ANNUAL REPORT | APRIL 2022

ANTELOPE SUBBASIN GROUNDWATER SUSTAINABILITY PLAN ANNUAL REPORT - 2021

PREPARED FOR

TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION GSA

TEHAMA COUNTY GSA-ANTELOPE

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
af	Acre-Feet
amsl	Above mean sea level
CASGEM	California Statewide Groundwater Elevation Monitoring Online System
CVP	Central Valley Project
District	Tehama County Flood Control and Water Conservation District
DMS	Data Management System
DWR	Department of Water Resources
ft	feet
GAMA	Groundwater Ambient Monitoring and Assessment Program
GSP	Groundwater Sustainability Plan
GSA	Groundwater Sustainability Agency
MO	Measurable Objective
MT	Minimum Threshold
NAVD 88	North American Vertical Datum of 1988
PMAs	Projects and Management Actions
RMS	Representative Monitoring Sites
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
Subbasin	Antelope Groundwater Subbasin
SVSim	Sacramento Valley Groundwater-Surface Water Simulation Model
TNC	The Nature Conservancy
TSS	Technical Support Services
USGS	United States Geological Survey

EXECUTIVE SUMMARY

ES 1. Introduction

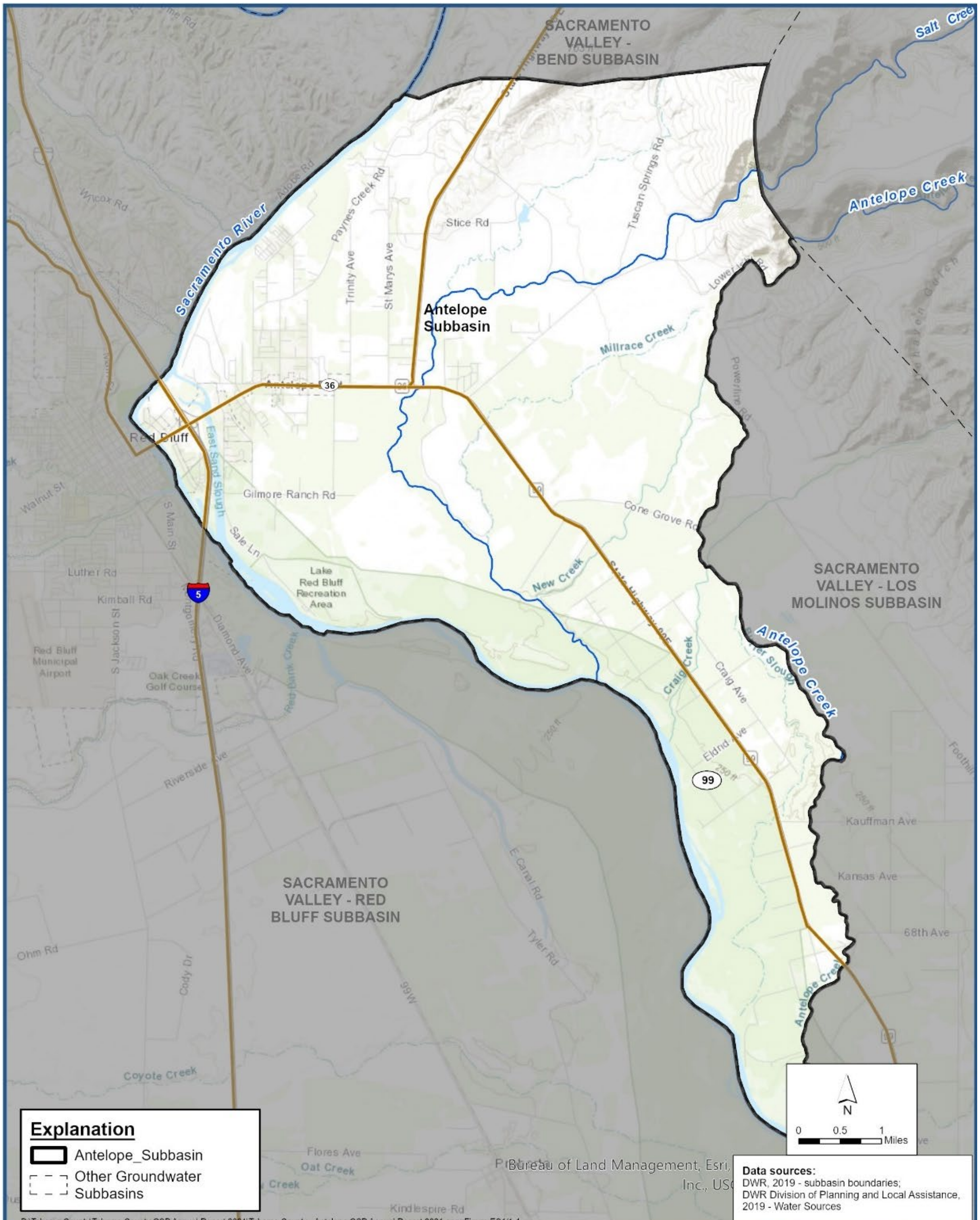
The annual report for the Antelope Subbasin (Subbasin) (5-021.54) was prepared on behalf of the Tehama County Groundwater Sustainability Agency (GSA) to fulfill the statutory requirements of the Sustainable Groundwater Management Act (SGMA) legislation (Section 10728) and regulatory requirements developed by the California Department of Water Resources (DWR) included in the Groundwater Sustainability Plan (GSP) Regulations (Section 354.40 and Section 356.2). The Regulations require the GSA to submit an Annual Report to DWR by April 1, 2022 following the reporting year (October through September).

The Antelope Subbasin covers 19,100 acres and is in the Northern Sacramento Valley Groundwater Basin (**Figure ES-1**). Antelope is one of seven (7) groundwater subbasins within Tehama County. The Tehama County FCWCD is the exclusive GSA for six (6) of those subbasins: Antelope, Bend, Bowman, Los Molinos, Red Bluff, and South Battle Creek. The seventh, the Corning Subbasin, extends into Glenn County, that subbasin is being managed in a coordinated effort between the Tehama County FCWCD and the Corning Sub-basin GSA.

This report is the first Annual Report prepared to support the adopted Antelope Subbasin GSP submitted in January 2022. This Annual Report includes data elements for the current and previous reporting water years (2020-2021). Pursuant to GSP Regulations, the Annual Report includes:

1. Groundwater Elevation Data
2. Water Supply and Use
3. Change in Groundwater Storage
4. GSP Implementation Progress

All data and information in the annual report are for the Antelope Subbasin. This Annual Report coincides with one of the most severe and extensive droughts that has ever gripped the western United States. In December 2021, as the final GSP was being assembled, drought conditions throughout most of California, including in this subbasin were classified as “exceptional,” the most extreme classification defined by the U.S. Drought Monitor. Historically, observed impacts during exceptional drought generally include: widespread water supply shortages, depleted surface water supplies, extremely low federal and state surface water deliveries, curtailment of water rights, extremely high surface water prices, increased groundwater pumping to satisfy water demands, dry groundwater wells, increased well drilling and deepening, increased pumping costs, wildfire, decreased recreational opportunities, and poor water quality, among other potential impacts reported by the U.S. Drought Monitor. All of these conditions were experienced to some degree across California in 2021 and, at least in part, within the Subbasin.



TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

LSCE Team

Antelope Subbasin Area Map

Figure ES-1

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

ES 2. Groundwater Elevations

Groundwater elevation data in the Upper and Lower Aquifers for the 2020-2021 water years were analyzed. The water year is defined as October through September. Groundwater elevation contour maps for seasonal low and seasonal high-water levels were prepared for the 2020-2021 water years. Three Representative Monitoring Site (RMS) wells exist that monitor groundwater levels in the Upper Aquifer while no RMS wells are screened in the Lower Aquifer. Through the TSS program, an additional monitoring well is planned to be installed in fall 2022. This nested monitoring well will provide an added well to both the Upper and Lower Aquifers. Seasonal high groundwater elevations were all at or above the measurable objectives during the 2020-2021 water years.

ES 3. Water Supply and Use

Table ES-1 includes groundwater use data by sector for the 2020 and 2021 water years. The agricultural sector had the greatest increase in use going from 20,000 af in 2020 to 26,000 af in 2021 whereas native vegetation decreased from 590 to 460 af. Urban water use remained largely unchanged increasing slightly from 990 to 1,000 af.

Table ES-1. Groundwater Use in Each Water Year by Water Use Sector

Sector	2020 (D) (af)	2021 (C) (af)
Agricultural	20,000	26,000
Urban	990	1,000
Native Vegetation (Groundwater Uptake)	590	460
Total	**21,580**	**27,460**

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

Surface water use by sector and source for the 2020 and 2021 water years is presented in **Table ES-2**. Both urban and native vegetation sectors contributed to no surface water use in either 2020 or 2021. Agricultural surface water use declined between years going from 9,480 to 7,810 af.

Table ES-2. Surface Water Use in Each Water Year by Water Use Sector and Source				
Sector	2020 (D) (af)		2021 (C) (af)	
	Supply Source			
	CVP	Local	CVP	Local
Agricultural	580	8,900	710	7,100
Urban	0	0	0	0
Native Vegetation	0	0	0	0
Total	**9,480**		**7,810**	

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

ES 4. Groundwater Storage

Changes in groundwater storage values were calculated based on water years for the Upper and Lower Aquifers. Groundwater storage change was estimated for the 2020 water year based on the change in seasonal high groundwater levels between the 2019 and 2020 water years. Likewise, 2021 storage change was calculated based on the change in seasonal high groundwater levels between 2020 and 2021 water years. Change in storage calculations are described further in Sections 2.1. **Table ES-3** presents the annual storage change values for each principal aquifer.

Table ES-3. Change in Groundwater Storage Based on Seasonal High Groundwater Levels		
Aquifer	2020 (D) (af)	2021 (C) (af)
Upper Aquifer	-7,000	-11,000
Lower Aquifer	-1,000	-4,000
Total	**-8,000**	**-15,000**

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

ES 5. GSP Implementation Progress

Implementation of the GSP focused primarily on enactment of projects and management actions (PMAs). PMAs were developed to manage groundwater conditions in the Subbasin and achieve groundwater sustainability objectives described in the GSP. Due to the recent adoption of the GSP, no progress towards the implementation of PMAs has occurred. In coordination with DWR the Subbasin is scheduled for an Airborne Electromagnetic (AEM) Survey in Spring 2022. Additionally, DWR is scheduled to install a nested monitoring well for monitoring of both the Upper and Lower Aquifers. The GSA has also scheduled a well survey to better establish the vertical datum of one RMS well.

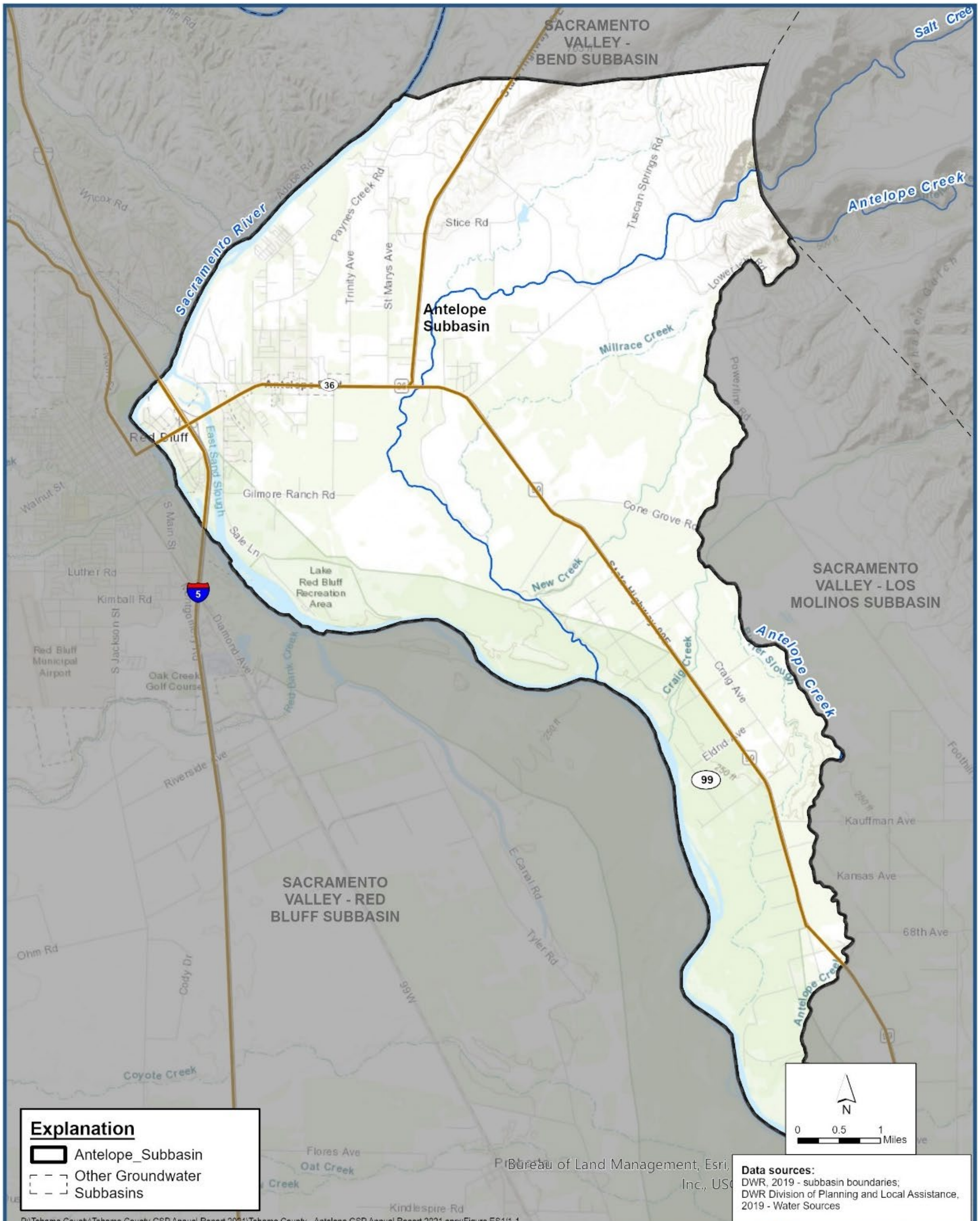
1. GENERAL INFORMATION

The annual report for the Antelope Subbasin (Subbasin) (5-021.54) was prepared on behalf of the Tehama County Flood Control and Water Conservation District (Tehama County FCWCD), Groundwater Sustainability Agency (GSA) to fulfill the statutory requirements of the Sustainable Groundwater Management Act (SGMA) legislation (Section 10728) and regulatory requirements developed by the California Department of Water Resources (DWR) included in the Groundwater Sustainability Plan (GSP) Regulations (Section 354.40 and Section 356.2). The Regulations require the GSA to submit an Annual Report to DWR by April 1st following the reporting year (October through September).

1.1. Subbasin Setting

The Antelope Subbasin (DWR Subbasin No. 5-021.54) covers 19,100 acres and is located in the Northern Sacramento Valley Groundwater Basin. The lateral extent of the Subbasin is defined by the Subbasin boundaries provided in Bulletin 118 (DWR, 2018). It is bounded on the north by the Bend Subbasin (DWR Subbasin No. 5-0.21.53) and Red Bluff Subbasin (DWR Subbasin No. 5-021.50), on the east and south by the Los Molinos Subbasin (DWR Subbasin No. 5-021.56), and on the south and west by the Red Bluff Subbasin (DWR Subbasin No. 5-021.50). The eastern and western boundaries of the Subbasin generally follow Antelope Creek and the Sacramento River, respectively, and the southern boundary ends at the confluence of both waterways. A small portion of the northeast border of the Subbasin is adjacent to the Cascade Mountain Range and does not border another groundwater subbasin (**Figure 1-1**).

The Subbasin is comprised of approximately 48 percent farmland. The Subbasin's agricultural water users rely on both surface water and groundwater to irrigate their crops. The Subbasin receives surface water supplies from the Central Valley Project (CVP) through surface water diverted by small CVP contractors to irrigated land along the Sacramento River.



TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

LSCE Team

Antelope Subbasin Area Map

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 1-1

Fresh groundwater bearing geologic deposits in the Subbasin are subdivided from previous studies into two units: The Upper Aquifer and the Lower Aquifer (DWR, 2003; DWR, 2004). The two-aquifer designation is based on an examination of groundwater elevation time-series, electric resistivity data from geophysical logs, lithologic logs, well construction details, and review of previous studies in the Subbasin. Generally, semi-confined, and confined aquifer conditions are encountered at depth and unconfined conditions are seen in the shallower porous media. The complexity of the geologic materials and the formations makes it difficult to define a singular widespread aquitard or distinctive change in geologic materials separating an Upper and Lower Aquifer. To delineate between areas with a higher likelihood of confined conditions, well construction data throughout the Subbasin were examined. Water bearing geologic units in the Upper Aquifer include the Quaternary formations and the upper portions of the Tehama and Tuscan Formations. Wells screened in the Upper Aquifer are largely for domestic purposes. The depth to the bottom of the Upper Aquifer is approximately 350-450 ft bgs.

The Lower Aquifer is defined as the freshwater bearing geologic units throughout the Subbasin from the bottom of model layer 5 at approximately 350-450 ft bgs, to the bottom of the Subbasin. The aquifer has confined to semi-confined conditions. Water bearing geologic units include the lower portions of the Tehama and Tuscan Formations. Wells screened in the Lower Aquifer are largely for non-domestic purposes.

1.2. Report Contents

This report is the first Annual Report prepared to support the adopted Antelope Subbasin GSP submitted in January 2022. As a result, the Annual Report includes data elements for the current reporting water year (WY), 2021, as well as a “bridge year”, 2020. The historical water budget period of the GSP was 1990-2018, and 2019 was considered as a current water budget period. The bridge year closes the gap between the water budget period presented in the GSP and current reporting water year. Data elements presented in this report refer to water years (12-month periods of October through September) unless otherwise noted. Pursuant to of the GSP Regulations, the Annual Report includes:

1. Groundwater Elevation Data
2. Water Supply and Use
3. Change in Groundwater Storage
4. GSP Implementation Progress

2. GROUNDWATER ELEVATIONS SECTION 356.2(B)(1)

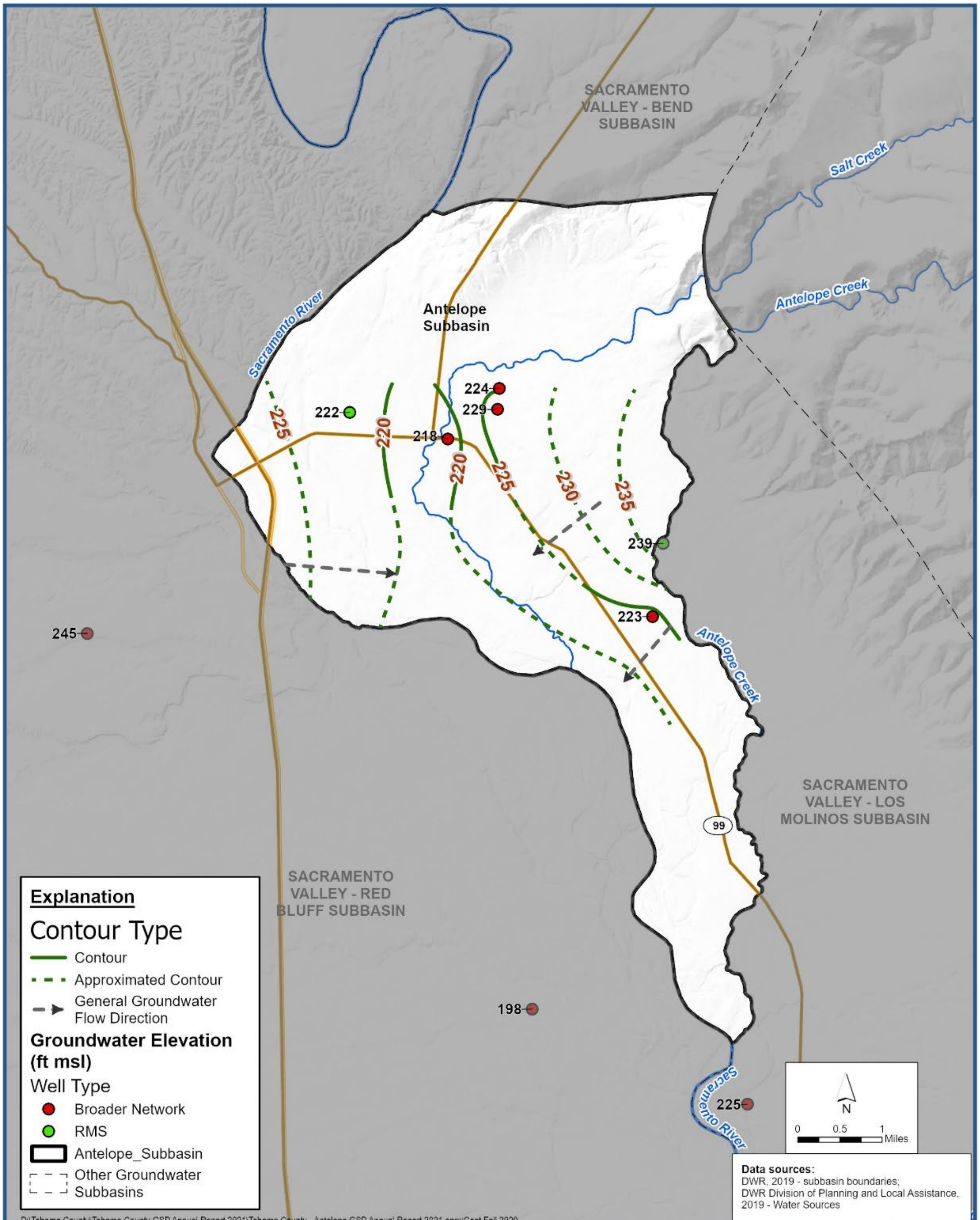
Currently 20 wells are monitored as part of a broad network for groundwater levels and three are RMS wells assigned Sustainability Management Criteria. The wells are measured at least in the spring and fall each year. Groundwater elevation data in each of the principal aquifers for the 2020 and 2021 water years were analyzed. Hydrographs for these wells are included in **Appendix A**. **Appendix B** includes a copy of the monitoring data used to generate this Annual Report pursuant to GSP regulations (Section 354.40). Groundwater elevation contour maps for seasonal low and seasonal high water levels were prepared for the 2020 and 2021 water years. Groundwater level data collected at RMS and other wells used to develop groundwater contours and RMS well hydrographs are collected by DWR, USGS, TNC and the District and records are maintained by GAMA and CASGEM. Records of groundwater elevations are also maintained in the GSA's DMS.

2.1. Groundwater Elevation Contours - Section 356.2(b)(1)(A)

Seasonal high and seasonal low groundwater elevation contour maps for the 2020-2021 water years are presented for the Upper Aquifer on **Figures 2-1** through **2-4**. The seasonal high contours were prepared based on observed maximum springtime (February-May) water levels, while the seasonal low contours were prepared based on minimum water levels measured in July-October. Due to the limited number of wells in the subbasin and to resolve data gaps near the edge of the subbasin wells neighboring the Antelope subbasin were included in the contouring process. Wells were not displayed in contour maps if data did not exist at that well during the mapping period. Contours are shown solid if there is good confidence in the contour placement whereas contours are shown dashed if their position is inferred from data yet generally representative of the contour's true location. Contours are not drawn if confidence in contours is poor. Most notably this occurs on the northeastern side of the subbasin where coverage of monitoring wells is poor. Groundwater elevations on the contour maps are shown as feet above mean sea level (ft amsl) based on the North American Vertical Datum of 1988 (NAVD 88). No contours were produced for the Lower Aquifer due to the limited number of available Lower Aquifer wells.

The contour maps illustrate several general features of the groundwater flow system in the Antelope Subbasin, including:

- A general groundwater flow moving from the north to south within the subbasin.
- Movement of water towards the Sacrament River most strongly from the east in 2020 while 2021 contours indicating flow across the Sacramento River flowing east to west.
- Steep groundwater gradients in the north and west sides of the subbasin with gradual gradients in the center of the subbasin.



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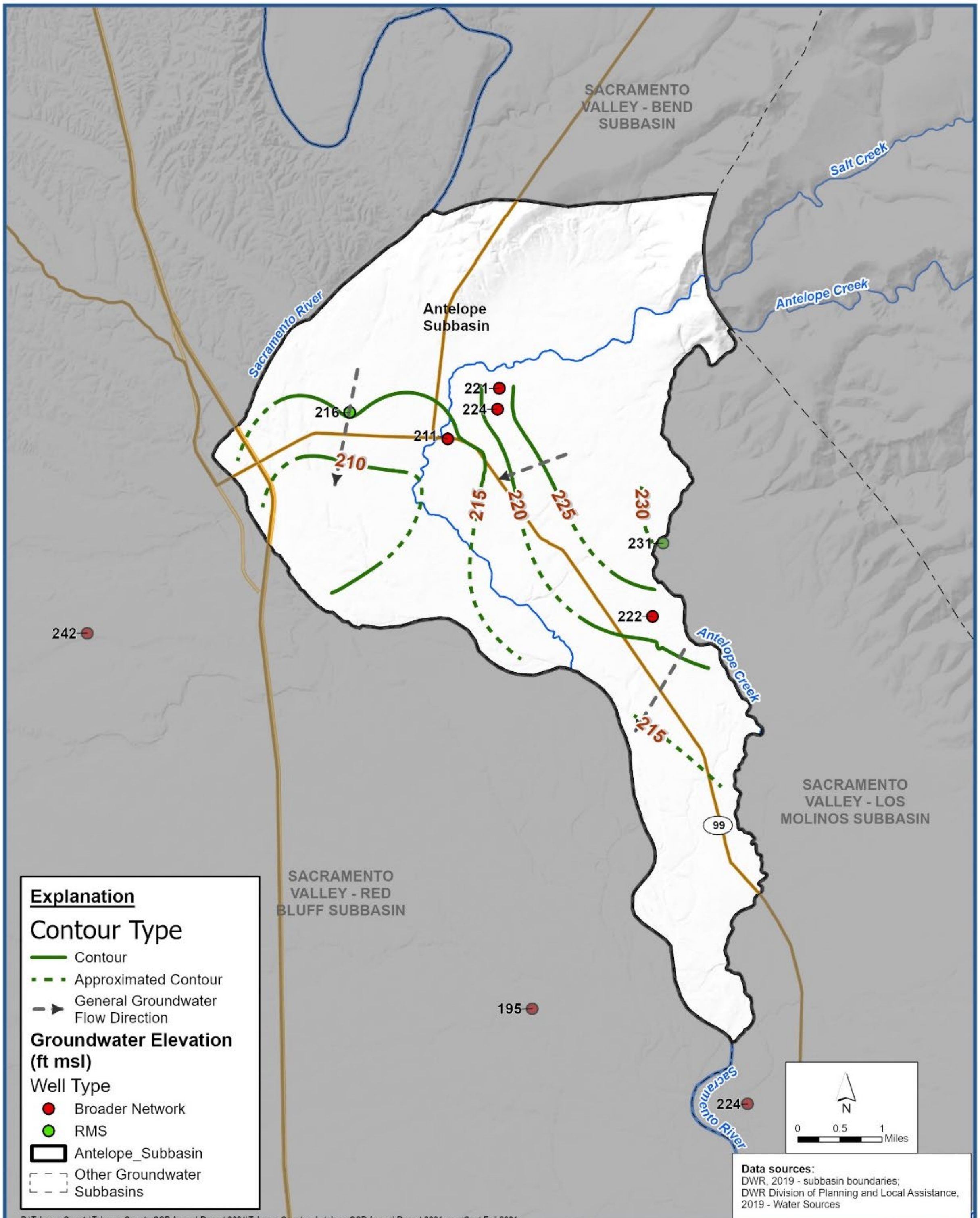
Contours of Equal Groundwater Elevation
Upper Aquifer - Fall 2020

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 2-1



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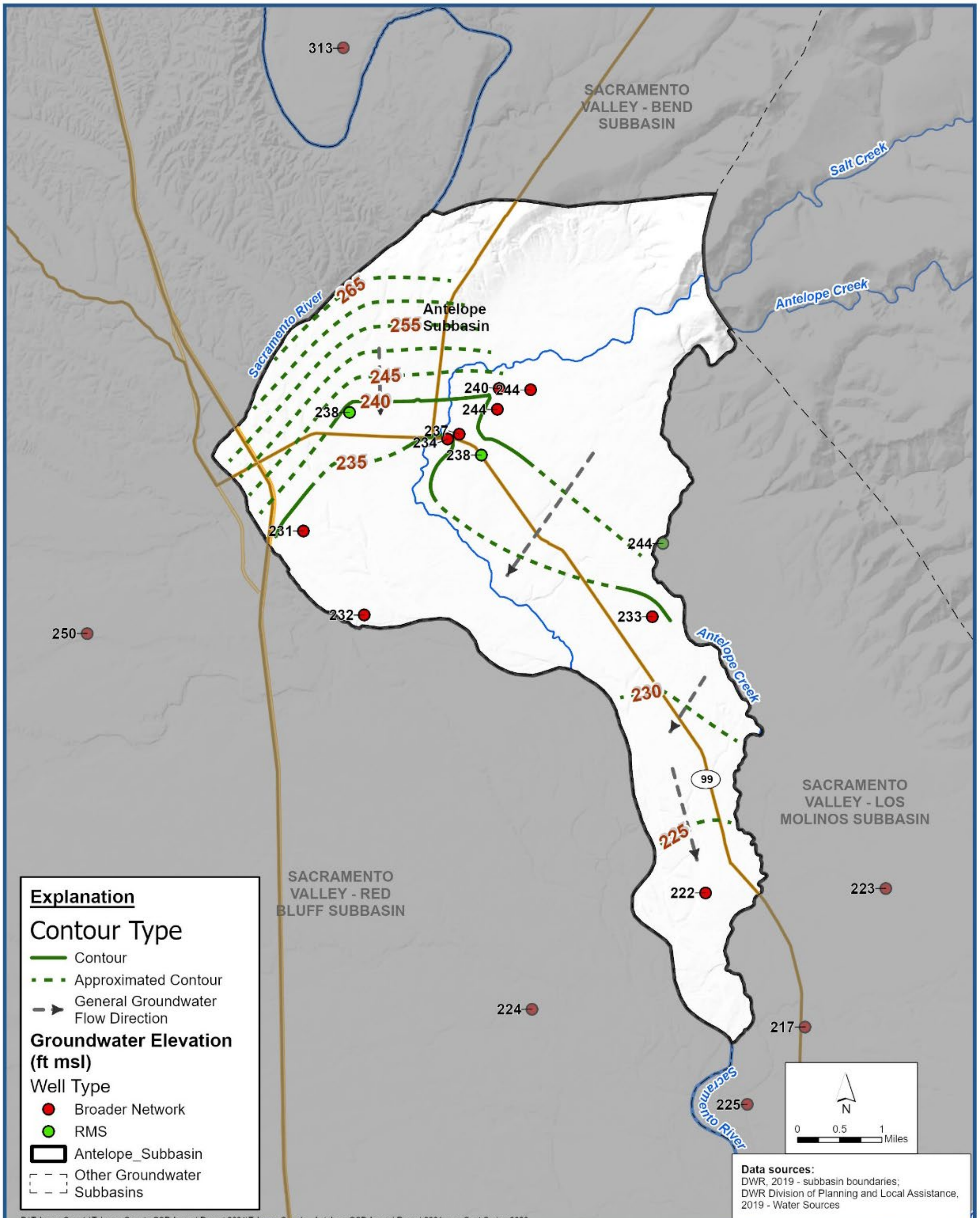
Contours of Equal Groundwater Elevation
Upper Aquifer - Fall 2021

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 2-2



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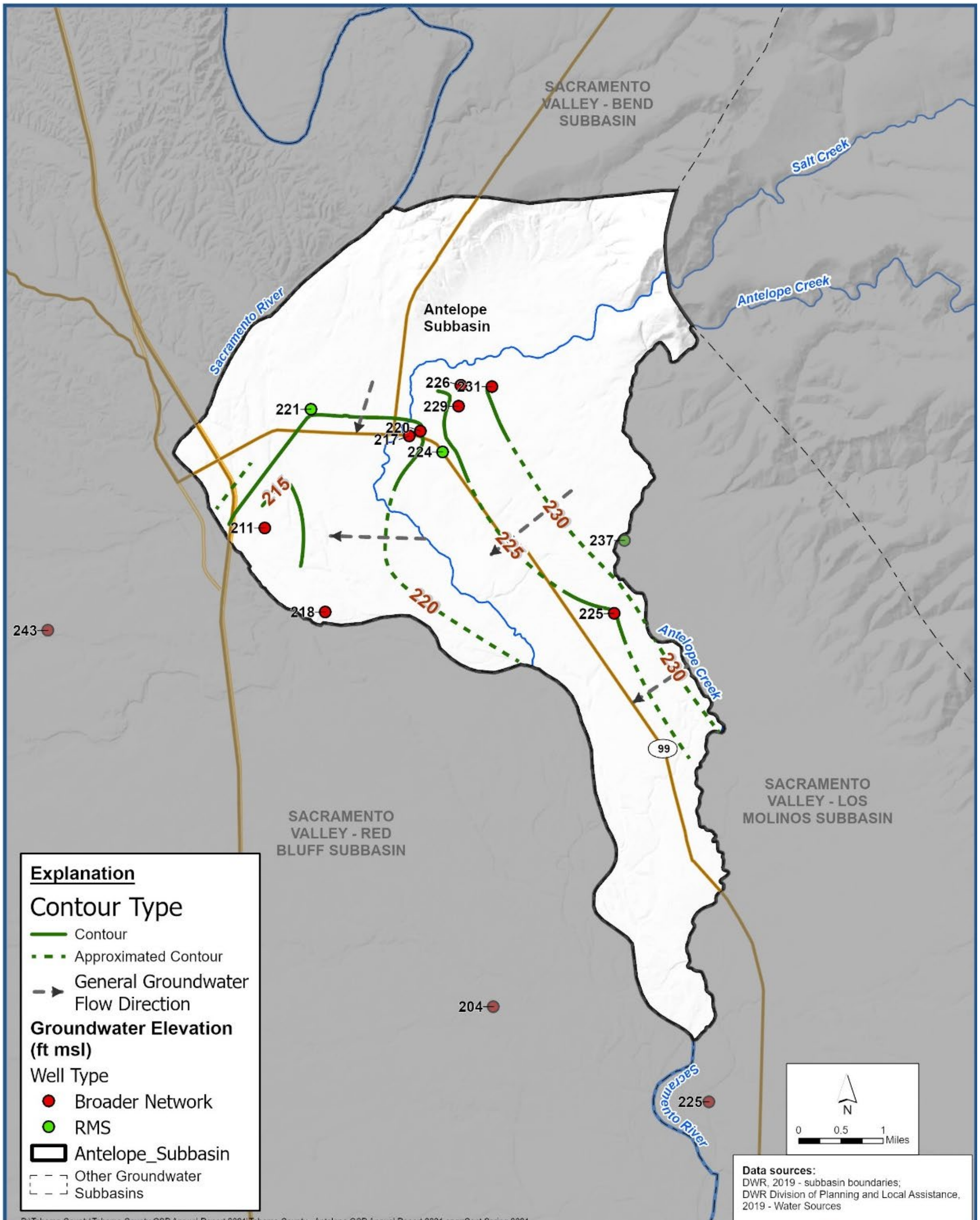
Contours of Equal Groundwater Elevation
Upper Aquifer - Spring 2020

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 2-3



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Contours of Equal Groundwater Elevation
Upper Aquifer - Spring 2021

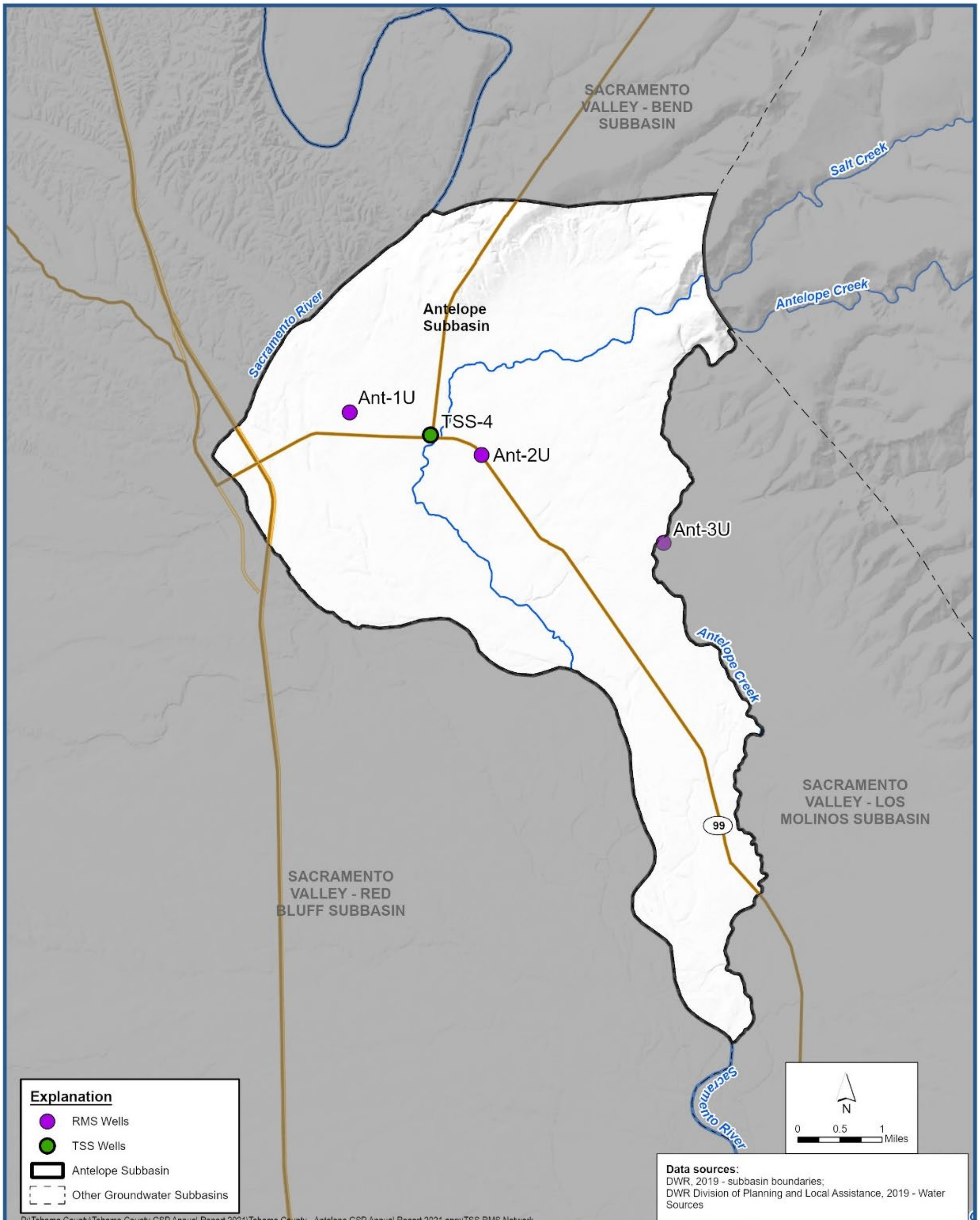
Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 2-4

2.2. Groundwater Elevation Hydrographs - Section 356.2(b)(1)(B)

Hydrographs of groundwater elevations were prepared for all three RMS in the Upper Aquifer. No RMS are screened in the Lower Aquifer therefore no Lower Aquifer hydrographs were produced. RMS wells are distributed throughout the Subbasin to provide broad spatial coverage of the Subbasin. **Figure 2-5** shows the distribution of the current RMS wells and the locations of the approved TSS slated for installation in fall 2022. The process for selecting these sites is documented in the Antelope Subbasin GSP. Long-term fluctuations in groundwater levels (and groundwater in storage) occur when there is an imbalance between the volume of water recharged into the aquifer and the volume of water removed from the aquifer, either by extraction or natural discharge to surface water bodies. If, over a period of years, the amount of water recharged to the aquifer exceeds the amount of water removed from the aquifer, then groundwater levels will increase and groundwater storage increases (i.e., positive change in storage). Conversely, if, over time, the amount of water removed from the aquifer exceeds the amount of water recharged then groundwater levels decline. These long-term changes can be linked to various factors including increased or decreased groundwater extraction or variations in recharge associated with wet or dry hydrologic cycles.

All seasonal high groundwater elevations were above the minimum thresholds (MT) during the 2020 and 2021 water years. Likewise, no wells experienced spring maximums that fell below the Measurable Objectives (MO). Fall time measurements at two wells (Ant-1U, Ant-2U) have a history of falling below the MO whereas only the most recent fall measurement at Ant-3U meet the MO but do not drop below it.



RMS Network With TSS Wells

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 2-5

3. WATER SUPPLY AND USE

Water supply and use information are presented below. Water use data by sector (required per Section 356.2) is summarized in Section 3 and categorized by groundwater extraction, surface water supply and total supply using the best data available. Water use sectors are broadly identified as agricultural, urban, and native vegetation land uses.

3.1. Groundwater Extraction - Section 356.2(b)(2)

Groundwater extraction by water use sector is reported for the 2020 and 2021 water years. Groundwater extraction data was estimated from modeled results using the Tehama IHM model. The model estimates groundwater extraction based on available land use information, climate data and access to surface water. The Tehama IHM model was developed to support GSP development through adaptation of the Sacramento Valley Groundwater-Surface Water Simulation Model (SVSim, version BETA 3-19-2020). Direct measurements of groundwater extraction data could not be used in the model calibration to determine accuracy due to the limited number of observations. Instead, water levels and stream flows were used to calibrate the model resulting in a normalized root mean of squared residual error of 5%. Additional information about the Tehama IHM development process is described in the GSP (Appendix 2-J). Groundwater extraction in the Antelope Subbasin for water years 2020 and 2021 in both the Upper and Lower Aquifers was estimated on an element-basis by simulating groundwater pumping. The general location and volume of groundwater extractions are presented in **Figures 3-1** through **3-4**. **Table 3-1** includes groundwater use data by sector for each year. In all annual report tables numbers are rounded to two significant digits consistent with the uncertainty associated with the methods and sources used in the analysis. The exception to this rule applies to totals of other numbers presented in the tables. The 2020 water year is denoted as "D" (Dry) and the 2021 year as "C" (Critical). The agricultural sector had the greatest increase in use from 20,000 af to 26,000 af whereas native vegetation decreased from 590 to 460 af. Urban groundwater use remained largely unchanged increasing slightly from 990 to 1,000 af. The large increase in agricultural sector use is likely due to the increased water demand of crops during dryer conditions as well as the need for growers to offset decreased surface water delivers during droughts.

Table 3-1. Groundwater Use in Each Water Year by Water Use Sector

Sector	2020 (D) (af)	2021 (C) (af)
Agricultural	20,000	26,000
Urban	990	1,000
Native Vegetation (Groundwater Uptake)	590	460
Total	**21,580**	**27,460**

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

3.2. Surface Water Supply - Section 356.2(b)(3)

Surface water use by sector for the 2020 and 2021 water years is presented in **Table 3-2**. Surface water data was obtained from real world observations when available and was otherwise estimated from model results. Both urban and native vegetation sectors utilized no surface water use in either 2020 or 2021. Agricultural surface water use declined between years going from 9,480 in 2020 to 7,810 af in 2021. This decline is likely due to the decreased access to or increased cost of surface water. Local supplies accounted for the majority of surface water use in both years.

Table 3-2. Surface Water Use in Each Water Year by Water Use Sector and Source

Sector	2020 (D) (af)		2021 (C) (af)	
	Supply Source			
	CVP	Local	CVP	Local
Agricultural	580	8,900	710	7,100
Urban	0	0	0	0
Native Vegetation	0	0	0	0
Total	**9,480**		**7,810**	

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

3.3. Total Water Use by Sector - Section 356.2(b)(4)

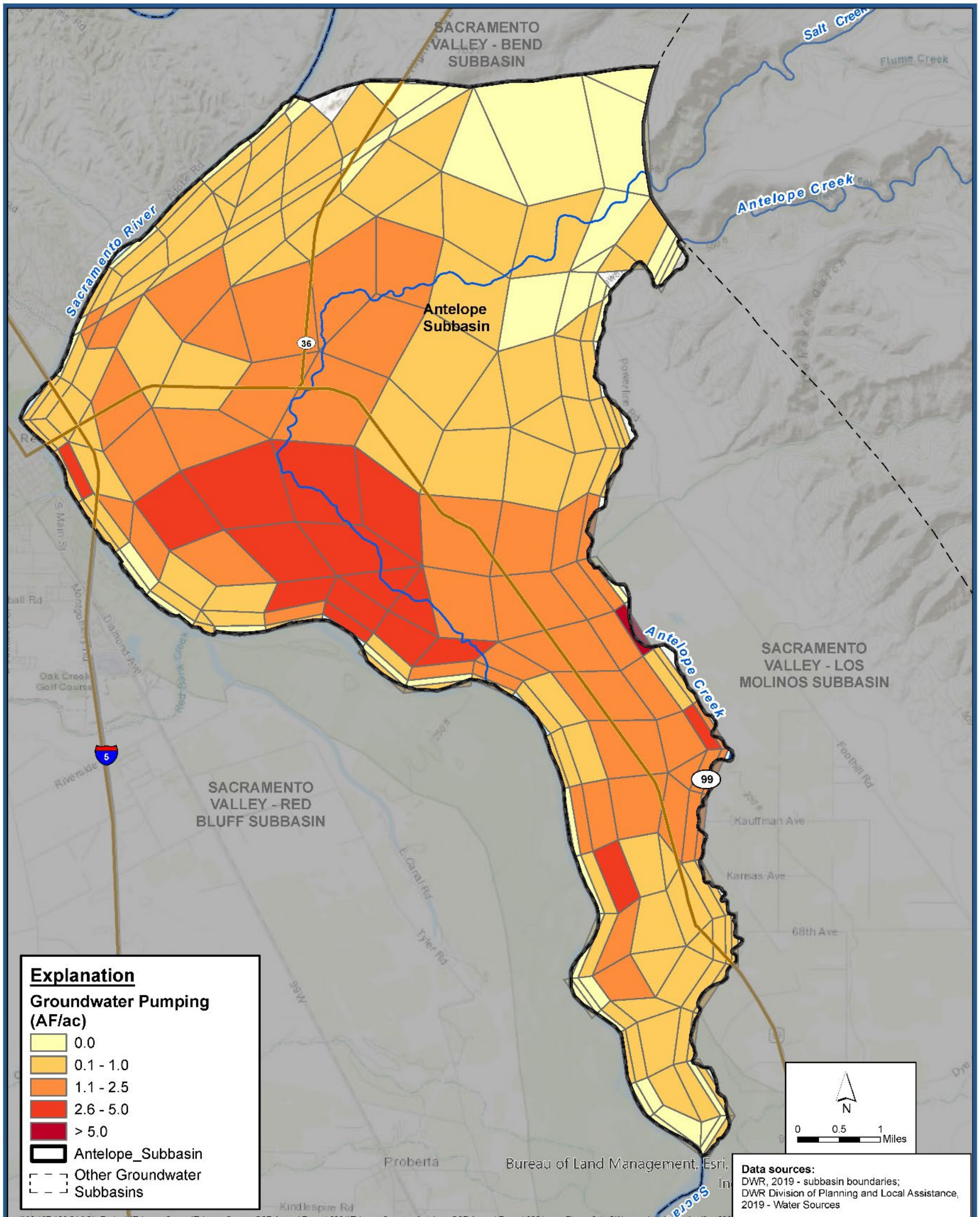
Total water use by sector for the 2020 and 2021 water years is included in **Table 3-3**. Total water use is summarized from results presented in **Section 3.1** and **3.2**. Total agricultural water use increased from 29,480 to 33,810 af from the 2020 to 2021 water years. By comparison urban water use remained nearly unchanged and native vegetation water use declined from 590 af to 460 af. Overall water use increased from 31,060 af in 2020 to 35,270 af in 2021.

Table 3-3. Total Water Use in Each Water Year by Water Use Sector

Sector	2020 (D) (af)	2021 (C) (af)
Agricultural	29,480	33,810
Urban	990	1,000
Native Vegetation	590	460
Total	**31,060**	**35,270**

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.



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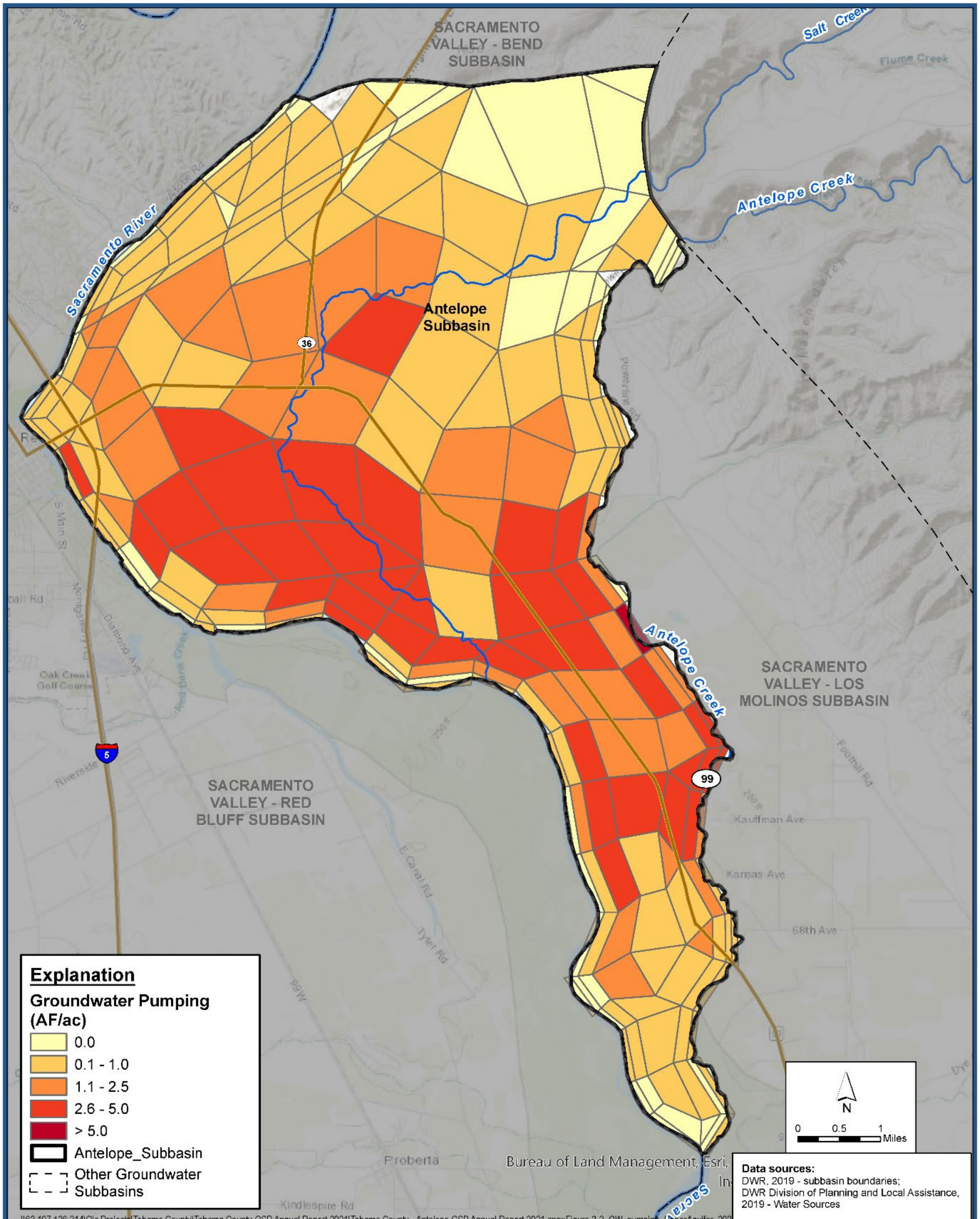
Groundwater Extraction in the Upper Aquifer - Water Year 2020

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

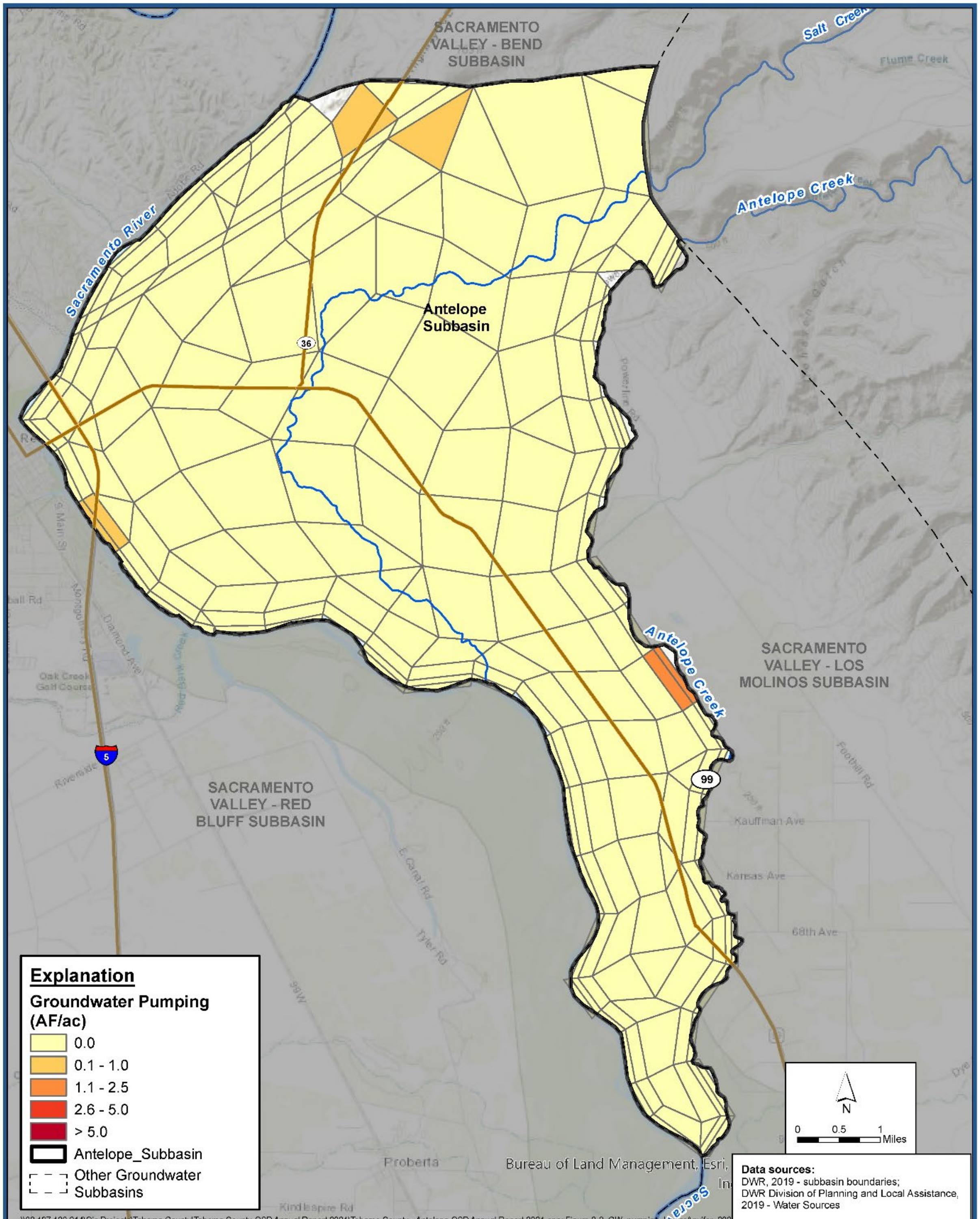
Figure 3-1



Groundwater Extraction in the Upper Aquifer - Water Year 2021

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

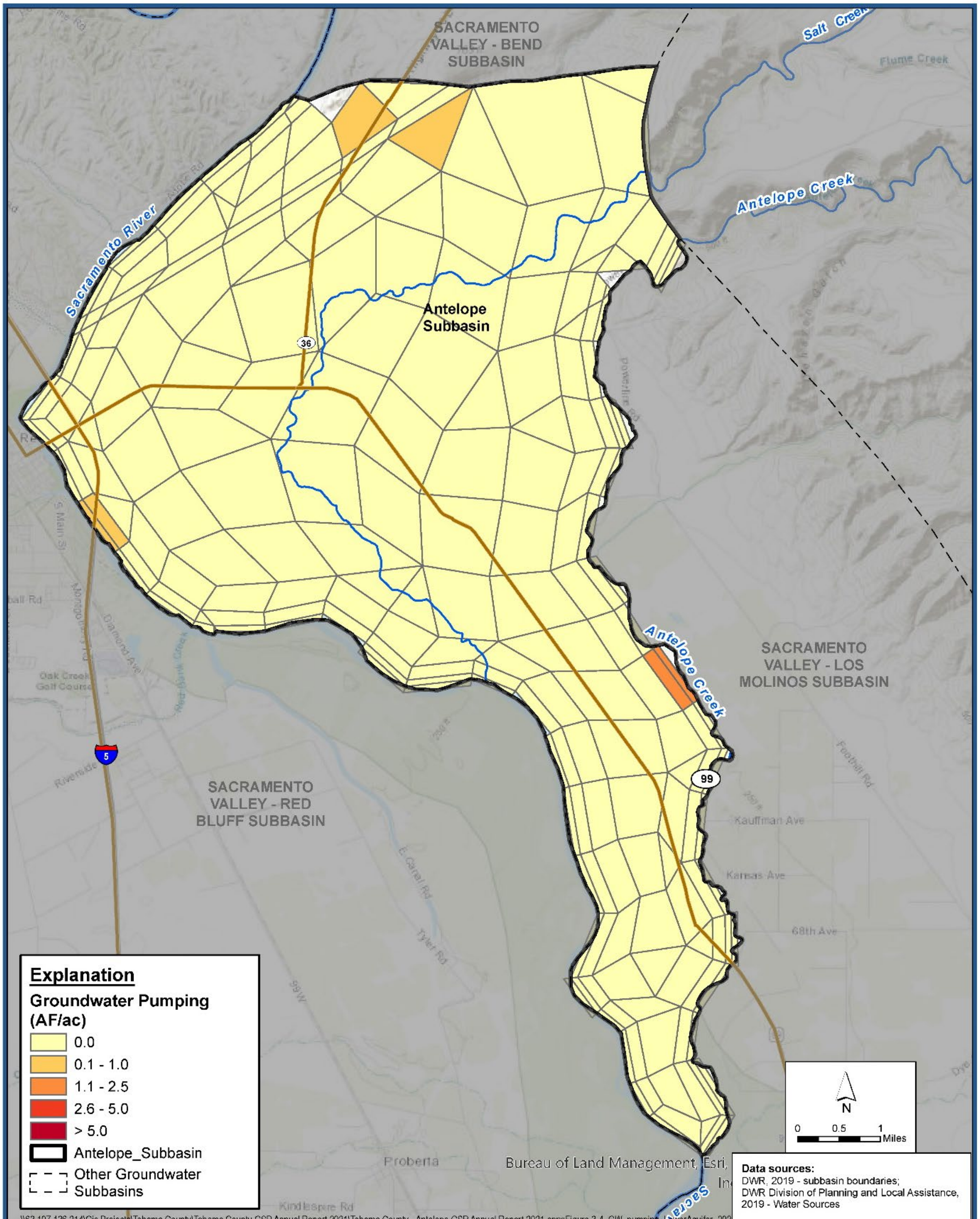
Figure 3-2



Groundwater Extraction in the Lower Aquifer - Water Year 2020

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 3-3



Groundwater Extraction in the Lower Aquifer - Water Year 2021

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 3-4

4. GROUNDWATER STORAGE

Changes in groundwater storage values were calculated for the 2020 and 2021 water years for the Upper and Lower Aquifers. Groundwater storage change was estimated based on the change in seasonal high groundwater levels (spring to spring). Seasonal high measurements made in the winter and spring provide a more reliable method to calculate change in groundwater storage than measurements made from seasonal low measurements that may be influenced by residual groundwater pumping. Storage change in the 2020 water year was estimated based on the change in seasonal high groundwater levels between the 2019 and 2020 water years. Likewise, 2021 storage change was calculated based on the change in seasonal high groundwater levels between 2020 and 2021 water years. While contour maps show wells over a large area of the subbasin water level change was calculated within a smaller monitoring area to exclude areas of poor data density. As the groundwater level monitoring network improves this area will expand to include more of the subbasin. A groundwater elevation surface was generated using either natural neighbor or kriging interpolation methods. The average groundwater level change over the monitored area was applied to the subbasin extent. Lastly, groundwater model average aquifer properties (storage coefficients) for each Aquifer (Upper, Lower) were used to calculate change in storage. This represents a departure from change in storage calculations made in the GSP where the groundwater model was utilized to calculate groundwater storage changes. **Table 4-1** presents the annual storage change values for both the Upper and Lower Aquifers.

Since there are no monitoring wells in the Lower Aquifer within the subbasin two wells near the southeast side of but outside of the subbasin were used. An average change in groundwater elevations from these two nearby Lower Aquifer wells was applied to the subbasin and aquifer properties for the Lower Aquifer were obtained from the groundwater model to calculate change in storage.

It should be noted that although fundamentally the approach is similar to that used to estimate groundwater storage change in the GSP, the groundwater model was not used to estimate storage changes for 2020 and 2021. Therefore, future updates to the model may result in different estimates for 2020 and 2021 groundwater storage changes. The approach of using spring groundwater elevation contours is considered reasonable and cost effective for the purposes of the annual report. **Table 4-2** includes estimates of annual groundwater pumping, groundwater uptake, storage change and cumulative storage change for water years 1990-2021. Change in storage and cumulative change in storage for water years 2020-2021 was estimated based on the above method. The Tehama IHM Model was used to estimate groundwater pumping and groundwater uptake for all water years. Change in storage and cumulative change in storage were Model estimated for water years 1990-2019.

Table 4-1. Change in Groundwater Storage Based on Seasonal High Groundwater Levels		
Aquifer	2020 (D) (af)	2021 (C) (af)
Upper Aquifer	-7,000	-11,000
Lower Aquifer	-1,000	-4,000
Total	**-8,000**	**-15,000**

D: Dry Sacramento Valley Water Year as defined by DWR.

C: Critical Sacramento Valley Water Year as defined by DWR.

Table 4-2. Change in Groundwater Storage Based on Tehama IHM Model				
Water Year & Type1	Groundwater Pumping (af)	Groundwater Uptake (af)	Annual Groundwater Storage Change (af)	Cumulative Groundwater Storage Change (af)
1990 (C)	-14,000	-1,000	-7,200	-7,200
1991 (C)	-14,000	-620	-5,900	-13,000
1992 (C)	-15,000	-550	-4,100	-17,000
1993 (AN)	-11,000	-870	8,000	-9,200
1994 (C)	-14,000	-620	-4,800	-14,000
1995 (W)	-11,000	-1,900	12,000	-2,000
1996 (W)	-12,000	-1,900	2,600	600
1997 (W)	-12,000	-2,100	-600	0
1998 (W)	-7,200	-4,400	11,000	11,000
1999 (W)	-11,000	-3,600	-4,000	7,000
2000 (AN)	-9,600	-3,200	-880	6,100
2001 (D)	-13,000	-1,800	-7,500	-1,400
2002 (D)	-14,000	-1,300	-3,700	-5,100
2003 (AN)	-12,000	-1,800	3,700	-1,400
2004 (BN)	-14,000	-2,200	81	-1,300
2005 (AN)	-9,900	-1,700	780	-520
2006 (W)	-9,400	-3,800	7,600	7,100
2007 (D)	-13,000	-1,600	-9,100	-2,000
2008 (C)	-17,000	-920	-8,100	-10,000
2009 (D)	-14,000	-670	-3,700	-14,000
2010 (BN)	-11,000	-700	2,600	-11,000
2011 (W)	-9,900	-980	6,800	-4,400
2012 (BN)	-14,000	-740	-7,100	-12,000
2013 (D)	-16,000	-680	-2,000	-14,000
2014 (C)	-17,000	-560	-7,300	-21,000
2015 (C)	-21,000	-490	-4,800	-26,000

Table 4-2. Change in Groundwater Storage Based on Tehama IHM Model				
Water Year & Type[1]	Groundwater Pumping (af)	Groundwater Uptake (af)	Annual Groundwater Storage Change (af)	Cumulative Groundwater Storage Change (af)
2016 (BN)	-15,000	-570	4,400	-21,000
2017 (W)	-15,000	-1,200	9,600	-12,000
2018 (BN)	-18,000	-600	-6,300	-18,000
2019 (W)	-13,000	-920	7,700	-10,000
2020 (D)	-21,000	-590	-8,000[2]	-18,000[2]
2021 (C)	-27,000	-460	-15,000[2]	-33,000[2]
Average	**-14,000**	**-1,400**	**-1000**	

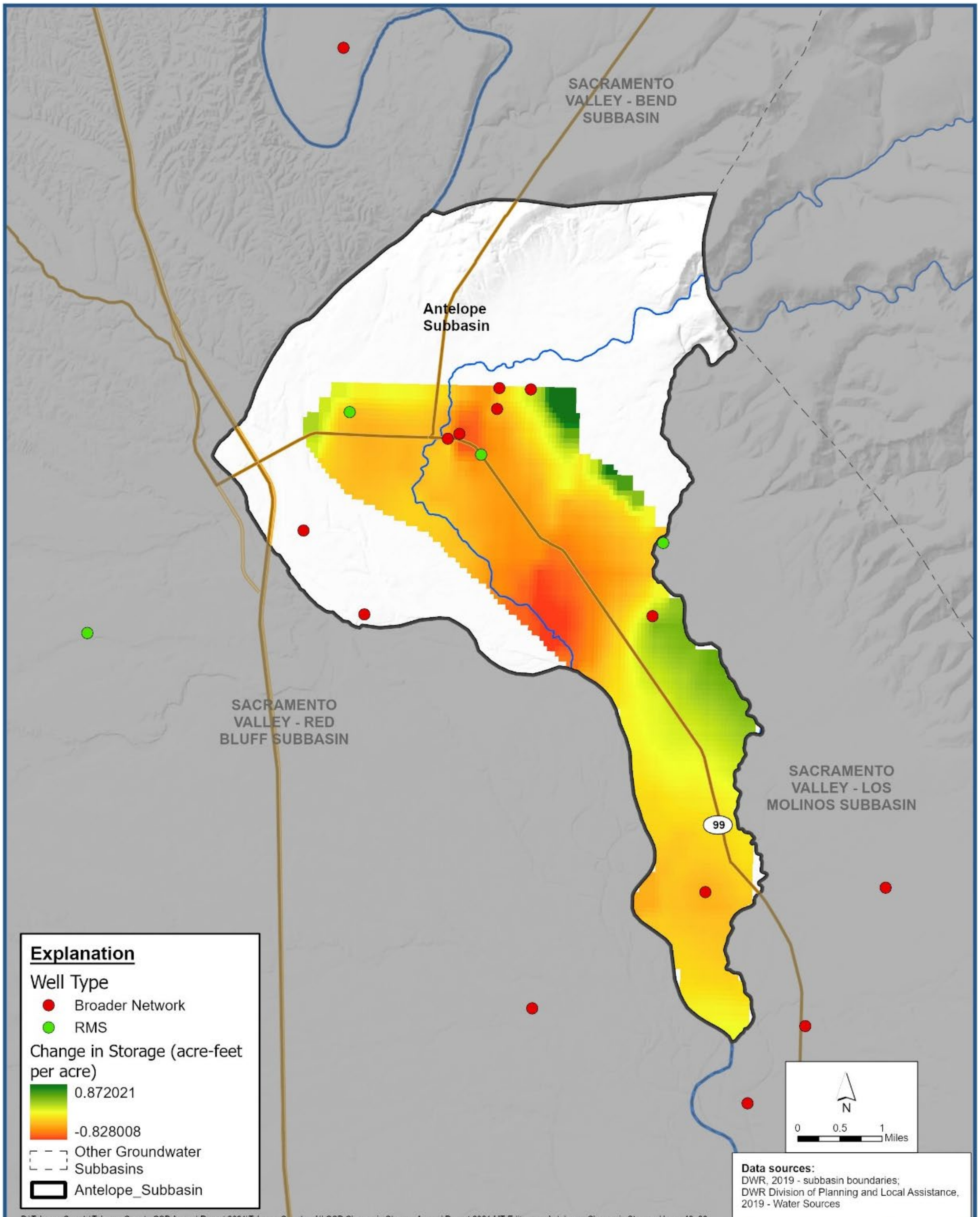
All volumes are rounded to two significant figures
1. Sacramento Valley Water Year Type is provided by DWR for years 1990-2020. Water year 2021 meets the criteria to be considered a critical water, as shown in CDEC resources, but has not officially been assigned that designation by DWR. Wet (W), Above Normal (AN, Below Normal (BN), Dry (D), Critical (C)
2. Storage change in water years 2020-2021 was estimated using seasonal high spring to spring water levels and in all other years was estimated using the Tehama IHM Model.

4.1. Groundwater Storage Maps - Section 356.2(b)(5)(A)

Figures 4-1 and **4-2** present the distribution of storage change in the Upper Aquifer for the 2020 and 2021 water years, respectively. Maps include the groundwater wells used to calculate change in storage. Groundwater storage change is not shown on **Figures 4-1** and **4-2** outside the established monitoring area to avoid extrapolating beyond the control points (i.e., reliable monitoring well data). Lower Aquifer storage change maps were not prepared because groundwater elevation surfaces were not created due to lack of sufficient Lower Aquifer wells.

4.2. Subbasin Water Budget - Section 356.2(b)(5)(B)

A graph depicting water year type, groundwater pumping, groundwater uptake, the annual change in groundwater storage, and the cumulative change in groundwater storage is presented on **Figure 4-3**.



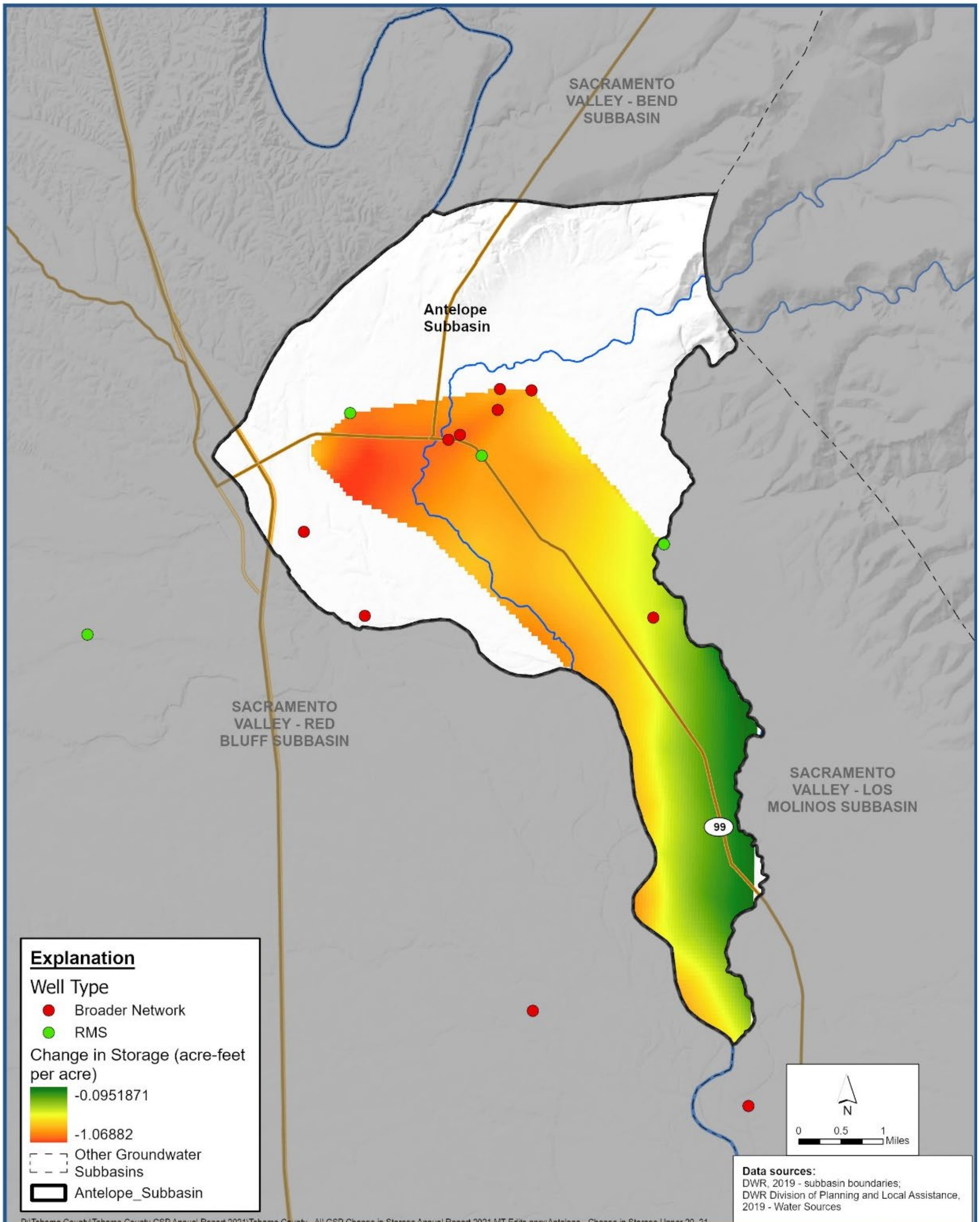
TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

LSCE Team

Groundwater Change in Storage, Upper Aquifer - 2019-2020

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

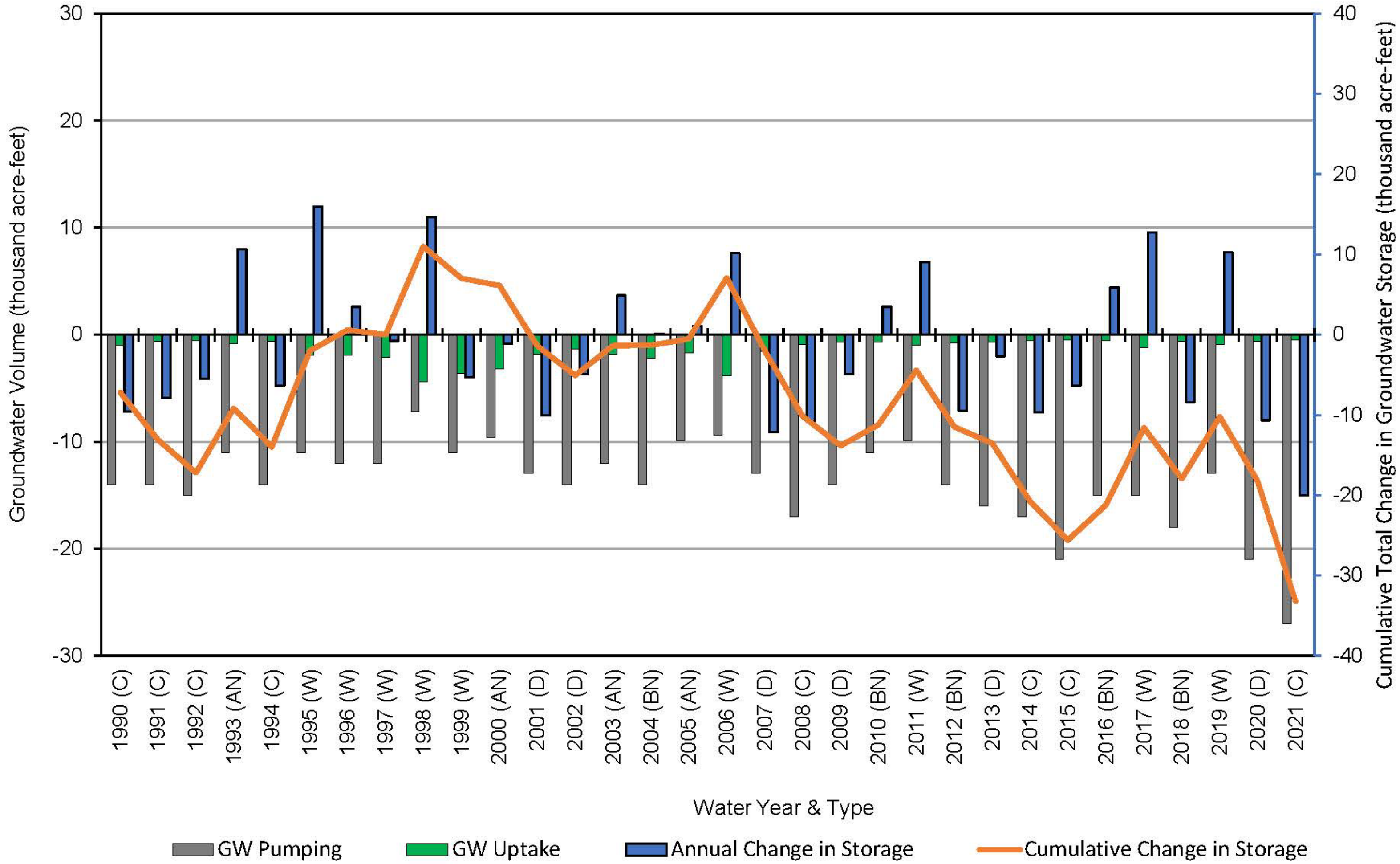
Figure 4-1



Groundwater Change in Storage, Upper Aquifer - 2020-2021

Groundwater Sustainability Plan – Annual Report WY 2020-2021
Antelope Subbasin

Figure 4-2



TEHAMA COUNTY

LSCE Team

Groundwater Extraction and Change in Groundwater Storage

2021 Groundwater Sustainability Plan Annual Report
Tehama County Flood Control and Water Conservation District

Figure 4-3

5. GSP IMPLEMENTATION PROGRESS - SECTION 356.2(B)

The GSP for the Antelope Subbasin was adopted by the GSA in December 2021 and submitted to DWR in January 2022. This is the first annual report to be prepared since the GSP was submitted. The GSP implementation progress reported in this report covers ongoing work during GSP development since late 2021.

Projects and management actions (PMAs) were developed to manage groundwater conditions in the Subbasin and achieve groundwater sustainability objectives described in the GSP. Due to the recent adoption of the GSP, progress towards the implementation of PMAs has not progressed since GSP adoption. The Antelope Subbasin GSA is continuing to engage stakeholders in the subbasin as they coordinate to develop a workplan for 2022 and discuss implementation priorities.

Finally, ongoing activities include monitoring and reporting, updating, and maintaining the subbasin's Data Management System, outreach to stakeholders, inter-basin coordination, and coordination with outside efforts to improve characterization of the subbasin (such as DWR's Airborne Electromagnetic Survey Program expected to collect data in the subbasin in May 2022).

As part of the GSA's efforts to address data gaps in the subbasin, An Airborne Electromagnetic (AEM) Survey is scheduled by DWR in summer of 2022. The data collected will provide a better understanding of aquifer characteristics and will help refine current hydrogeologic conceptual models. Additionally, the GSA is coordinating with DWR to install a nested monitoring well (TSS-4) in the fall 2022. This new monitoring well will be screened in the Upper and Lower Aquifers and will be incorporated in the RMS well network. Lastly, the GSA is scheduled to survey the Ant-3U RMS well to establish a more accurate vertical datum. This surveying will take place before the end of the year.

6. CONCLUSIONS

Recent progress made on all of the, above mentioned, activities applicable to the GSA since late 2021 demonstrates the commitment of the GSA to implement the GSP by allocating the necessary time and resources to achieve long-term sustainable management of the groundwater resources in the subbasin.

7. REFERENCES

California Department of Water Resources. 2004. Sacramento Valley Groundwater Basin, Antelope Subbasin, California's Groundwater, Bulletin 118. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/5_021_54_AntelopeSubbasin.pdf.

California Department of Water Resources. 2003. Tehama County Groundwater Inventory, Pre-Publication Draft.

California Department of Water Resources, 2018 Groundwater Basin Boundary Assessment Tool. https://gis.water.ca.gov/app/bbat/.

California Department of Water Resources. 2019. SVSim: Sacramento Valley Groundwater-Surface Water Simulation Model. https://data.cnra.ca.gov/dataset/svsim.

Tehama County Flood Control and Water Conservation District. 2022. Antelope Groundwater Sustainability Plan. https://tehamacountywater.org/gsa/groundwater-sustainability-plans-public-draft/#antelope-subbasin-final-gsp.

APPENDIX A

Water Level Hydrographs of Representative Monitoring Wells for Groundwater Level

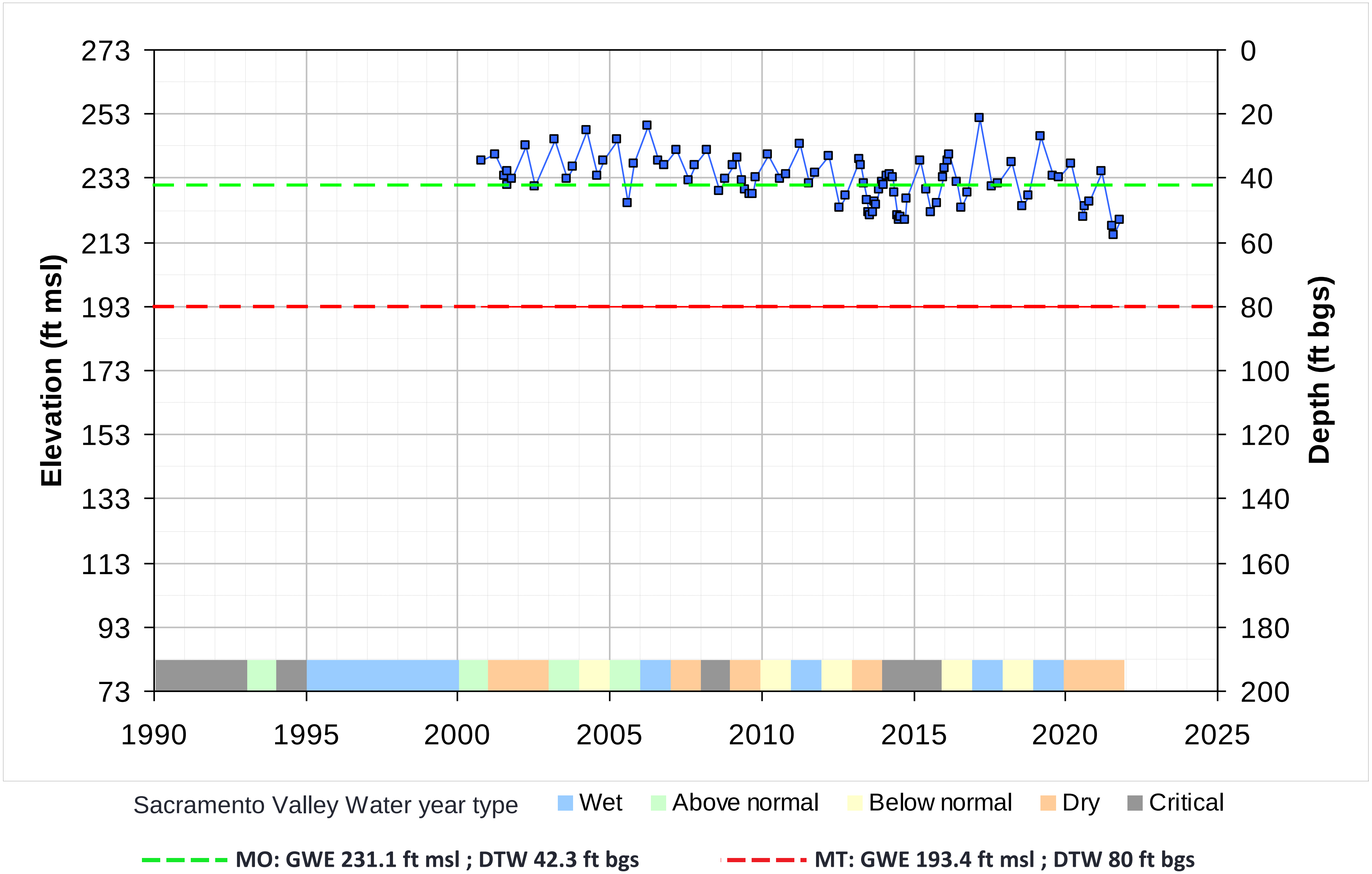
See Figure 2-5 to see the location of wells.

Ant-1U (Antelope Subbasin - Upper Aquifer)

SWN: 27N03W16K003M

Well Depth (ft): 137; Screens (ft bgs): 117 - 137

Well Type: Domestic



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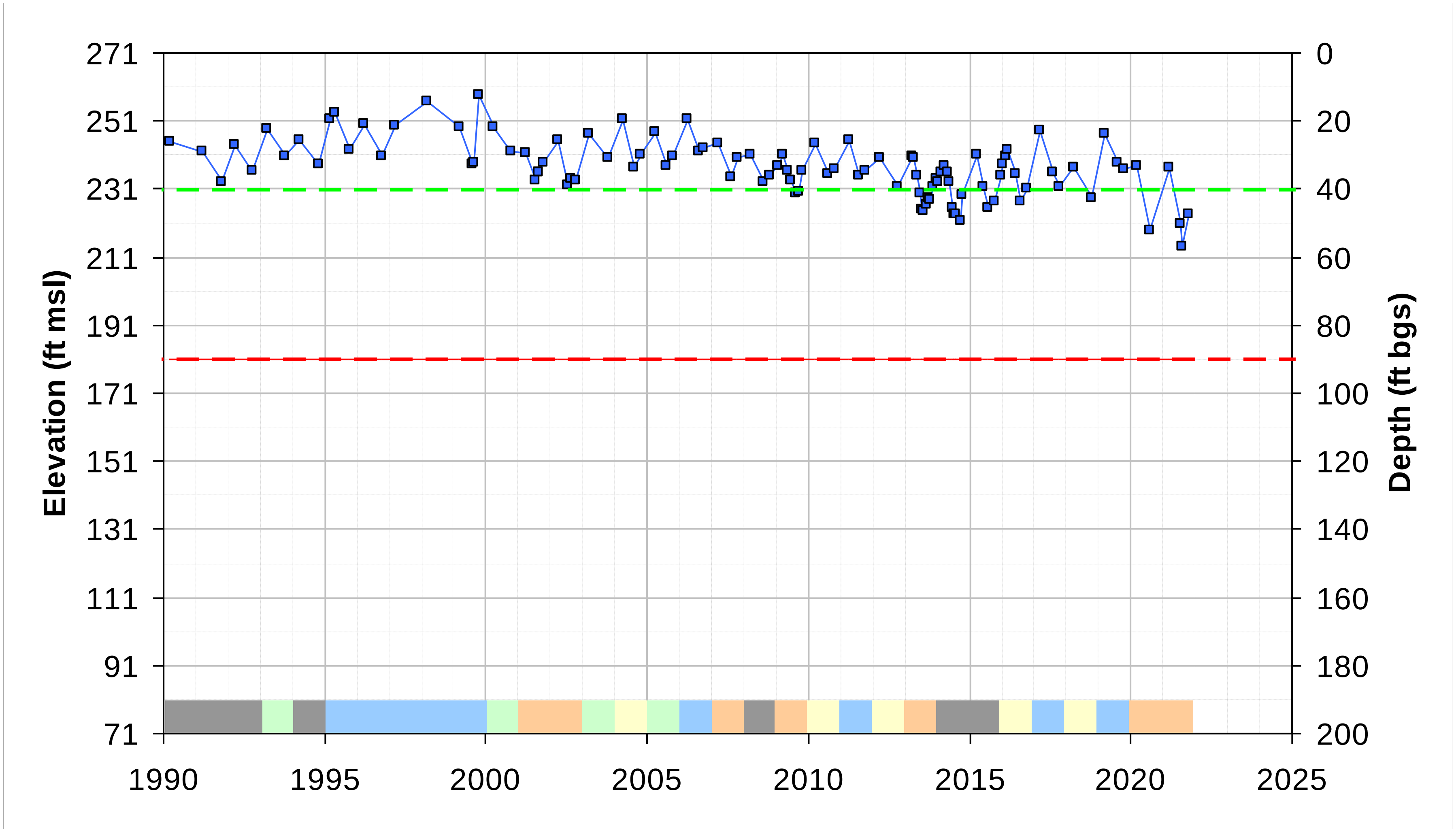
Ant-2U (Antelope Subbasin - Upper Aquifer)

SWN: 27N03W23D001M

Well Depth (ft): 250; Screens (ft bgs): 30 - 155

Well Type: Irrigation



Sacramento Valley Water year type: Wet, Above normal, Below normal, Dry, Critical

MO: GWE 231.2 ft msl ; DTW 40.3 ft bgs

MT: GWE 181.4 ft msl ; DTW 90 ft bgs

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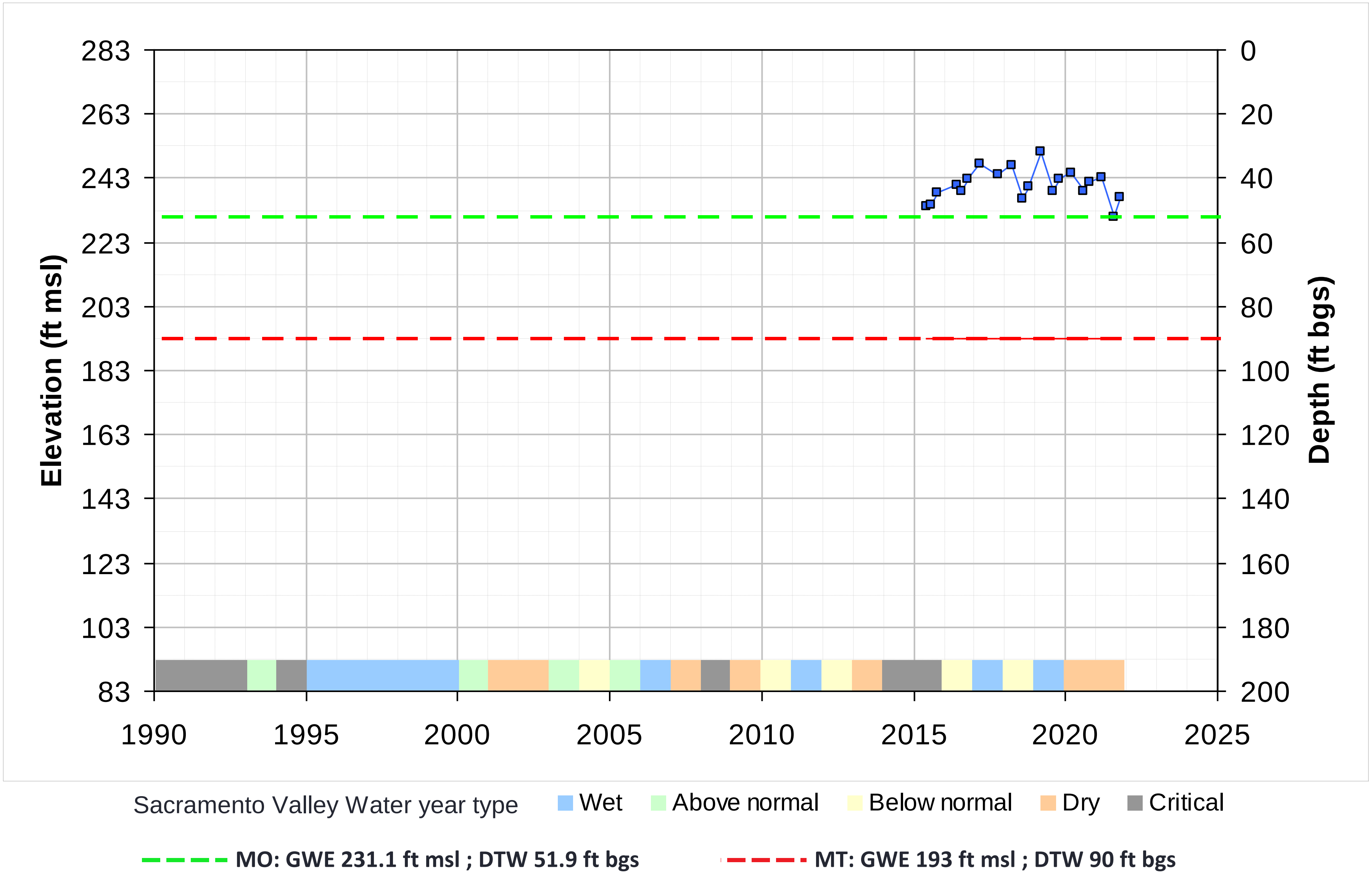
Ant-3U (Antelope Subbasin - Upper Aquifer)

SWN: 27N02W30C003M

Well Depth (ft): 170; Screens (ft bgs): 157 - 170

Well Type: Irrigation



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APPENDIX B

Annual Report Water Level Data

Data sources:

CA Department of Water Resources

Tehama County Flood Control and Water Conservation District

United States Geological Survey

The Nature Conservancy

LSCE

Table B-1 Water Level Data for Upper Aquifer										
Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
26N02W15C001M	3/10/2020	262.42	260.42	37.20	39.20	223.22		Locked		ST
26N02W15C001M	9/4/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	9/11/2020	262.42	260.42	40.80	42.80	219.62				ST
26N02W15C001M	9/18/2020	262.42	260.42	42.10	44.10	218.32				ST
26N02W15C001M	9/23/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	10/2/2020	262.42	260.42	40.70	42.70	219.72				ST
26N02W15C001M	10/9/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	10/16/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	10/23/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	10/30/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	11/6/2020	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	3/15/2021	262.42	260.42	39.00	41.00	221.42				ST
26N02W15C001M	7/8/2021	262.42	260.42	48.30	50.30	212.12				ST
26N02W15C001M	7/12/2021	262.42	260.42	31.80	33.80	228.62				ST
26N02W15C001M	7/16/2021	262.42	260.42	32.30	34.30	228.12				ST
26N02W15C001M	7/20/2021	262.42	260.42	35.90	37.90	224.52				ST
26N02W15C001M	7/26/2021	262.42	260.42	36.40	38.40	224.02				ST
26N02W15C001M	8/4/2021	262.42	260.42	42.70	44.70	217.72	4			ST
26N02W15C001M	8/5/2021	262.42	260.42	40.50	42.50	219.92				ST
26N02W15C001M	8/11/2021	260.00	158.00	-57.30	44.70	215.30				ST
26N02W15C001M	9/2/2021	262.42	260.42	43.10	45.10	217.32				ST
26N02W15C001M	9/10/2021	262.42	260.42	43.20	45.20	217.22				ST
26N02W15C001M	9/14/2021	262.42	260.42	43.10	45.10	217.32				ST
26N02W15C001M	9/17/2021	262.42	260.42	42.90	44.90	217.52				ST
26N02W15C001M	9/30/2021	262.42	260.42	42.60	44.60	217.82				ST

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing

Table B-1 Water Level Data for Upper Aquifer										
Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
26N02W15C001M	10/7/2021	262.42	260.42	42.30	44.30	218.12				ST
26N02W15C001M	10/15/2021	262.42	260.42	42.00	44.00	218.42				ST
26N02W17E001M	3/10/2020	241.41	240.41	18.30	19.30	222.11				ST
26N02W17E001M	10/14/2020	241.41	240.41	19.70	20.70	220.71				ST
26N02W17E001M	3/15/2021	241.41	240.41	19.20	20.20	221.21				ST
26N02W17E001M	10/11/2021	241.41	240.41	20.70	21.70	219.71				ST
26N02W21Q001M	3/10/2020	238.90	237.40	20.60	22.10	216.80				ST
26N02W29R001M	3/10/2020	234.00	230.40	5.00	8.60	225.40				ES
26N02W29R001M	8/4/2020	234.00	230.40	5.00	8.60	225.40				ES
26N02W29R001M	9/4/2020	234.00	230.40	4.97	8.57	225.43				ES
26N02W29R001M	9/11/2020	234.00	230.40	5.20	8.80	225.20				ES
26N02W29R001M	9/18/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	9/23/2020	234.00	230.40	5.20	8.80	225.20				ES
26N02W29R001M	10/2/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	10/9/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	10/16/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	10/23/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	10/30/2020	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	11/6/2020	234.00	230.40	5.15	8.75	225.25				ES
26N02W29R001M	1/13/2021	234.00	230.40	5.15	8.75	225.25				ES
26N02W29R001M	3/15/2021	234.00	230.40	5.20	8.80	225.20				ES
26N02W29R001M	7/8/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	7/12/2021	234.00	230.40	6.00	9.60	224.40				ES
26N02W29R001M	7/16/2021	234.00	230.40	6.30	9.90	224.10				ES
26N02W29R001M	7/20/2021	234.00	230.40	5.30	8.90	225.10				ES

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing

Table B-1 Water Level Data for Upper Aquifer

Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
26N02W29R001M	7/23/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	7/26/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	7/30/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	8/3/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	8/5/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	8/11/2021	234.00	230.40	5.10	8.70	225.30				ES
26N02W29R001M	8/20/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	8/27/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	9/3/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	9/10/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	9/14/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	9/17/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	9/24/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	9/28/2021	234.00	230.40	5.50	9.10	224.90				ES
26N02W29R001M	9/30/2021	234.00	230.40	5.40	9.00	225.00				ES
26N02W29R001M	10/7/2021	234.00	230.40	5.30	8.90	225.10				ES
26N02W29R001M	10/15/2021	234.00	230.40	5.30	8.90	225.10				ES
26N03W24M001M	3/11/2020	246.91	246.41	22.50	23.00	223.91				ES
26N03W24M001M	8/5/2020	246.91	246.41	48.24	48.74	198.17				ES
26N03W24M001M	10/13/2020	246.91	246.41	38.35	38.85	208.06				ES
26N03W24M001M	3/16/2021	246.91	246.41	28.30	28.80	218.11				ES
26N03W24M001M	8/5/2021	246.91	246.41	51.52	52.02	194.89				ES
26N03W24M001M	10/13/2021	246.91	246.41	42.74	43.24	203.67				ES
27N02W30C003M	3/10/2020	287.00	283.00	38.60	42.60	244.40				ST
27N02W30C003M	8/5/2020	287.00	283.00	44.30	48.30	238.70				ST

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing

Table B-1 Water Level Data for Upper Aquifer

Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
27N02W30C003M	10/14/2020	287.00	283.00	41.30	45.30	241.70				ST
27N02W30C003M	3/15/2021	287.00	283.00	39.80	43.80	243.20				ST
27N02W30C003M	8/4/2021	287.00	283.00	52.16	56.16	230.84				ES
27N02W30C003M	10/11/2021	287.00	283.00	45.80	49.80	237.20				ST
27N02W31C001M	3/10/2020	263.43	263.43	30.90	30.90	232.53				ST
27N02W31C001M	8/4/2020	263.43	263.43	40.00	40.00	223.43				ST
27N02W31C001M	10/14/2020	263.43	263.43	32.10	32.10	231.33				ST
27N02W31C001M	3/15/2021	263.43	263.43	31.40	31.40	232.03				ST
27N02W31C001M	8/4/2021	263.43	263.43	41.80	41.80	221.63				ST
27N02W31C001M	10/11/2021	263.43	263.43	38.80	38.80	224.63				ST
27N03W14F001M	3/12/2020	277.93	277.43	37.20	37.70	240.23				ES
27N03W14F001M	8/5/2020	277.93	277.43	52.95	53.45	224.48				ES
27N03W14F001M	10/14/2020	277.93	277.43	46.68	47.18	230.75				ES
27N03W14F001M	8/4/2021	277.93	277.43	56.67	57.17	220.76				ES
27N03W14F001M	10/11/2021	277.93	277.43	51.27	51.77	226.16				ES
27N03W14H001M	3/12/2020	281.30	280.00	36.10	37.40	243.90				ST
27N03W14H001M	3/26/2021	281.30	280.00	39.70	41.00	240.30				ST
27N03W14H001M	8/4/2021	281.30	280.00	50.50	51.80	229.50				ST
27N03W14H001M	10/11/2021	281.30	280.00	49.50	50.80	230.50				ST
27N03W14L001M	3/12/2020	279.93	277.43	33.05	35.55	244.38				ES
27N03W14L001M	8/5/2020	279.93	277.43	48.82	51.32	228.61				ES
27N03W14L001M	10/14/2020	279.93	277.43	43.60	46.10	233.83				ES
27N03W14L001M	3/26/2021	279.93	277.43	36.20	38.70	241.23				ES
27N03W14L001M	8/4/2021	279.93	277.43	53.73	56.23	223.70				ES
27N03W14L001M	10/11/2021	279.93	277.43	48.74	51.24	228.69				ES

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing

Table B-1 Water Level Data for Upper Aquifer

Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
27N03W14N001M	3/12/2020	268.10	266.00	28.70	30.80	237.30				ST
27N03W14N001M	3/26/2021	268.10	266.00	33.00	35.10	233.00				ST
27N03W14N001M	8/4/2021	268.10	266.00	50.30	52.40	215.70				ST
27N03W14N001M	10/11/2021	268.10	266.00	46.20	48.30	219.80				ST
27N03W16K003M	3/12/2020	274.73	273.43	35.60	36.90	237.83				ST
27N03W16K003M	8/5/2020	274.73	273.43	51.90	53.20	221.53				ST
27N03W16K003M	8/22/2020	274.73	273.43	49.02	50.32	224.41				ST
27N03W16K003M	10/14/2020	274.73	273.43	47.50	48.80	225.93				ST
27N03W16K003M	3/15/2021	274.73	273.43	38.10	39.40	235.33				ST
27N03W16K003M	7/28/2021	274.73	273.43	54.80	56.10	218.63				ST
27N03W16K003M	8/4/2021	274.73	273.43	57.80	59.10	215.63				ST
27N03W16K003M	10/11/2021	274.73	273.43	52.90	54.20	220.53				ST
27N03W22A001M	3/10/2020	265.00	265.00	30.80	30.80	234.20				ST
27N03W22A001M	8/5/2020	265.00	265.00	47.40	47.40	217.60				ST
27N03W22A001M	10/14/2020	265.00	265.00	42.80	42.80	222.20				ST
27N03W22A001M	3/15/2021	265.00	265.00	26.90	26.90	238.10				ST
27N03W22A001M	7/28/2021	265.00	265.00	50.20	50.20	214.80				ST
27N03W22A001M	8/4/2021	265.00	265.00	53.70	53.70	211.30				ST
27N03W22A001M	10/11/2021	265.00	265.00	48.00	48.00	217.00				ST
27N03W23D001M	3/10/2020	272.43	271.43	33.30	34.30	238.13				ST
27N03W23D001M	8/5/2020	272.43	271.43	52.30	53.30	219.13	4			ST
27N03W23D001M	3/15/2021	272.43	271.43	33.80	34.80	237.63				ST
27N03W23D001M	7/28/2021	272.43	271.43	50.00	51.00	221.43	4			ST
27N03W23D001M	8/4/2021	272.43	271.43	57.00	58.00	214.43				ST
27N03W23D001M	10/11/2021	272.43	271.43	47.50	48.50	223.93				ST

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing

Table B-1 Water Level Data for Upper Aquifer

Well ID	Measure Date	RPE (ft amsl)	GSE (ft amsl)	DTW (ft bgs)	DTW (ft brp)	WSE (ft amsl)	WL QM CD[1]	Comments	QA_CD	Method
27N03W28D002M	3/9/2020	263.20	263.00	31.90	32.10	231.10	8			ST
27N03W28D002M	10/14/2020	263.20	263.00	32.30	32.50	230.70	8			ST
27N03W28D002M	3/15/2021	263.20	263.00	33.60	33.80	229.40	8			ST
27N03W28D002M	8/4/2021	263.20	263.00	60.70	60.90	202.30				ST
27N03W28D002M	10/11/2021	263.20	263.00	52.30	52.50	210.70	8			ST
27N03W33A002M	3/9/2020	258.50	258.00	26.50	27.00	231.50				ST
27N03W33A002M	8/5/2020	258.50	258.00	42.20	42.70	215.80				ST
27N03W33A002M	3/15/2021	258.50	258.00	27.30	27.80	230.70				ST
27N03W33A002M	8/4/2021	258.50	258.00	44.20	44.70	213.80	8			ST
27N03W33A002M	10/11/2021	258.50	258.00	39.70	40.20	218.30	6			ST
27N03W36C002M	3/15/2021	261.60	261.00	26.50	27.10	234.50				ES
27N03W36C002M	8/4/2021	261.60	261.00	33.01	33.61	227.99				ES
27N04W36G001M	3/10/2020	364.24	362.44	112.88	114.68	249.56				ST
27N04W36G001M	8/5/2020	364.24	362.44	116.64	118.44	245.80				ST
27N04W36G001M	10/13/2020	364.24	362.44	117.61	119.41	244.83				ST
27N04W36G001M	3/16/2021	364.24	362.44	115.15	116.95	247.29				ST
27N04W36G001M	7/28/2021	364.24	362.44	119.76	121.56	242.68				ST
27N04W36G001M	8/4/2021	364.24	362.44	119.89	121.69	242.55				ST
27N04W36G001M	10/12/2021	364.24	362.44	120.32	122.12	242.12				ST
28N03W28G002M	3/9/2020	341.35	340.00	27.45	28.80	312.55	6	Cascading		ST
28N03W28G002M	8/5/2020	341.35	340.00	33.95	35.30	306.05	3			ST
28N03W28G002M	3/16/2021	341.35	340.00	22.25	23.60	317.75	3			ST
28N03W28G002M	7/28/2021	341.35	340.00	45.85	47.20	294.15				ES

[1]WL QM CD: 3-Casing leaking or wet, 4-Pumped recently, 6-Other, 8-Oil or foreign substance in casing