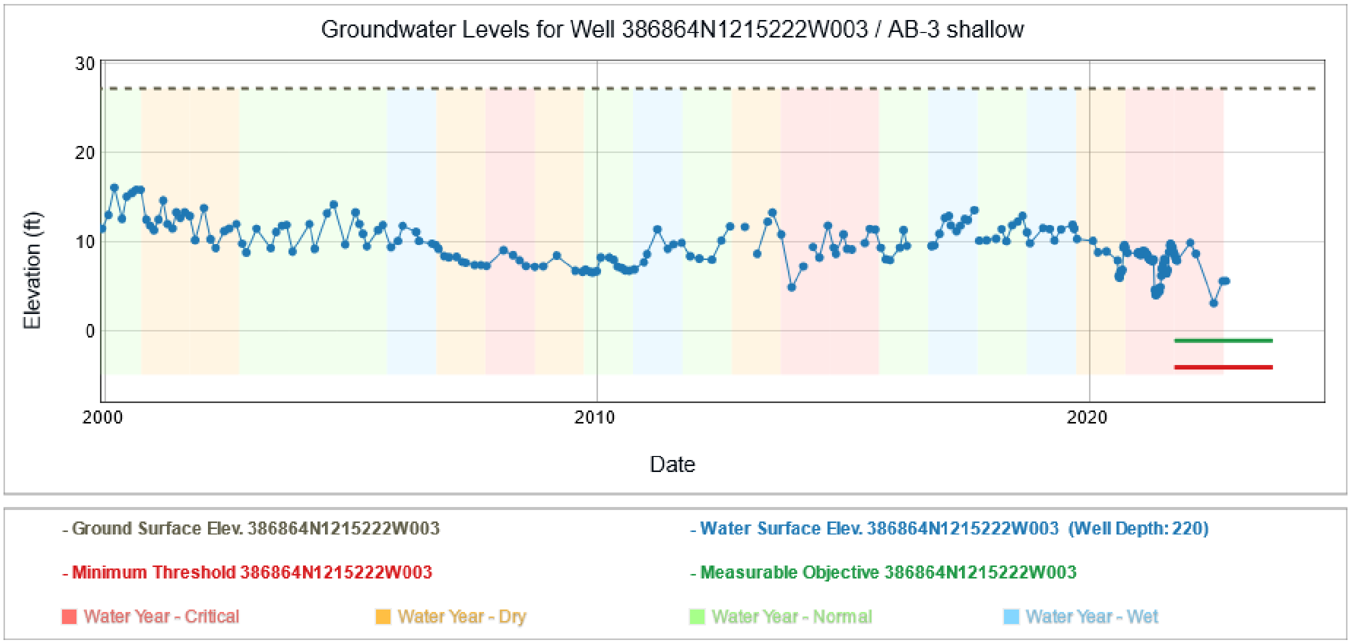


Figure A-12. AB-3 shallow, Map No. 27

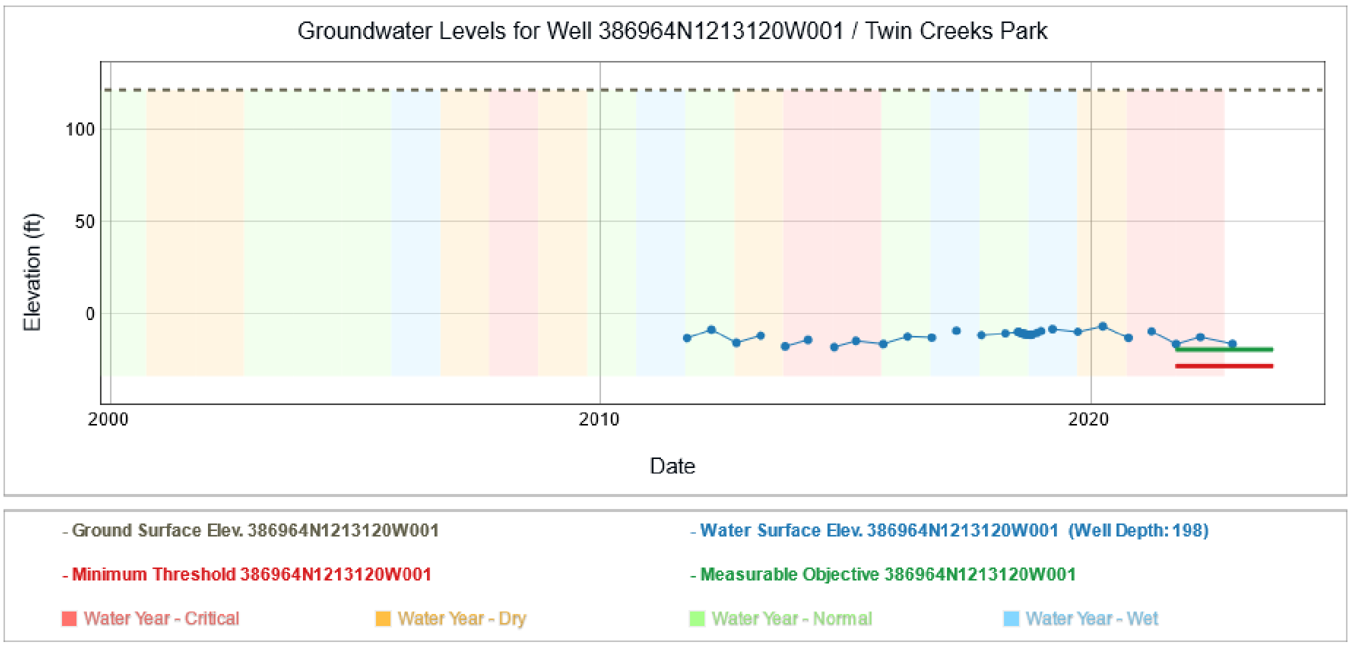


Figure A-13. Twin Creeks Park, Map No. 28

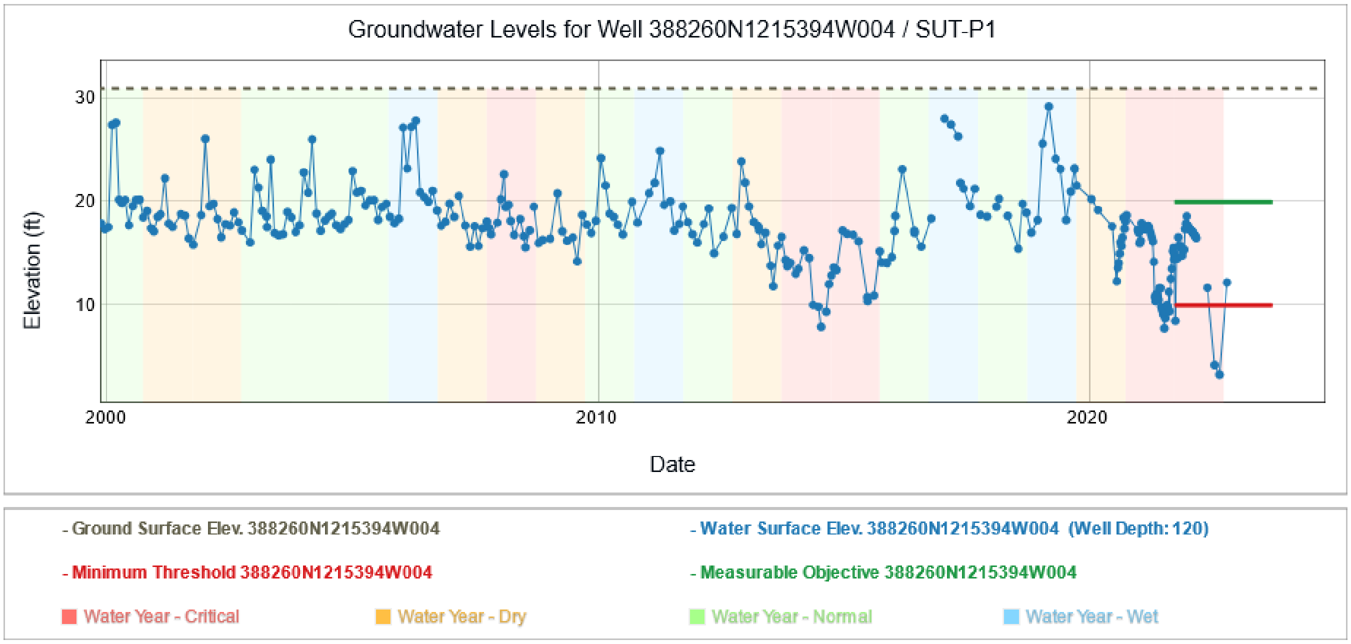


Figure A-14. SUT-P1, Map No. 37

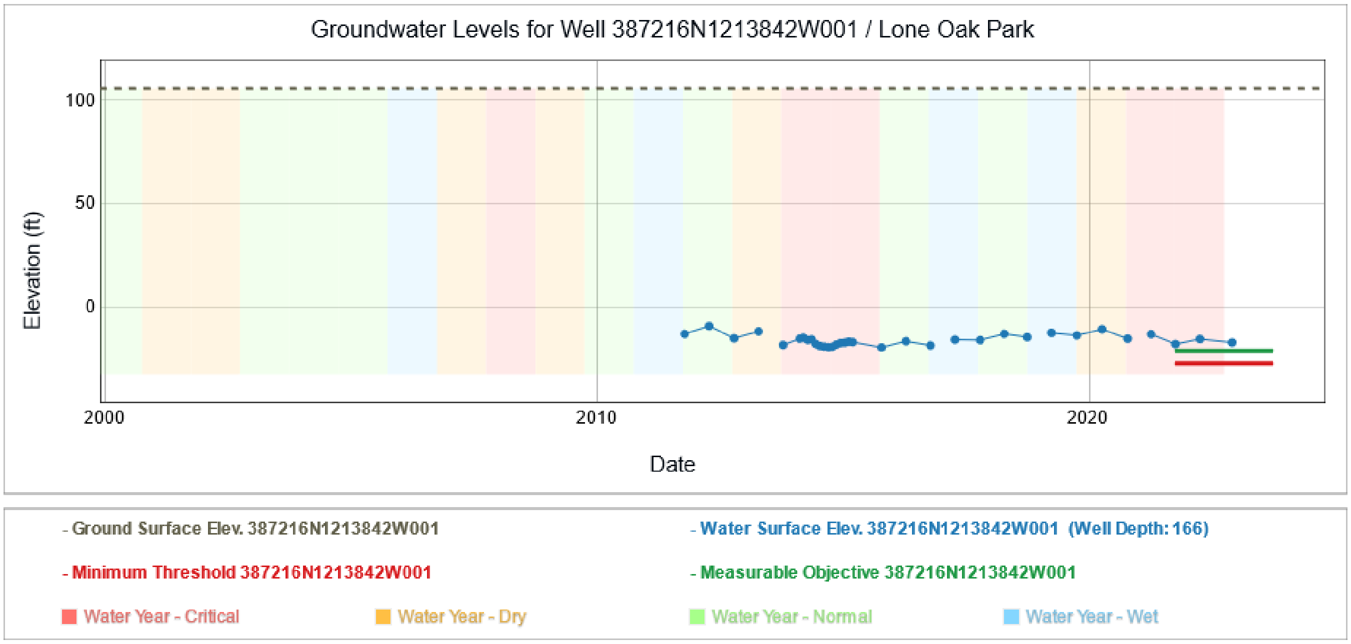


Figure A-15. Lone Oak Park, Map No. 38

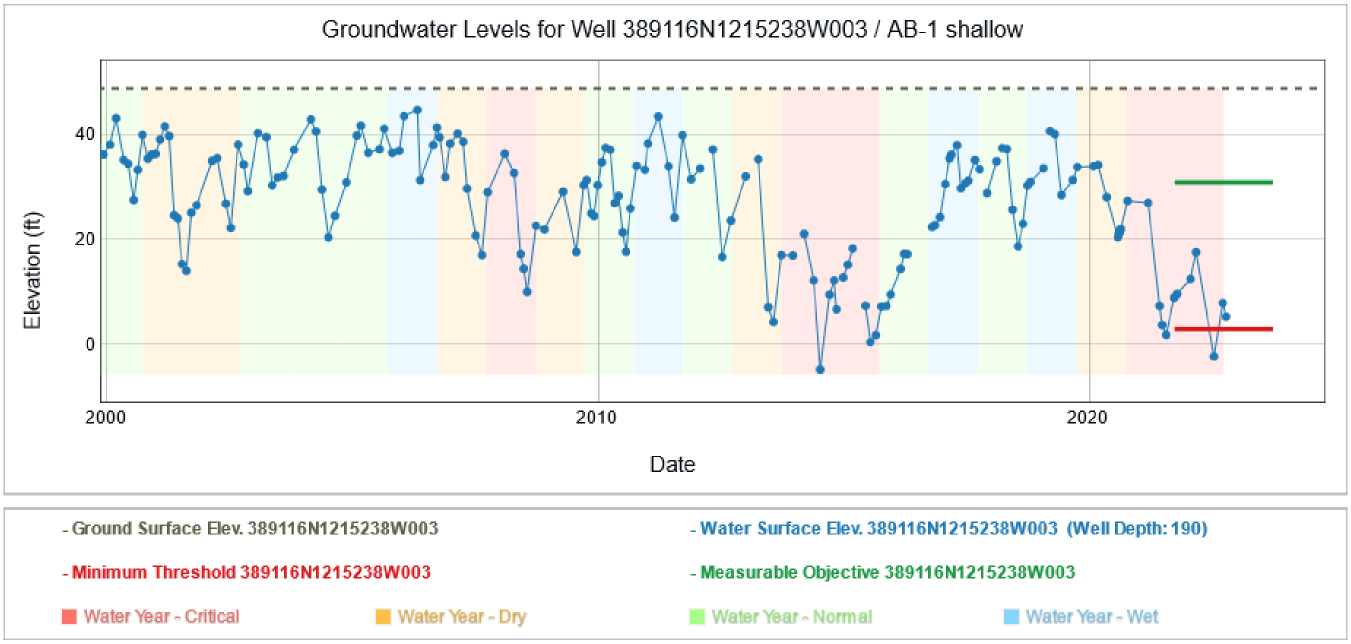


Figure A-16. AB-1 shallow, Map No. 39

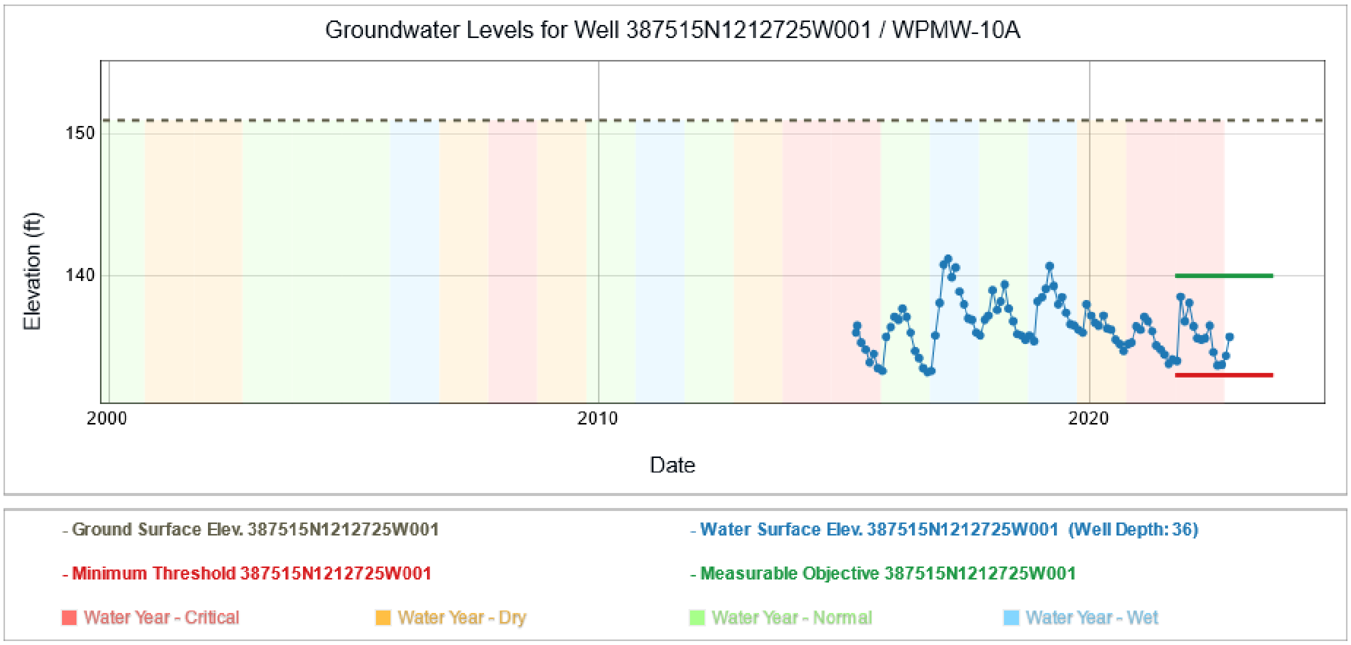


Figure A-17. WPMW-10A, Map No. 44

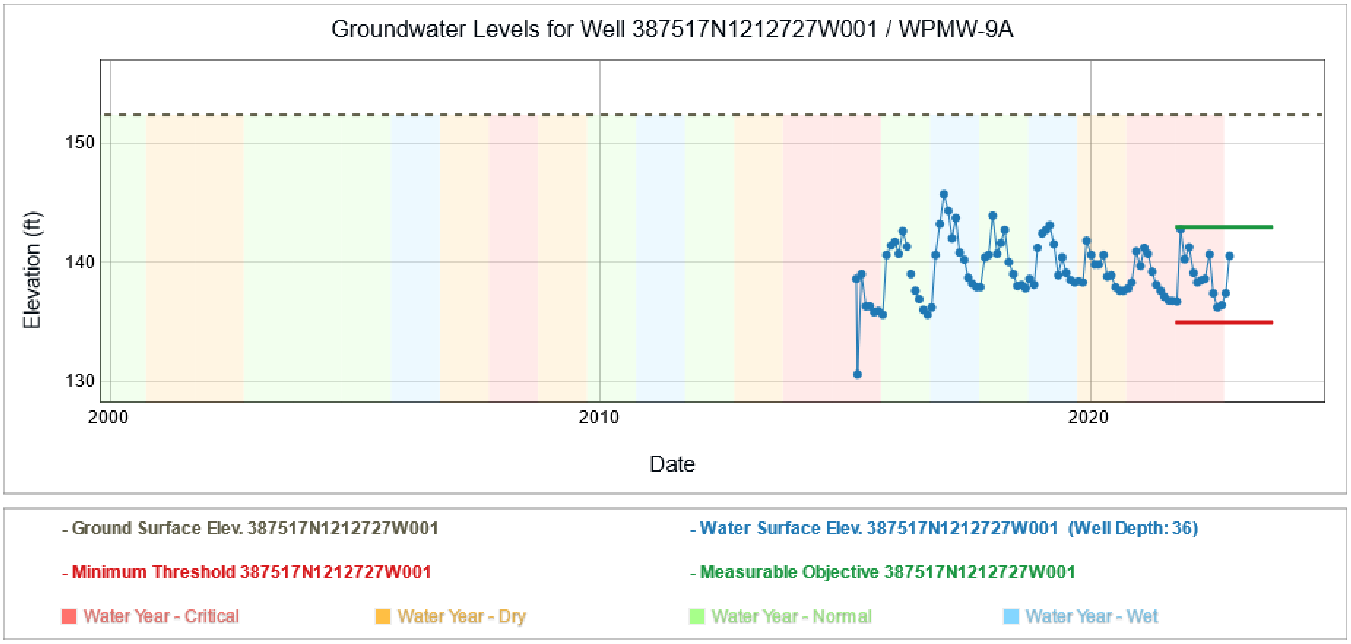


Figure A-18. WPMW-9A, Map No. 45

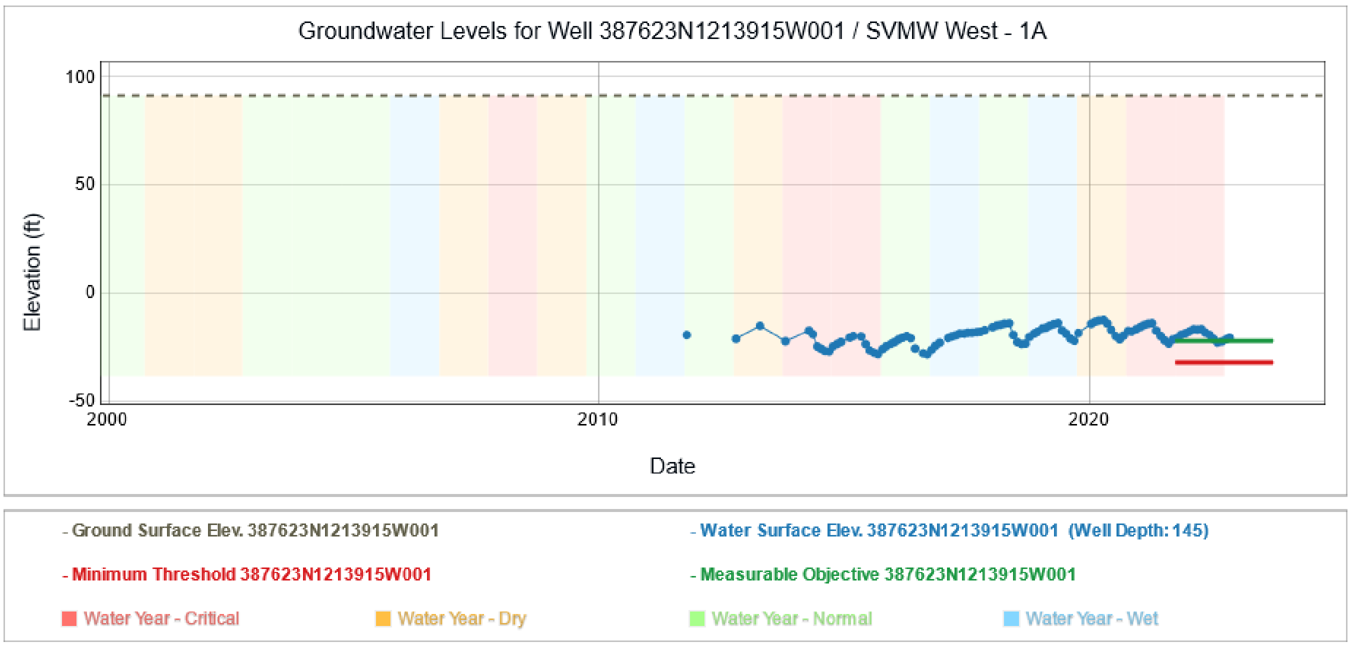


Figure A-19. SVMW West-1A, Map No. 46

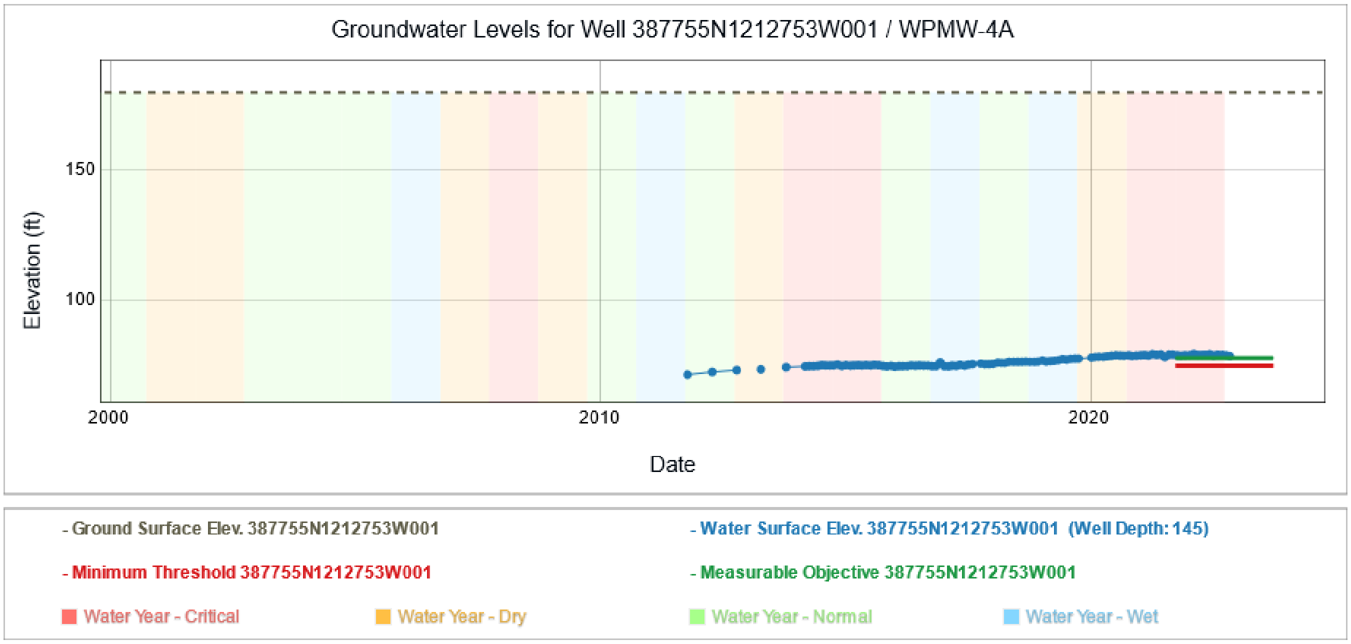


Figure A-20. WPMW-4A, Map No. 48

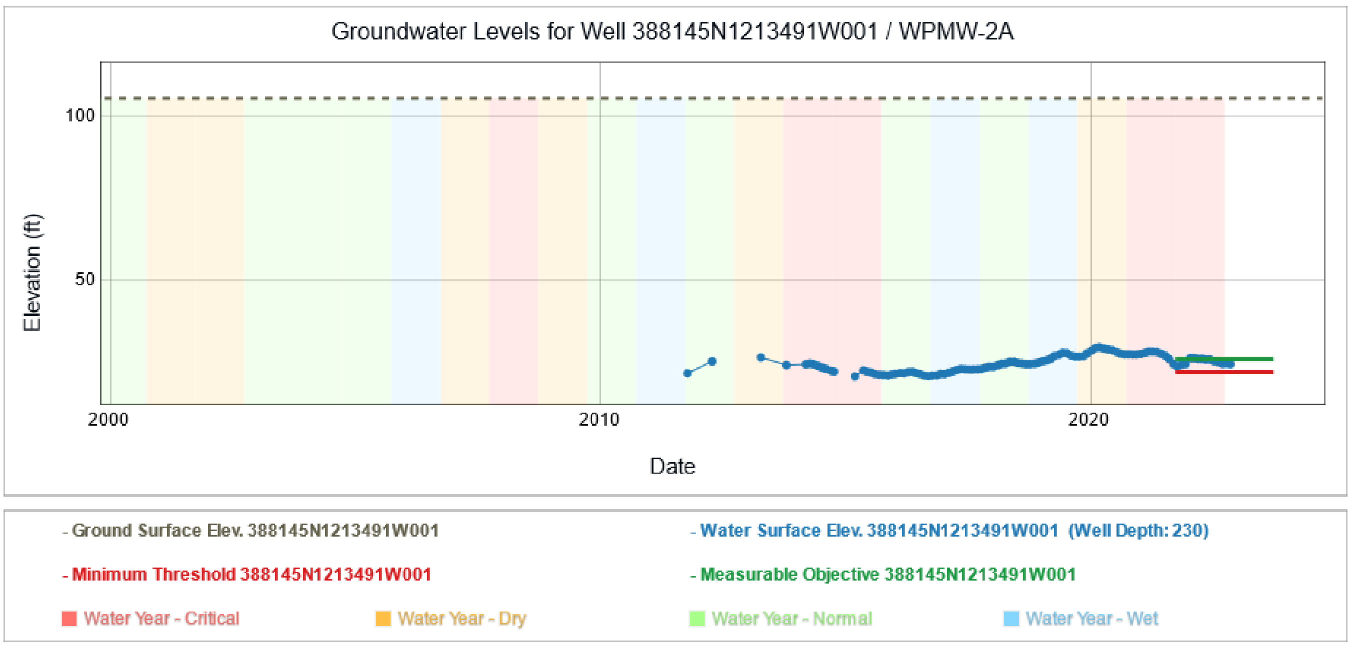


Figure A-21. WPMW-2A, Map No. 60

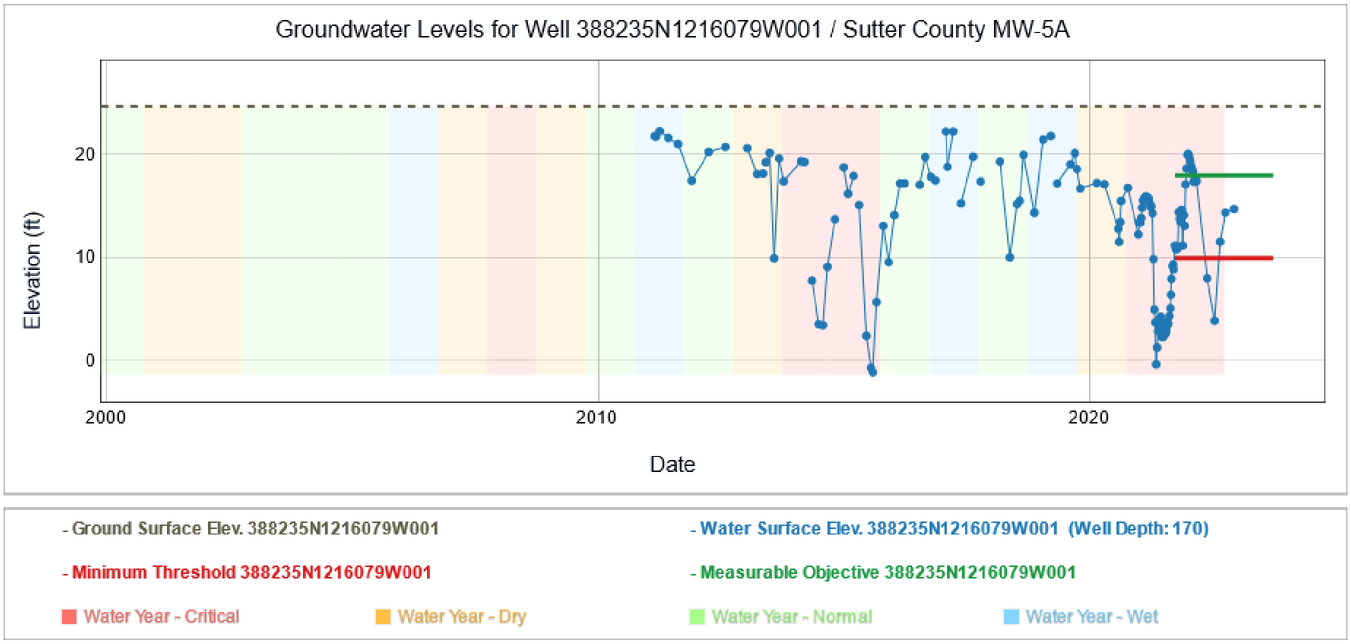


Figure A-22. Sutter County MW-5A, Map No. 61

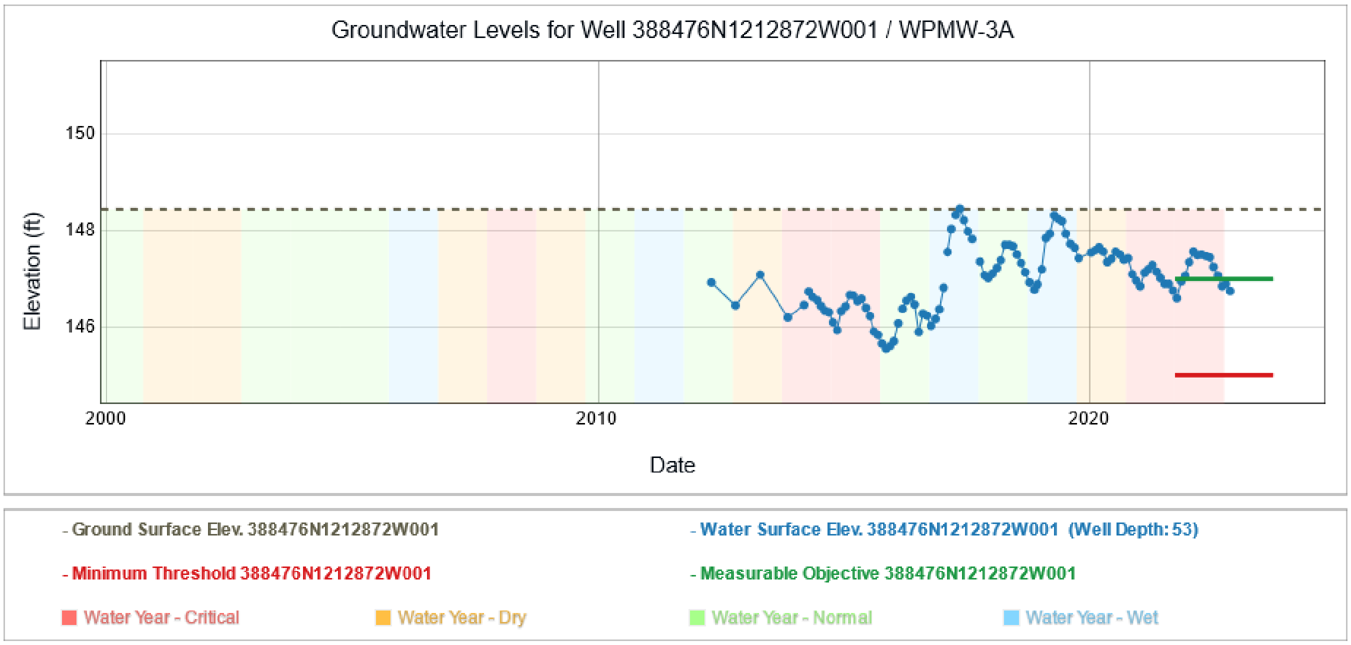


Figure A-23. WPMW-3A, Map No. 63

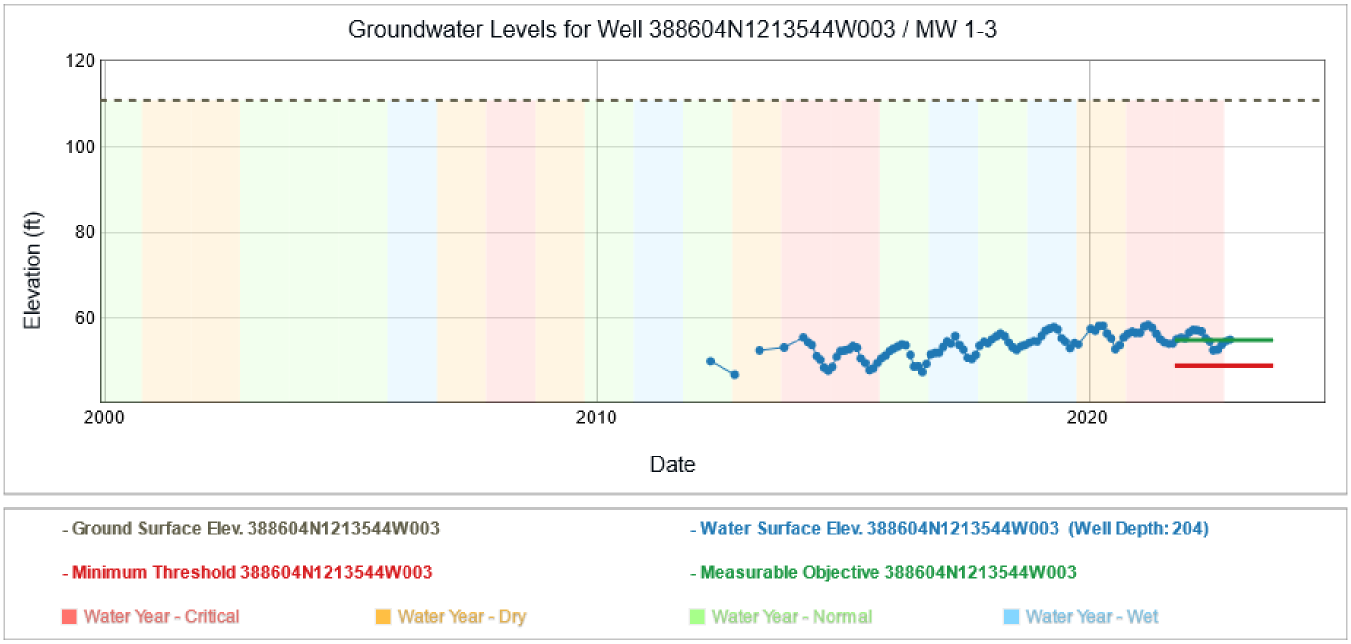


Figure A-24. MW 1-3, Map No. 65

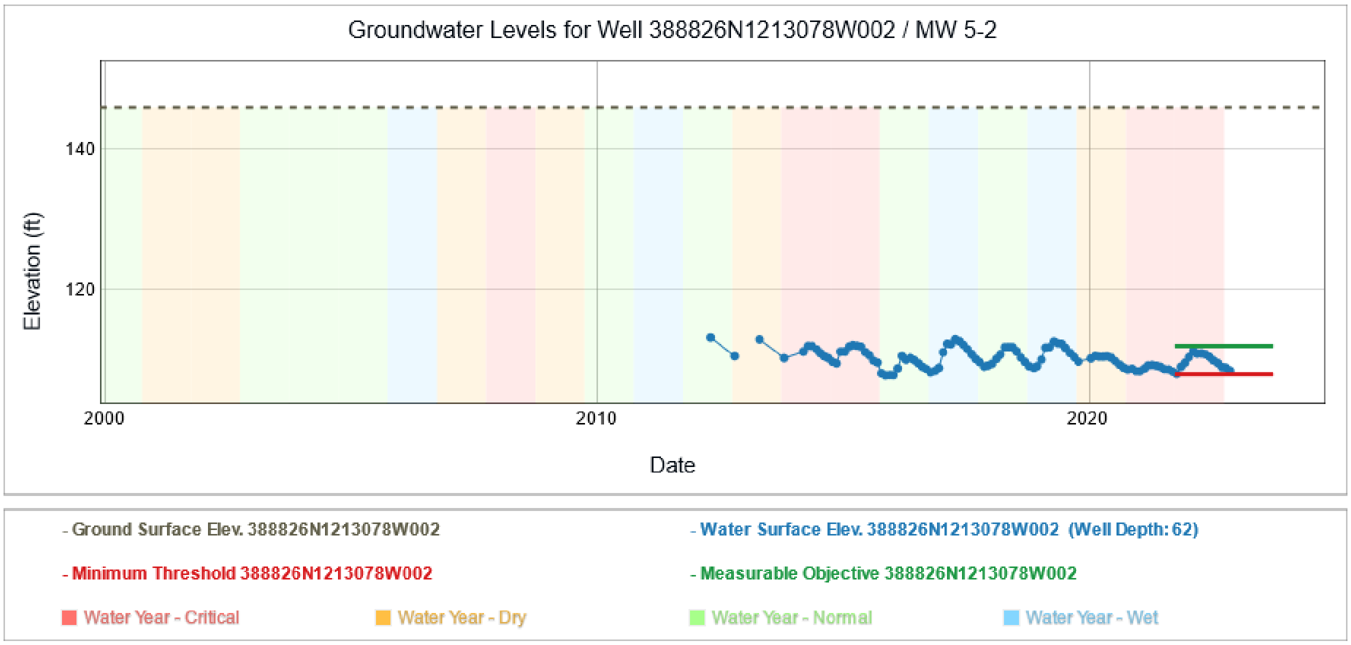


Figure A-25. MW 5-2, Map No. 66

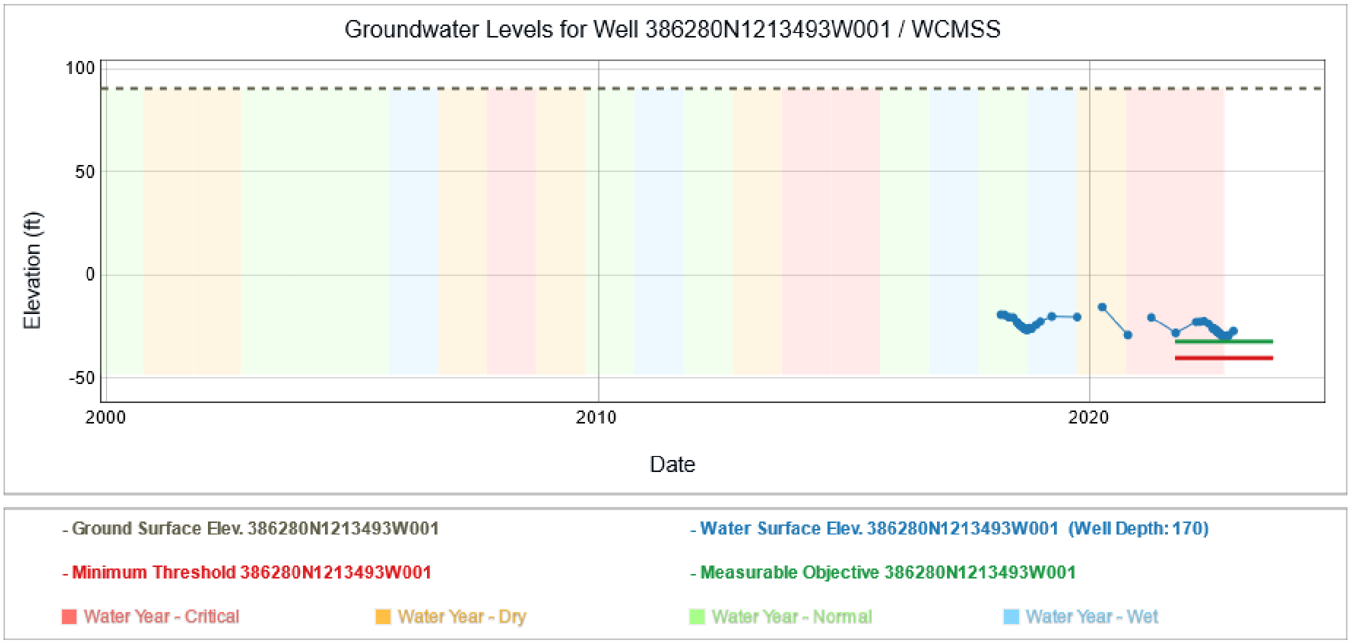


Figure A-26. WCMSS, Map No. 71

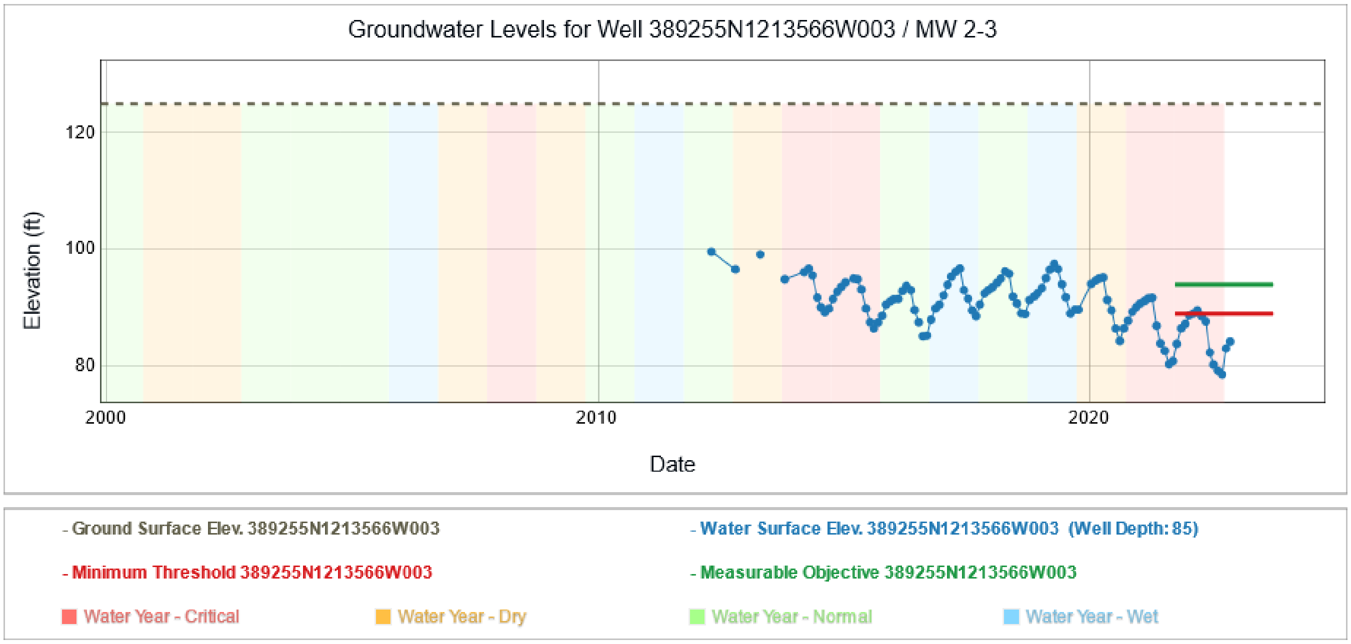


Figure A-27. MW 2-3, Map No. 75

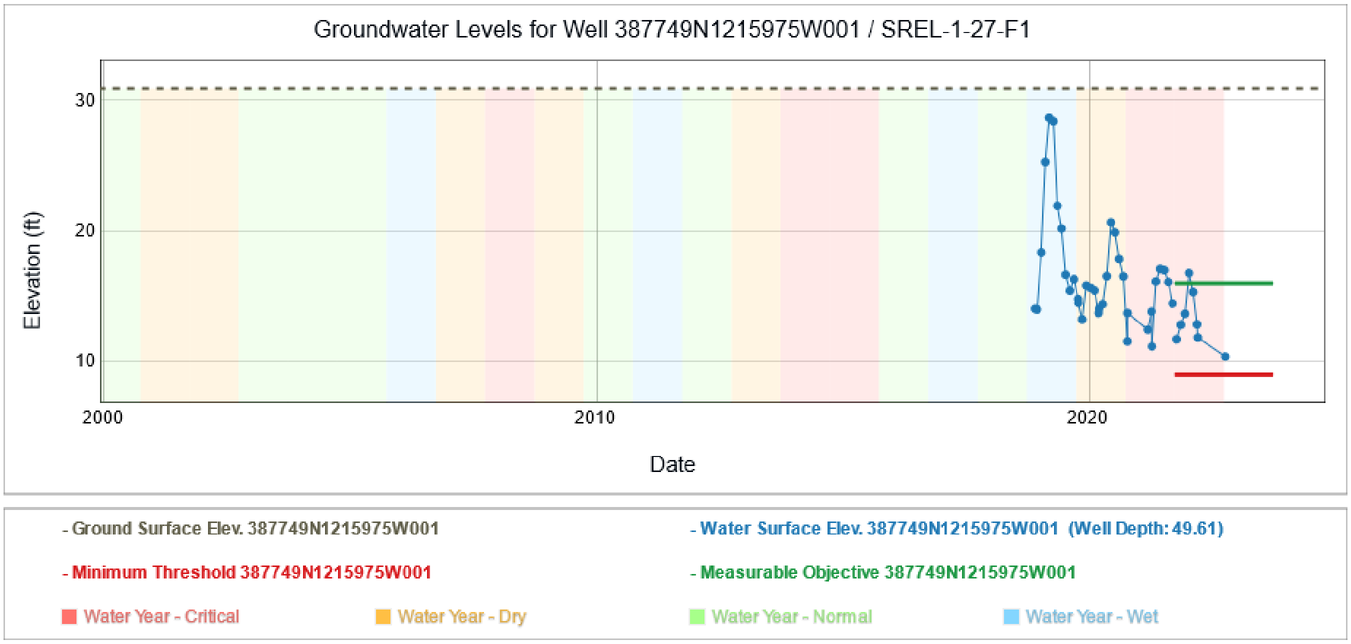


Figure A-28. SREL-1-27-F1, Map No. 77

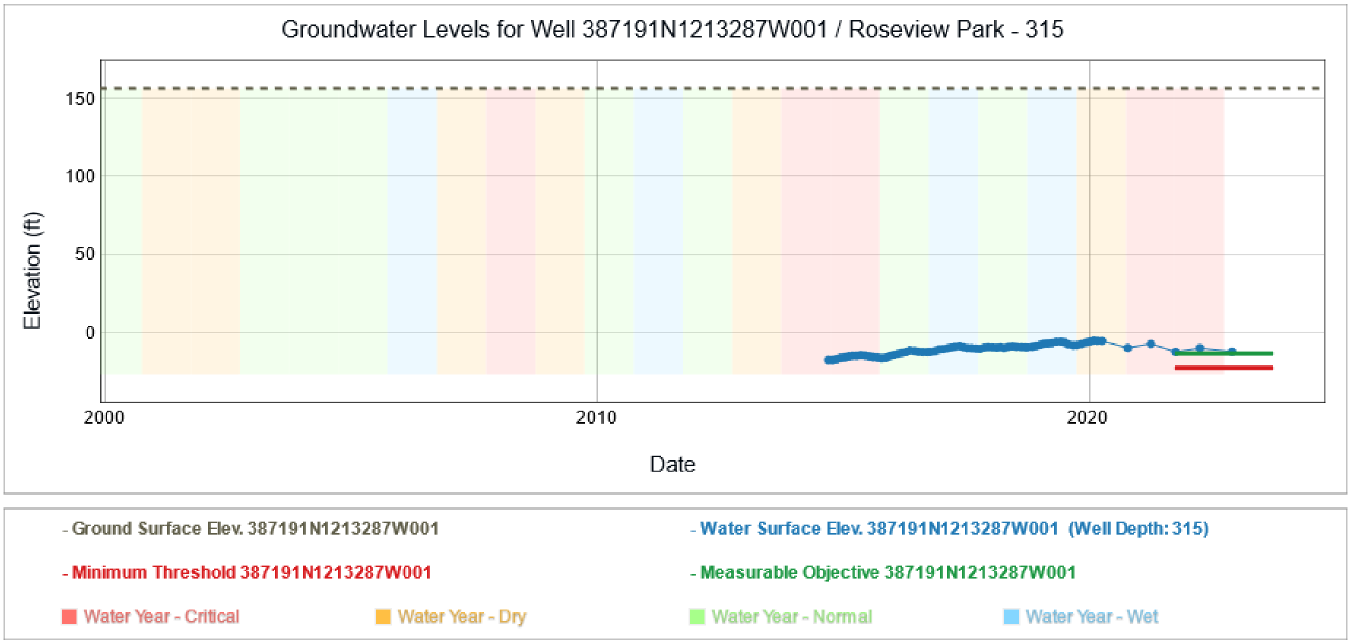


Figure A-29. Roseview Park-315, Map No. 89

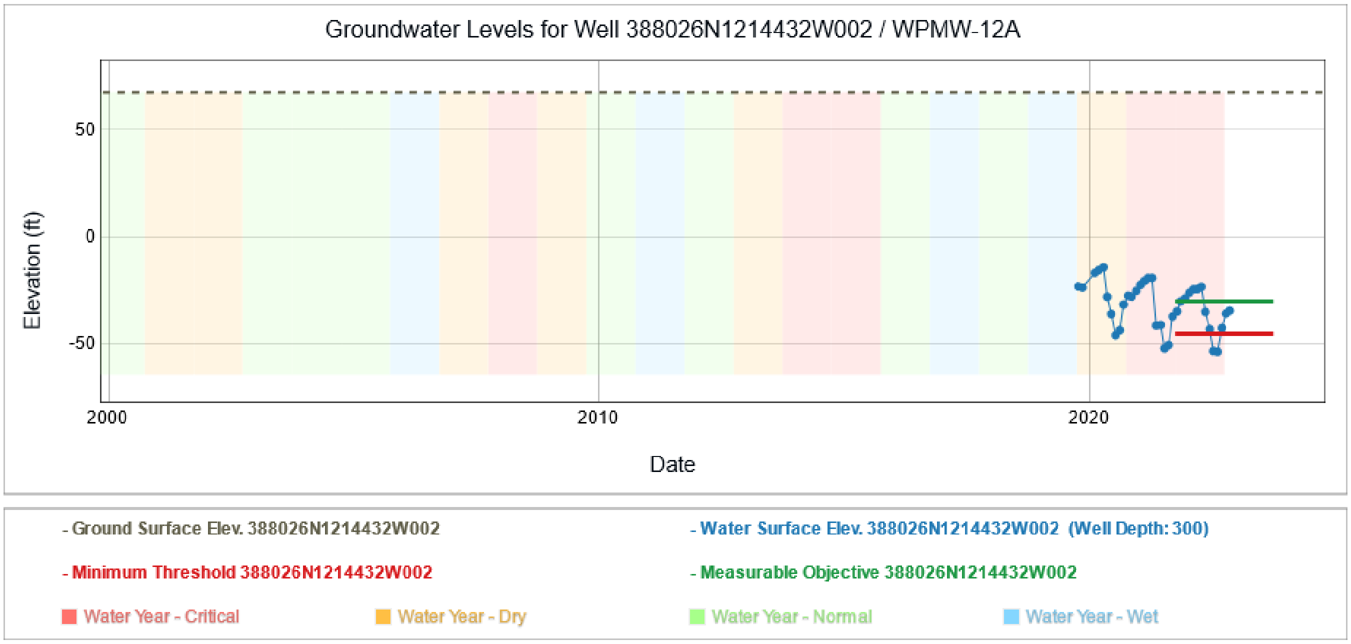


Figure A-30. WPMW-12A, Map No. 90

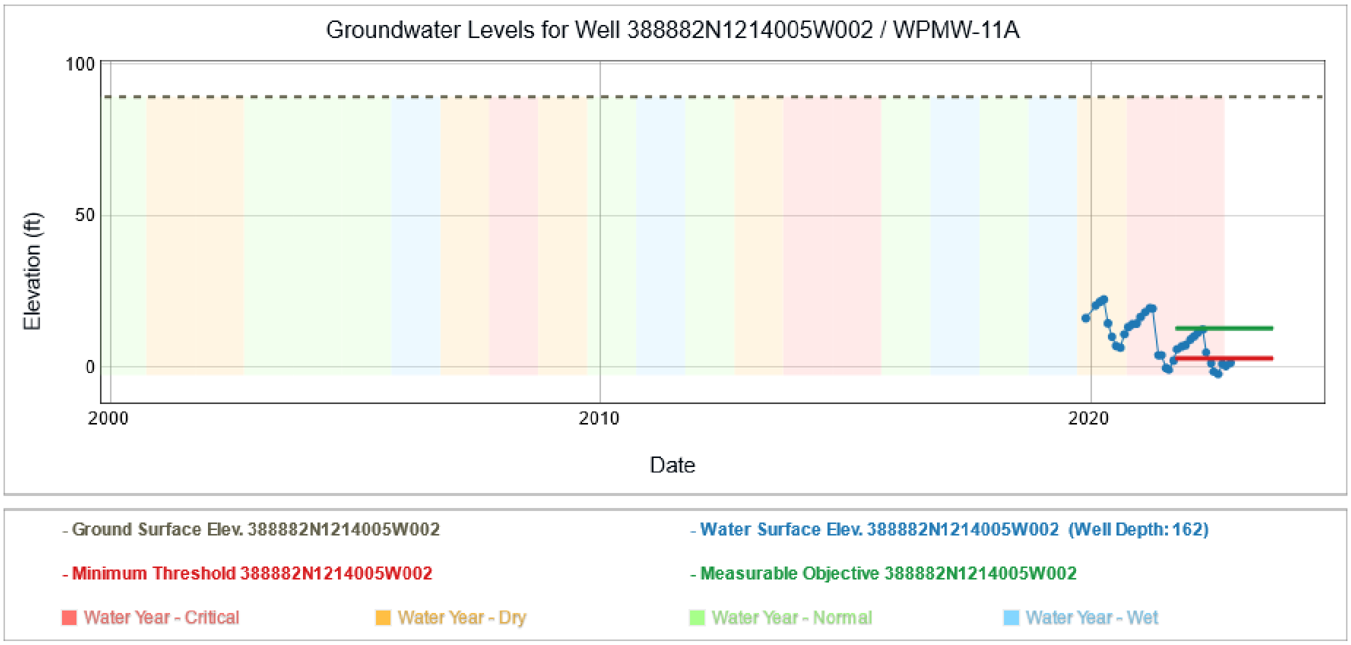


Figure A-31. WPMW-11A, Map No. 91

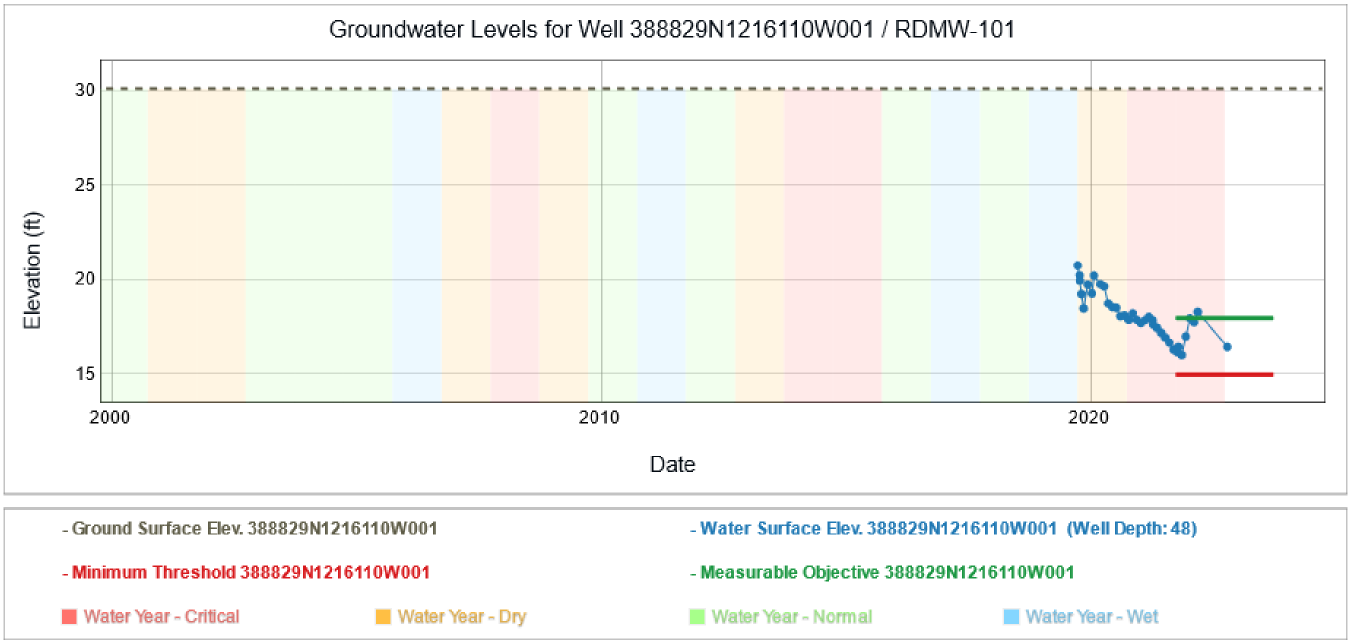


Figure A-32. RDMW-101, Map No. 92

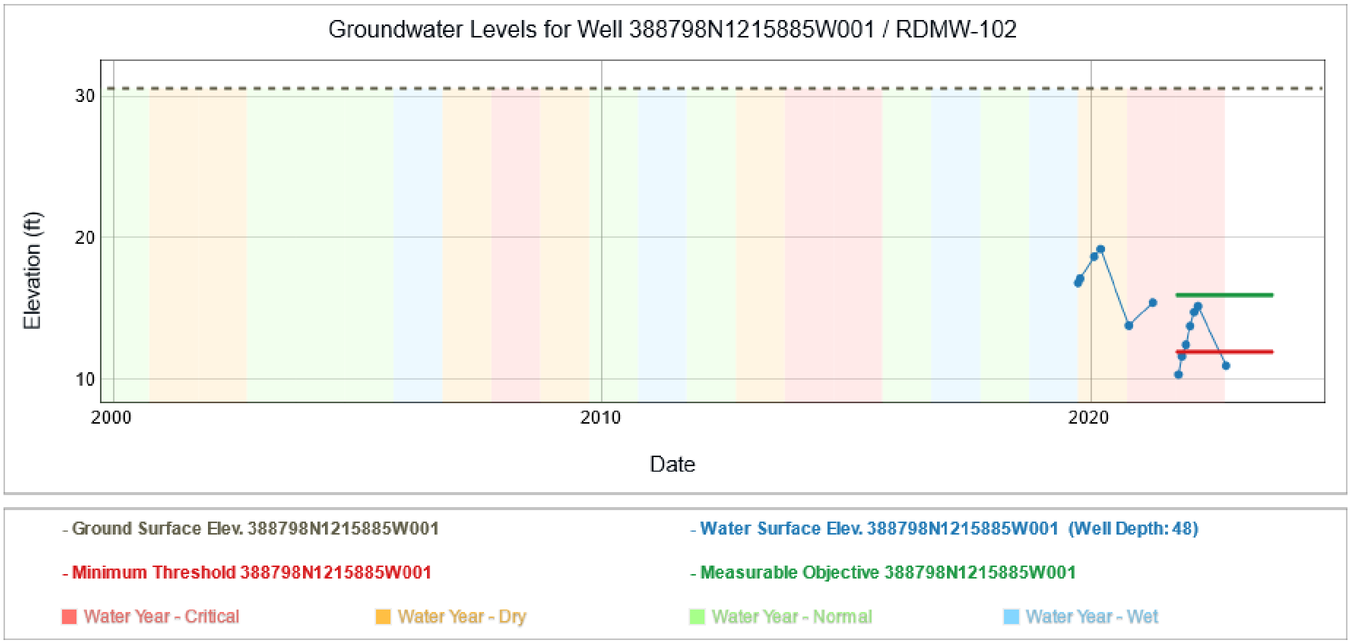


Figure A-33. RDMW-102, Map No. 93

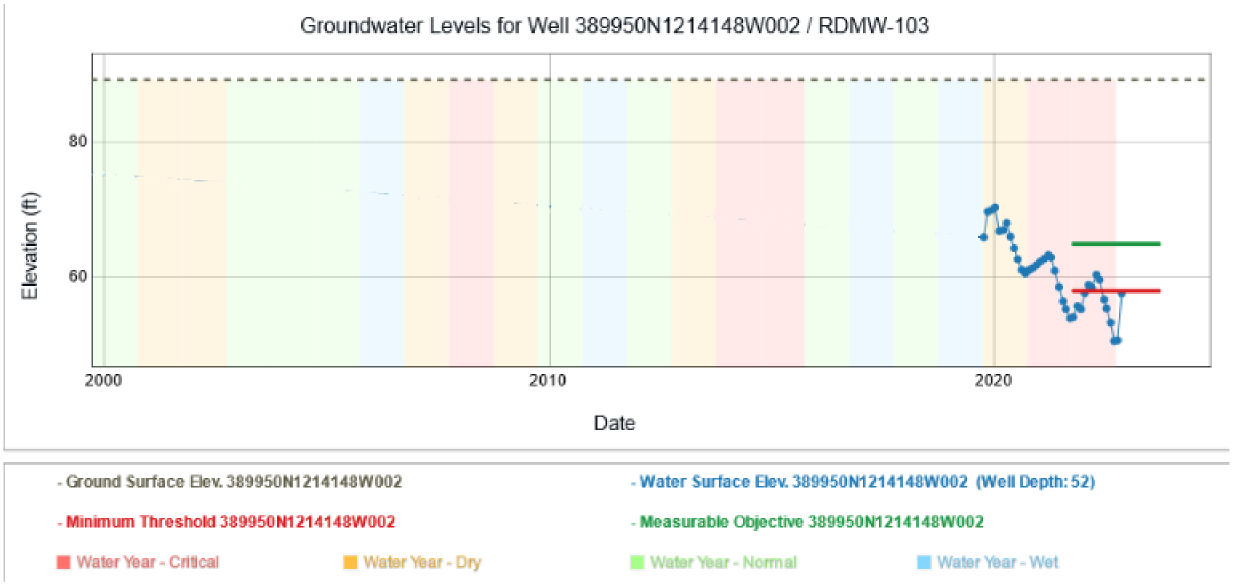


Figure A-34. RDMW-103, Map No. 94

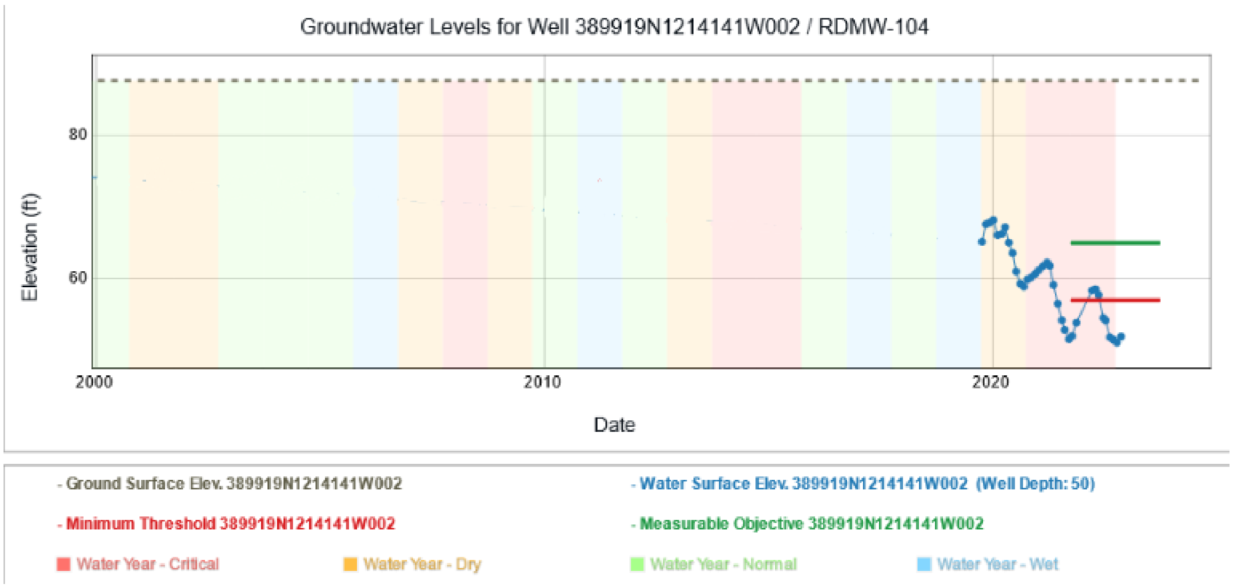


Figure A-35. RDMW-104, Map No. 95

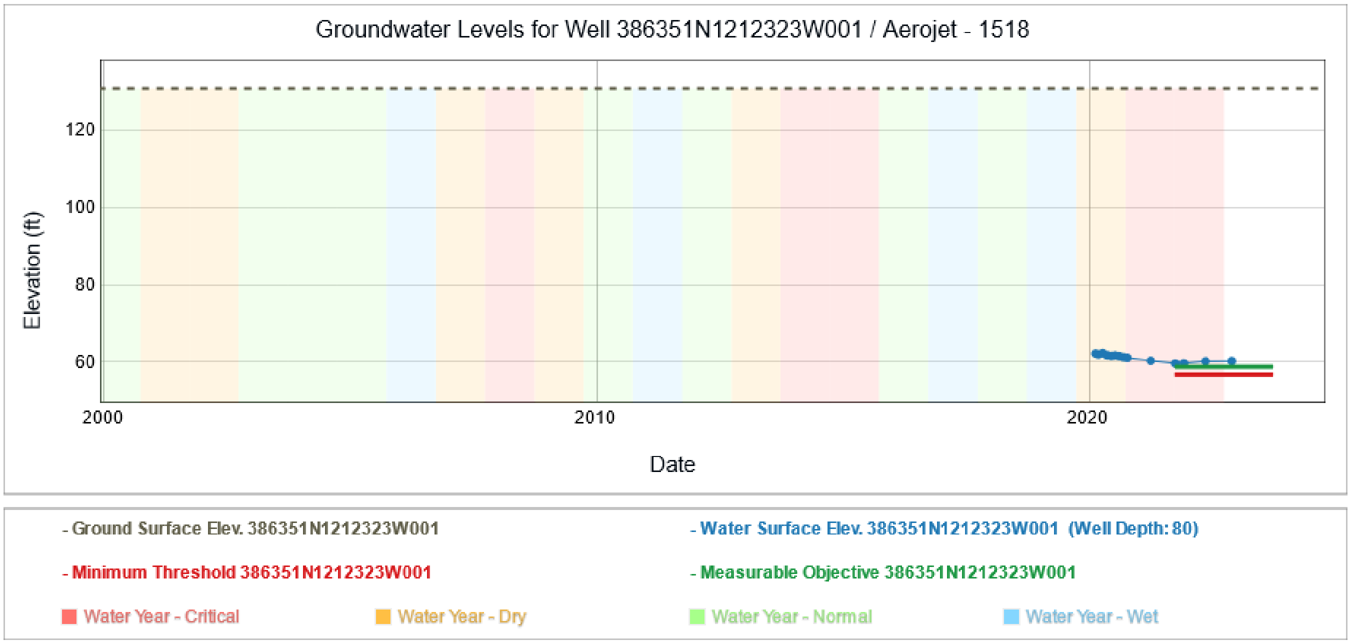


Figure A-36. Aerojet 1518, Map No. 96

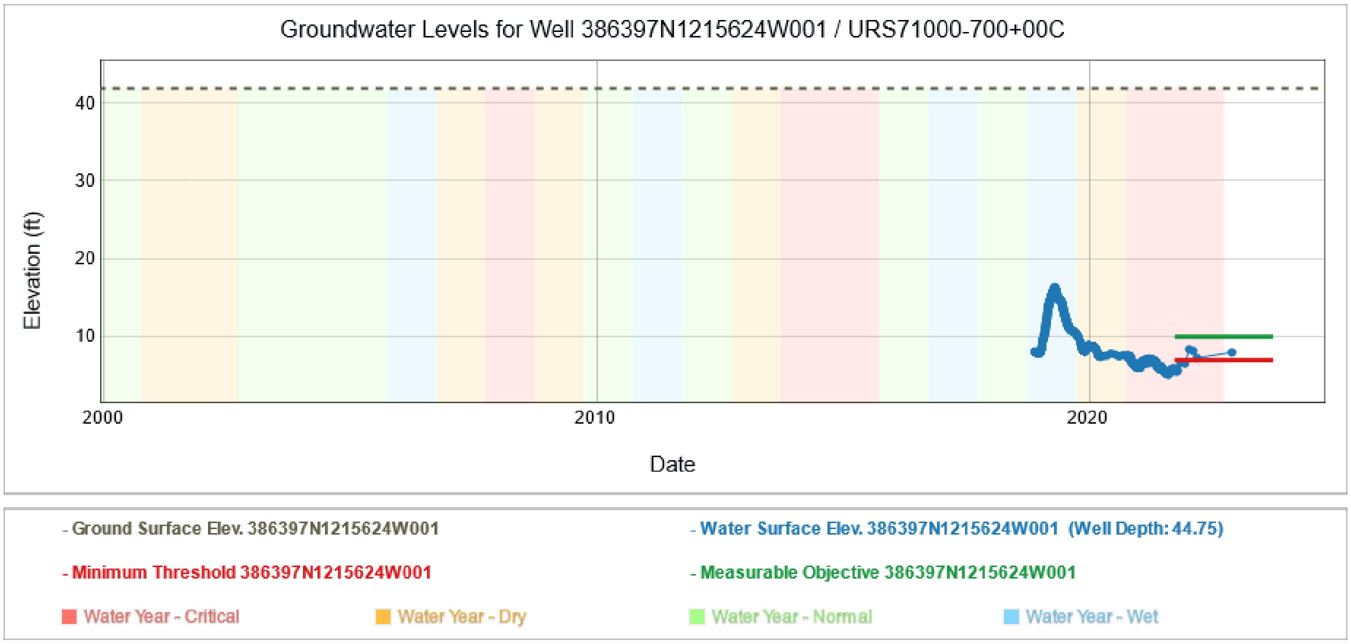


Figure A-37. URS71000-700+00C, Map No. 98

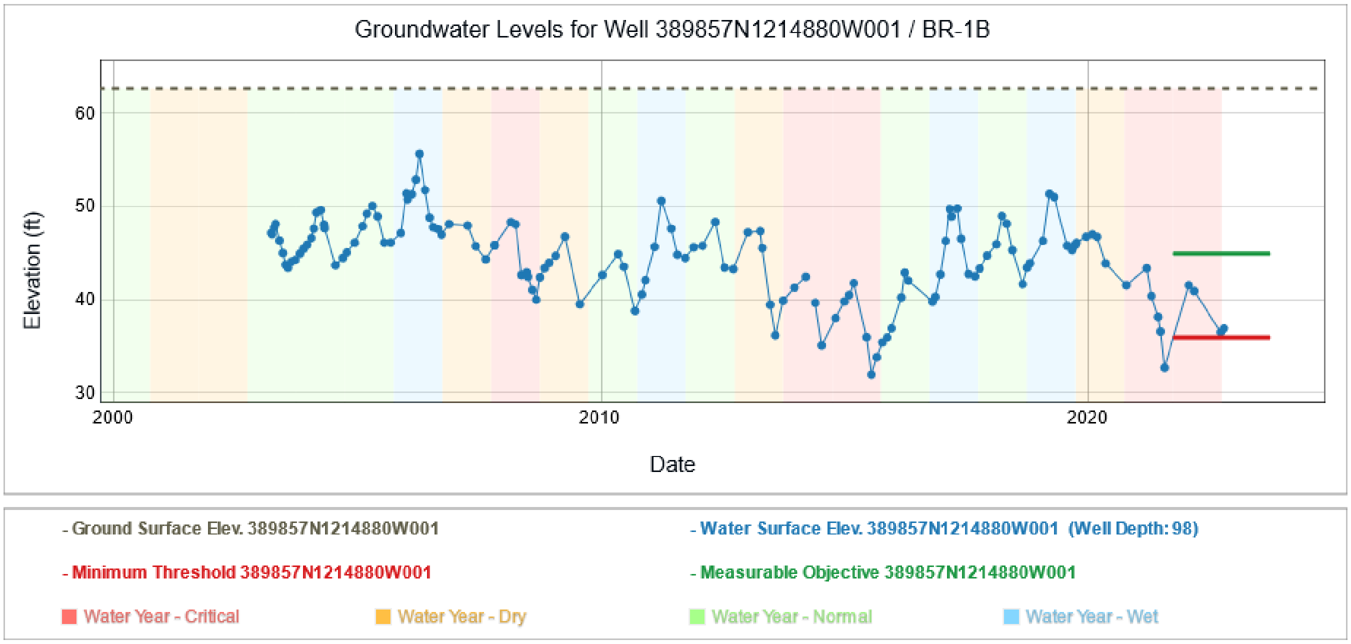


Figure A-38. BR-1B, Map No. 103

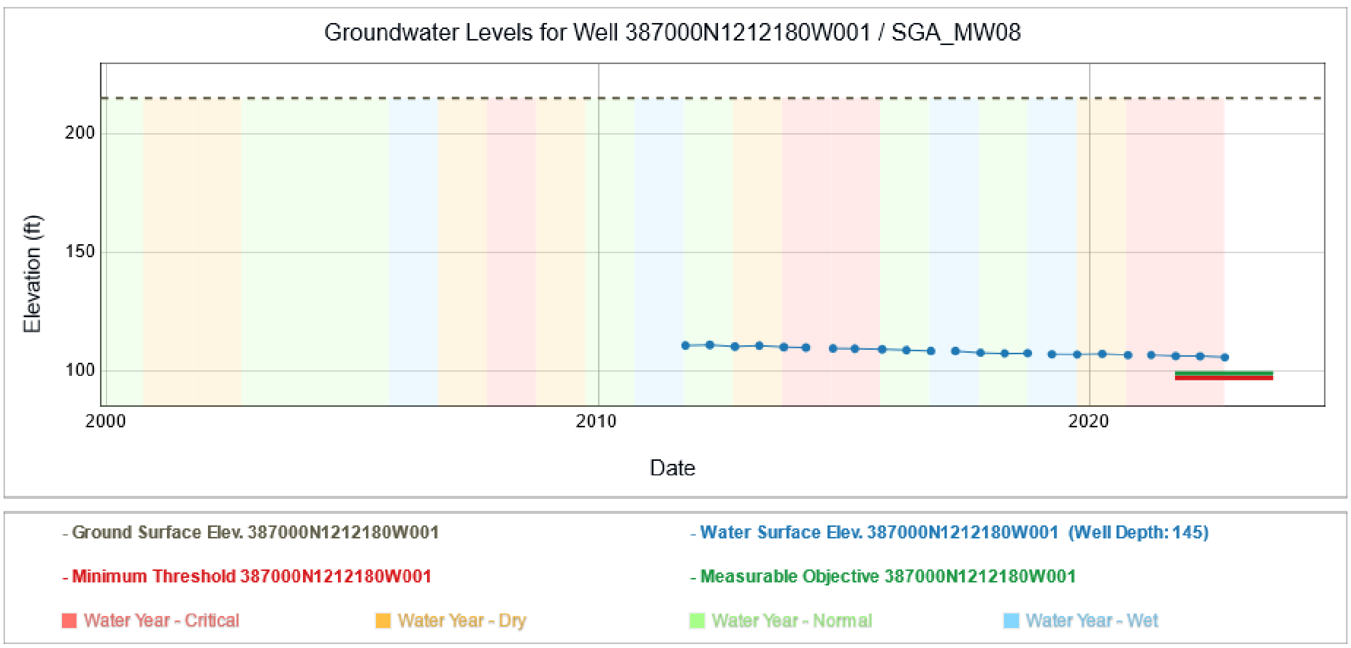


Figure A-39. SGA_MW08, Map No. 104

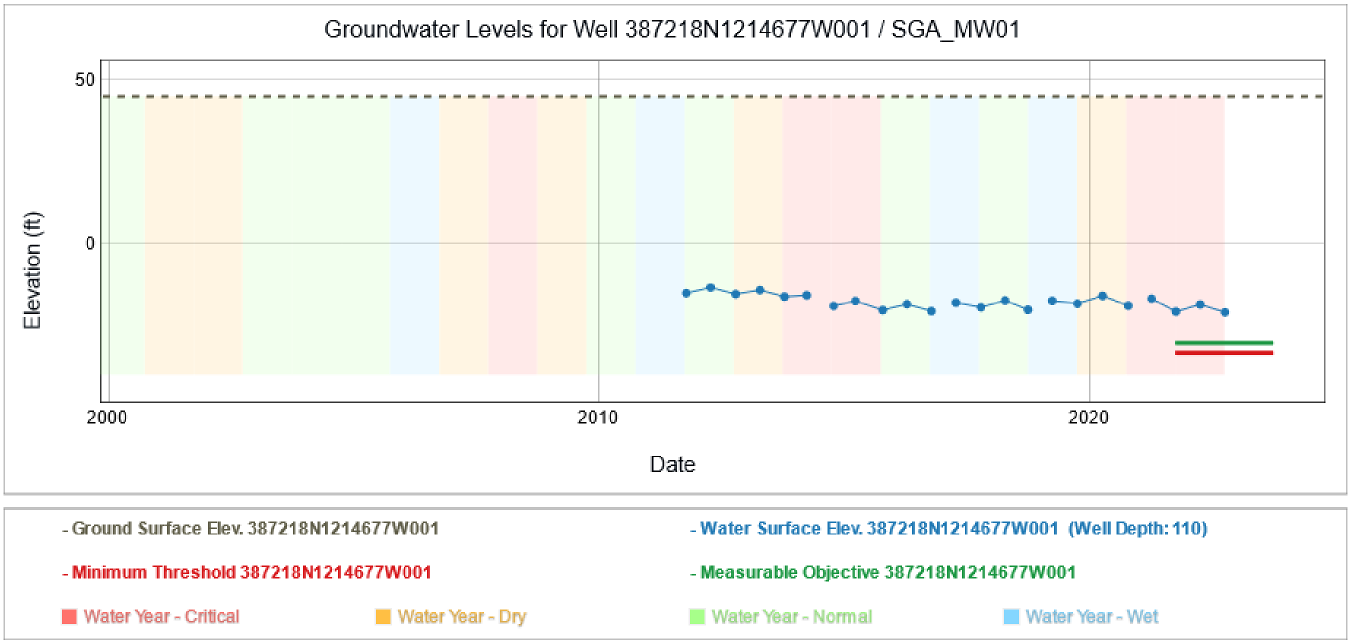


Figure A-40. SGA_MW01, Map No. 109

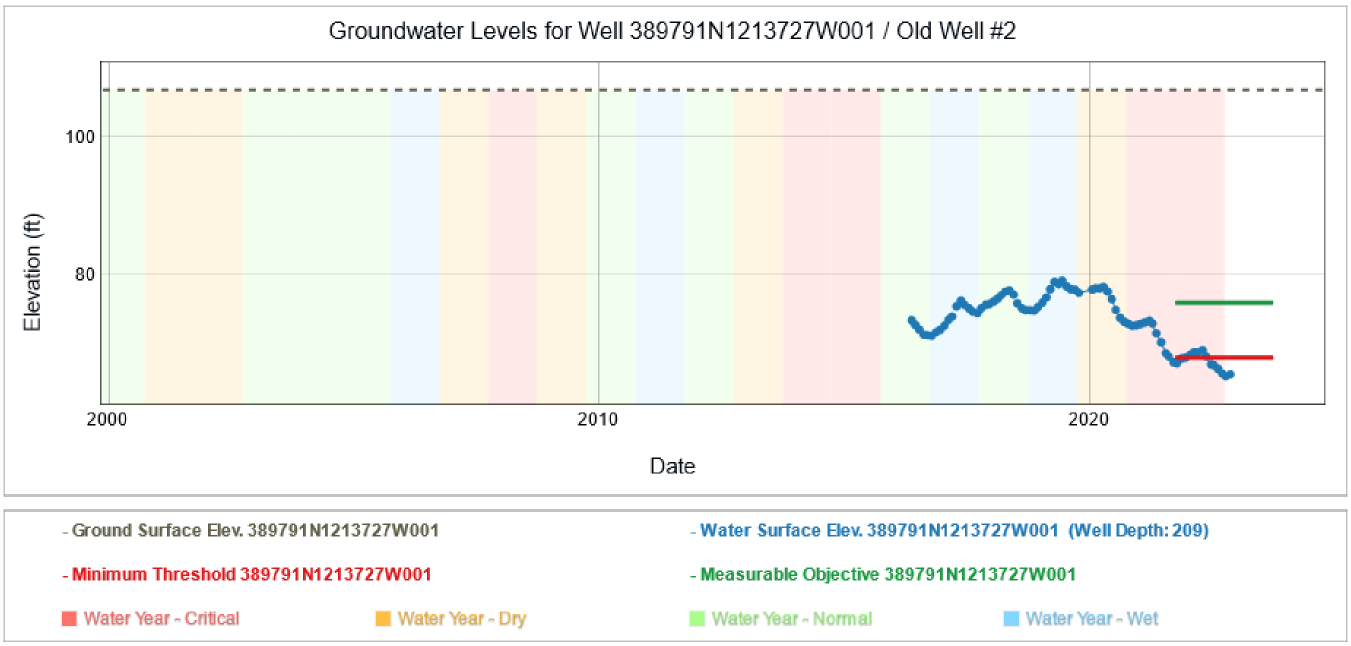


Figure A-41. Old Well #2, Map No. 116

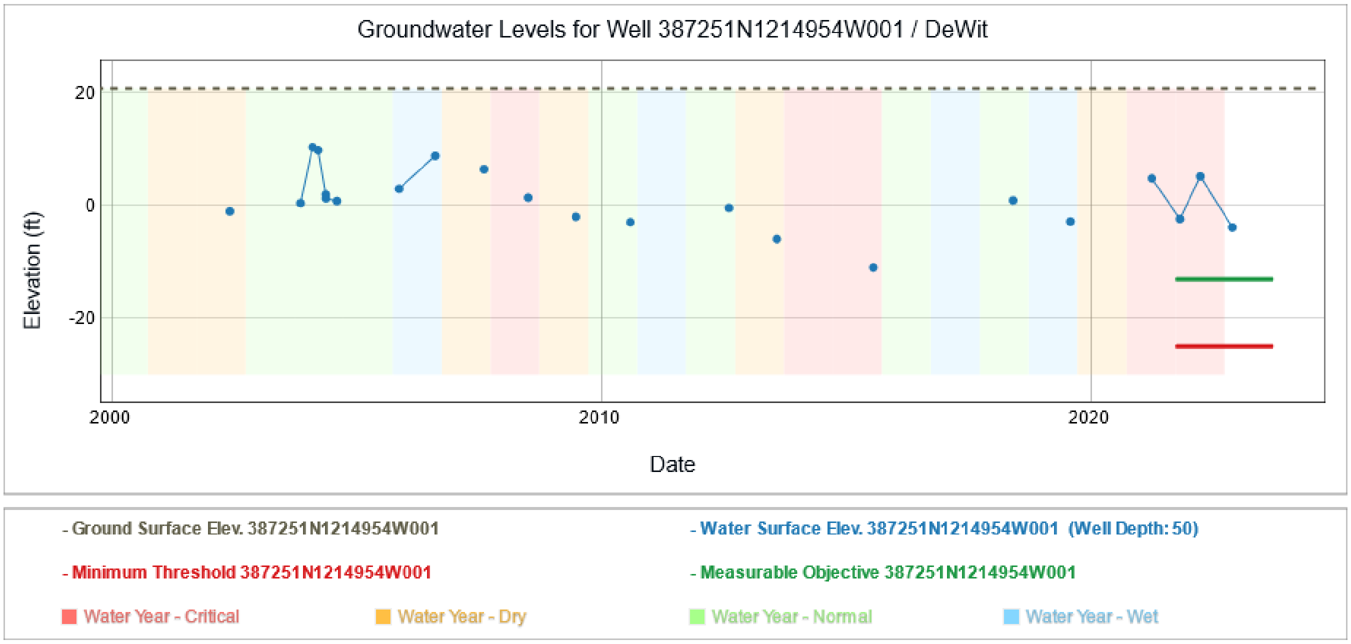


Figure A-42. DeWit, Map No. 126

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Appendix B Implementation Tracker

WY22 NASb GSP Implementation Action Tracker

Implementation Action	Action Due/Requirements	Status	Comments	Responsibility
Monitoring				
Groundwater Elevation Monitoring				
1. Continue ongoing semi-annual monitoring of the groundwater elevation monitoring network.	*Semi-annual*	Complete for 2022	Complete for spring 2022. Complete for fall 2022.	All NASb GSAs
2. Conduct confirmation water level monitoring, as needed.	*As needed*	In Progress	More frequent monitoring being conducted at sites that measured below MT in fall 2022.	GSAs where MT occurs
3. Download transducer data semi-annually.	*Semi-annual*	Complete for 2022	Spring 2022 data downloaded. Fall 2022 data downloaded.	Applicable GSA
Groundwater Quality Monitoring				
1. Download public supply well water quality monitoring data for TDS and Nitrates from the State DDW by December 31st of each year for MT and MO evaluation.	*December 31st*	Complete for 2022	Downloaded 230 distinct data points for TDS and 267 distinct values for N in February 2023.	SGA
2. Download data for Arsenic, Hexavalent Chromium, Iron, and Manganese from DDW as it becomes available for individual public supply wells and observe for trends. *If future upward trends emerge for these constituents, assess if establishing sustainable management criteria for them would be beneficial.*	*As available*	Complete for 2022	Downloaded 237 distinct data points for Arsenic, 228 distinct data points for Hexavalent Chromium, 234 distinct data points for Iron, and 233 distinct data points for Manganese in February 2023.	SGA
3. Collect water quality samples in the shallow water quality monitoring network in the Fall of odd numbered years (e.g., 2023).	*Not applicable for WY 2022*	-	-	Applicable GSA
Subsidence Monitoring				
1. No current action required unless water level MT exceedances are occurring or if optional DWR InSAR monitoring indicates a potential undesirable result.	*None*	In Progress	More frequent monitoring being conducted at sites that measured below MT in fall 2022.	GSAs where MT occurs
Other Monitoring				
1. Collect additional monitoring data (e.g., surface water stages) from the CDEC on an as-needed basis (e.g., during preparation of Annual Report).	*As needed*	Follow Up Needed	Included in Water Year 2022 (WY22) Annual Report.	SGA
Data Management				
1. Upload groundwater elevation data on an ongoing basis to CASGEM (or other applicable State SGMA database) within one month after semi-annual monitoring.	*One month after semi-annual monitoring*	Complete for 2022	Complete for spring 2022. Complete for fall 2022.	SGA
2. Upload water quality data from shallow monitoring well network by December 31 of each year that it is collected.	*Not applicable for WY 2022*	-	-	SGA
3. Update NASb Data Management System with appropriate data by December 31 of each year.	*December 31st*	Not Yet Started	Need to arrange training from GEI.	SGA
Data Analysis				
Sustainability Indicators				
1. Review all representative groundwater levels in comparison to MOs and MTs by December 31 of each year for potential emergence of undesirable results.	*December 31st*	Complete for 2022	Included in WY22 Annual Report.	SGA
2. Calculate the public water supply wells TDS and N rolling averages to determine if the Subbasin is meeting MOs and MTs by January 31 each year.	*January 31st*	Complete for 2022	Included in WY22 Annual Report.	SGA
3. Review shallow monitoring network TDS and N data to determine if the Subbasin is meeting MOs and MTs by January 31 of each year following its collection.	*Not applicable for WY 2022*	-	-	SGA
Annual Report				
1. Complete the recurring Annual Report for review by GSAs by February 28 each year and submit to DWR by April 1 each year.	*Review: February 28* *Submit to DWR: April 1*	In Progress	Preparation of Draft WY22 Annual Report began November 2022. Final draft was completed in early March 2023.	SGA to coordinate
CoSANA Groundwater Model				
1. In 2025, a comprehensive assessment and update of the CoSANA model will begin. This will be coordinated with the South American and Cosumnes subbasins. Update to the model will include the use of the most updated urban water supplier demand projections, the latest climate change projections (using multiple future projection scenarios), consideration of an extreme scenario, consideration of the model recommendations in Section 6 of the CoSANA model report included in Appendix P of the GSP.	*Continuous*	In Progress	Annual land use and hydrology are being routinely updated as part of the annual report preparation.	SGA
Coordination and Outreach				
1. Continue quarterly meetings of the NASb GSAs.	*Quarterly*	Complete for 2022	Met January, February, March, April, August 2022.	All NASb GSAs
2. Hold at least one public meeting each year in which basin conditions will be presented and upcoming year activities will be described. The meeting will be scheduled when the Annual Report has been completed each year.	*At least one meeting each year (scheduled after completion of the Annual Report)*	Complete for 2022	Presented WY21 Annual Report on June 28, 2022 via Zoom.	All NASb GSAs
3. Meet with each adjacent subbasin at least annually. The meeting will be scheduled as the Annual Report is being prepared, so that any observations about potential concerns near common boundaries can be discussed.	*Annually (scheduled during preparation of the Annual Report)*	Complete for 2022	Met with Yolo and Yuba subbasins on August 4, 2022. Met with South American Subbasin on September 13, 2022. Met with Sutter Subbasin on October 6, 2022.	SGA to coordinate
4. Meet with County and City land use planning staff of respective counties once each year to share the results of the Annual Report and discuss any upcoming anticipated changes to land use designations or General Plans. The meetings will be scheduled shortly after the Annual Report is submitted.	*Once per year (scheduled shortly after Annual Report is submitted)*	Complete for 2022	Met with Sacramento County Planning Department on October 7, 2022. Met with Placer County Lange Use agency on September 29, 2022 to discuss guide for land use agencies for SGMA.	All NASb GSAs
5. Continue quarterly meetings of the Regional Contamination Issues Committee to identify and report on potential emerging issues of contamination or constituents of concern. The committee is facilitated by SGA staff and includes State and Federal regulatory agencies, local water agencies, responsible parties, and members of the public.	*Quarterly*	Complete for 2022	Meetings held on January 27, 2022 and April 28, 2022. July meeting cancelled due to schedule conflicts.	SGA
Other Management Activities				
1. Fill data gaps noted in the monitoring well network by December 31, 2024.	*December 31, 2024*	Follow Up Needed	Have not begun Technical Support Services funding application.	All NASb GSAs
2. Track implementation of urban area conjunctive use program as part of Annual Report preparation. Identify if there are barriers to its planned expansion.	*Continuous*	Complete for 2022	Water use reported in WY22 Annual Report.	SGA
3. Work with the Regional Water Authority in its development of the Sacramento Regional Water Bank to ensure that it is consistent with achieving the sustainability goal in the NASb.	*Continuous*	In Progress	RWA began public engagement for the Water Bank and held its first Stakeholder Forum on October 26, 2022.	SGA
4. Begin technical work on well construction practices (e.g., depth and spacing) to protect the most sensitive beneficial uses and users of groundwater in the NASb. Work will commence in early 2022 and be completed by the end of 2023. This will require a cooperative effort with local permitting agencies.	*Begin early 2022* *Completed by 2023*	Follow Up Needed	Governor's Executive Order related to drought has taken priority and technical work on well construction practices put on hold as a result of the Executive Order.	All NASb GSAs
5. Commence shallow/domestic well analysis in early 2022 and conclude by early 2024.	*Begin early 2022* *Completed by early 2024*	In Progress	SGA staff has initial study. Approach is to identify parcels in subbasin that have homes that are not served by public water suppliers.	SGA to coordinate
6. Commence GDE assessment management action in early 2022 and conclude major assessment by early 2024. Continue annual monitoring of GDE health.	*Begin early 2022* *Conclude assessment by early 2024* *Continuous yearly annual monitoring of GDE health*	In Progress	SGA staff is researching options for assessing GDE health.	SGA to coordinate
7. Track progress on supplemental projects on an annual basis. Update progress and any information on newly proposed supplemental projects in the Annual Report.	*Annually*	Complete for 2022	Included in WY22 Annual Report.	Applicable GSA