



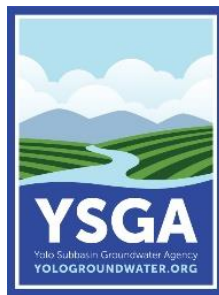
# Yolo Subbasin Groundwater Agency Annual Report - WY 2019, 2020, 2021 Yolo County, CA



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# Yolo Subbasin Groundwater Sustainability Plan

2022 Annual Report  
Covering Water Years 2019, 2020, and 2021



Prepared by:

YSGA Staff  
34274 State Highway 16  
Woodland, CA 95695

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## EXECUTIVE SUMMARY

The Yolo Subbasin Groundwater Agency (YSGA) has prepared this report for the Yolo Subbasin Groundwater Sustainability Plan (GSP) in compliance with the Sustainable Groundwater Management Act (SGMA; California Water Code Section 10720 et seq.) SGMA requires Groundwater Sustainability Agencies to submit annual reports to DWR each April 1 following adoption of a GSP, whether or not DWR has officially approved of the GSP. [DWR's GSP Regulations](#) provide details on the data requirements for annual reports; the annual report must include data and information collected from the monitoring network, including groundwater extractions, surface water supply, total water use, and changes in groundwater storage for the subbasin.

The YSGA adopted the Yolo Subbasin GSP on January 24, 2022 and submitted the GSP to DWR on January 28, 2022. With the YSGA only recently beginning implementation of the Yolo Subbasin GSP, this annual report is serving as a “first draft” template that allows the YSGA to communicate groundwater conditions within the Yolo Subbasin GSP. The annual report template will improve every year as we obtain additional information and as we collect additional data and enhance our robust groundwater monitoring network. This annual report is a compilation of three water years: Water Year 2019, 2020, and 2021 (October 1-September 30).

Water Year 2019 was a wet water year, in which precipitation was approximately 29.2” for the Subbasin and 150% of the historical average precipitation within the Subbasin. Water Year 2019 provided significant recovery in groundwater levels illustrating the highest spring groundwater levels in the past 10 years (2011-2021). From Spring 2019 to Fall 2019 there was an approximate 12-foot drawdown on groundwater levels.

Water Year 2020 was a dry water year, in which precipitation was approximately 10.9” for the Subbasin and 56% of the historical average precipitation within the Subbasin. Water Year 2020 prevented additional groundwater recovery opportunities and Spring 2020 groundwater levels were approximately 8 feet higher than Spring 2015 groundwater levels. From Spring 2020 to Fall 2020 there was an approximate 7-foot drawdown on groundwater levels.

Water Year 2021 was a critical water year, in which precipitation was approximately 6.6” for the Subbasin and 34% of the historical average precipitation within the Subbasin. Water Year 2021 prevented additional groundwater recovery opportunities and Spring 2021 groundwater levels were approximately 6 feet higher than Spring 2015 groundwater levels. Unfortunately, Fall 2021 measurements illustrated an unprecedented single year drop in average groundwater elevations.



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## 1. INTRODUCTION

The Yolo Subbasin Groundwater Agency Joint Powers Agreement (JPA) was officially executed on June 19, 2017 by 19 member agencies and five affiliated parties via memoranda of understandings (MOU). Since the YSGA was formed, three additional member agencies have signed onto the JPA; three other member agencies consolidated into one; and one affiliated party has entered into an MOU with the JPA, which has resulted in 20 member agencies and six affiliated parties for a total of 26 YSGA members.

The Yolo Subbasin Groundwater Sustainability Plan (GSP) was adopted on January 24, 2022 by the YSGA Board of Directors, and submitted to the California Department of Water Resources (DWR) on January 28, 2022 by YSGA staff. The Plan provides an overview of the planning considerations, hydrogeologic properties, and hydrologic conditions of the area from 1970 to 2018. It also outlines a water budget for the Yolo Subbasin, establishes Sustainable Management Criteria, and identifies projects and management actions to maintain sustainability. For a summary of the plan's contents, please refer to the Executive Summary of the Yolo Subbasin GSP<sup>1</sup>.

This 2022 Annual Report is intended to provide an update on current activities and conditions within the Subbasin and bring the Plan up to date. This report therefore covers Water Years 2019, 2020, and 2021 (October 2018 – October 2021).

## 2. PLAN AREA

The Yolo Subbasin (Subbasin) covers approximately 540,700 acres, spanning nearly 845 square miles. The Subbasin is located in the southwestern side of the Sacramento Valley Groundwater Basin and is about 27 miles wide from west to east and up to 45 miles long from north to south. The current Subbasin boundaries are the result of the consolidation of portions of the Capay Valley, Colusa, and Solano subbasins via two applications for jurisdictional modifications of the Subbasin's boundary. Land use designations within the YSGA jurisdictional boundary are predominately agriculture and native vegetation, accounting for approximately 60 and 31 percent, respectively. Approximately 6 percent of the Subbasin contains managed wetlands, which provide migratory bird habitat and other ecosystem services. Source of water for agricultural lands is a combination of surface water and groundwater. Urban and incorporated land use areas are scattered throughout the Subbasin and account for approximately five percent of the Subbasin. The Yolo Subbasin boundary, member entities, and affiliated parties are shown in Figure 1.

The Subbasin contains six Management Areas for implementation of project and management actions to achieve groundwater sustainability. In developing these Management Areas, YSGA considered geologic, aquifer, and topographic characteristics. To prevent undesirable results in adjacent Management Areas, consistent minimum thresholds and measurable objectives have been developed as discussed in the Yolo Subbasin GSP ([Section 3 – Sustainable Management Criteria](#))<sup>2</sup>. The six Management Areas are known as the Capay Valley, Dunnigan Hills, North Yolo, Central Yolo, South Yolo, and Clarksburg.

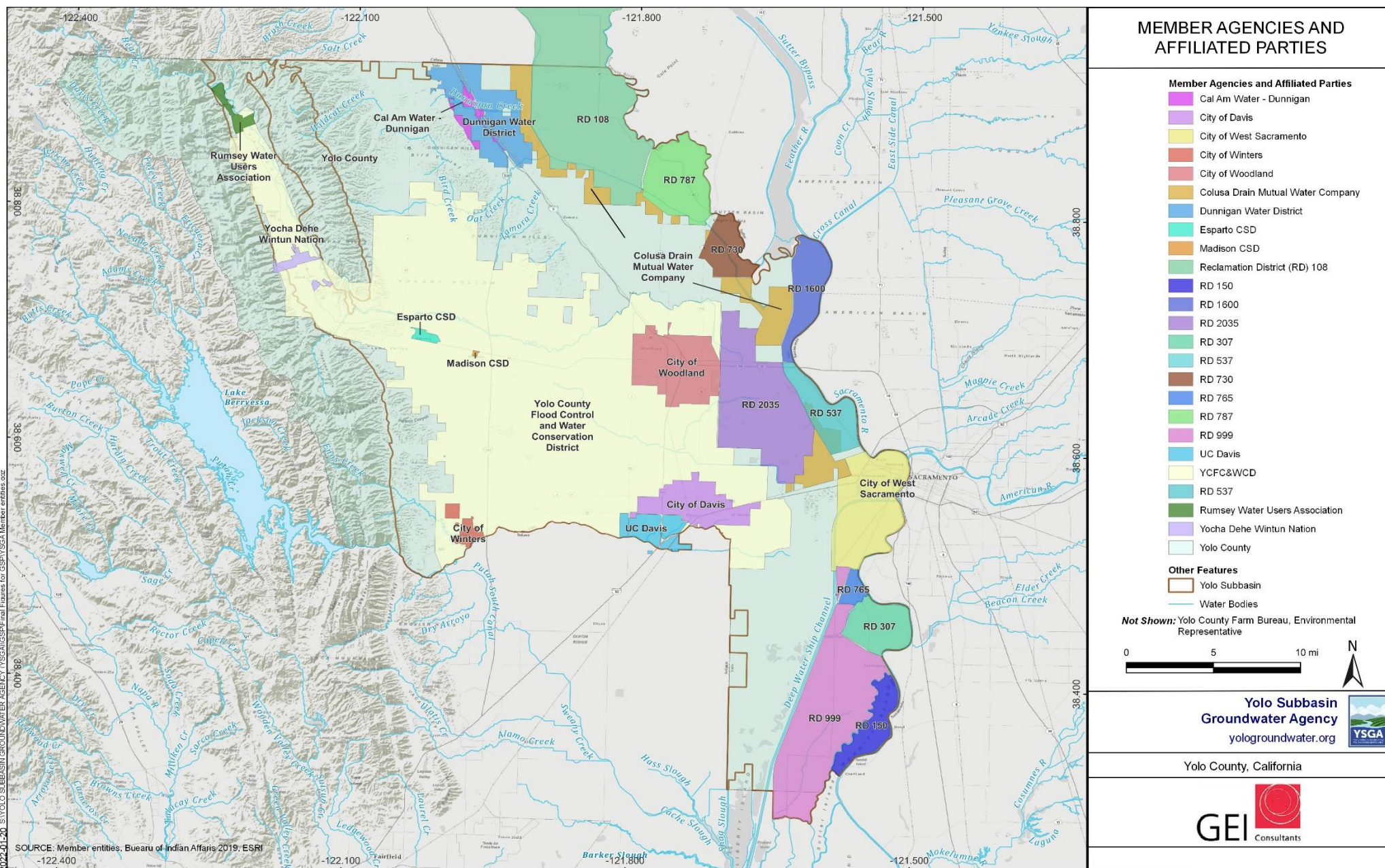
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<sup>1</sup> [https://www.yologroundwater.org/files/3aac57af3/YoloGSP\\_Adopted\\_ExecutiveSummary.pdf](https://www.yologroundwater.org/files/3aac57af3/YoloGSP_Adopted_ExecutiveSummary.pdf)

<sup>2</sup> [https://www.yologroundwater.org/files/acff83c75/YoloGSP\\_Adopted.pdf#page=279](https://www.yologroundwater.org/files/acff83c75/YoloGSP_Adopted.pdf#page=279)



**FIGURE 1. YOLO SUBBASIN MAP**



### 3. GROUNDWATER MANAGEMENT ACTIVITIES AND MILESTONES

#### 3.1 GSP IMPLEMENTATION PROGRESS

Since adoption of the Yolo Subbasin GSP, YSGA staff has worked to complete this annual report and begin the implementation process. As part of transitioning to GSP implementation, the YSGA Board of Directors have initiated conversations on properly preparing projects for grant funding opportunities, which will likely require additional planning and feasibility analyses. YSGA staff is investigating ways to appropriately prioritize projects for the entire Subbasin, which will be presented to the Board of Directors for formal review and approval. Once projects are prioritized, YSGA member agencies, affiliated parties, and beneficiaries will move towards developing funding strategies for corresponding projects.

The YSGA Board of Directors authorized funding to assist with the monitoring and administrative development of the Buckeye Creek Trickle Recharge Project in the North Yolo Management Area. In February 2022, an opportunity was provided to conduct a test of the Buckeye Creek Trickle Recharge Project as the Tehama-Colusa Canal developed a small leak in the siphon under Buckeye Creek, immediately downstream of the dewatering gate used designated for project use. Approximately 275 and 200 acre-feet of water was discharged into Buckeye and Bird Creeks, respectively. YSGA staff were involved in monitoring activities and completing groundwater recharge estimates, and there was valuable information and lessons learned as part of this initial, fortuitous opportunity.

The YSGA Board of Directors formed the ad hoc *Drought Contingency Planning Committee* to advise the Board of Directors on 1) local planning strategies; 2) appropriate management actions for drought conditions; and 3) coordination with Yolo County Supervisors for management of groundwater resources during drought. Additionally, the *Committee* intends to identify available resources to mitigate drought impacts, implement sustainability projects, and investigate whether demand management strategies are necessary. The *Committee* has directed YSGA staff to develop a joint Yolo County/YSGA Groundwater Communications Plan to provide clarity on the authority and purpose of the YSGA and Yolo County in groundwater resources management.

The YSGA has been coordinating closely with the County of Yolo to aid with domestic well owners experiencing dry wells from drought conditions. The County of Yolo's Office of Emergency Services recently received approximately \$560,000 in grant funding to provide water hauling resources to domestic well owners, and the YSGA is assisting with facilitating the availability of those resources. Additionally, YSGA staff is participating in the Water Resources Association of Yolo County (WRA) Technical Committee's *Drought Task Force* meetings to assist the County with developing a Water Shortage Contingency Plan (in compliance with [Senate Bill 552](#)).

Lastly, the YSGA has been working with Yolo County's Division of Environmental Health to improve the well permitting data collection process to better understand the true spatial impacts of the drought on subsurface conditions. As part of this, the YSGA and County are discussing improvements to well permitting requirements that may minimize the impact to domestic wells drilled in the future (i.e., requiring domestic wells to be an appropriate depth to ensure there are no construction/operational constraints in future dry year conditions).



## 3.2 MONITORING NETWORK REVISIONS

### 3.2.1 Representative Well Replacements

Representative monitoring wells (RMW) will be replaced when they can no longer be measured with consistency and/or accuracy. The selection of new representative wells prioritizes geographic proximity, consistency in groundwater elevation values and patterns, and similar construction information. As of March 2022, one RMW needs to be replaced: Well 230. We are recommending that Well 230 be replaced by Well 430.

Since October 2020, well 230 (State Well Number (SWN) 09N01E03C003M), in the Central Yolo Management Area, has had a continuous tape hang up with pump equipment or an obstruction only allowing us to measure up to approximately 100 feet. Well 430 (SWN 10N01E34A003M) is approximately 1.25 miles northwest of Well 230, has a period of record dating back to 1951, and displays similar groundwater elevation readings to Well 230.

Table 1 provides the sustainable management criteria and construction information for the current and replacement RMW (Wells 230 and 430, respectively). Replacements of RMWs will be implemented over the course of the following water year.

**TABLE 1: REPRESENTATIVE MONITORING WELL REPLACEMENTS**

|  | Current RMW  | Replacement RMW    |
|--|--|--------------------|
| <b>Management Area</b>                         | Central Yolo   | Central Yolo       |
| <b>RMW Number</b>                              | 230  | 430                |
| <b>State Well Number</b>                       | 09N01E03C003M  | 10N01E34A003M      |
| <b>Minimum Threshold, feet DTW<sup>3</sup></b> | 157.4  | 147.5              |
| <b>Minimum Threshold, feet MSL<sup>4</sup></b> | -56.4  | -47.41             |
| <b>Measurable Objective, feet DTW</b>          | 81.7   | 72.46              |
| <b>Measurable Objective, feet MSL</b>          | 19.3   | 27.63              |
| <b>Latitude</b>                                | 38.66226   | 38.67767           |
| <b>Longitude</b>                               | -121.85337   | -121.84156         |
| <b>Well Use Type</b>                           | Irrigation   | Irrigation         |
| <b>Well Depth, feet</b>                        | 567  | 235                |
| <b>Perforations, feet</b>                      | 50-54<br>105-108<br>160-164<br>216-220<br>285-316<br>360-364 | 100-171<br>195-235 |

### 3.2.2 Additional Monitoring Sites

As part of cooperative drought mitigation efforts, two additional real-time monitoring units were recently installed at Knights Landing and Cacheville Community Services Districts (SWNs 11N02E14N003M and 10N01E12B004M). Specific water levels in these wells have been identified as local levels of concern that

<sup>3</sup> DTW = Depth to Water

<sup>4</sup> MSL = Mean Surface Level

will allow Knights Landing and Cacheville Community Services Districts to proactively manage groundwater elevations and community supply.

Three additional monitoring wells were established in the Hungry Hollow/Dunnigan Hills area (SWNs 11N02W14Q001M, 11N01W18H501M, and 11N01W16B500M). Well 11N01W16B500M is outfitted with a real-time monitoring unit. As additional data is collected, the YSGA will work to establish sustainable management criteria in at least one of these wells and formally add it as an RMW.

Additionally, one well south of Esparto (SWN 10N02W25N500M), and one well west of Winters (08N01W19R500M) were added to the bi-annual monitoring network (measurements are taken spring and fall of every year).

Current data for all monitoring wells, including those listed above, is available on the YSGA's groundwater mapping site ([sgma.yologroundwater.org](https://sgma.yologroundwater.org)). Additionally, data is stored in the Yolo County Water Resources Information Database (WRID; [wrid.facilitiesmap.com](https://wrid.facilitiesmap.com)).

### 3.3 UPCOMING ACTIVITIES FOR WATER YEAR 2022

In 2022, the YSGA will be working with the WRA to merge WRA activities (integrated water resources management) into the YSGA's mission, which will require revisions to the YSGA JPA and Board of Directors approval of the JPA revisions, along with a formal dissolution of the WRA by the WRA Board of Directors. The merger of the WRA into the YSGA will increase overall efficiency by eliminating overlapping meetings and activities and will facilitate the integration of SGMA-related groundwater management activities with broader water resource planning efforts within Yolo County. Additionally, as part of re-opening the JPA, the YSGA will be investigating alternative funding mechanisms and voting structures for the long-term implementation of groundwater sustainability in the Yolo Subbasin.

Also in 2022, the YSGA will develop Advisory Committees for the six Management Areas within the Subbasin to proceed with local implementation of projects and management actions. These Advisory Committees will be created based on the premise of Article 8 of the YSGA JPA. YSGA staff will work with stakeholders to properly define the roles and responsibilities of the Advisory Committees, defining the authorities provided along with their relationship to the YSGA Board of Directors. In addition, staff will assist with formally documenting the representation and membership of each Management Area Advisory Committee and the level of public involvement by beneficial users within the Subbasin. Once the Advisory Committees are convened, the first task for review and discussion will be an update on current groundwater conditions and the status of sustainability indicators to determine whether any near-term projects or management actions should be implemented to avoid minimum threshold exceedances.

The YSGA will continue to coordinate with the County of Yolo to assist them in complying with SB 552 and assist with the thoughtful development of a domestic well mitigation program for the Yolo Subbasin. YSGA staff plan to provide the County and water managers with frequent updates on projected groundwater conditions to best prepare for and manage expectations of Fall 2022 conditions. Additionally, staff will work to prepare the YSGA the capture and retention of any excess winter flows for groundwater recharge in Winter 2022. The North Yolo Management Area is currently planning groundwater recharge projects for implementation as soon as hydrologic conditions allow.

## 4. MONITORING AND CONDITIONS ASSESSMENT

### 4.1 HYDROLOGIC CONDITIONS

A summary of Water Years 2019, 2020, and 2021 is provided below. Figure 2 provides combined surface water storage for Indian Valley Reservoir and Clear Lake as an illustrative representation of the general surface water storage conditions for the Subbasin.

#### 4.1.1 Water Year 2019

Water Year 2019 was a wet water year, in which precipitation was approximately 29.2” for the Subbasin and 150% of the historical average precipitation within the Subbasin (as shown in Table 2). Significant rain events in headwater regions resulted in Yolo County water purveyors storing a significant amount of surface water to meet all beneficial needs. Because of the rainfall and access to surplus surface water supplies, Water Year 2019 provided significant recovery in groundwater levels illustrating the highest spring groundwater levels in the past 10 years (2011-2021). From Spring 2019 to Fall 2019 there was an approximate 12-foot drawdown on groundwater levels.

#### 4.1.2 Water Year 2020

Water Year 2020 was a dry water year, in which precipitation was approximately 10.9” for the Subbasin and 56% of the historical average precipitation within the Subbasin (as shown in Table 2). With limited rainfall and limited inflow to surface water reservoirs, Water Year 2020 prevented additional groundwater recovery opportunities and Spring 2020 groundwater levels were approximately 8 feet higher than Spring 2015 groundwater levels. From Spring 2020 to Fall 2020 there was an approximate 7-foot drawdown on groundwater levels.

#### 4.1.3 Water Year 2021

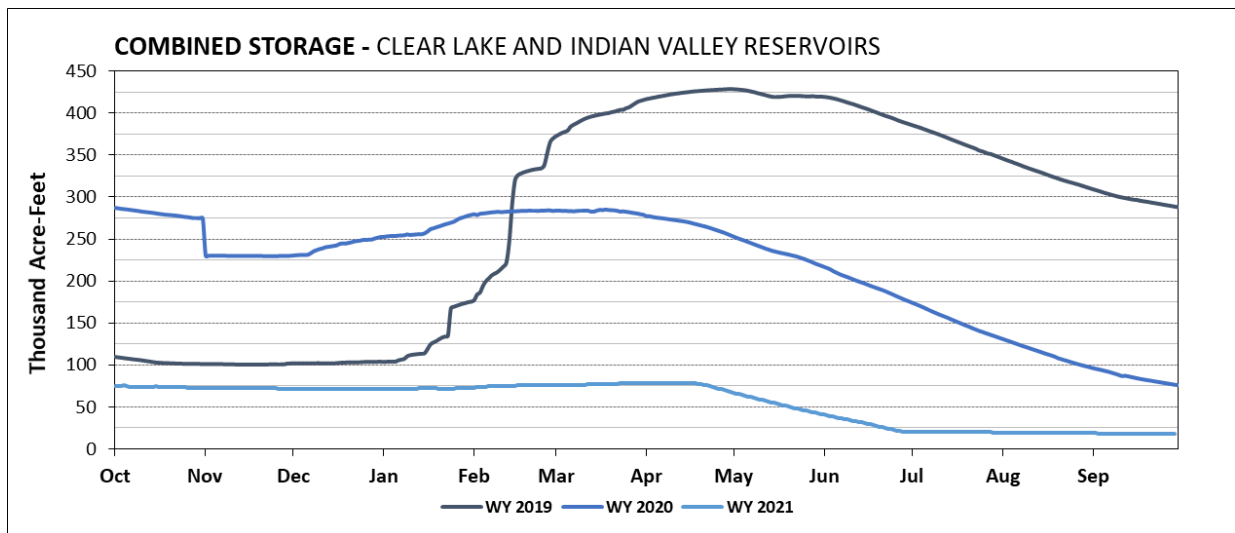
Water Year 2021 was a critical water year, in which precipitation was approximately 6.6” for the Subbasin and 34% of the historical average precipitation within the Subbasin (as shown in Table 2). With limited rainfall and limited inflow to surface water reservoirs, Water Year 2021 prevented additional groundwater recovery opportunities and Spring 2021 groundwater levels were approximately 6 feet higher than Spring 2015 groundwater levels. Unfortunately, Fall 2021 measurements illustrated an unprecedented single year drop in average groundwater elevations.

**TABLE 2: HYDROLOGIC CONDITIONS<sup>5</sup>**

| Water Year | Sacramento Valley Index | Sac Valley Water Year Type | Yolo Subbasin Estimated Precipitation (PRISM) | Percent of Subbasin Average <sup>6</sup> |
|------------|-------------------------|----------------------------|---|--|
| 2019       | 10.2                    | Wet                        | 29.2”   | 150%                                     |
| 2020       | 6.0                     | Dry                        | 10.9”   | 56%                                      |
| 2021       | 3.8                     | Critical                   | 6.6”  | 34%                                      |

<sup>5</sup> <https://cdec.water.ca.gov/reportapp/javareports?name=wsihist>;  
<http://cdec4gov.water.ca.gov/reportapp/javareports?name=WSI>

<sup>6</sup> 19.5” based on average precipitation from PRISM, 1900 – 2018, at each representative well location.



**FIGURE 2: COMBINED STORAGE AT CLEAR LAKE AND INDIAN VALLEY RESERVOIRS**

## 4.2 GROUNDWATER ELEVATIONS AND STORAGE

Figure 3 displays the historical average depth to water in the representative monitoring network for Water Years 2019-2021, which includes 62 RMWs. This historical average depth to water hydrograph covers Spring 1975 to Fall 2021, which technically brings us into the start of Water Year 2022. With wet hydrologic conditions, Water Year 2019 provided significant recovery in groundwater levels, showing the highest spring groundwater level in the past ten years (2011- 2021). A dry 2020 prevented additional recovery of groundwater levels. Critical conditions in Water Year 2021 led to a very limited spring recovery, and an unprecedented single calendar-year drop in average depth to water (17 feet between Spring and Fall 2021).

Figure 4 through Figure 10 display the seasonal high and low groundwater elevation contours for Water Years 2019-2021 and Fall of 2021.

**FIGURE 3: YOLO SUBBASIN AVERAGE DEPTH TO WATER**

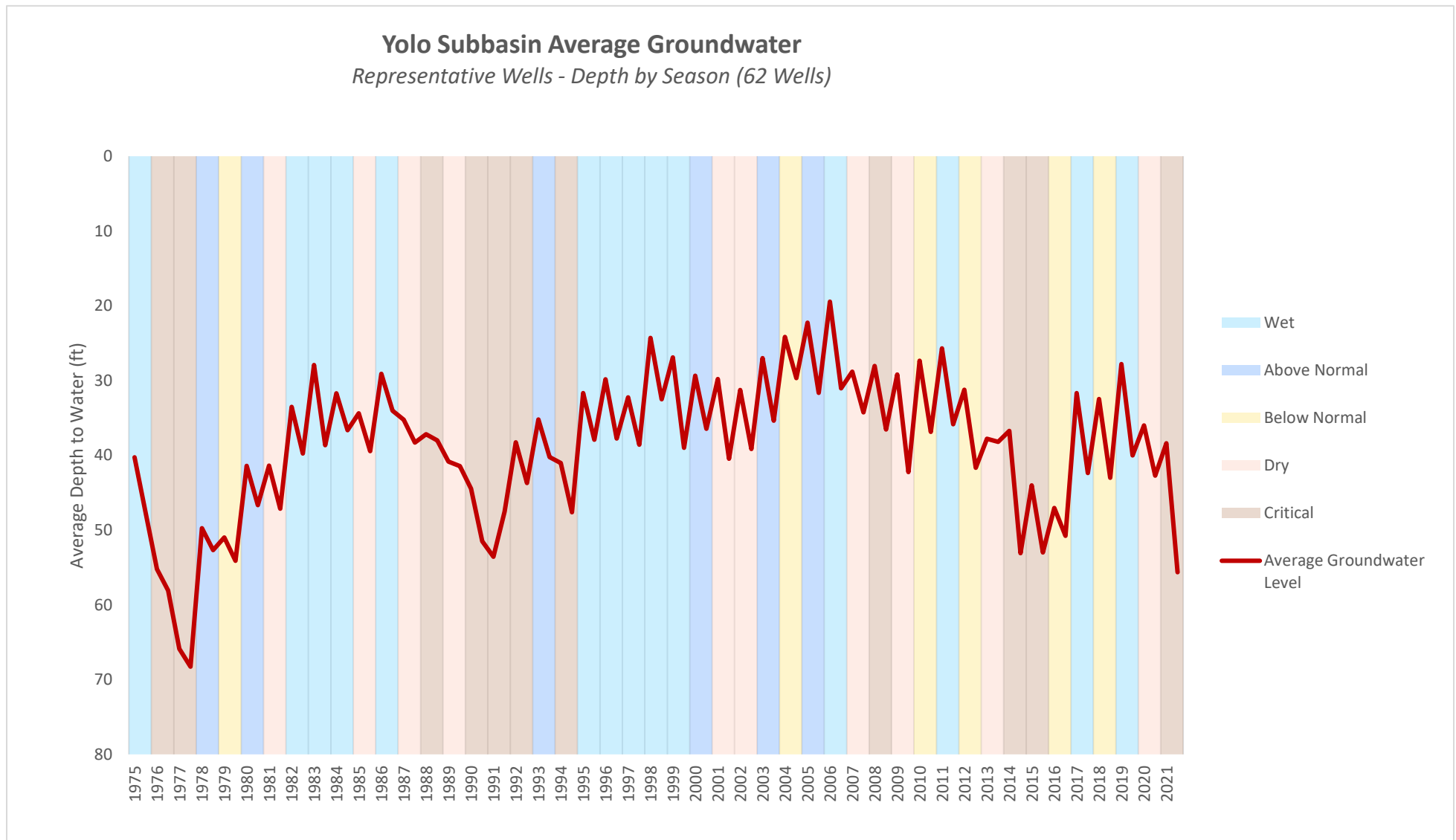




FIGURE 4: GROUNDWATER ELEVATION CONTOUR – FALL 2018

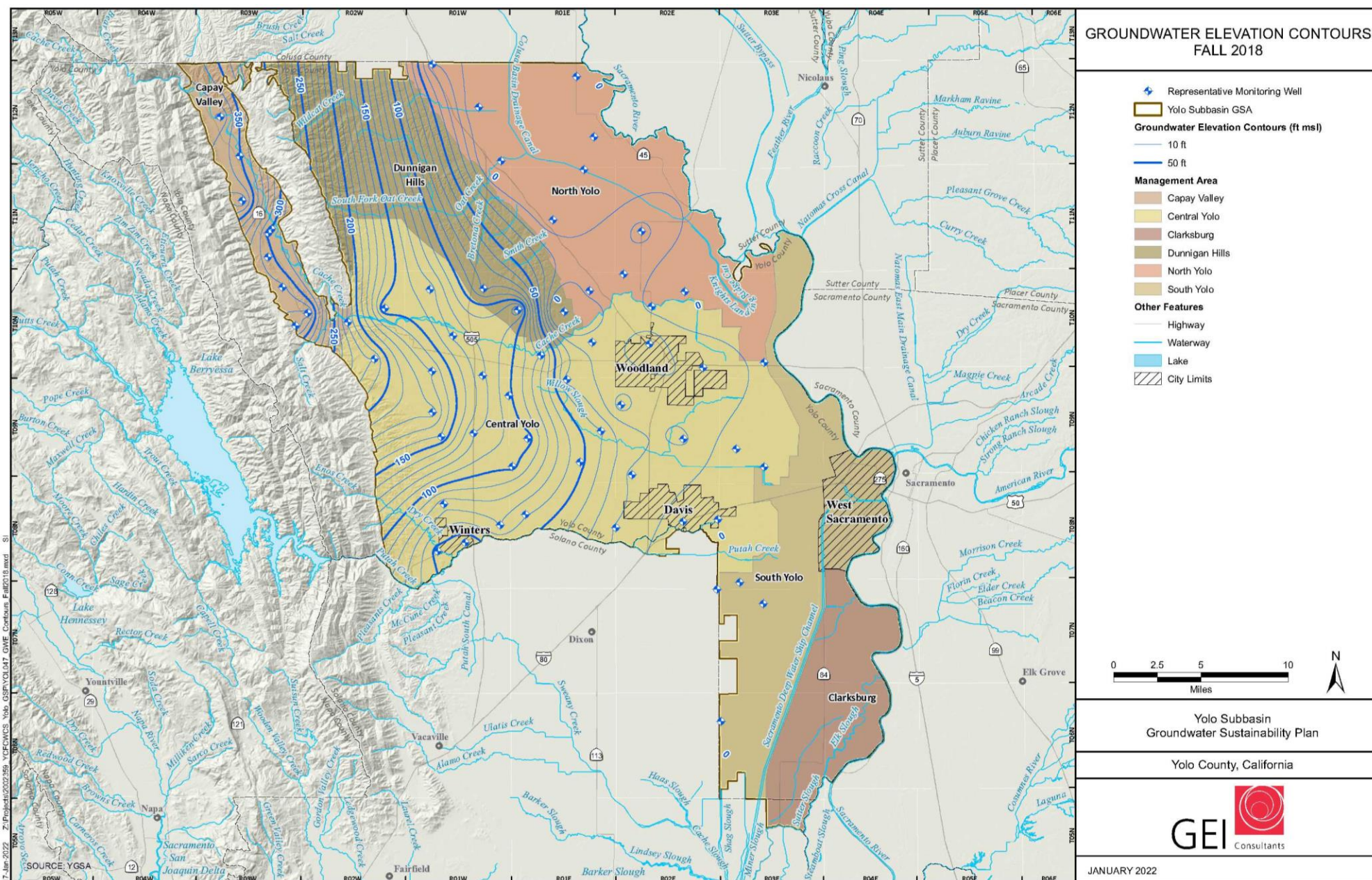




FIGURE 5: GROUNDWATER ELEVATION CONTOUR – SPRING 2019

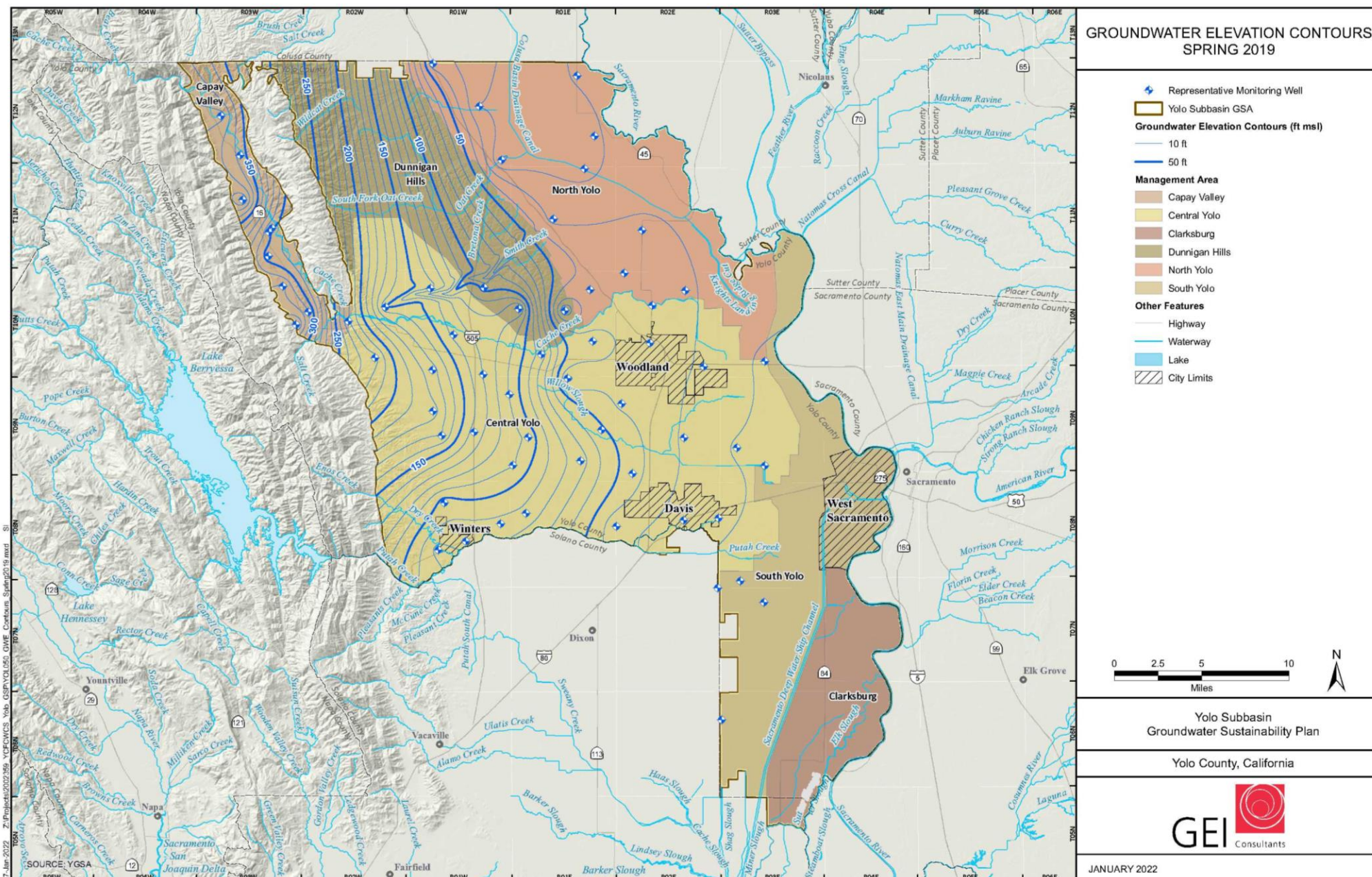




FIGURE 6: GROUNDWATER ELEVATION CONTOUR – FALL 2019

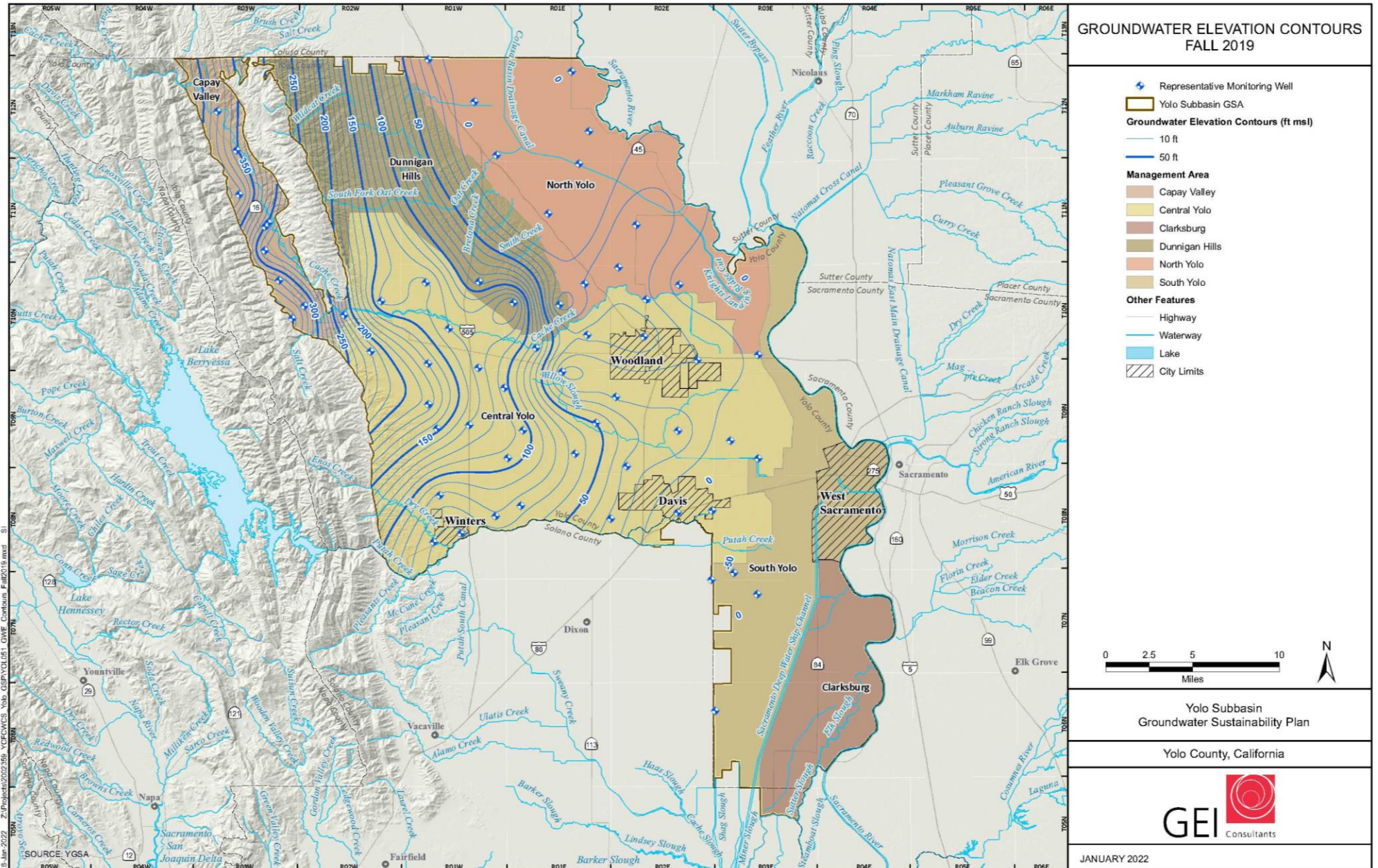




FIGURE 7: GROUNDWATER ELEVATION CONTOUR – SPRING 2020

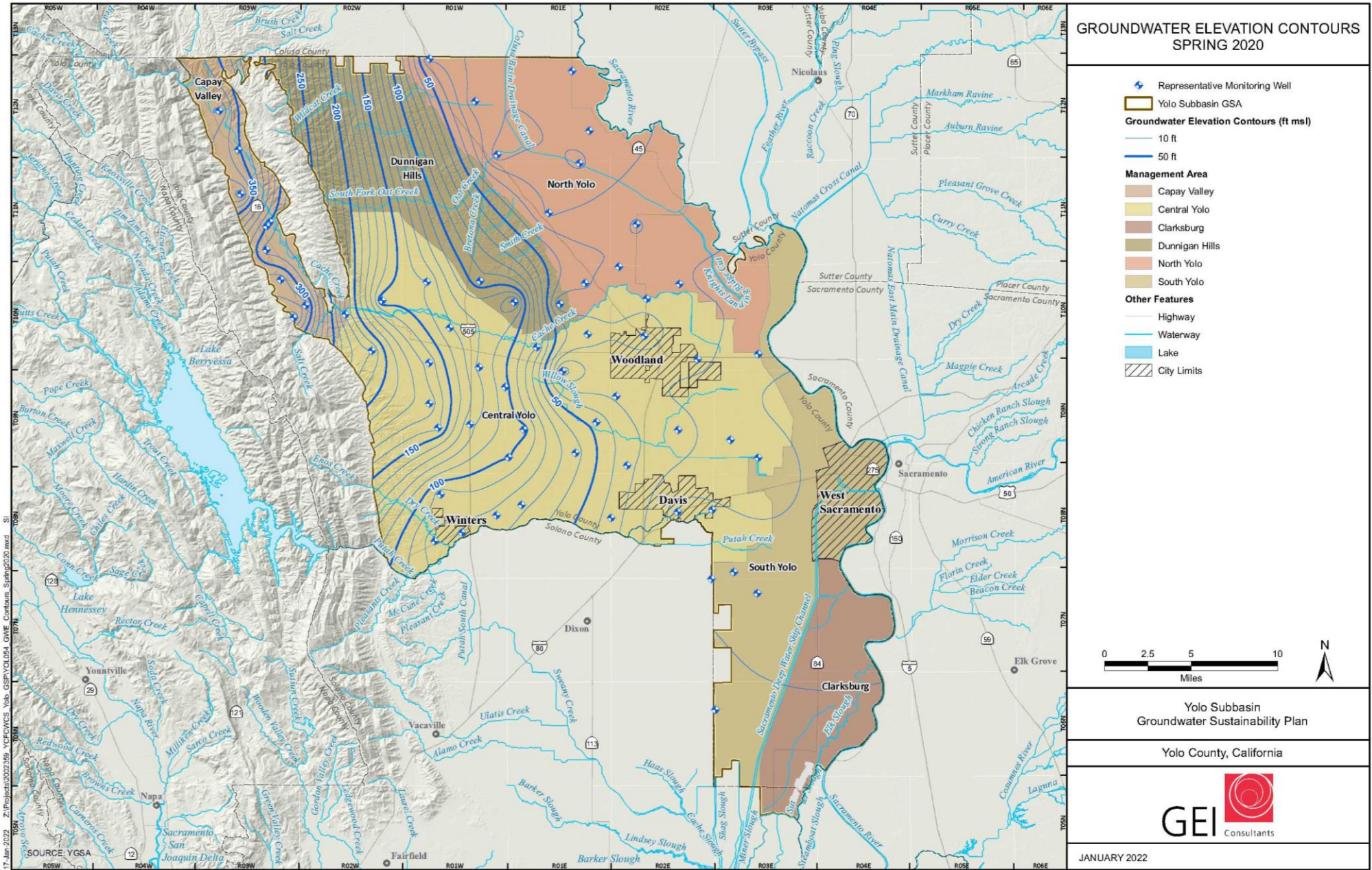




FIGURE 8: GROUNDWATER ELEVATION CONTOUR – FALL 2020

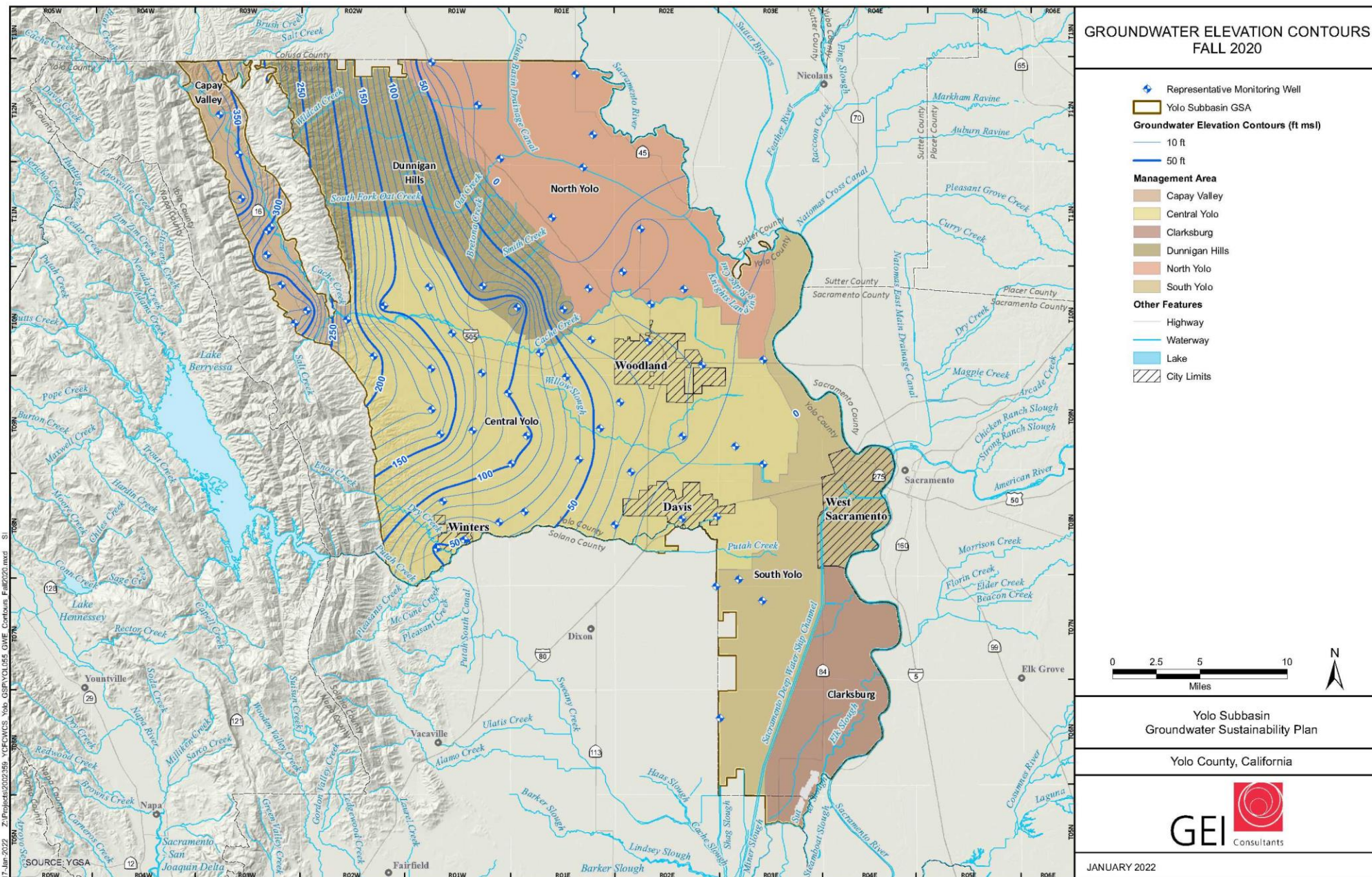




FIGURE 9: GROUNDWATER ELEVATION CONTOUR – SPRING 2021

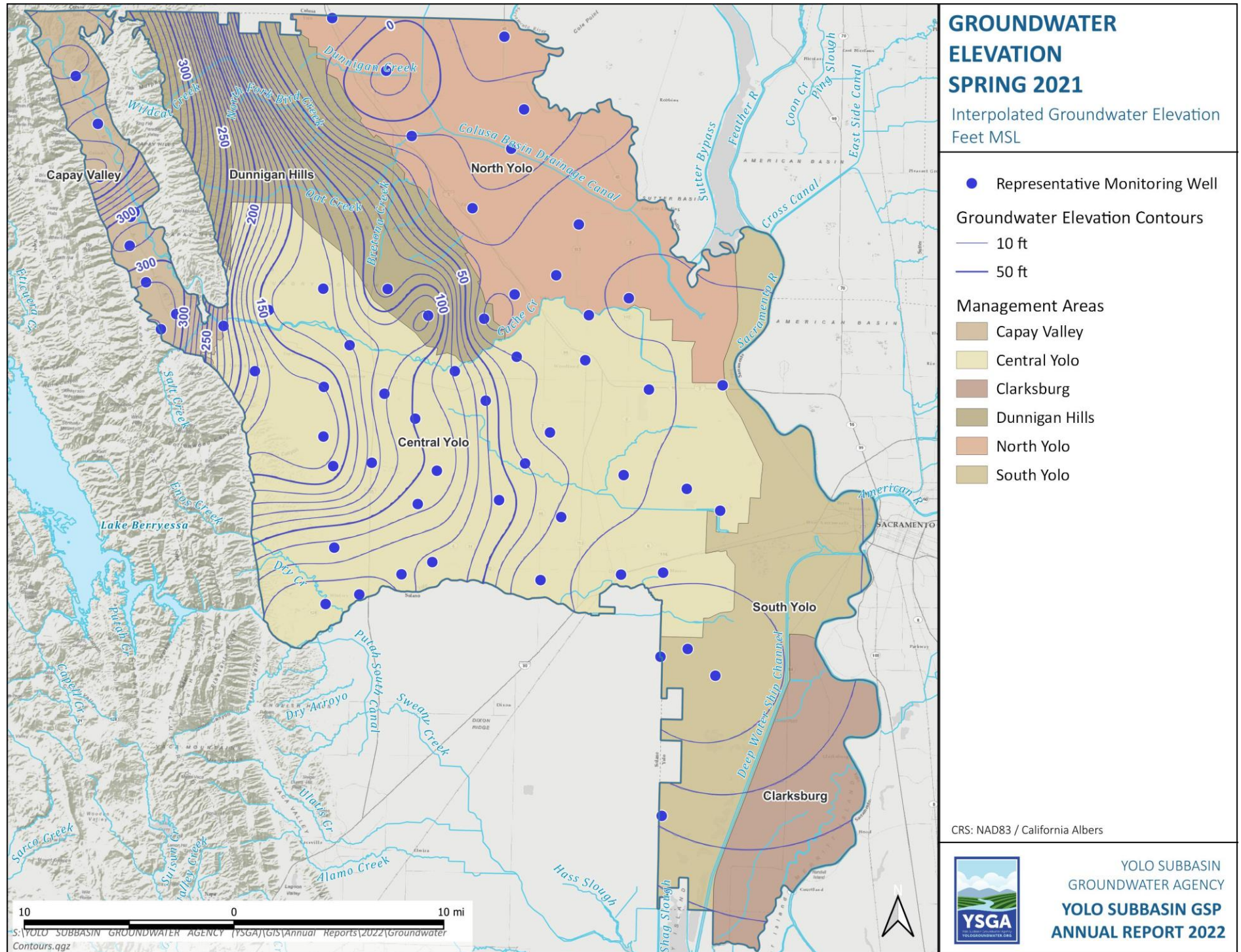




FIGURE 10: GROUNDWATER ELEVATION CONTOUR – FALL 2021

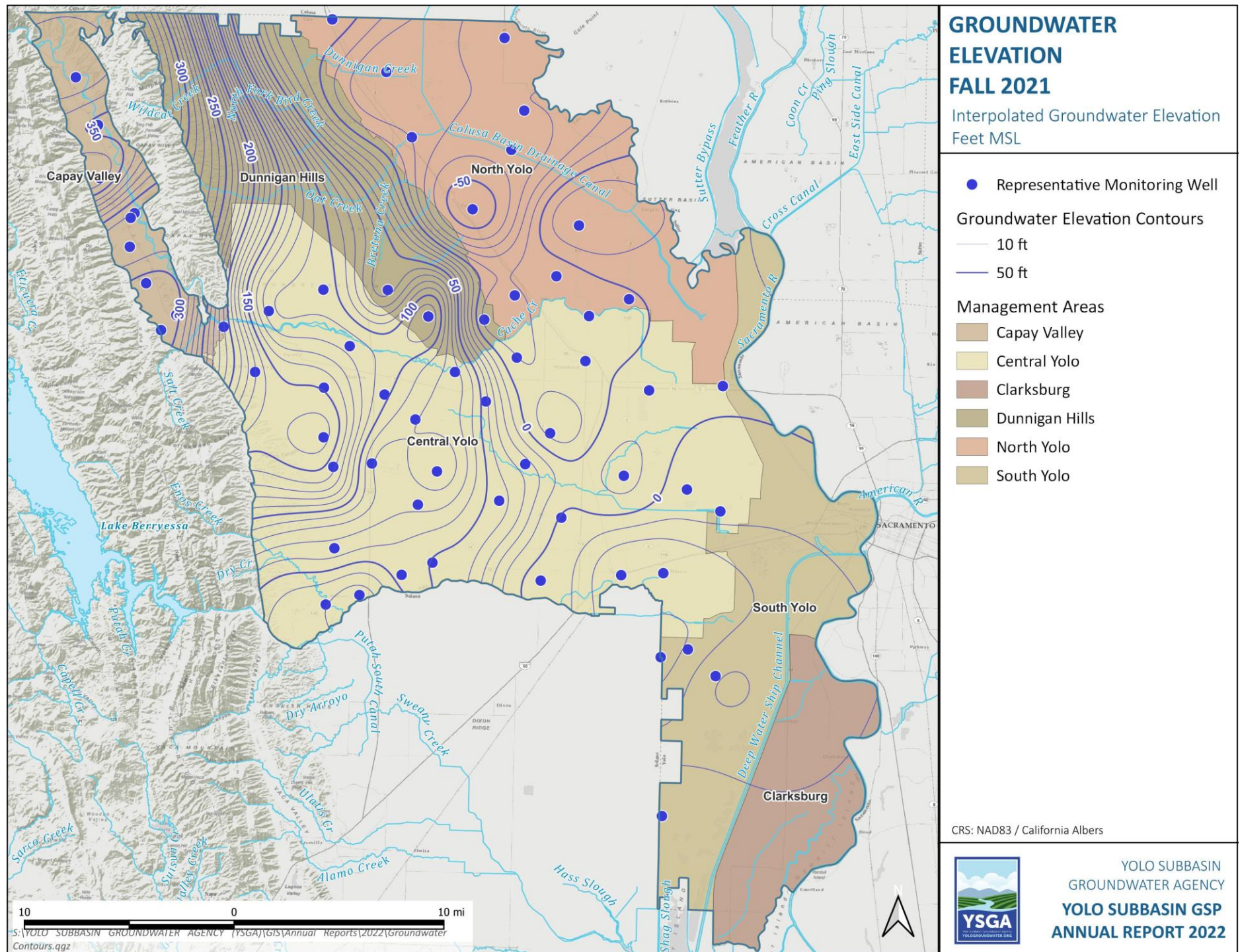


Table 3 through Table 7 show spring and fall groundwater elevation values in the RMWs for each management area and provide a comparison to the sustainable management criteria values as established in the Yolo Subbasin GSP. These RMWs, and the sustainable management criteria assigned to them, represent both the groundwater levels and groundwater storage sustainability indicators. The hydrograph of each of these RMWs is provided in Attachment A.

Per the GSP, *“An undesirable result occurs when the minimum threshold criteria is exceeded in 51 percent or more of representative monitoring wells in two (2) MAs.”* In Water Years 2019, 2020, and 2021, no basin-wide undesirable results occurred according to this criteria. The GSP also establishes an “undesirable result watch area”, which is a Management Area “that has triggered the exceedance criteria for an undesirable result for a given sustainability indicator, but where the number of MAs exceeding the criteria has not been reached. An undesirable result watch area triggers responses from the YSGA and its member agencies to address the local conditions of exceeding minimum threshold values to avoid triggering the criteria for a basin-wide undesirable result.”

The minimum threshold values listed in Table 3 through Table 7 provide a minimum groundwater level established by the YSGA for each RMW. At a single RMW, the well violates the minimum threshold when the groundwater elevation falls below the designated threshold value for two consecutive years. Fall measurements in which the groundwater elevation fell below the minimum threshold value are highlighted in orange. During the drought conditions of Fall 2021 (technically the start of Water Year 2022), five representative wells fell below the minimum threshold value. No wells have fallen below this value for two consecutive years.














The measurable objective values provide a single value at each well that the YSGA intends to manage towards in the long term. Per the GSP, *“Performance of the measurable objective will be measured as the five (5) year running average of the minimum fall (Sep.-Dec.) groundwater elevation.”* The last two columns in Table 3 through Table 7 provide the five-year (2017-2021) fall average groundwater elevation, and the difference in feet between the measurable objective value and the five-year average. Due to the historic drought conditions, levels at most RMWs are currently below the measurable objective.

**TABLE 3: CAPAY VALLEY REPRESENTATIVE MONITORING WELL GROUNDWATER ELEVATIONS**

| State Well Number               | Representative Well Number  | Measurable Objective         | Minimum Threshold            | Fall 2018   | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5 yr Fall Average          | Distance to Measurable Objective |
|---------------------------------|-----------------------------|------------------------------|------------------------------|---|-------------|-----------|-------------|-----------|-------------|-----------|----------------------------|----------------------------------|
| <i>DWR assigned well number</i> | <i>YSGA GSP Well Number</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation, ft. MSL<br/>Shaded values are below the minimum threshold value<br/>*** represents no measurement</i> |             |           |             |           |             |           | <i>Fall 2017-Fall 2021</i> | <i>5-year average minus MO</i>   |
| 10N02W16R001M                   | 276                         | 215.0                        | 207.7                        | 217.0   | 219.9       | 216.7     | 216.2       | 214.6     | 214.2       | 211.2     | 214.7                      | -0.3                             |
| 10N02W18F001M                   | 277                         | 315.6                        | 304.2                        | 325.6   | 312.9       | 318.5     | 317.8       | 325.9     | 314.8       | 311.2     | 320.1                      | 4.4                              |
| 10N03W02R002M                   | 280                         | 319.5                        | 308.2                        | 312.7   | 322.5       | 316.6     | 316.7       | 313.3     | 313.4       | 309.3     | 312.9                      | -6.6                             |
| 11N03W09Q001M                   | 285                         | 383.7                        | 355.8                        | 382.2   | 394.4       | 384.9     | 389.3       | 382.3     | 381.6       | 377.6     | 381.9                      | -1.9                             |
| 11N03W23L001M                   | 287                         | 296.0                        | 287.6                        | 298.5   | 301.0       | 298.9     | 298.7       | 298.2     | ***         | 285.9     | 294.2                      | -1.8                             |
| 11N03W23N001M                   | 288                         | 287.3                        | 271.0                        | 295.3   | 301.6       | 298.3     | 297.5       | 294.5     | 289.3       | 284.4     | 293.4                      | 6.1                              |
| 11N03W33F001M                   | 289                         | 351.1                        | 341.2                        | 351.5   | 356.2       | 351.6     | 352.0       | 351.3     | 351.2       | 344.4     | 349.4                      | -1.7                             |
| 12N03W20D001M                   | 293                         | 382.8                        | 376.4                        | 383.4   | 387.1       | 382.4     | 383.6       | 382.0     | 382.4       | 380.0     | 381.3                      | -1.5                             |
| 11N03W35D003M                   | 415                         | 280.7                        | 273.0                        | ***   | 293.1       | 282.1     | 284.1       | 281.2     | 283.1       | 275.9     | 279.6                      | -1.0                             |
| 10N03W24B002M                   | 416                         | 324.8                        | 281.1                        | 327.8   | 345.9       | 343.7     | 339.6       | 327.2     | 326.6       | 310.4     | 327.3                      | 2.4                              |



**TABLE 4: NORTH YOLO REPRESENTATIVE MONITORING WELL GROUNDWATER ELEVATIONS**

| State Well Number               | Representative Well Number  | Measurable Objective         | Minimum Threshold            | Fall 2018   | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5 yr Fall Average          | Distance to Measurable Objective  |
|---------------------------------|-----------------------------|------------------------------|------------------------------|---|-------------|-----------|-------------|-----------|-------------|-----------|----------------------------|---|
| <i>DWR assigned well number</i> | <i>YSGA GSP Well Number</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation, ft. MSL<br/>Shaded values are below the minimum threshold value<br/>*** represents no measurement</i> |             |           |             |           |             |           | <i>Fall 2017-Fall 2021</i> | <i>5-year average minus MO</i>  |
| 11N01E02D001M                   | 127                         | -13.3                        | -88.3                        | -17.4   | 16.2        | -10.3     | 7.6         | -27.2     | 5.6         | -37.1     | -24.2                      |  -10.9 |
| 11N01E16P001M                   | 128                         | -33.1                        | -129.8                       | 0.4   | 26.3        | -24.1     | 17.3        | -25.9     | 10.5        | -58.5     | -20.4                      |  12.7  |
| 12N01E03R002M                   | 129                         | 9.1                          | -44.3                        | -1.0  | 20.6        | 3.5       | 19.2        | -9.0      | 15.3        | -32.8     | -3.8                       |  -12.9 |
| 12N01E26A002M                   | 131                         | -4.2                         | -46.1                        | -5.0  | 19.3        | -2.0      | 13.0        | -12.5     | 5.6         | -29.7     | -9.1                       |  -4.9  |
| 10N03E33B011M                   | 153                         | 3.8                          | -73.3                        | 8.6   | ***         | 7.5       | 14.2        | 3.1       | 11.3        | 1.7       | 6.9                        |  3.1   |
| 12N01W14M001M                   | 178                         | 10.5                         | -30.9                        | -7.5  | 19.3        | -7.5      | 10.8        | -14.9     | -12.5       | -29.5     | -9.0                       |  -19.4 |
| 12N01W36K002M                   | 180                         | -7.7                         | -49.7                        | -29.5   | 8.5         | -24.5     | 2.1         | -34.5     | ***         | ***       | -27.2                      |  -19.5 |
| 10N01E02Q002M                   | 251                         | 32.1                         | -32.6                        | 17.1  | 40.4        | 20.3      | 32.6        | 17.6      | 22.5        | ***       | 18.0                       |  -14.1 |
| 10N02E06B001M                   | 405                         | 26.0                         | -85.7                        | 18.6  | 37.6        | 28.6      | 29.6        | 23.6      | 25.0        | -8.1      | 14.1                       |  -11.9 |
| 12N01W05B001M                   | 411                         | 49.5                         | -25.3                        | 18.7  | 30.5        | 20.6      | 25.6        | 15.5      | 16.5        | 4.4       | 15.2                       |  -34.4 |
| 10N02E09N001M                   | 410                         | 12.9                         | -63.7                        | 7.3   | 36.6        | 23.0      | 28.0        | 17.1      | 23.2        | -3.4      | 9.7                        |  -3.2  |
| 10N02E03R002M                   | 420                         | 12.2                         | -39.2                        | -9.8  | 31.8        | 6.5       | 22.3        | ***       | 15.7        | ***       | -5.2                       |  -17.4 |
| 11N02E20K004M                   | 421                         | 28.8                         | -31.6                        | 25.7  | 33.4        | 29.5      | 32.9        | 26.8      | 29.1        | 20.9      | 26.9                       |  -1.9  |



**TABLE 5: CENTRAL YOLO REPRESENTATIVE MONITORING WELL GROUNDWATER ELEVATIONS**

| State Well Number               | Representative Well Number  | Measurable Objective         | Minimum Threshold            | Fall 2018   | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5 yr Fall Average               | Distance to Measurable Objective   |
|---------------------------------|-----------------------------|------------------------------|------------------------------|---|-------------|-----------|-------------|-----------|-------------|-----------|---------------------------------|------------------------------------|
| <i>DWR assigned well number</i> | <i>YSGA GSP Well Number</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation, ft. MSL<br/>Shaded values are below the minimum threshold value<br/>*** represents no measurement</i> |             |           |             |           |             |           | <i>Fall 2017-<br/>Fall 2021</i> | <i>5-year average<br/>minus MO</i> |
| 08N02E15A002M                   | 114                         | -25.1                        | -61.3                        | ***   | ***         | 0.4       | 16.8        | -9.6      | 10.0        | -28.6     | -10.3                           | 14.8                               |
| 08N03E07N001M                   | 132                         | -22.0                        | -78.0                        | ***   | ***         | ***       | ***         | ***       | ***         | -28.9     | ***                             | ***                                |
| 09N03E33B002M                   | 151                         | 4.7                          | -35.3                        | 4.8   | 19.0        | 3.6       | 15.0        | -2.1      | 12.9        | -4.2      | 3.0                             | -1.8                               |
| 08N02E18M002M                   | 170                         | 20.4                         | 1.5                          | 15.5  | 30.1        | 23.5      | ***         | 13.5      | 22.5        | -3.5      | 17.5                            | -2.9                               |
| 08N01E07R001M                   | 220                         | 82.3                         | 16.5                         | 60.5  | 87.6        | 74.1      | 72.2        | ***       | 65.1        | 46.5      | 60.6                            | -21.7                              |
| 08N01W09C001M                   | 222                         | 110.9                        | 40.3                         | 72.0  | 92.6        | 78.2      | 82.6        | 85.4      | 88.6        | 69.0      | 75.3                            | -35.6                              |
| 08N01W13G003M                   | 224                         | 80.0                         | 47.8                         | 70.9  | ***         | 78.4      | 77.8        | 71.8      | 73.3        | 58.8      | 69.5                            | -10.5                              |
| 08N01W20R005M                   | 229                         | 72.8                         | 36.4                         | 44.7  | 75.4        | 60.9      | 72.0        | 45.0      | 59.6        | 31.2      | 47.3                            | -25.6                              |
| 09N01E03C003M                   | 230                         | 19.3                         | -56.4                        | 23.1  | 24.9        | 9.1       | -0.7        | ***       | ***         | ***       | 18.6                            | -0.8                               |
| 09N01E07D001M                   | 231                         | 111.1                        | 68.3                         | 102.4   | 109.6       | 104.7     | 104.5       | 99.2      | 97.2        | 76.5      | 93.8                            | -17.3                              |
| 09N01E20E001M                   | 233                         | 104.8                        | 67.1                         | 106.7   | 108.8       | 106.0     | 105.0       | 105.7     | 98.9        | 91.7      | 101.3                           | -3.5                               |
| 09N01E24D001M                   | 234                         | 52.2                         | 7.6                          | 41.5  | 51.5        | 49.5      | 47.3        | 45.3      | 40.7        | 29.1      | 39.7                            | -12.4                              |
| 09N01E31D001M                   | 235                         | 104.6                        | 68.3                         | 103.7   | 111.3       | 106.1     | 100.7       | 101.8     | 92.6        | 70.9      | 92.6                            | -12.0                              |
| 09N01W08Q001M                   | 239                         | 185.1                        | 152.2                        | 185.7   | 186.3       | 184.7     | 178.3       | 184.5     | 174.9       | 172.9     | 181.5                           | -3.6                               |
| 09N01W21E001M                   | 240                         | 163.4                        | 144.7                        | 160.4   | 171.1       | 153.7     | 165.1       | 162.4     | 159.4       | 149.5     | 159.9                           | -3.5                               |
| 09N02E07L001M                   | 246                         | 24.7                         | -45.4                        | 2.2   | 37.6        | 18.4      | 28.2        | ***       | 23.4        | -19.6     | -1.4                            | -26.1                              |
| 09N02E32M001M                   | 248                         | 29.1                         | -7.0                         | 16.2  | 44.2        | 27.1      | 32.7        | 21.6      | 27.2        | -2.7      | 14.9                            | -14.2                              |
| 09N03E19R002M                   | 250                         | 6.7                          | -14.1                        | 2.5   | 18.7        | 3.3       | 15.0        | -0.6      | 12.9        | -5.5      | 3.3                             | -3.4                               |
| 10N01E23Q002M                   | 254                         | 26.8                         | -43.0                        | 16.8  | 44.9        | 31.7      | 37.7        | 23.0      | 29.6        | -12.2     | 12.3                            | -14.5                              |
| 10N01E29K001M                   | 256                         | 77.8                         | 58.4                         | 80.0  | 87.2        | 81.8      | 80.8        | 80.2      | 79.5        | 77.2      | 79.5                            | 1.7                                |
| 10N01W08B001M                   | 261                         | 139.5                        | 73.3                         | 136.0   | 144.9       | 141.9     | 140.5       | 137.3     | 135.7       | 106.9     | 128.4                           | -11.2                              |
| 10N01W21J001M                   | 265                         | 127.5                        | 90.9                         | 127.5   | 137.0       | 130.6     | 131.2       | 129.7     | 129.3       | 115.4     | 125.0                           | -2.6                               |
| 10N01W32E001M                   | 268                         | 169.9                        | 144.5                        | 169.6   | 174.9       | 169.6     | 167.1       | 168.6     | 164.1       | 152.0     | 164.4                           | -5.5                               |
| 10N01W35Q001M                   | 269                         | 120.5                        | 93.0                         | 121.9   | 128.7       | 124.0     | 116.2       | 123.3     | 110.0       | 104.8     | 117.6                           | -2.9                               |
| 10N02W14A001M                   | 275                         | 137.8                        | 91.1                         | 136.0   | 148.7       | 138.4     | 138.8       | 137.2     | 134.1       | 104.8     | 127.3                           | -10.5                              |
| 10N02W26P001M                   | 279                         | 241.7                        | 212.7                        | 220.6   | 225.6       | 219.7     | 221.4       | 211.2     | ***         | ***       | 218.1                           | -23.6                              |
| 10N02E29A001M                   | 406                         | 35.7                         | 9.9                          | 29.6  | 38.3        | 35.9      | 37.4        | ***       | ***         | ***       | 31.9                            | -3.8                               |
| 09N02E22H002M                   | 400                         | 22.9                         | -24.8                        | 22.4  | 28.6        | 26.8      | 28.4        | 23.3      | 24.2        | 14.0      | 19.9                            | -3.0                               |
| 10N02E36E001M                   | 401                         | 22.1                         | 9.0                          | 20.4  | 28.7        | 19.8      | 25.8        | 19.6      | 23.6        | 14.1      | 19.7                            | -2.4                               |
| 09N01E26N001M                   | 403                         | 71.7                         | 32.2                         | 53.5  | 76.3        | 66.1      | 64.8        | 61.0      | 58.7        | 46.3      | 55.1                            | -16.7                              |
| 09N01W23D001M                   | 404                         | 135.8                        | 82.9                         | 119.7   | 136.0       | 128.6     | 122.1       | 122.8     | 121.6       | 67.9      | 110.2                           | -25.6                              |
| 08N01W22G500M                   | 419                         | 71.9                         | 6.5                          | 39.5  | 79.5        | 58.5      | 78.5        | 47.5      | 62.5        | 16.5      | 50.8                            | -21.0                              |

**TABLE 6: SOUTH YOLO REPRESENTATIVE MONITORING WELL GROUNDWATER ELEVATIONS**

| State Well Number               | Representative Well Number  | Measurable Objective         | Minimum Threshold            | Fall 2018   | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5 yr Fall Average          | Distance to Measurable Objective |
|---------------------------------|-----------------------------|------------------------------|------------------------------|---|-------------|-----------|-------------|-----------|-------------|-----------|----------------------------|----------------------------------|
| <i>DWR assigned well number</i> | <i>YSGA GSP Well Number</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation, ft. MSL<br/>Shaded values are below the minimum threshold value<br/>*** represents no measurement</i> |             |           |             |           |             |           | <i>Fall 2017-Fall 2021</i> | <i>5-year average minus MO</i>   |
| 08N03E32L001M                   | 122                         | -1.9                         | -71.8                        | -10.1   | 16.4        | -56.5     | 8.8         | -18.4     | 2.9         | -31.1     | -13.0                      | -11.1                            |
| 06N03E07M001M                   | 160                         | 9.9                          | -10.8                        | -2.8  | 14.7        | -2.0      | 12.2        | -5.4      | ***         | -7.0      | -0.9                       | -10.8                            |
| 08N03E31N001M                   | 422                         | -7.0                         | -49.3                        | -10.2   | 14.3        | -9.0      | 2.9         | -20.8     | ***         | -34.2     | -8.8                       | -1.7                             |
| 07N03E04Q001M                   | 423                         | 0.5                          | -27.1                        | -1.4  | 16.9        | -0.9      | 7.7         | ***       | ***         | -7.7      | 1.4                        | 0.9                              |

**TABLE 7: DUNNIGAN HILLS MONITORING WELL GROUNDWATER ELEVATIONS**

| State Well Number               | Representative Well Number  | Measurable Objective         | Minimum Threshold            | Fall 2018   | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5 yr Fall Average          | Distance to Measurable Objective |
|---------------------------------|-----------------------------|------------------------------|------------------------------|---|-------------|-----------|-------------|-----------|-------------|-----------|----------------------------|----------------------------------|
| <i>DWR assigned well number</i> | <i>YSGA GSP Well Number</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation</i> | <i>Groundwater Elevation, ft. MSL<br/>Shaded values are below the minimum threshold value<br/>*** represents no measurement</i> |             |           |             |           |             |           | <i>Fall 2017-Fall 2021</i> | <i>5-year average minus MO</i>   |
| 10N01E18C001M                   | 253                         | 143.1                        | 132.8                        | 137.8   | 138.0       | 140.1     | 137.5       | 138.5     | 135.4       | 134.5     | 137.8                      | -5.3                             |
| 10N01W02Q001M                   | 260                         | 128.3                        | 73.6                         | 76.8  | 94.6        | 86.0      | 91.0        | 79.8      | 78.4        | 46.2      | 69.5                       | -58.8                            |
| 10N01E15D001M                   | 402                         | 17.5                         | -69.6                        | -53.0   | 6.3         | 5.1       | 17.7        | -2.3      | 7.4         | -23.6     | -24.3                      | -41.8                            |

### 4.3 GROUNDWATER QUALITY

Groundwater quality measurements were aggregated from the SWRCB's Groundwater Ambient Monitoring and Assessment Program (GAMA) dataset<sup>7</sup>. Maps showing the measured values of arsenic, total dissolved solids, boron, and nitrate (as N) are shown below (Figure 11 through Figure 15). The displayed values for arsenic, boron, and nitrate were measured in 2021. For TDS, there are two figures – one displaying values measured in 2021 and another showing the most recent measurement for all wells measured in 2019, 2020, and 2021.

Sustainable management criteria were established for TDS in the Yolo Subbasin GSP. The SMC were established as follows:

*A representative monitoring well violates the minimum threshold when the total dissolved solids concentration exceeds 1,000 ppm over a three (3) year rolling average.*

*A representative monitoring well violates the measurable objective when the total dissolved solids concentration exceeds 750 ppm over a three (3) year rolling average.*

Of the 202 wells measured for TDS in the Yolo Subbasin between January 1, 2019 and December 31, 2021, TDS values were calculated based on average measurements over the three year period. Of the 202 well measured for TDS, 73 wells exceeded the 1000 ppm of TDS threshold. Of these 73 wells, 41 wells with exceedances of 1000 ppm were in the immediate vicinity of the Yolo County Central Landfill.

Of the 202 well measured for TDS, 98 wells exceeded the 750 ppm of TDS threshold. Of these 98 wells, 45 wells with exceedances of 750 ppm were in the immediate vicinity of the Yolo County Central Landfill.

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<sup>7</sup> <https://www.waterboards.ca.gov/gama/>

FIGURE 11: WATER QUALITY – ARSENIC, 2021

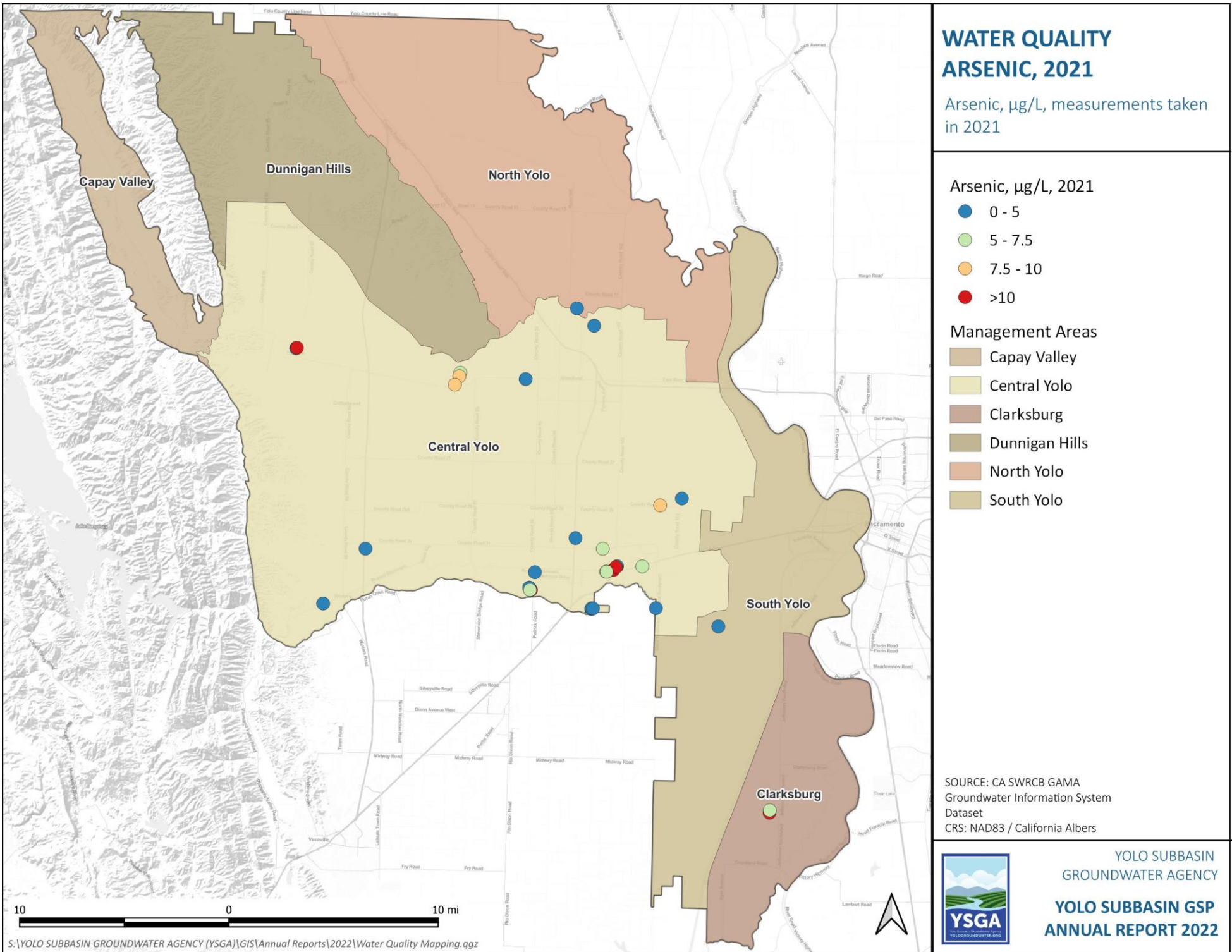




FIGURE 12: WATER QUALITY – BORON, 2021

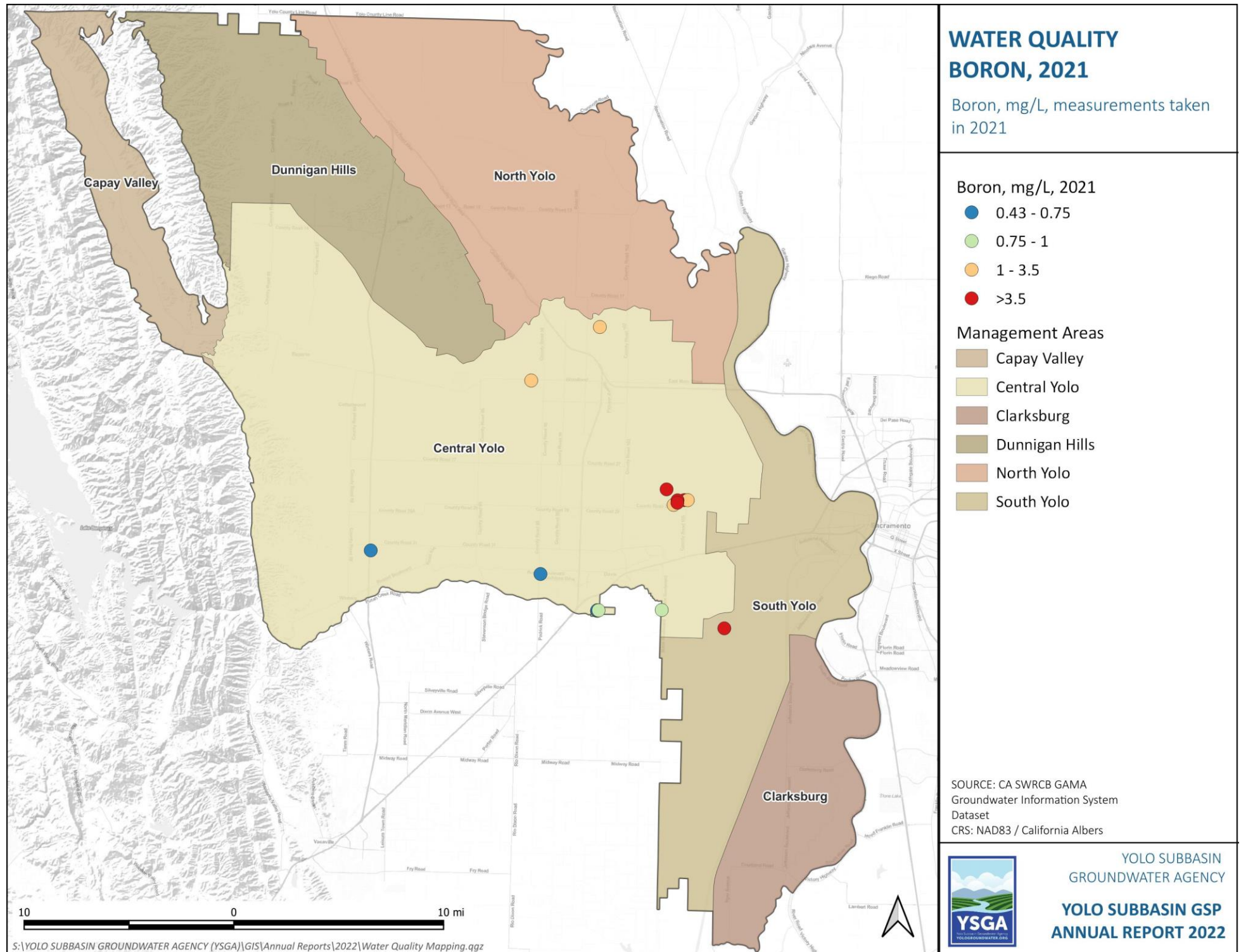




FIGURE 13: WATER QUALITY – NITRATE (AS N), 2021

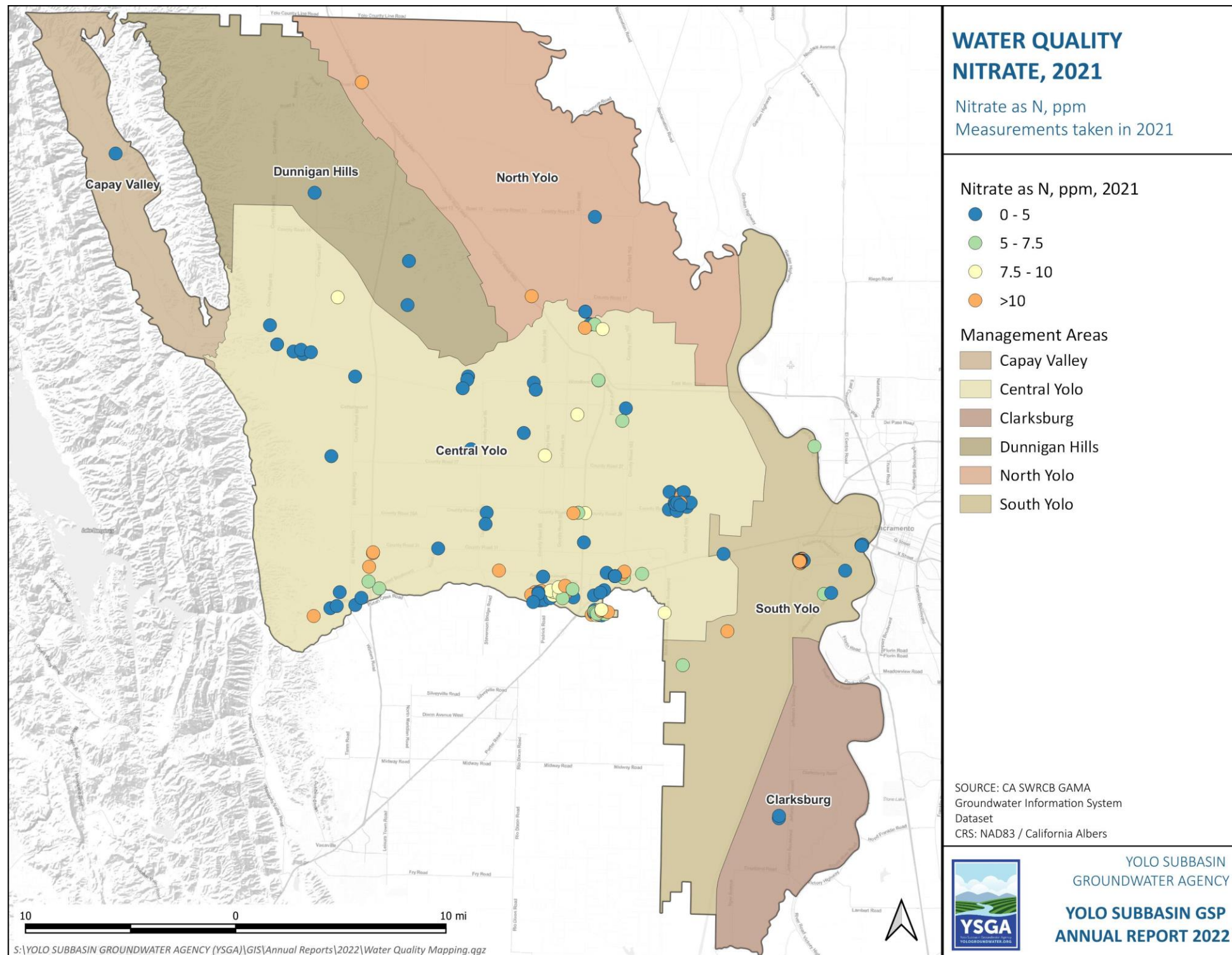


FIGURE 14: WATER QUALITY -- TDS, 2021

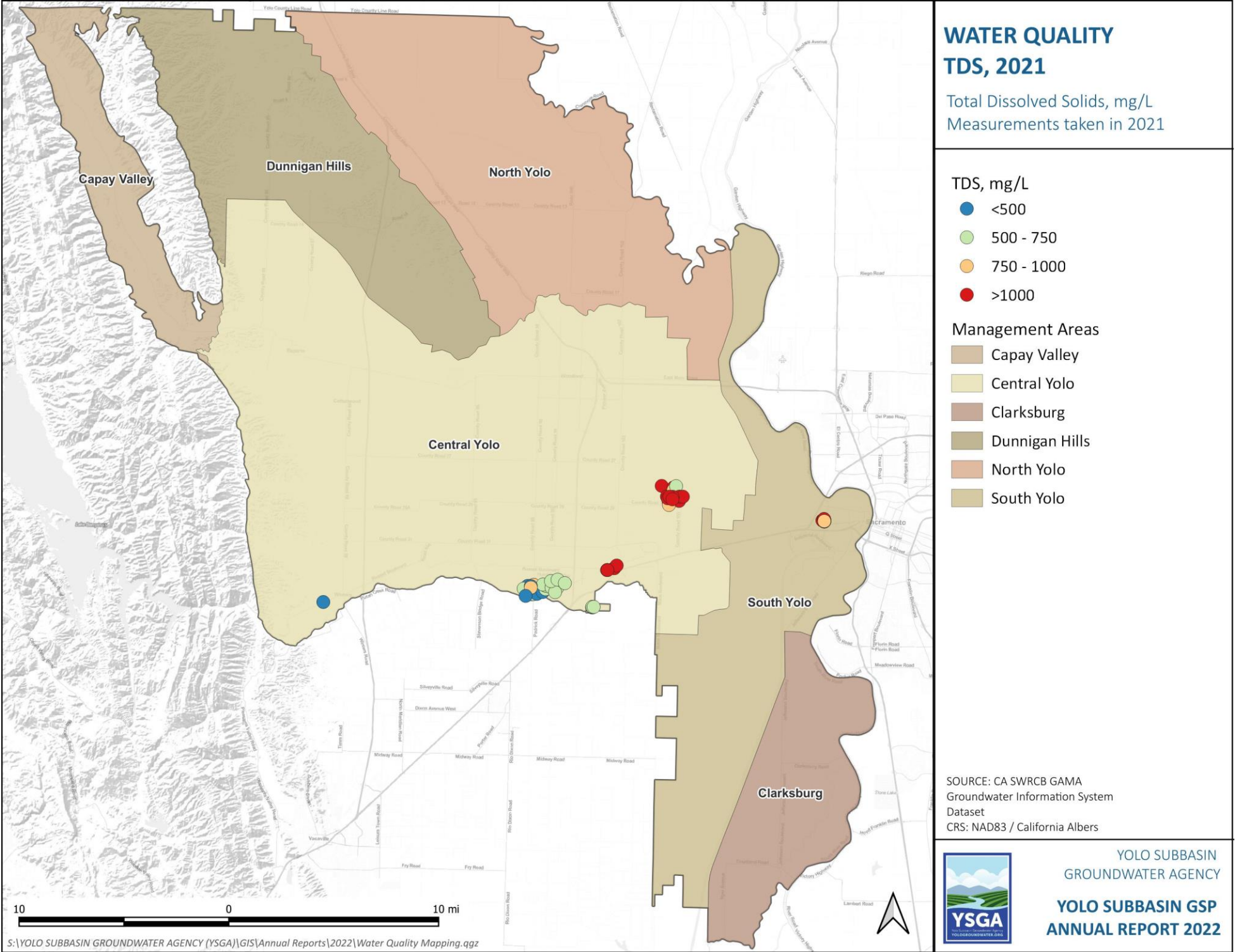
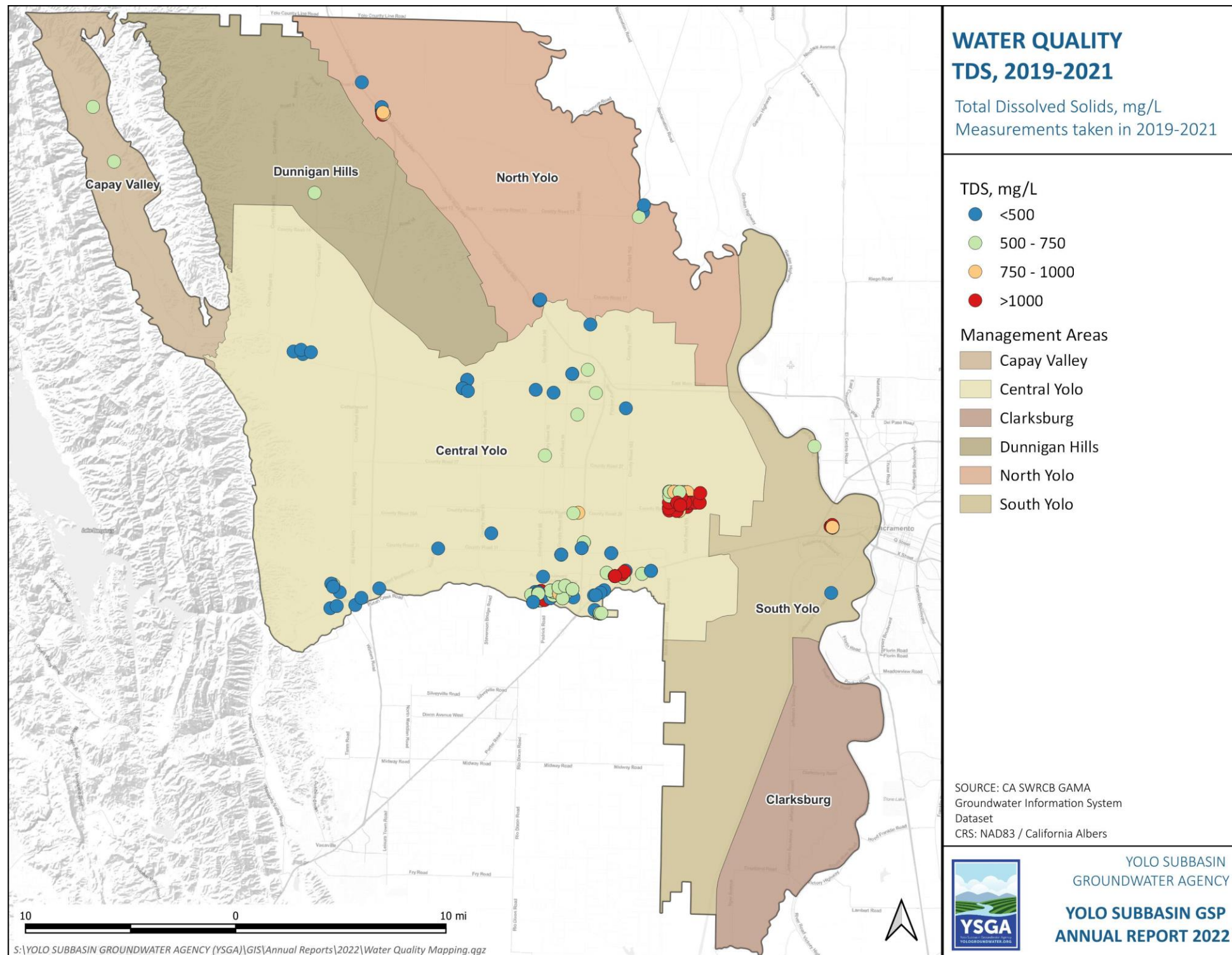




FIGURE 15: WATER QUALITY – TDS, 2019-2021



#### 4.4 LAND SUBSIDENCE

Land deformation occurs as both surface subsidence and surface uplifting and the Yolo Subbasin experiences both processes. Historically, steady levels of subsidence have been documented in the east portion of the Central Yolo Management Area and nearly the entire North Yolo Management Area. A slight amount of uplift has been observed in the western portion of the Central Yolo Management Area.

The source of the land subsidence data discussed below is the TRE Altamira InSAR Vertical Displacement dataset provided by DWR, available on [SGMA Data Viewer](#). This data uses radar data from the Sentinel-1 satellites to calculate changes in land surface elevation (known as vertical displacement). The reported statewide accuracy of the data is 18 mm, or 0.059 feet<sup>8</sup>. The dataset shows several pockets in the Yolo Subbasin where there are indications of subsidence and changes in the Subbasin's surface elevation.

Figure 16 shows the remotely sensed vertical displacement from Water Year 2019. During this time, the data indicates no significant subsidence occurred – all areas within the Subbasin show displacement within +0.1 to -0.1 feet.

Figure 17 displays the vertical displacement for Water Year 2020, which had relatively more groundwater reliance than Water Year 2019 due to limited rainfall and increasing drought conditions. A small amount of subsidence can be observed in the Yolo-Zamora area, as well as some scattered points in North Yolo and Central Yolo Management Areas.

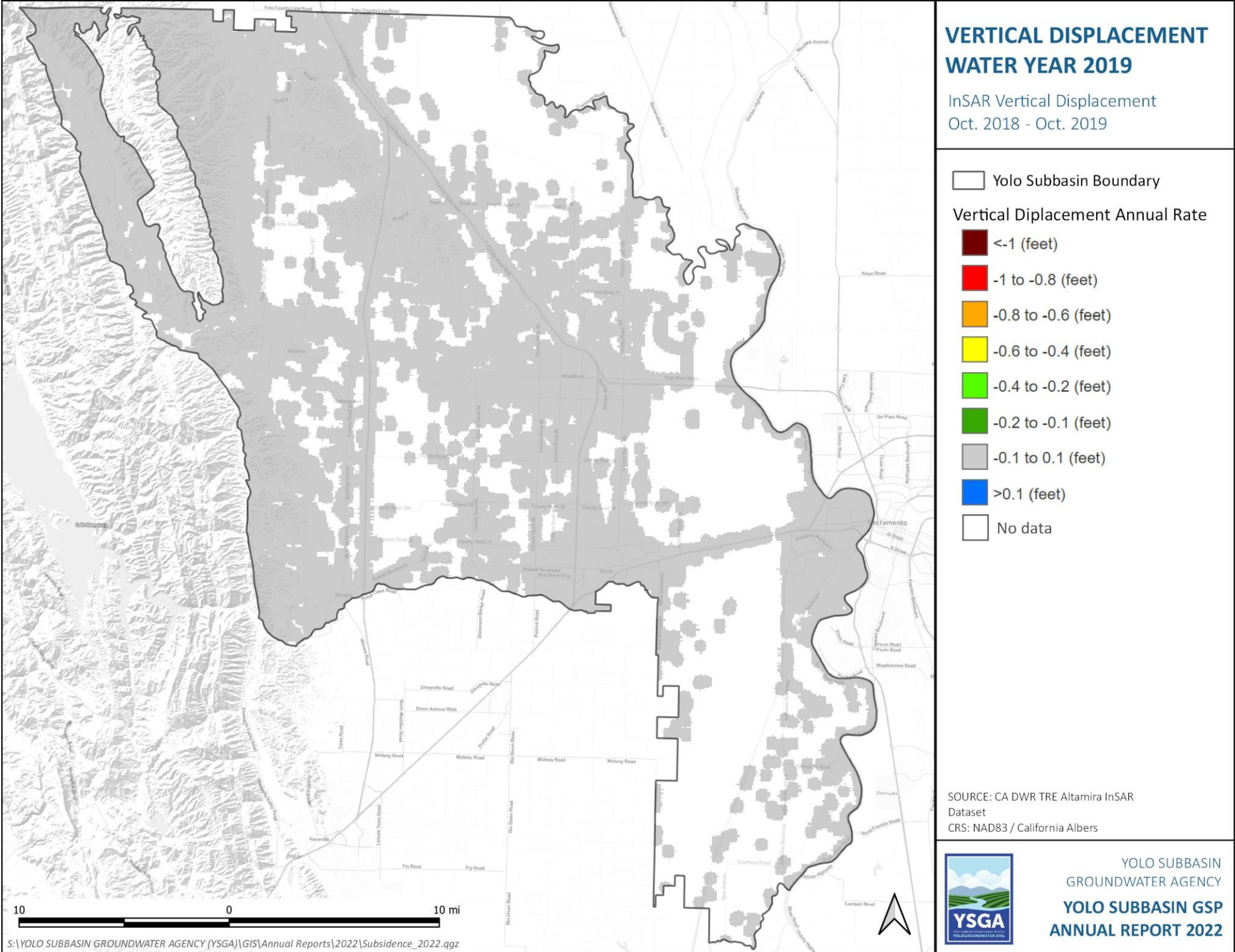
The vertical displacement for Water Year 2021 is displayed in Figure 18. The previous year's pocket of subsidence around the Yolo-Zamora area expanded, and a potentially new area of subsidence developed in the Central Yolo Management Area, southwest of Woodland. The extent and potential elasticity of the subsidence observed in Water Year 2021 will be determined from subsequent analyses using data provided by DWR's future updates, and any local ground-based GPS surveys.

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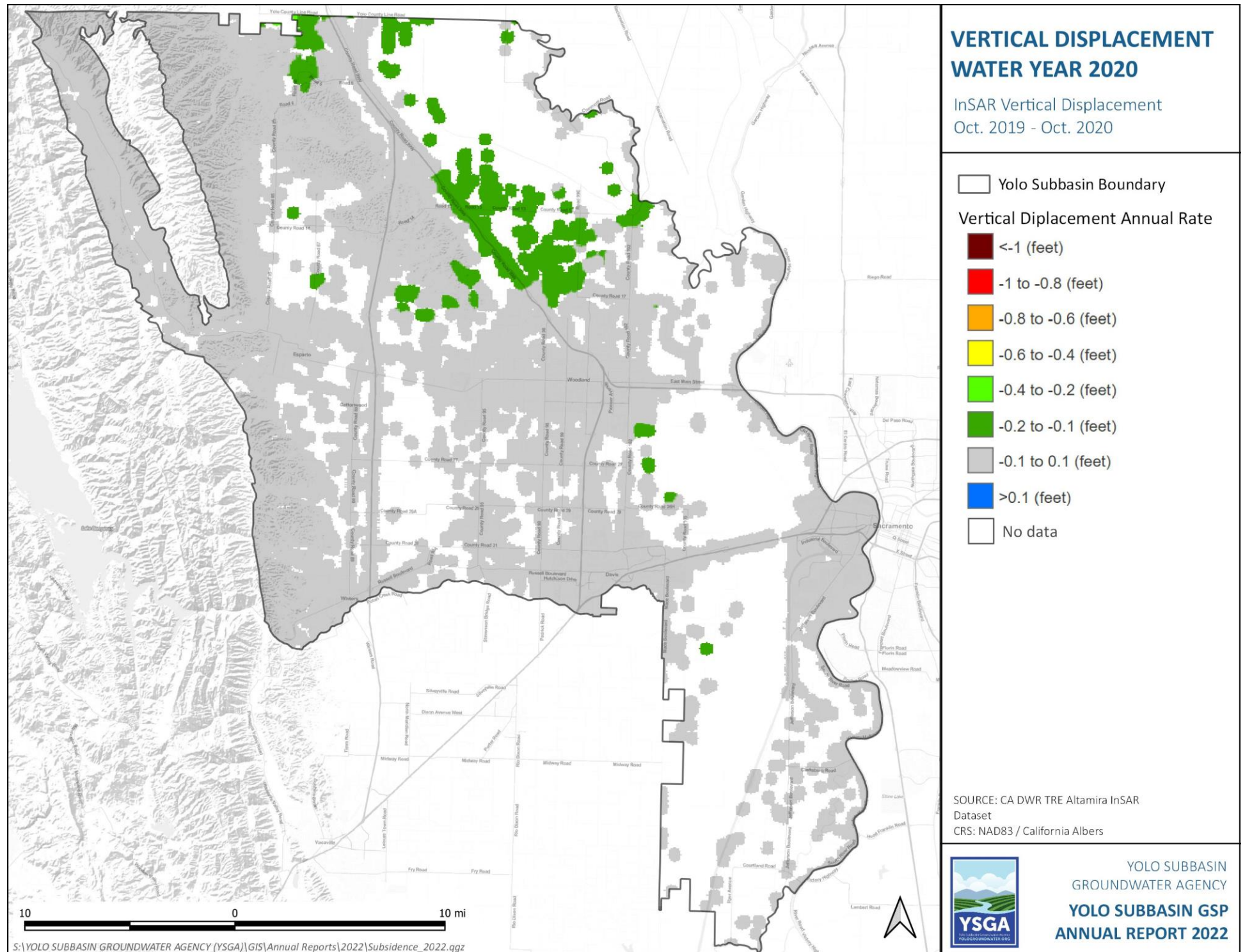
<sup>8</sup> <https://data.cnra.ca.gov/dataset/5e2d49e1-9ed0-425e-9f3e-2cda4a213c26/resource/a1949b59-2435-4e5d-bb29-7a8d432454f5/download/insar-data-accuracy-report-towill.pdf>



FIGURE 16: VERTICAL DISPLACEMENT – WATER YEAR 2019

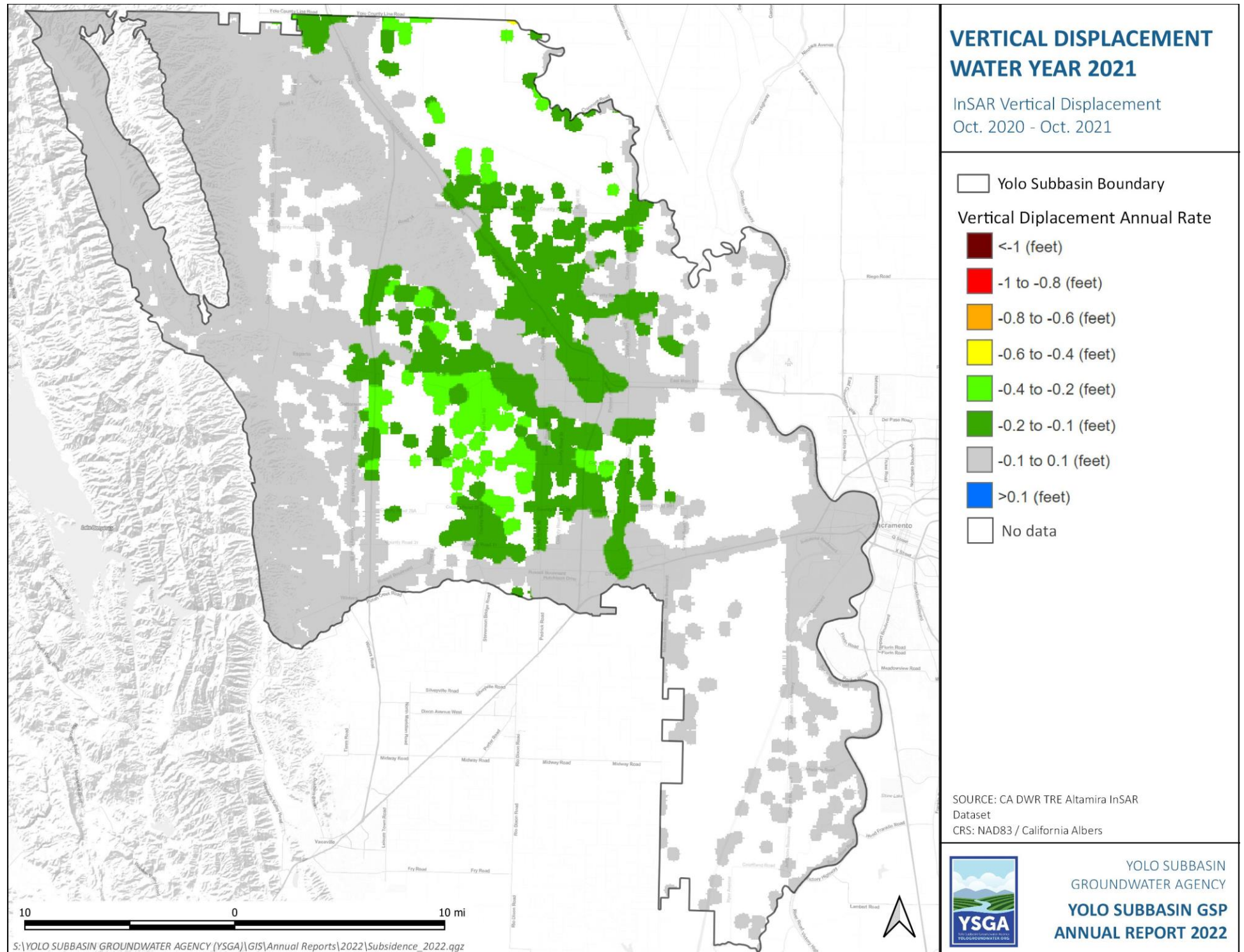


**FIGURE 17: VERTICAL DISPLACEMENT – WATER YEAR 2020**





**FIGURE 18: VERTICAL DISPLACEMENT – WATER YEAR 2021**





#### 4.5 INTERCONNECTED SURFACE WATERS

The Yolo Subbasin GSP designates minimum thresholds for the depletion of major interconnected surface water bodies in the Yolo Subbasin as follows:

Upper Cache Creek, Putah Creek, and Lower Sacramento River: *Minimum Threshold value is equal to the minimum elevation for the period of record at the RMW, exceeded in 2 consecutive years.*

Upper Sacramento River: *Exceedance of the historic minimum elevation in the period of record of each RMW plus 20 percent of the depth between the historic maximum and historic minimum elevation for the period of record of the RMW in 2 consecutive years.*

Lower Cache Creek: *The Minimum Threshold for depletion of interconnected surface water is the recurrence of the spring (March-May) average measurement for 1975 to present in at least one spring in every seven (7) years.*

Groundwater levels in RMWs for Upper Cache Creek, Upper Sacramento River, Lower Sacramento River, and Putah Creek are compared to the minimum thresholds in Table 8. During Water Years 2019 and 2020, no RMWs exceeded their minimum threshold value. During the critical conditions of Water Year 2021, there was one exceedance at Upper Cache Creek and two exceedances at Putah Creek. No RMWs have exceeded their minimum threshold value for two consecutive years.

Table 9 provides a comparison of representative groundwater levels around Lower Cache Creek to the minimum threshold value. Each well must remain below the minimum threshold value for seven to violate its minimum threshold. While all wells are currently below the minimum threshold value, Spring 2019 allowed for sufficient recovery to prevent the violation of minimum thresholds as defined in the GSP.

Table 8 and Table 9 also provide a comparison of the five-year running average of spring groundwater elevations to the measurable objectives. Due to historic drought conditions, almost all wells are currently below their measurable objective. The individual hydrographs of each of these wells are provided in Attachment B.

**TABLE 8: INTERCONNECTED SURFACE WATERS REPRESENTATIVE GROUNDWATER ELEVATIONS**

| ISW Management Zone | State Well Number | Representative Well Number | Measurable Objective Value | Minimum Threshold Value | Fall 2018 | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | 5-year Spring Average | Distance to Measurable Objective |
|---------------------|-------------------|----------------------------|----------------------------|-------------------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-----------------------|----------------------------------|
| Upper Cache Creek   | 11N03W23L001M     | 287                        | 298.7                      | 287.6                   | 298.5     | 301.0       | 298.9     | 298.7       | 298.2     | ***         | 285.9     | 299.3                 | 0.7                              |
| Upper Cache Creek   | 11N03W33F001M     | 289                        | 354.3                      | 341.2                   | 351.5     | 356.2       | 351.6     | 352.0       | 351.3     | 351.2       | 344.4     | 353.7                 | -0.6                             |
| Upper Cache Creek   | 12N03W20D001M     | 293                        | 385.2                      | 376.4                   | 383.4     | 387.1       | 382.4     | 383.6       | 382.0     | 382.4       | 380.0     | 385.0                 | -0.3                             |
| Upper Sac River     | 10N02E03R002M     | 420                        | 23.9                       | -39.2                   | -9.8      | 31.8        | 6.5       | 22.3        | ***       | 15.7        | ***       | 24.1                  | 0.2                              |
| Upper Sac River     | 12N01E03R003M     | 427                        | 29.3                       | -35.4                   | 14.1      | 28.7        | 14.7      | 23.4        | 6.4       | 20.6        | -26.7     | 24.8                  | -4.6                             |
| Upper Sac River     | 11N02E20K004M     | 421                        | 33.5                       | -31.6                   | 25.7      | 33.4        | 29.5      | 32.9        | 26.8      | 29.1        | 20.9      | 30.2                  | -3.3                             |
| Lower Sac River     | 09N03E33B002M     | 151                        | 15.7                       | -35.3                   | 4.8       | 19.0        | 3.6       | 15.0        | -2.1      | 12.9        | -4.2      | 14.9                  | -0.8                             |
| Lower Sac River     | 10N02E36E001M     | 401                        | 26.8                       | 9.0                     | 20.4      | 28.7        | 19.8      | 25.8        | 19.6      | 23.6        | 14.1      | 25.0                  | -1.9                             |
| Lower Sac River     | 08N04E19N001M     | 428                        | 8.7                        | -1.3                    | 3.3       | 11.2        | 3.5       | 7.5         | 2.0       | 6.9         | 2.0       | 8.6                   | -0.2                             |
| Putah Creek         | 08N02E18M002M     | 170                        | 29.7                       | 1.5                     | 15.5      | 30.1        | 23.5      | ***         | 13.5      | 22.5        | -3.5      | 24.5                  | -5.2                             |
| Putah Creek         | 08N01W20R005M     | 229                        | 91.6                       | 36.4                    | 44.7      | 75.4        | 60.9      | 72.0        | 45.0      | 59.6        | 31.2      | 69.3                  | -22.3                            |
| Putah Creek         | 08N01E17F001M     | 429                        | 76.0                       | 56.1                    | 63.2      | 78.5        | 66.6      | ***         | 63.7      | 64.4        | ***       | 71.4                  | -4.6                             |

**TABLE 9: LOWER CACHE CREEK REPRESENTATIVE GROUNDWATER ELEVATIONS**

| ISW Management Zone | State Well Number | Representative Well Number | Measurable Objective Value | Minimum Threshold Value | Fall 2018 | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | Years Below MT Value | 5-year Spring Average | Distance to Measurable Objective |
|---------------------|-------------------|----------------------------|----------------------------|-------------------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|----------------------|-----------------------|----------------------------------|
| Lower Cache Creek   | 10N01W21J001M     | 265                        | 132.7                      | 131.6                   | 127.5     | 137.0       | 130.6     | 131.2       | 129.7     | 129.3       | 115.4     | 2.5                  | 133.3                 | 0.5                              |
| Lower Cache Creek   | 10N02W14A001M     | 275                        | 145.4                      | 143.2                   | 136.0     | 148.7       | 138.4     | 138.8       | 137.2     | 134.1       | 104.8     | 2.5                  | 142.5                 | -2.9                             |
| Lower Cache Creek   | 10N01W23P001M     | 424                        | 115.8                      | 116.7                   | 113.4     | 118.4       | ***       | 112.2       | 111.8     | 115.7       | 106.3     | 2                    | 116.1                 | 0.3                              |
| Lower Cache Creek   | 10N01E22H500M     | 425                        | 61.2                       | 55.1                    | 52.8      | 65.5        | 53.1      | 57.3        | 54.4      | 50.1        | 38.4      | 1.5                  | 57.6                  | -3.5                             |
| Lower Cache Creek   | 10N01W16G500M     | 426                        | 138.0                      | 132.6                   | 129.6     | 139.5       | 133.0     | 133.0       | 129.5     | 130.2       | 102.7     | 1.5                  | 135.2                 | -2.8                             |

## 5. WATER BUDGET ASSESSMENT

An assessment of the Yolo Subbasin water budget was conducted using an analytical approach. With this being the first year in developing the annual report and creating this template, the YSGA anticipates that the water budget numbers reported will be refined and updated in future annual reports as we learn better ways to account for true water usage in the Subbasin. This annual report contains estimated acre-feet values for four metrics: change in groundwater storage, surface water diversions, groundwater extraction, and total water use.

The line-by-line water budget numbers are provided in Table 10. Values are reported in acre-feet (AF) and rounded to the nearest thousand acre-feet (TAF). The following sections provide an explanation of the reasoning and methodology in providing these estimates, referencing the row number on the left of the table for ease of understanding. For further details on each calculation, please see the referenced section.

**TABLE 10: WATER BUDGET ASSESSMENT**

|    | <b>Variable</b>                     | <b>WY 2019</b> | <b>WY 2020</b> | <b>WY 2021</b> | <b>See Text</b> |
|----|-------------------------------------|----------------|----------------|----------------|-----------------|
| 1  | Agricultural Eta                    | 981,000        | 994,000        | 929,000        | Section 5.2.2.1 |
| 2  | Effective Precipitation             | 208,000        | 78,000         | 47,000         | Section 5.2.2.2 |
| 3  | Total Ag Demand                     | 773,000        | 916,000        | 882,000        | Section 5.2.3   |
| 4  | Agricultural SW - Entities          | 345,000        | 410,000        | 210,000        | Section 5.1.2   |
| 5  | Agricultural SW - eWRIMS            | 102,000        | 90,000         | 44,000         | Section 5.1.2   |
| 6  | Agricultural SW Diversion           | 447,000        | 500,000        | 254,000        | Section 5.1.2   |
| 7  | Agricultural GW Extraction          | 326,000        | 415,000        | 628,000        | Section 5.2.2   |
| 8  | <b>Agricultural Total Water Use</b> | <b>773,000</b> | <b>916,000</b> | <b>882,000</b> |                 |
|    |                                     |                |                |                |                 |
| 9  | Urban SW - Entities                 | 33,000         | 35,000         | 30,000         | Section 5.1.1   |
| 10 | Urban GW Extraction - Entities      | 4,000          | 4,000          | 7,000          | Section 5.2.1   |
| 11 | <b>Urban Total Water Use</b>        | <b>36,000</b>  | <b>39,000</b>  | <b>37,000</b>  |                 |
|    |                                     |                |                |                |                 |
| 12 | Total SW Diversions                 | 480,000        | 535,000        | 284,000        | Section 5.1     |
| 13 | Total GW Extraction                 | 330,000        | 419,000        | 635,000        | Section 5.2     |
| 14 | <b>Total Water Use</b>              | <b>810,000</b> | <b>954,000</b> | <b>919,000</b> | Section 5.3     |



## 5.1 SURFACE WATER DIVERSIONS

### 5.1.1 Urban Surface Water Diversions

Urban surface water diversions (Table 10, line 9) were reported directly by the following municipalities:

- City of Davis
- City of Woodland
- City of West Sacramento
- City of Winters
- University of California, Davis

The above entities represent most of the surface water purveyed for urban uses in the Subbasin. This number may be slightly under-reported due to our inability to collect data from smaller urban water suppliers in the Subbasin.

### 5.1.2 Agricultural Surface Water Diversions

To estimate surface water diversion in agricultural areas, data reported from agricultural water purveyors was used with data extracted from eWRIMS. YSGA member agencies, as water purveyors, generally represent the largest water diverters in the Subbasin. The following agricultural water purveyors provided estimates of surface water diversions for Water Years 2019, 2020, and 2021 (Table 10, line 4):

- Yolo County Flood Control & Water Conservation District
- Colusa Drain Mutual Water Company
- Dunnigan Water District
- Reclamation District (RD) 108<sup>9</sup>
- RD 150
- RD 787
- RD 999
- RD 2035

The remainder of the agricultural surface water diverted in the Subbasin was estimated using the State Water Resources Control Board's eWRIMS database (Table 10, line 5)<sup>10</sup>. The eWRIMS database provides reported diversion amounts for each SWRCB permit. The entities who had reported directly to the YSGA, listed above, were removed from the total diversion amount to prevent double counting. Values clearly reported in the incorrect units were also removed.

Because the SWRCB's reporting deadline for the previous water year is April 1, data for Water Year 2021 was not available for incorporation in this report. Between Water Year 2020 and Water Year 2021, the surface water diversions reported by agricultural member entities listed above decreased by 48.8 percent. This factor applied to the 2020 eWRIMS diversions estimates 44,071 AF of water diverted in Water Year

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<sup>9</sup> RD 108 spans both Yolo and Colusa Subbasins; to estimate use in the Yolo Subbasin, the amount reported by RD 108 was multiplied by the proportionable amount of district area within the Yolo Subbasin.

<sup>10</sup> [https://www.waterboards.ca.gov/waterrights/water\\_issues/programs/ewrims/](https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/)

2021 for eWRIMS diverters and reporters (see Table 11, line 5). The significant reduction is likely reflective of and consistent with the historical curtailments that occurred in 2021.

### 5.1.3 Total Surface Water Diversions

Total surface water diversions (Table 10, line 12) are calculated as the sum of reported urban surface water diversions (line 9), reported agricultural surface water diversions (line 6), and agricultural surface water diversions from eWRIMS (line 5). This approach does not account for return flows, losses to evaporation or groundwater in canal transport, or irrigation efficiency; and therefore, represents the amount of surface water *available* for use rather than the quantity of water *consumed* for beneficial uses.

Major storm events in Water Year 2019 provided increased reservoir storage, allowing for an additional 55 TAF of surface water diversions going forward into Water Year 2020. However, critical Water Year 2021 brought historic drought conditions, leading to curtailments and a significant reduction (approximately 251 TAF) in surface water diversions.

## 5.2 GROUNDWATER EXTRACTION

### 5.2.1 Urban Groundwater Extraction

Extraction of groundwater for urban delivery was reported directly by the following entities, representing most urban water purveyors (Table 10, line 10). This number may be slightly under-reported due to our inability to collect data from smaller urban water suppliers in the Subbasin.

- City of Davis
- City of Woodland
- City of Winters
- University of California, Davis
- Esparto Community Services District (CSD)
- Madison CSD
- Knights Landing CSD
- Cacheville CSD
- California American Water Company, Dunnigan

Pump-to-waste was included in the numbers reported by the Cities of Davis and Woodland. The City of Woodland also injects surface water into the aquifer using aquifer storage and recovery (ASR) wells; the numbers reported by the City of Woodland include the injected surface water as a net negative to groundwater extraction.

### 5.2.2 Agricultural Groundwater Extraction

Agricultural groundwater extraction is not directly measured in the Yolo Subbasin. The following section details the methods of estimating groundwater extraction through a water balance approach, using the following equation:

$$\text{Agricultural Groundwater Extraction} = \text{Actual Evapotranspiration} - \text{Effective Precipitation} - \text{Agricultural Surface Water Diversions}$$

#### 5.2.2.1 Actual Evapotranspiration

Actual evapotranspiration ( $ET_a$ ; Table 10, line 1) represents the quantity of water removed from the land due to evaporation into the air or transpiration by plants, providing an estimate of consumptive water use.

Estimates of actual evapotranspiration for the Yolo Subbasin were provided by OpenET<sup>11</sup>, a newly emerging open-source effort to provide ET estimates for water management. OpenET provides satellite-based evapotranspiration estimates based on an ensemble of six models. The total  $ET_a$  for each water year was averaged for all irrigated acres in the Subbasin. The 2016 Statewide Crop Mapping dataset<sup>12</sup> was used to identify irrigated acreage, with a total of approximately 343,000 irrigated acres in the Yolo Subbasin.

The OpenET ensemble ET value has a mean absolute error of 91.3 mm (8.9%) for the water year, determined through comparison against 14 flux tower sites<sup>13</sup>. Over the 343,000 irrigated acres in the Yolo Subbasin, this amounts to a mean absolute error of approximately 103,000 AF.

#### 5.2.2.2 Effective Precipitation

Effective precipitation must be subtracted (Table 10, line 2) from agricultural water demand (estimated as  $ET_a$ ) to determine the amount of agricultural water demand fulfilled by irrigation. Effective precipitation represents the fraction of precipitation that remains in the root zone and can be utilized by plants (i.e., total precipitation subtracting deep percolation and runoff). In this analysis, a single value of 25% was used to determine effective precipitation. This 25% number is based on DWR's Urban Water Use Efficiency Standards<sup>14</sup>. It is acknowledged that this value is imperfect, and in the future an improved effective precipitation value will be developed on a year-by-year basis. The total effective precipitation utilized in this analysis only considers effective precipitation on irrigated agricultural land.

This result, shown in line 3, represents the total agricultural water demand. Subtracting the agricultural surface water diversions calculated in Section 5.1.2 gives the amount of groundwater extraction that occurred in each year to meet agricultural demand (line 7).

#### 5.2.3 Total Groundwater Extraction

Total groundwater extraction (Table 10, line 13) is found by adding the reported urban groundwater extraction (line 10) and calculated agricultural groundwater extraction (line 7).

As an estimate of the Subbasin's condition relative to the GSP's sustainability goal, annual groundwater extraction can be compared to the sustainable yield. The sustainable yield represents the amount of groundwater that can be withdrawn annually without causing undesirable results. The estimated annual pumping in the Subbasin varies widely over the historical period, from 197-519 TAF/year. (Note that SGMA does not incorporate sustainable yield estimates directly into sustainable management criteria.

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<sup>11</sup> <https://openetdata.org>

<sup>12</sup> <https://data.cnra.ca.gov/dataset/statewide-crop-mapping>

<sup>13</sup> OpenET Intercomparison and Accuracy Assessment Report, <https://openetdata.org/wp-content/uploads/2021/10/Intercomparison-and-Accuracy-Assessment-Report.pdf>

<sup>14</sup> <https://www.law.cornell.edu/regulations/california/23-CCR-Sec-494>



“Basinwide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for the six sustainability indicators” (DWR 2017).)

The GSP lists the sustainable yield of the Yolo Subbasin as approximately 346,000 AF. Table 11 presents the annual groundwater extraction estimates from Table 10 relative to the sustainable yield of 346 TAF, in which a negative number represents pumping in exceedance of the sustainable yield.

**TABLE 11: ESTIMATED ANNUAL GROUNDWATER EXTRACTION RELATIVE TO SUSTAINABLE YIELD**

|  | <b>WY 2019</b> | <b>WY 2020</b> | <b>WY 2021</b> |
|--|----------------|----------------|----------------|
| <b>Groundwater Extraction, AF</b>          | 330,000        | 419,000        | 635,000        |
| <b>Difference to Sustainable Yield, AF</b> | +16,000        | -73,000        | -289,000       |

### 5.3 TOTAL WATER USE

Total water use (Table 10, line 14) is estimated at the Yolo Subbasin scale as the sum of surface water diversions (line 12) and groundwater extraction (line 13). Of the three years reported, the lowest water use is observed in Water Year 2019 (810 TAF). This is likely due to the major storm events, which provided a large amount of effective precipitation for plant uptake. Water use is greatest in Water Year 2020 (954 TAF), then decreases by about 35 TAF in Water Year 2021 (919 TAF).

### 5.4 CHANGE IN GROUNDWATER STORAGE

Estimates of changes in groundwater storage for Water Years 2019, 2020, and 2021 are included in this section. Changes in groundwater storage were estimated by interpolating change in storage at each RMW across the Subbasin. Changes in storage at each RMW were calculated by multiplying the estimated specific yield at each well by the change in fall measurements year over year. The specific yield at each well was extracted from the YSGA model as built in developing the Yolo Subbasin GSP. This method of calculating change in storage was compared to a correlation of the YSGA’s historic model outputs and depth to water in RMWs. Both methods yielded similar results. Table 12 shows the results of this analysis as changes in groundwater water storage. Figure 22, Figure 23, and Figure 24 are maps of estimated change in storage at the Yolo Subbasin level.

**TABLE 12: ESTIMATED CHANGES IN GROUNDWATER STORAGE**

| <b>Water Year</b>                       | <b>2019</b> | <b>2020</b> | <b>2021</b> |
|---|-------------|-------------|-------------|
| <b>Estimated Change in Storage (AF)</b> | 142,000     | -102,000    | -390,000    |

Figure 19, Figure 20, and Figure 21 show the cumulative change groundwater storage, annual groundwater extraction, and annual change in storage values, along with the corresponding water year type. Groundwater storage from 1971-2018 comes from the YSGA model as built in developing the Yolo Subbasin GSP. Water Years 2019-2021 use the estimated data in Table 10 and Table 11.

FIGURE 19. CUMULATIVE CHANGE IN GROUNDWATER STORAGE

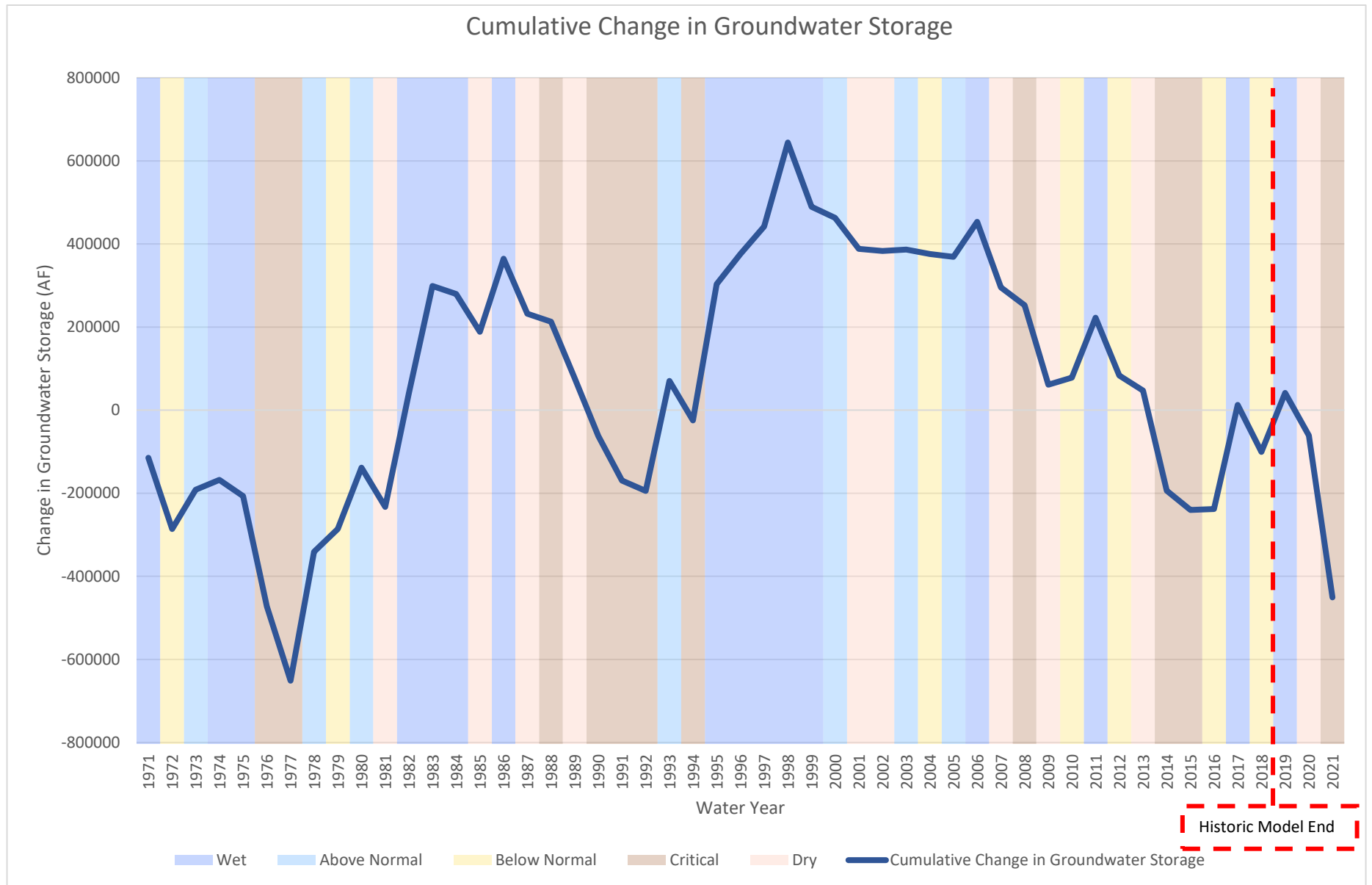


FIGURE 20. ANNUAL GROUNDWATER EXTRACTION

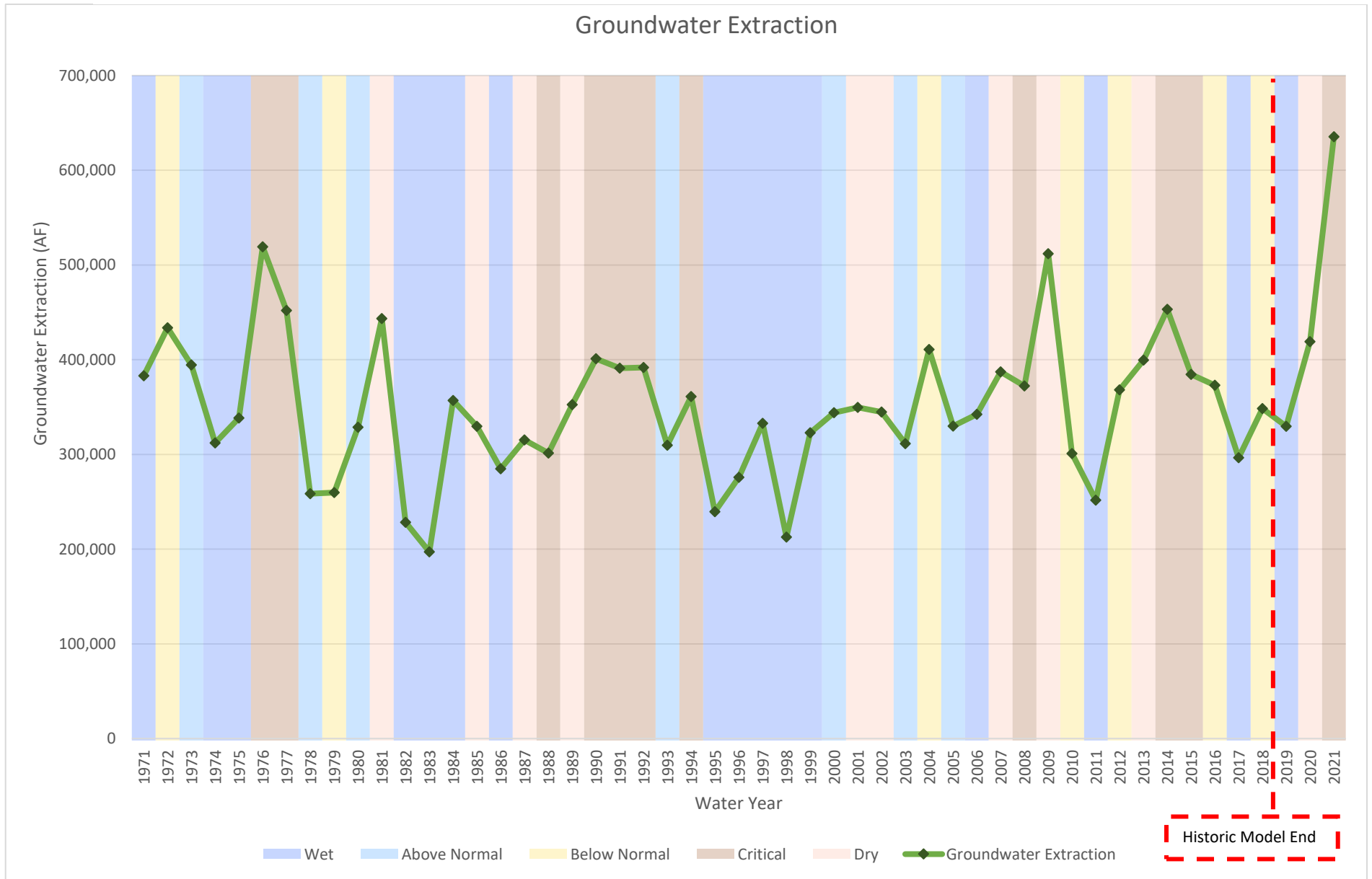




FIGURE 21. ANNUAL CHANGE IN GROUNDWATER STORAGE

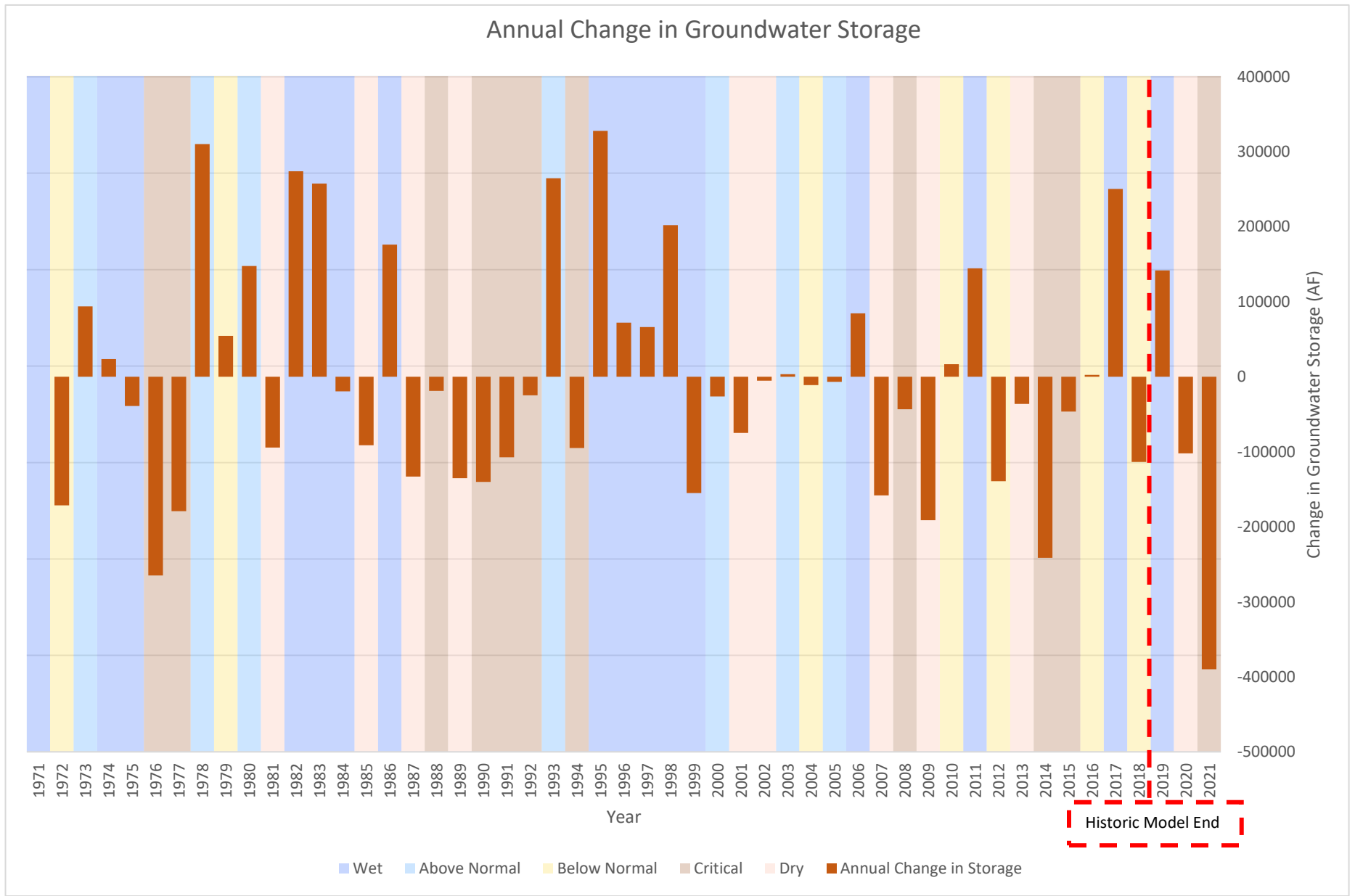


FIGURE 22. CHANGE IN GROUNDWATER STORAGE – WATER YEAR 2019

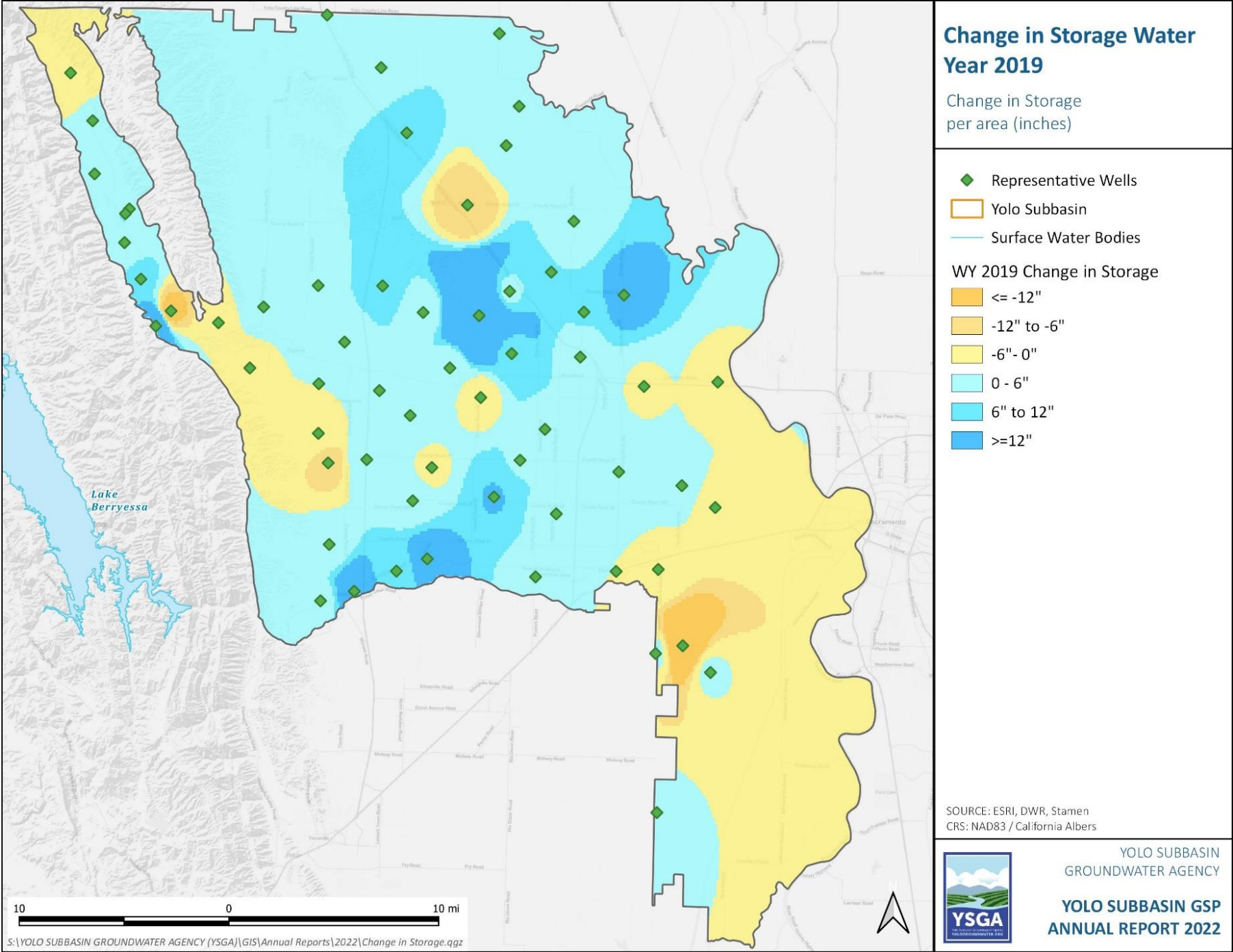


FIGURE 23. CHANGE IN GROUNDWATER STORAGE – WATER YEAR 2020

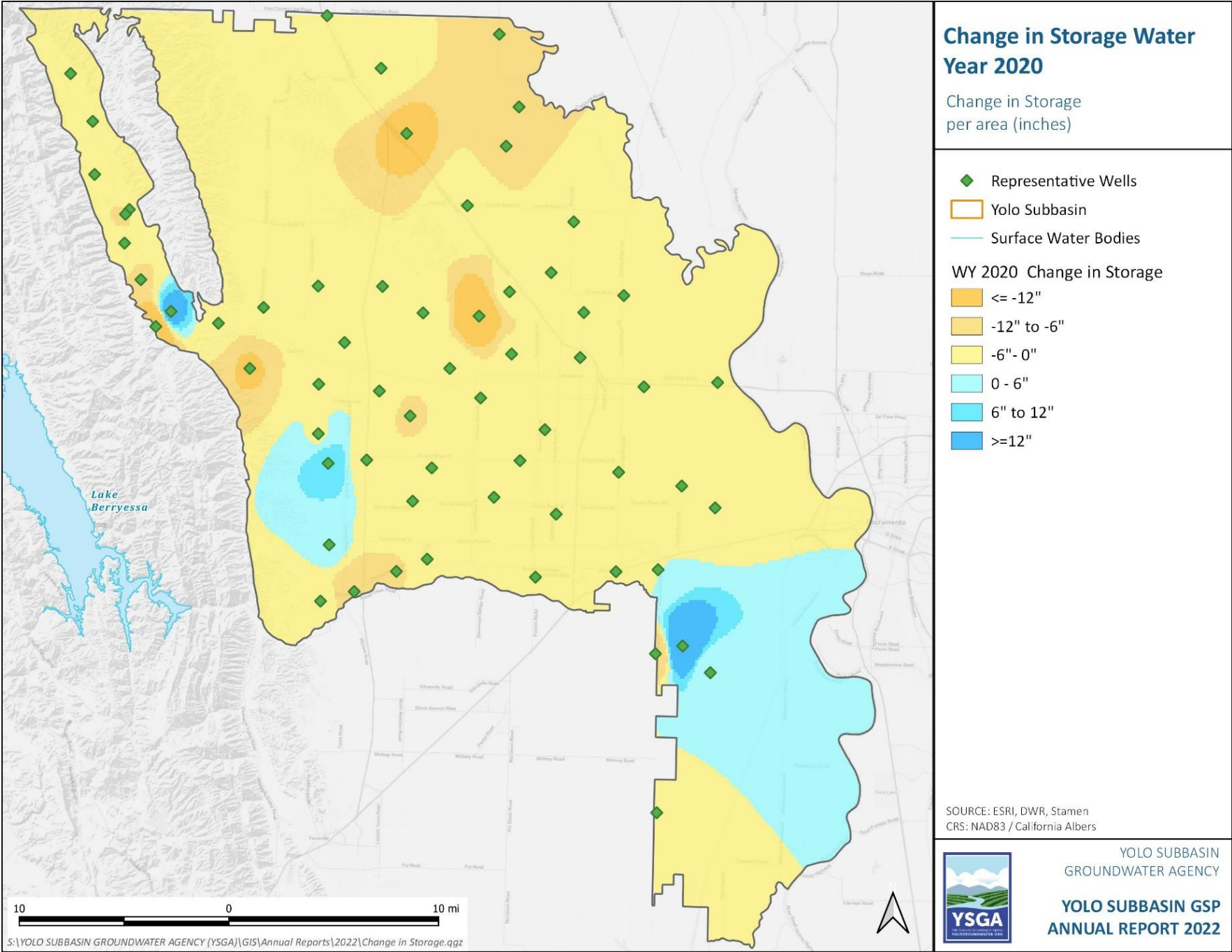
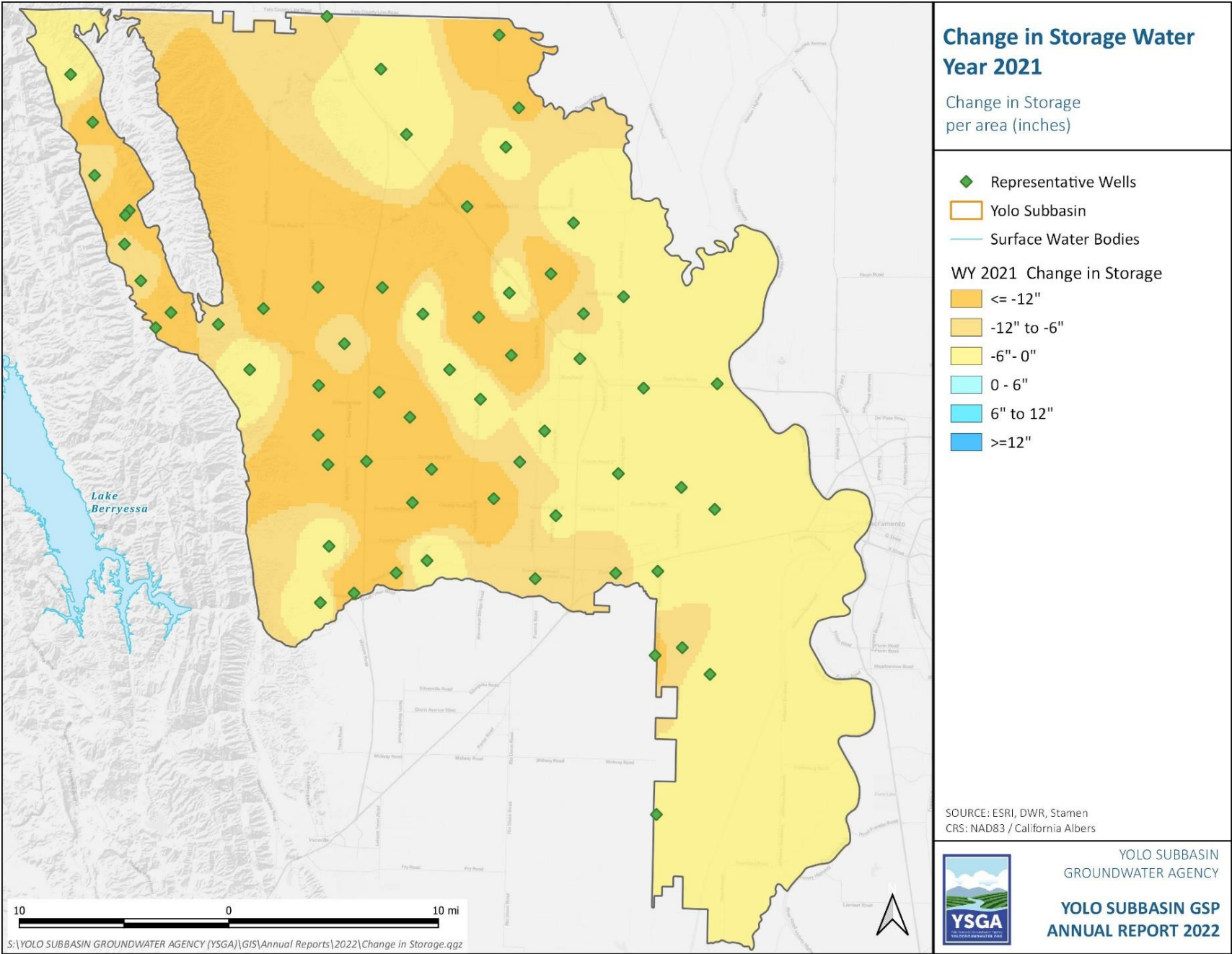




FIGURE 24. CHANGE IN GROUNDWATER STORAGE – WATER YEAR 2021



## 5.5 ACCURACY ESTIMATE

Table 13 provides the estimated accuracy of each data source. To estimate changes in groundwater storage and other water budget components, a number of different data sources were compiled. Each of these data sources have some level of uncertainty. The table below qualitatively describes the estimated accuracy for values used for precipitation, effective precipitation, surface water diversions, and changes in groundwater storage. The estimated accuracy of the OpenET data is based on ground-truthing that was conducted during the development process.

**TABLE 13: ESTIMATED DATA ACCURACY**

| <b>Variable</b>  | <b>Data Source</b>                                | <b>Estimated Accuracy</b>          |
|--|---|------------------------------------|
| <b>Actual Evapotranspiration</b>   | OpenET  | +/- 102,700 AF Mean Absolute Error |
| <b>Precipitation</b>   | PRISM   | High                               |
| <b>Effective Precipitation</b>   | DWR Standard Value for Urban Water Use Efficiency | Low                                |
| <b>Urban Surface Water and Groundwater Use, Agricultural Surface Water Diversion</b> | Entity reporting                                  | High                               |
| <b>Agricultural Surface Water Diversion</b>  | eWRIMS  | Medium                             |
| <b>Change in Groundwater Storage</b>   | Interpolated groundwater levels, specific yield   | Medium                             |

# YOLO SUBBASIN GSP ANNUAL REPORT 2022

## ATTACHMENT A

GROUNDWATER ELEVATION REPRESENTATIVE  
WELL HYDROGRAPHS

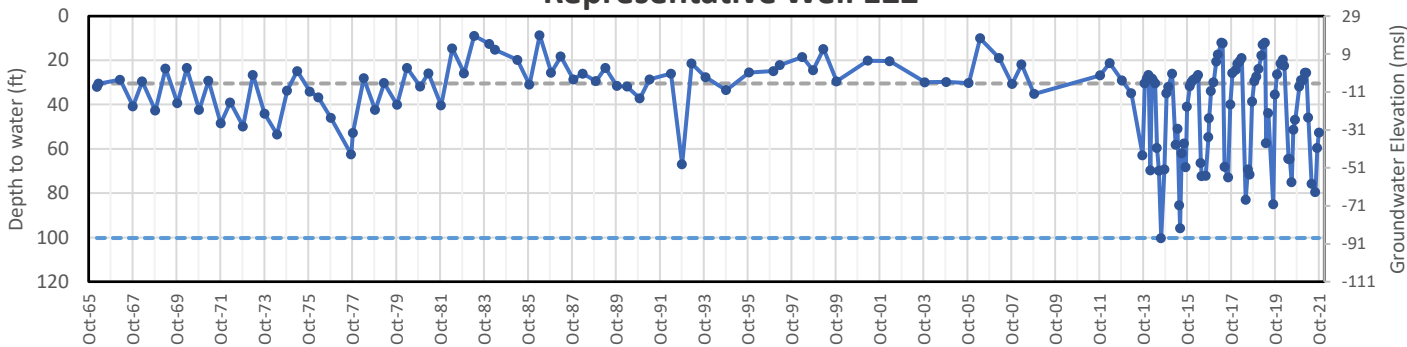


# SOUTH YOLO REPRESENTATIVE HYDROGRAPHS

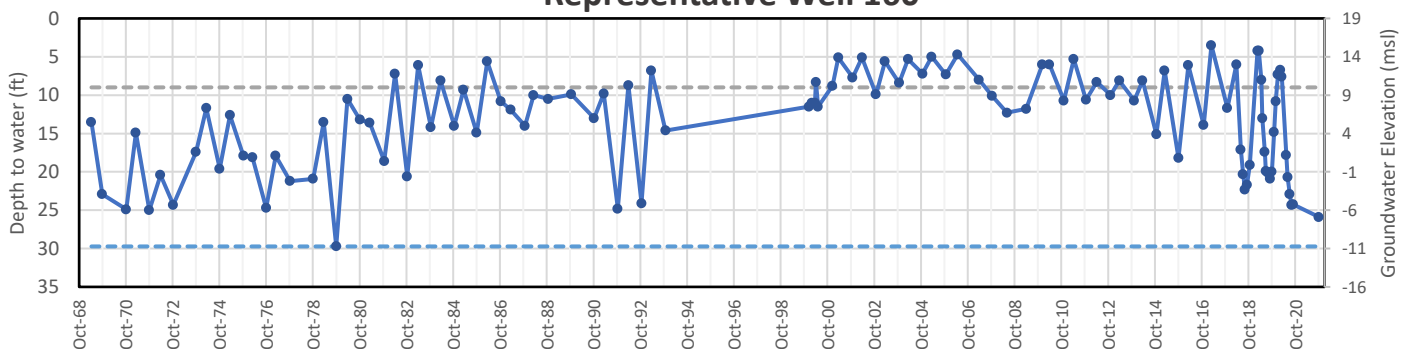
1 OF 1

Minimum Threshold      Measurable Objective      Groundwater Elevation

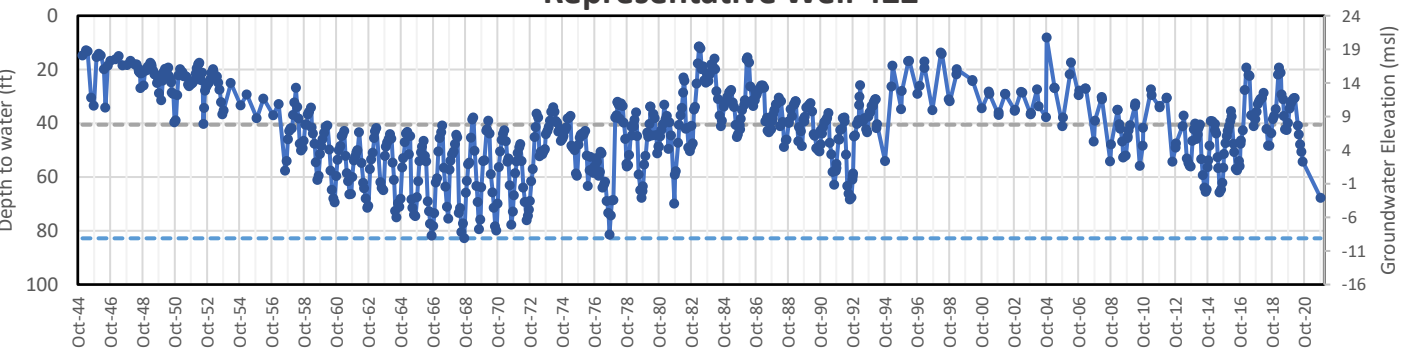
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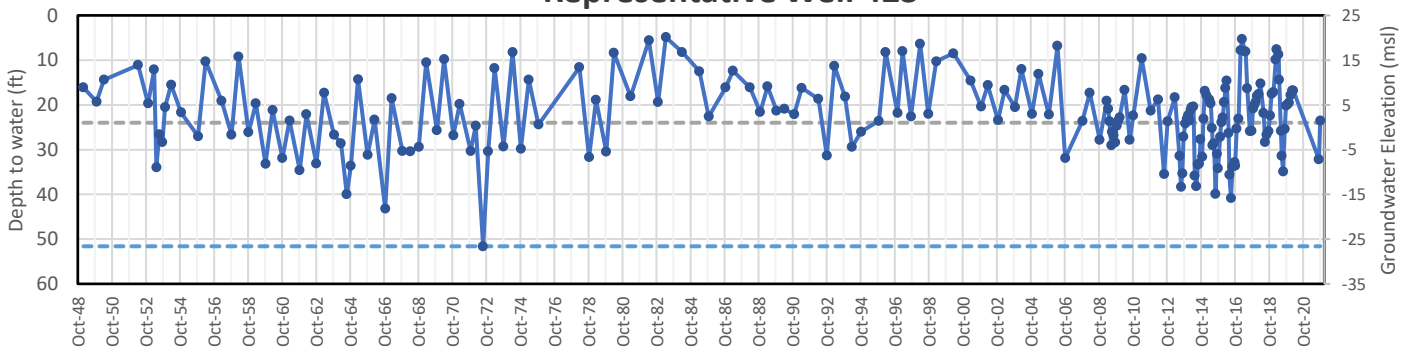
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## Representative Well 422



## Representative Well 423

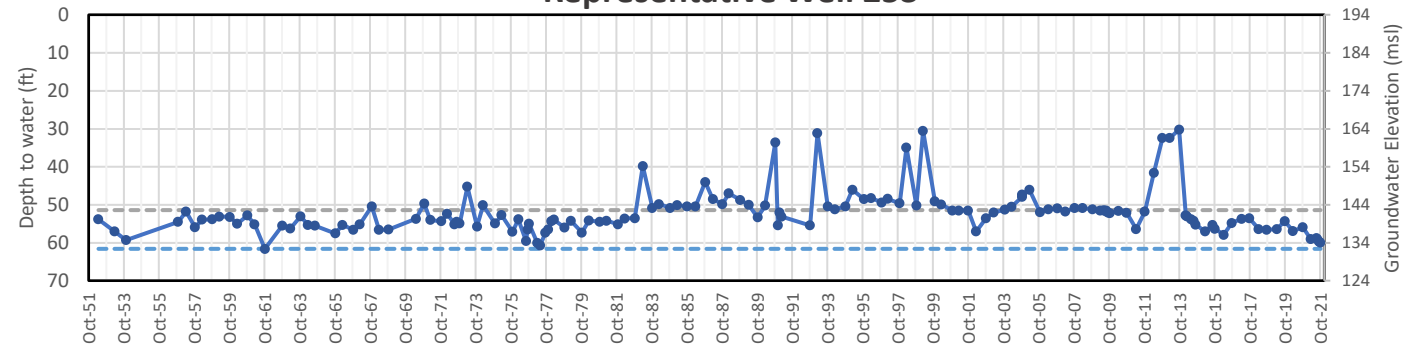


# DUNNIGAN HILLS REPRESENTATIVE HYDROGRAPHS

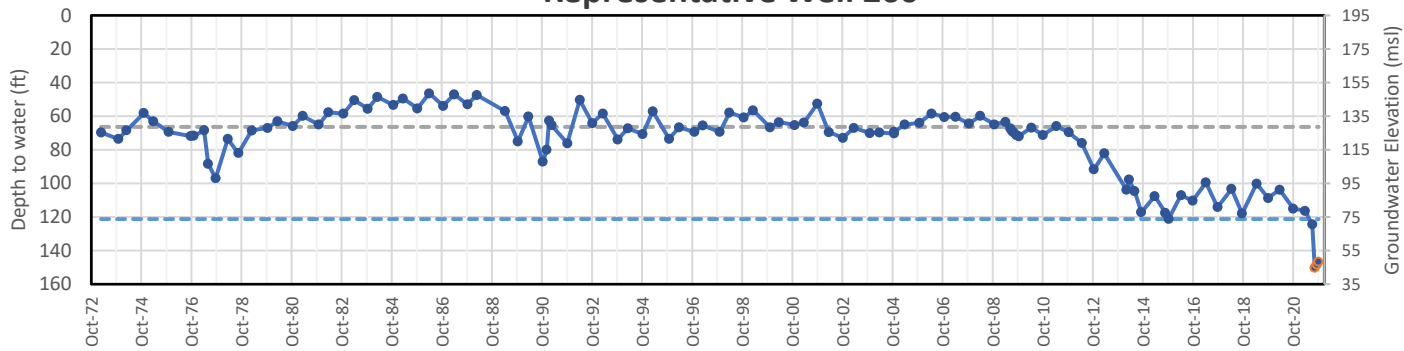
1 OF 1



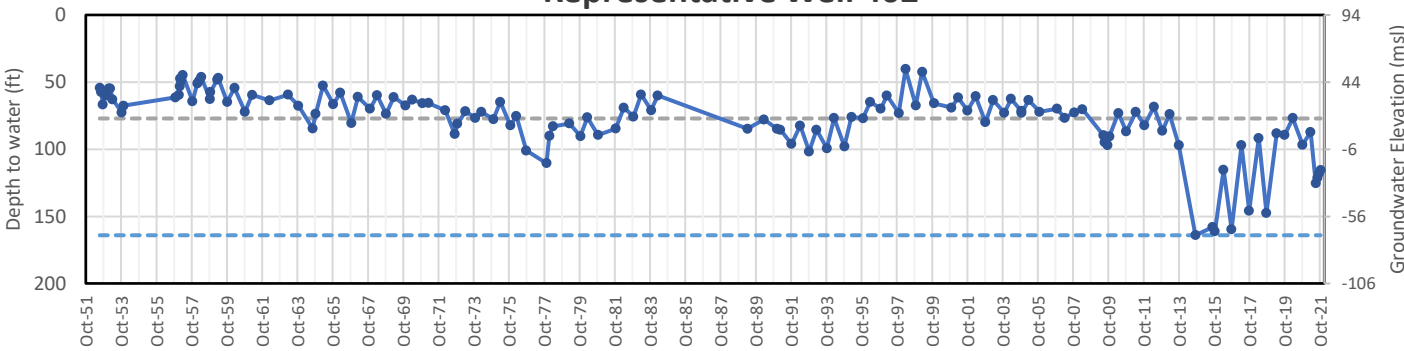
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## Representative Well 260



## Representative Well 402

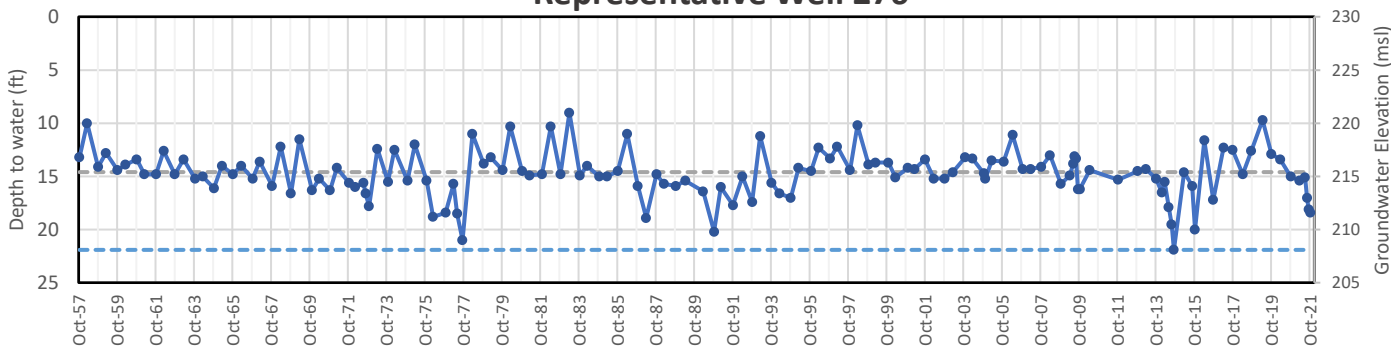


# CAPAY VALLEY REPRESENTATIVE HYDROGRAPHS

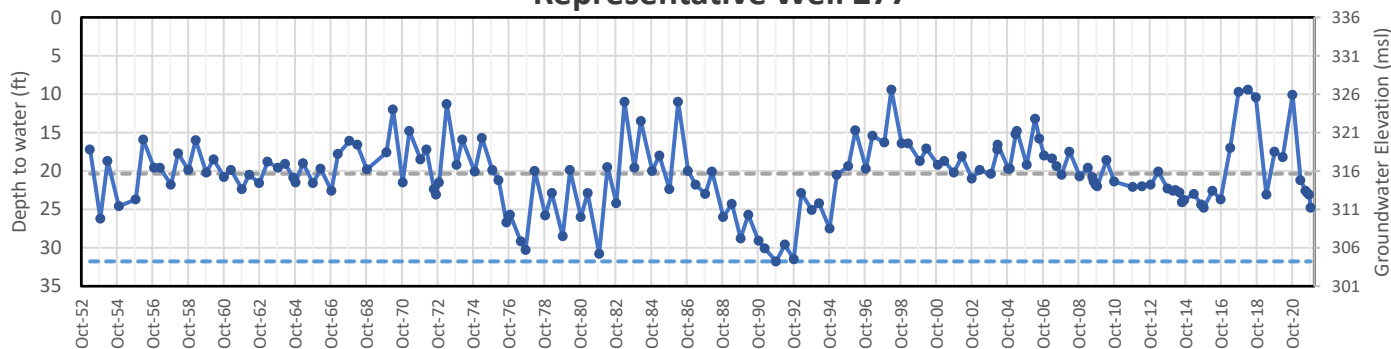
1 OF 3

Minimum Threshold    Measurable Objective    Groundwater Elevation

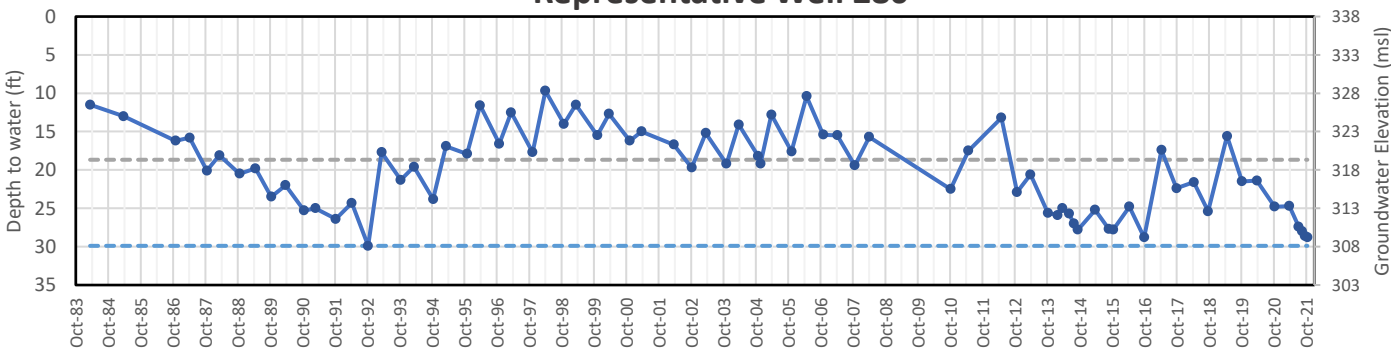
## Representative Well 276



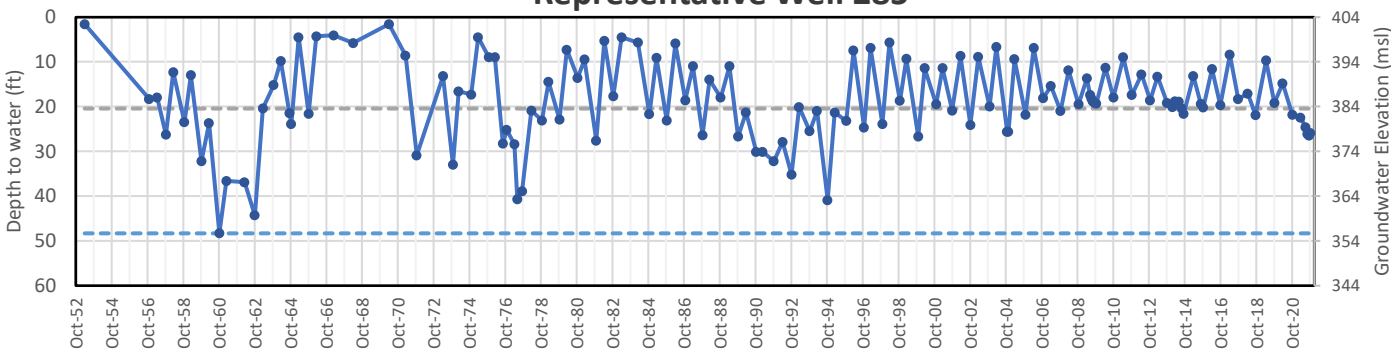
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## Representative Well 280



## Representative Well 285



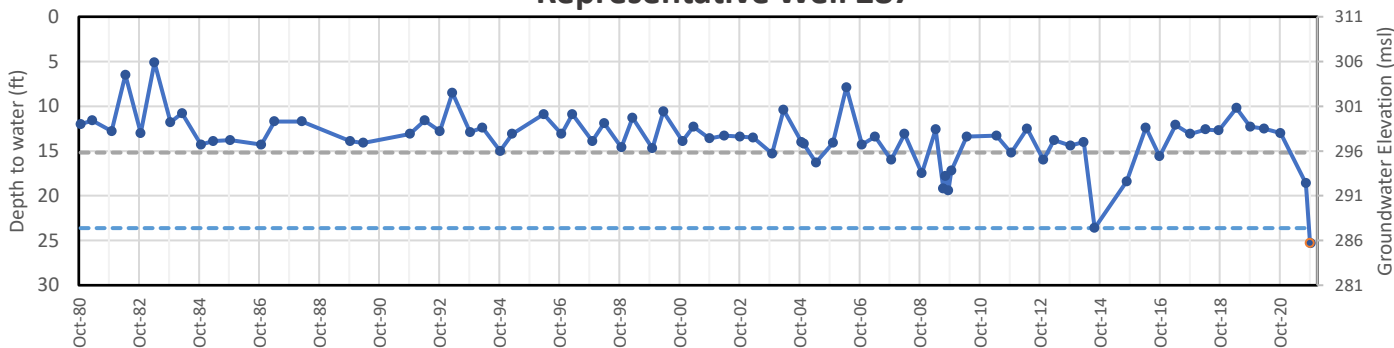


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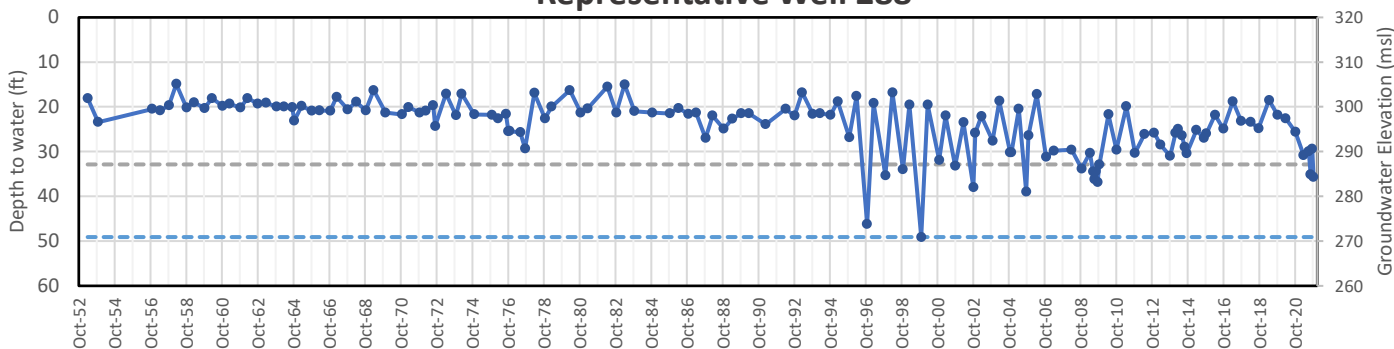
2 OF 3

Minimum Threshold      Measurable Objective      Groundwater Elevation

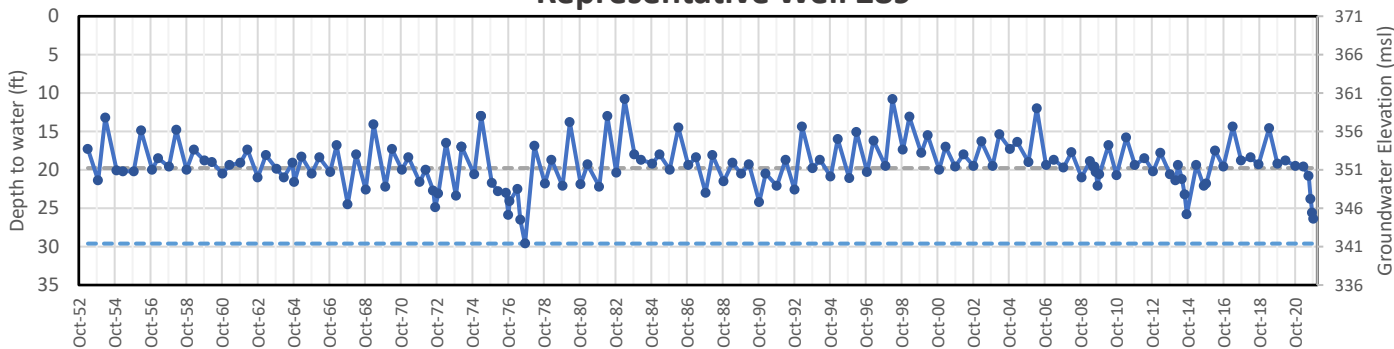
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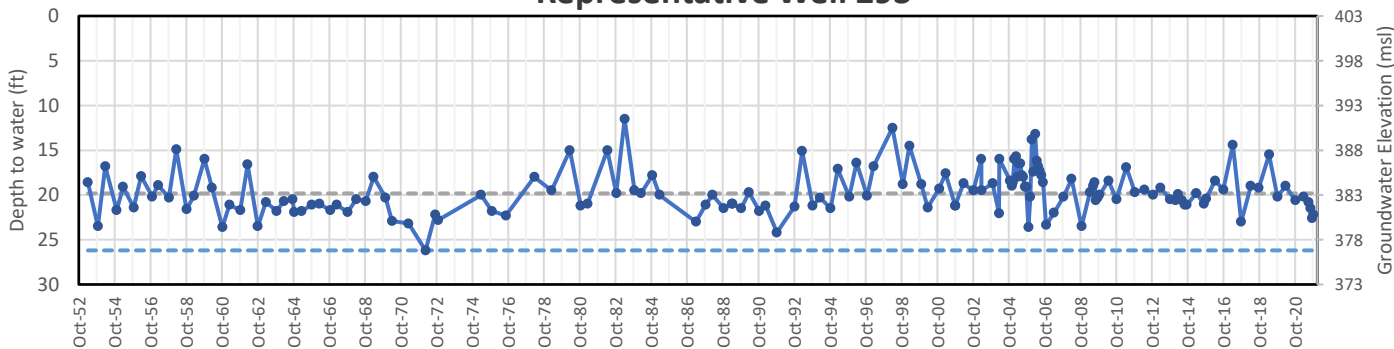
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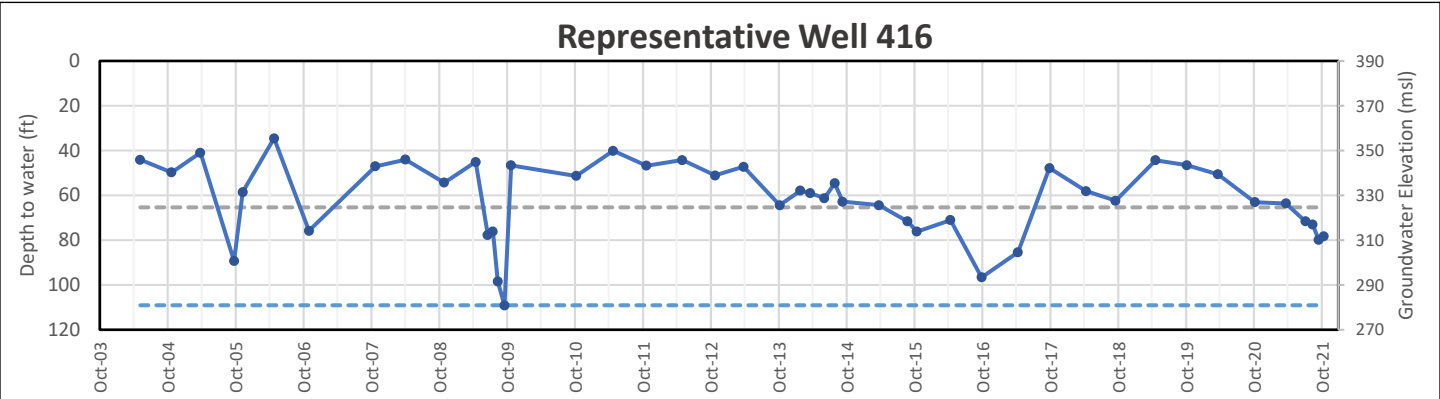
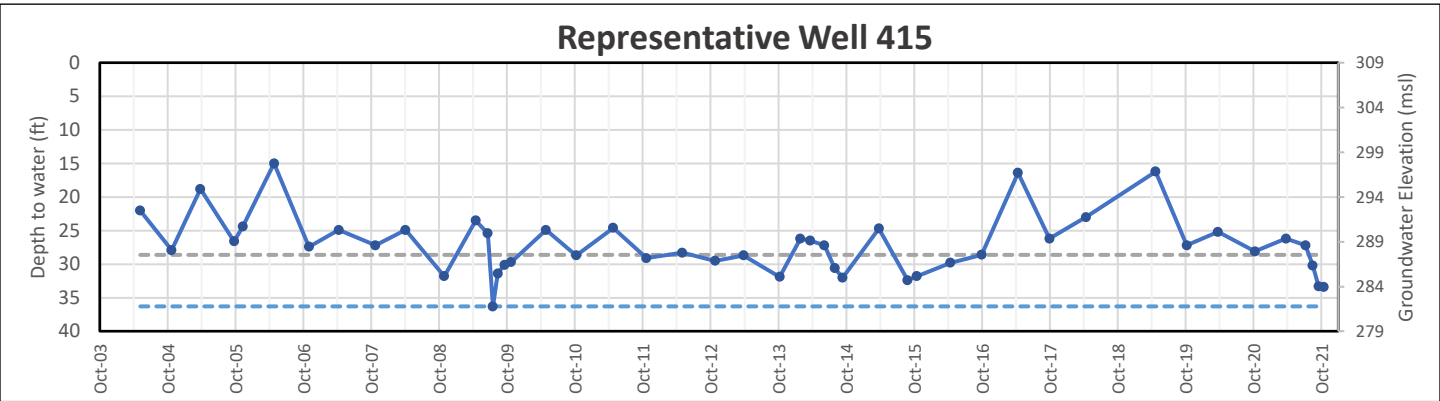
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## Representative Well 293



CAPAY VALLEY REPRESENTATIVE HYDROGRAPHS

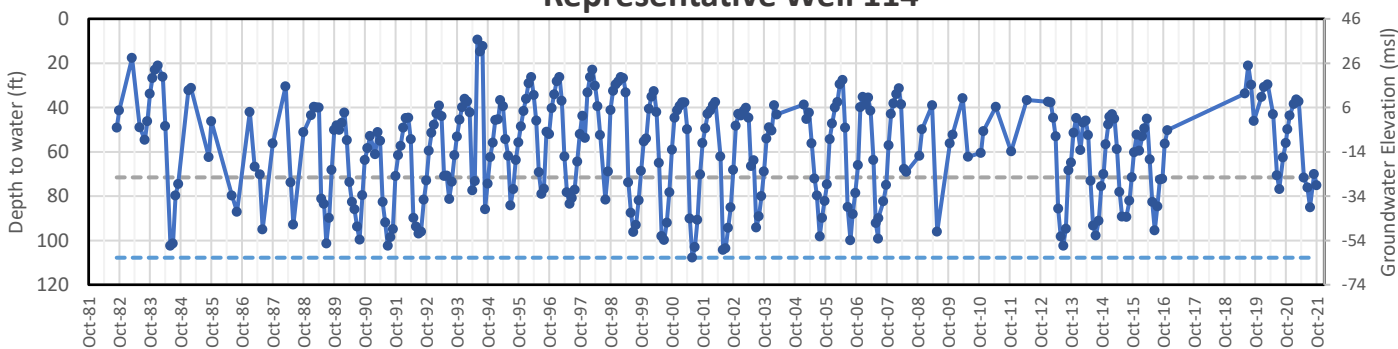


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

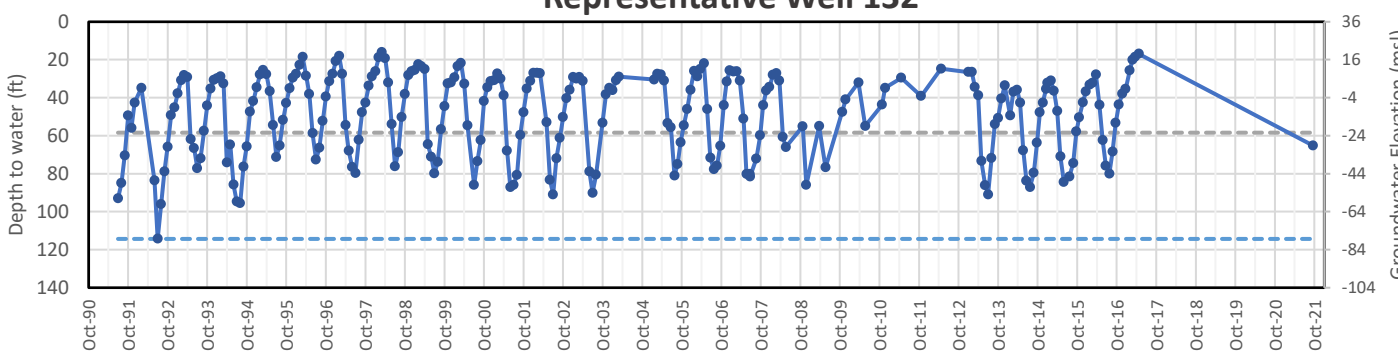
1 OF 8

Minimum Threshold    Measurable Objective    Groundwater Elevation

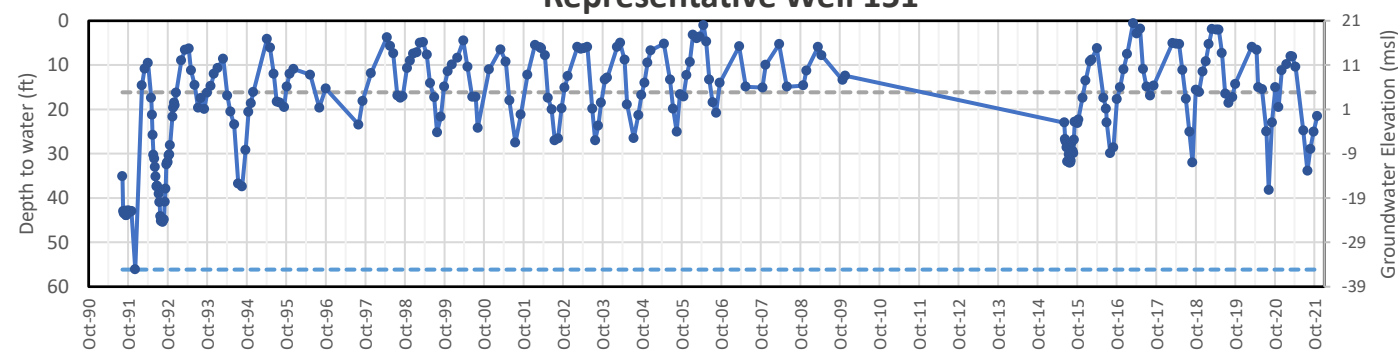
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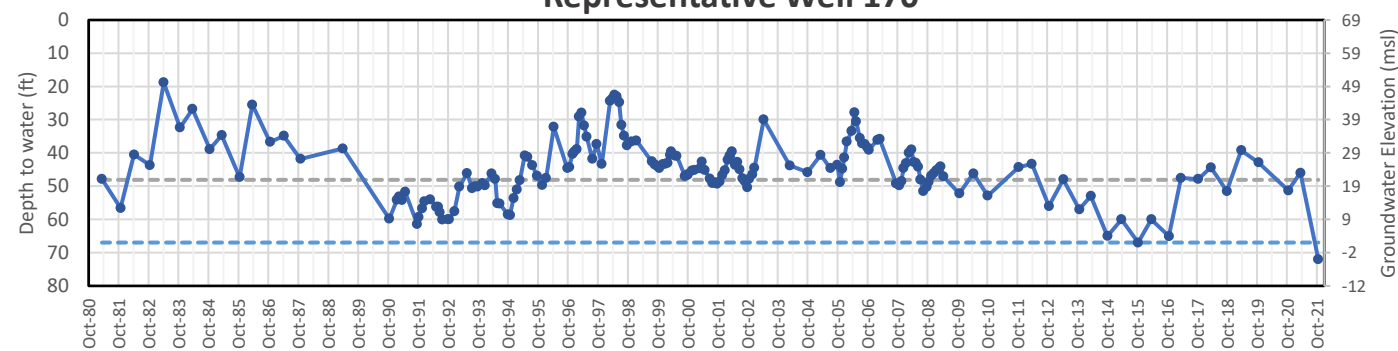
## Representative Well 132



## Representative Well 151



## Representative Well 170



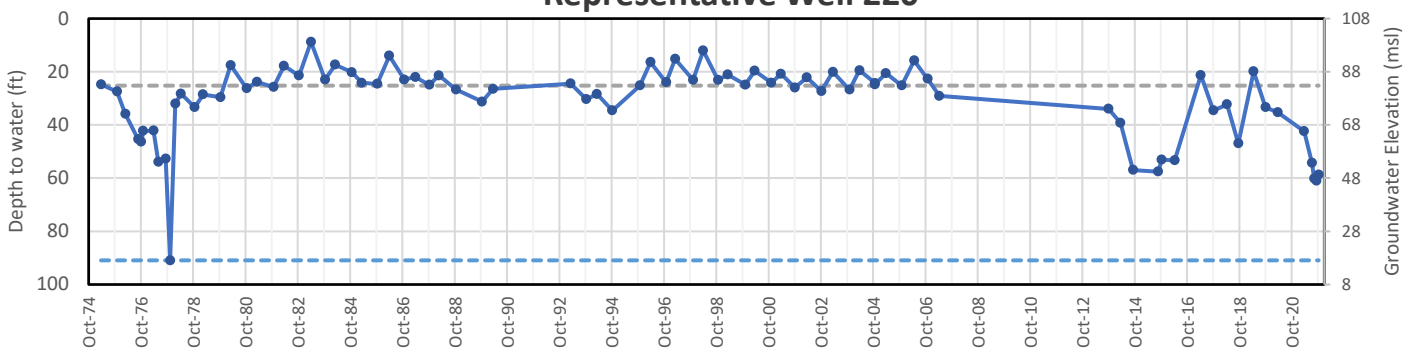


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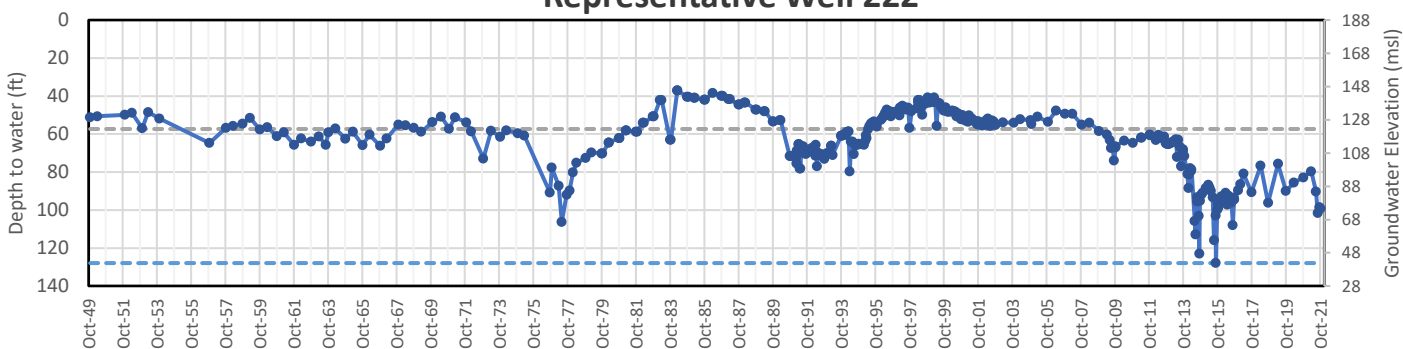
2 OF 8

Minimum Threshold      Measurable Objective      Groundwater Elevation

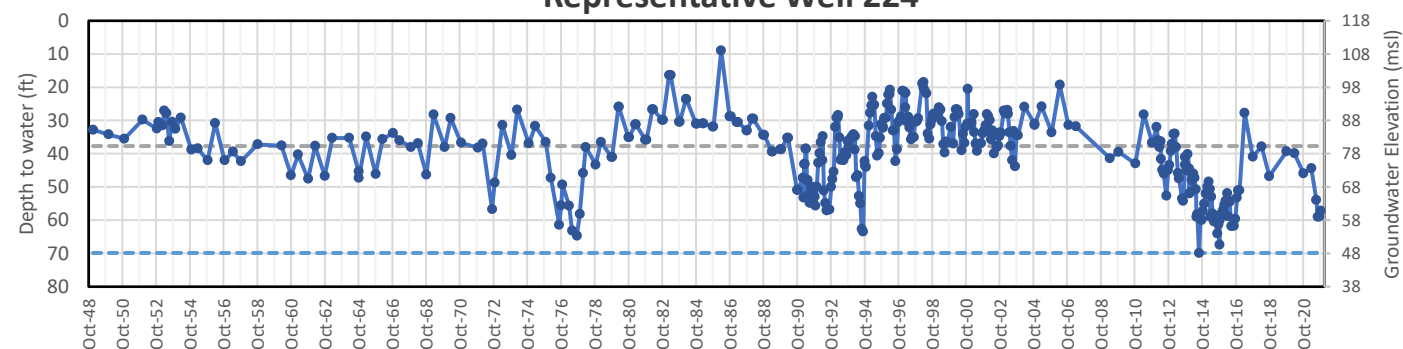
## Representative Well 220



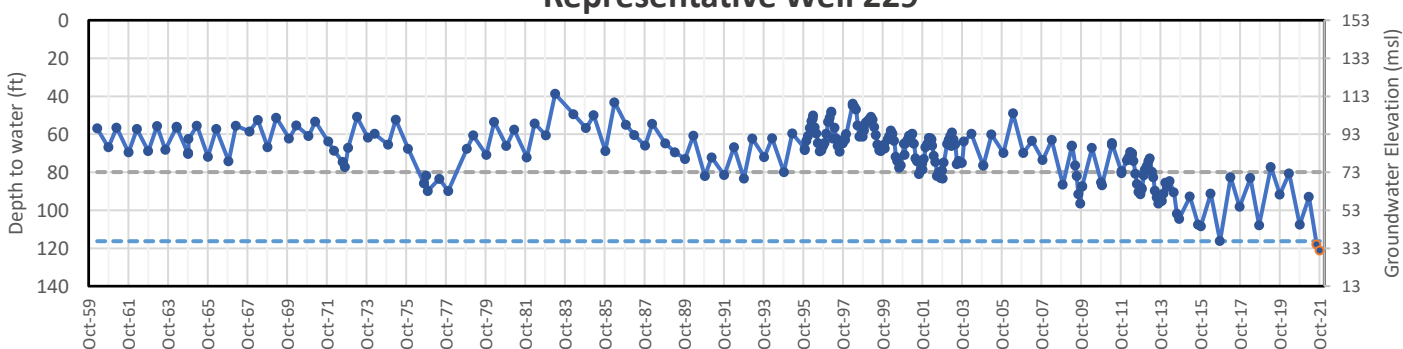
## Representative Well 222



## Representative Well 224



## Representative Well 229

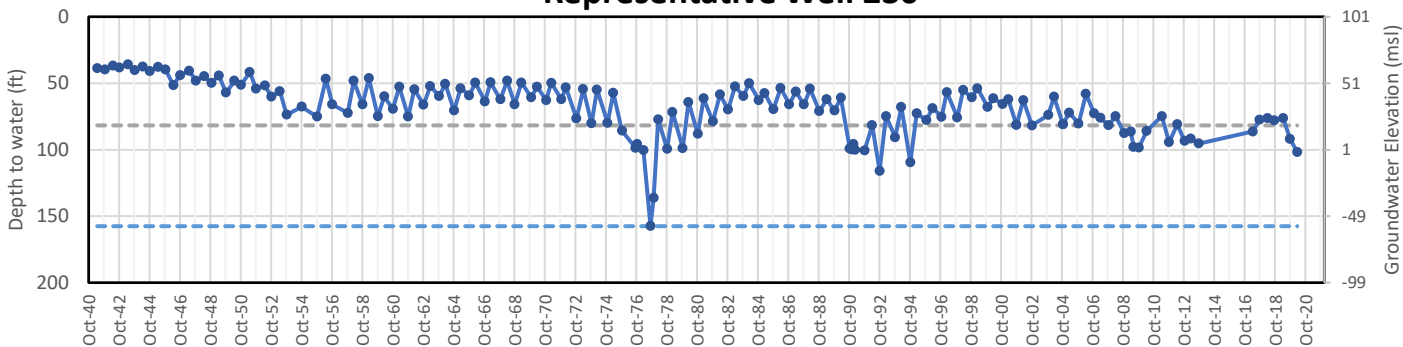


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

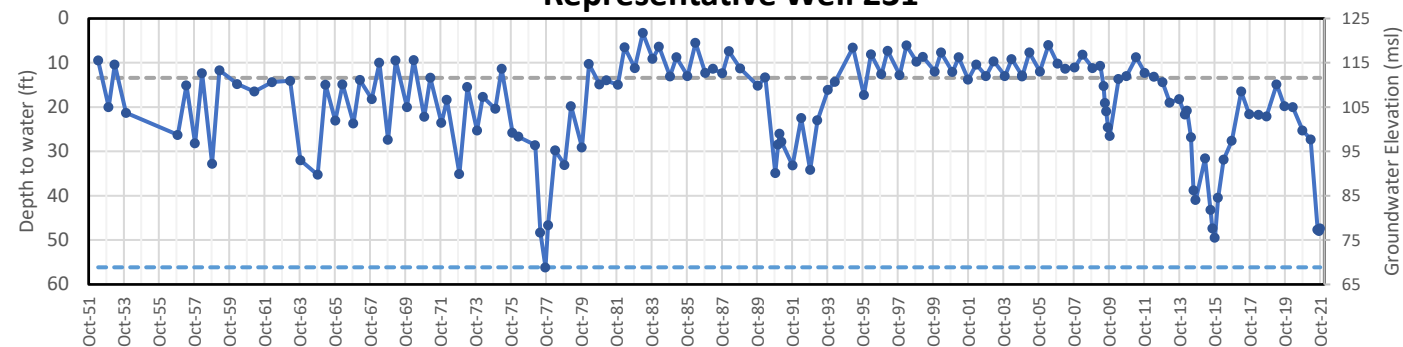
3 OF 8

Minimum Threshold      Measurable Objective      Groundwater Elevation

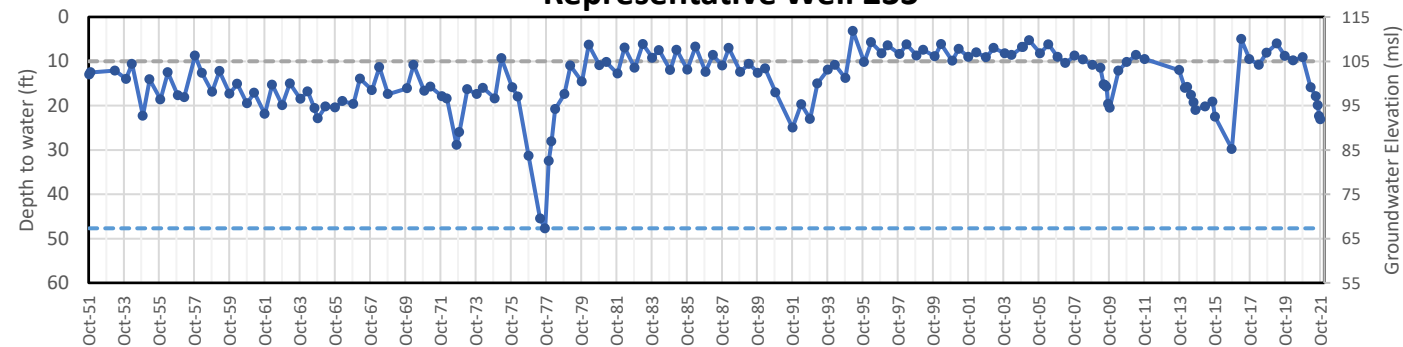
## Representative Well 230



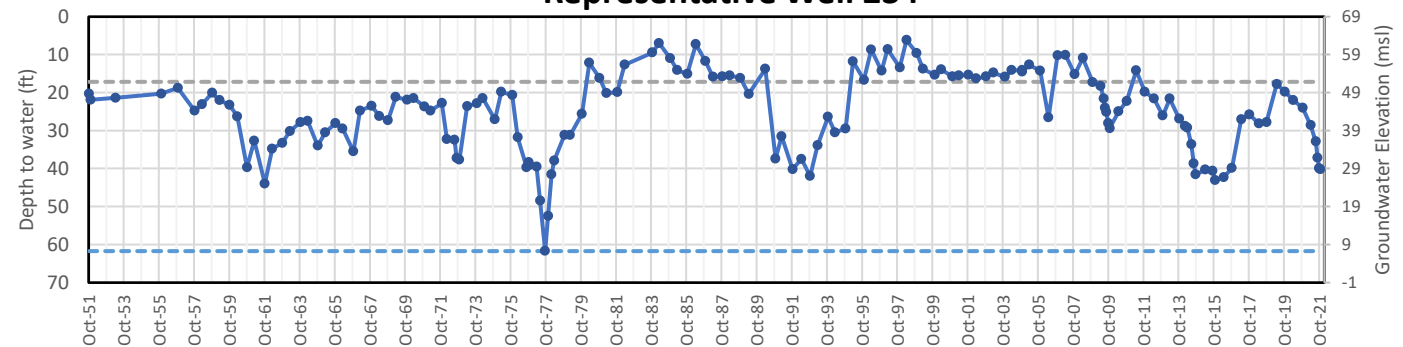
## Representative Well 231



## Representative Well 233



## Representative Well 234

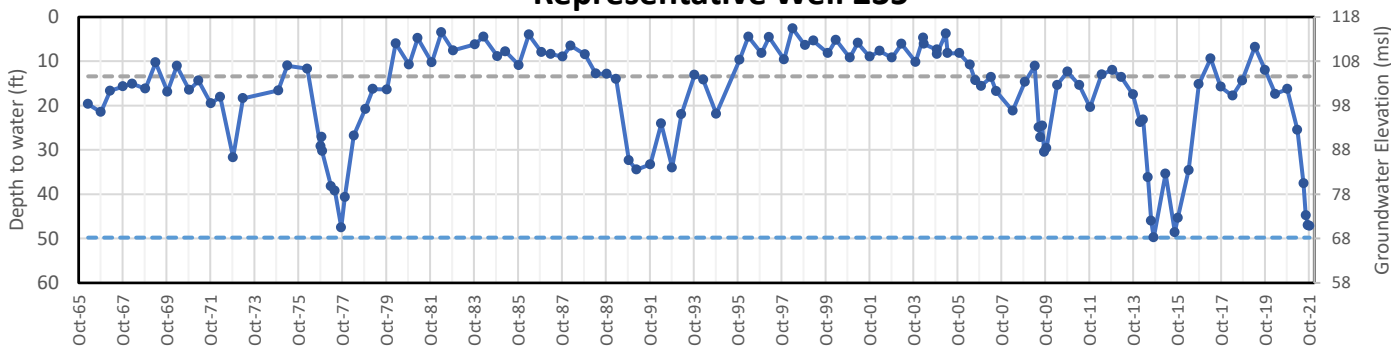


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

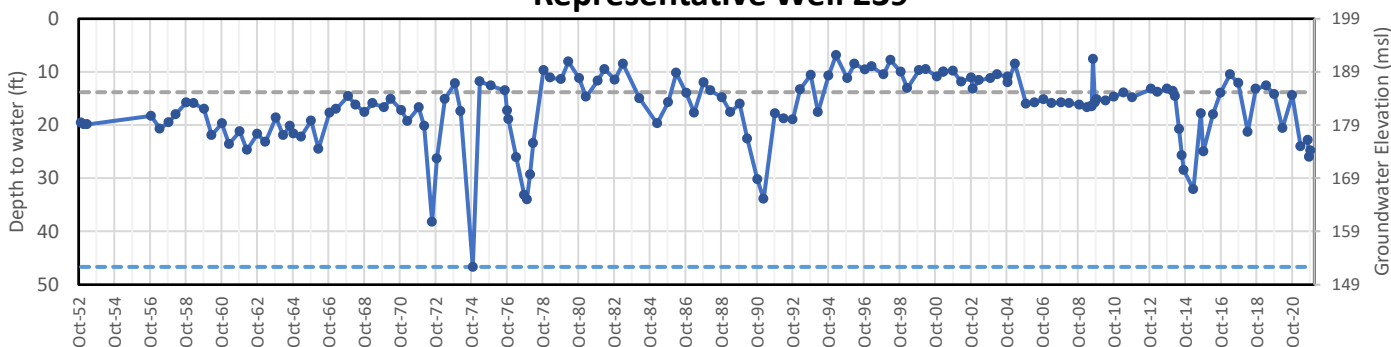
4 OF 8

--- Minimum Threshold    --- Measurable Objective    —●— Groundwater Elevation

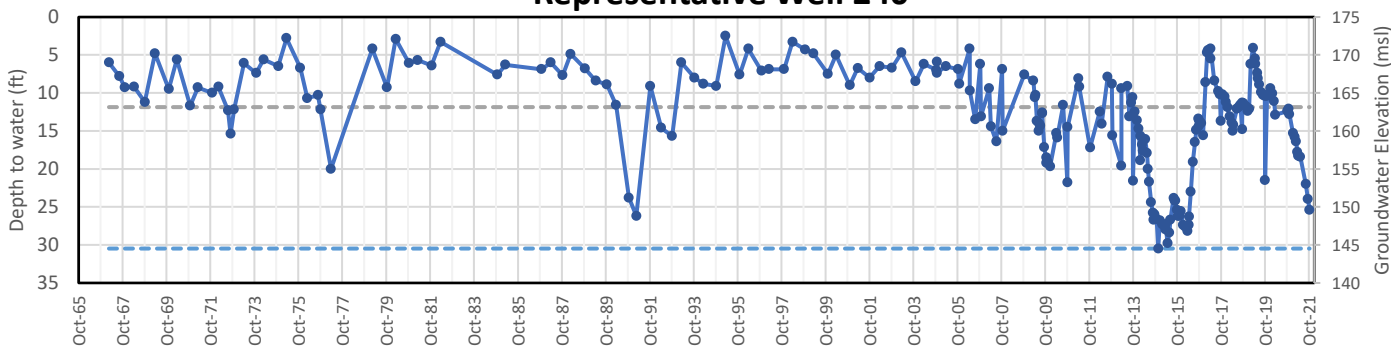
## Representative Well 235



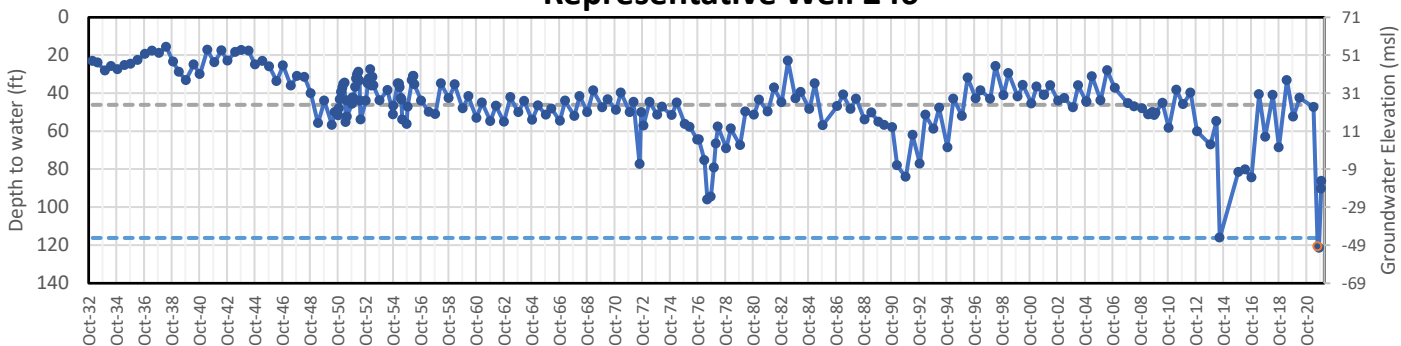
## Representative Well 239



## Representative Well 240



## Representative Well 246





# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

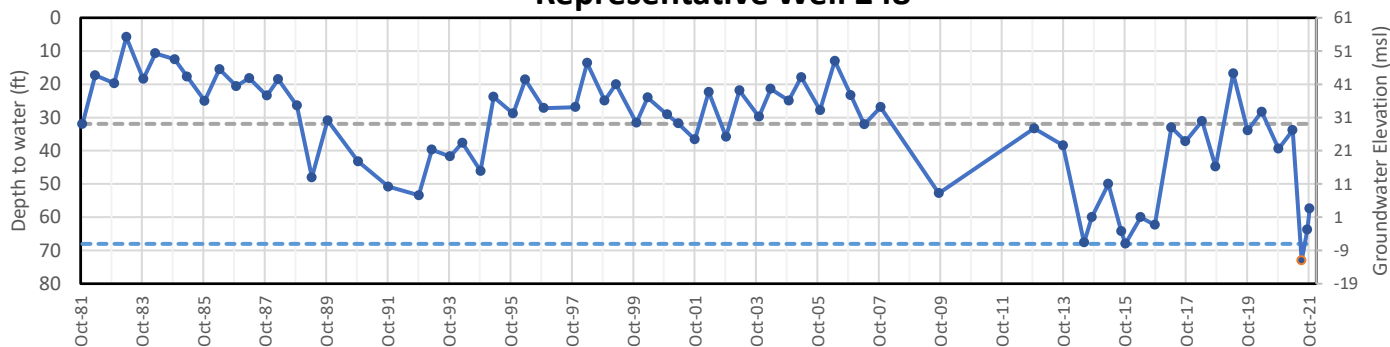
5 OF 8

Minimum Threshold

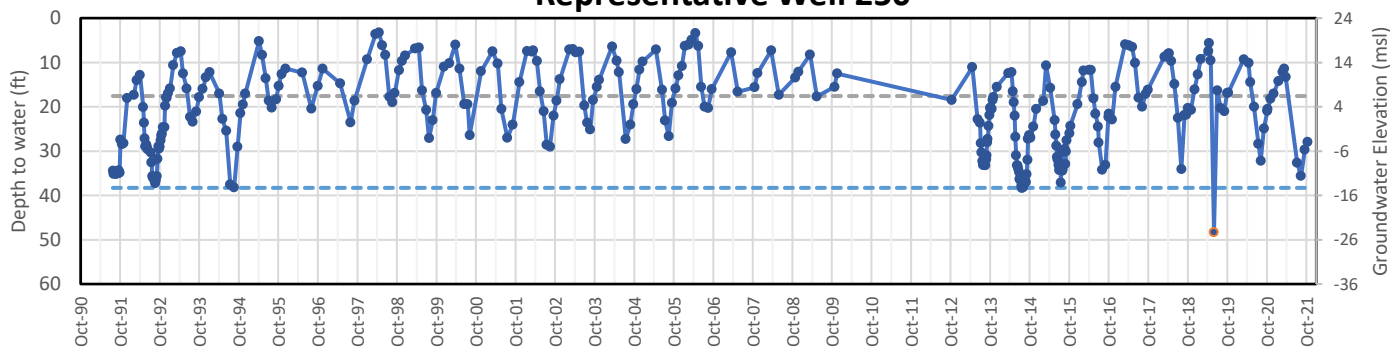
Measurable Objective

Groundwater Elevation

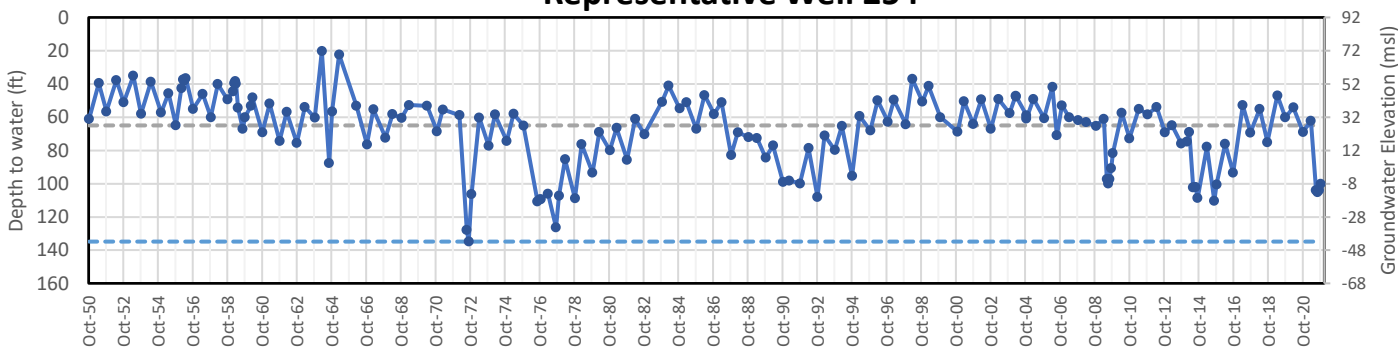
## Representative Well 248



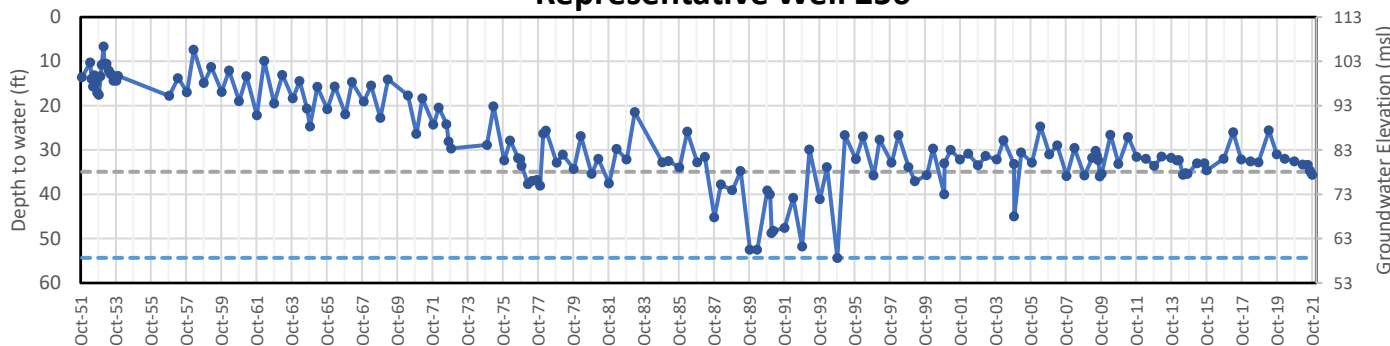
## Representative Well 250



## Representative Well 254



## Representative Well 256

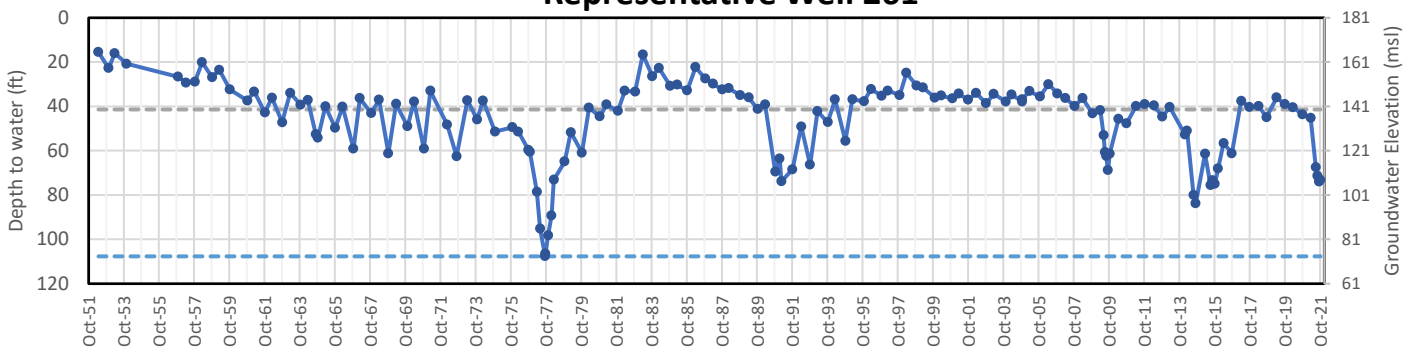


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

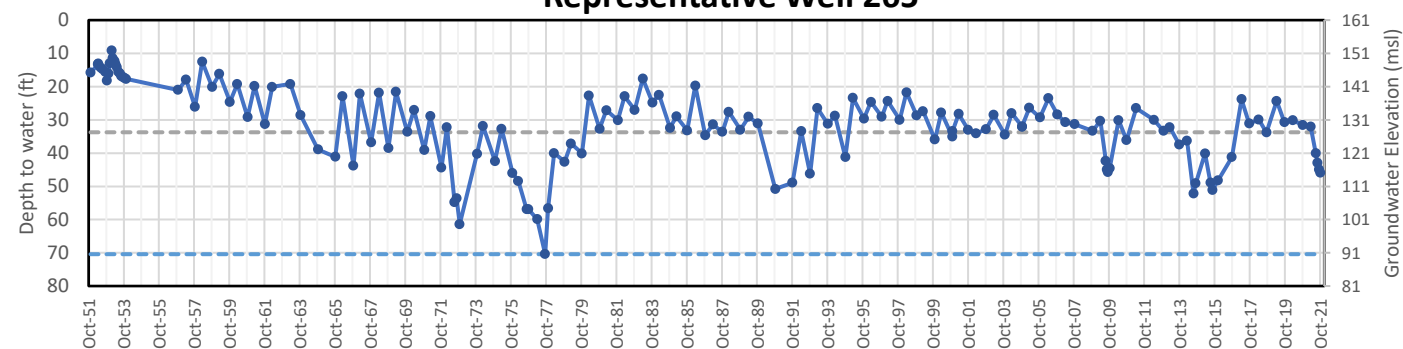
6 OF 8

Minimum Threshold      Measurable Objective      Groundwater Elevation

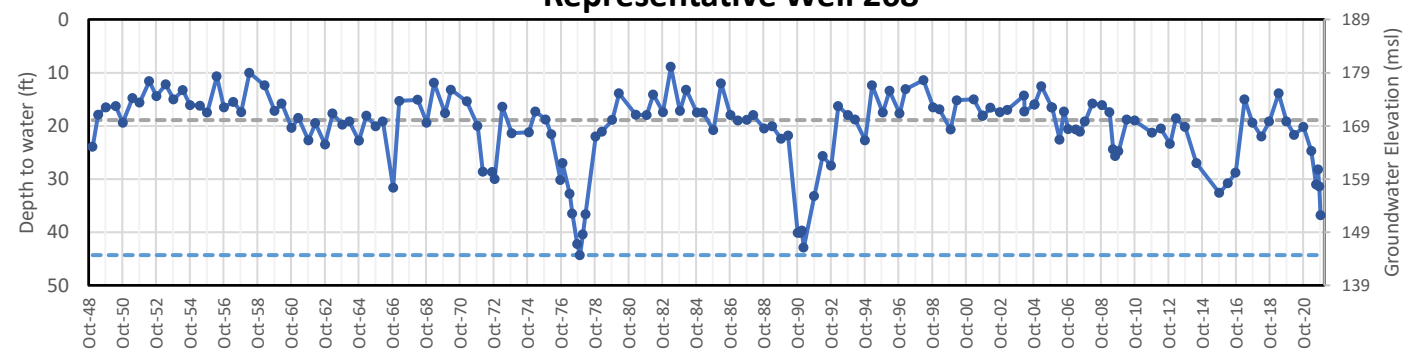
## Representative Well 261



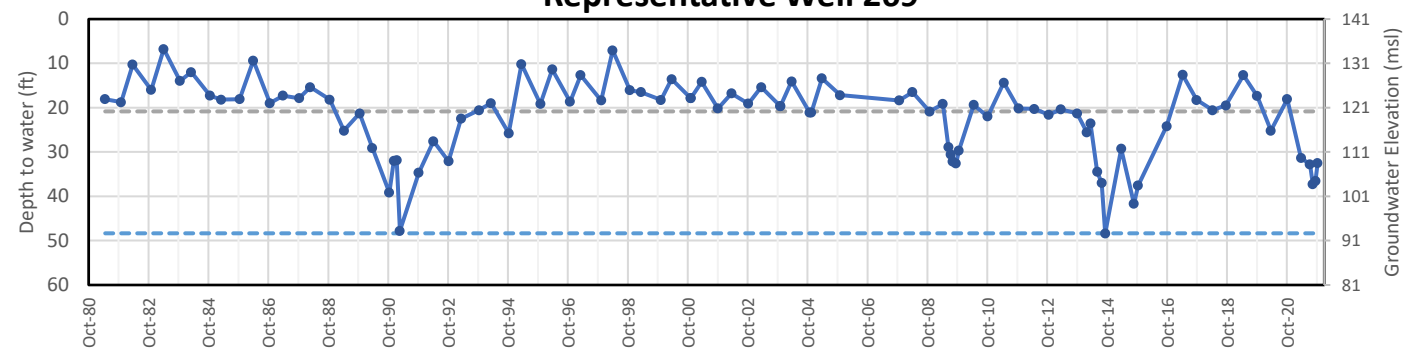
## Representative Well 265



## Representative Well 268



## Representative Well 269

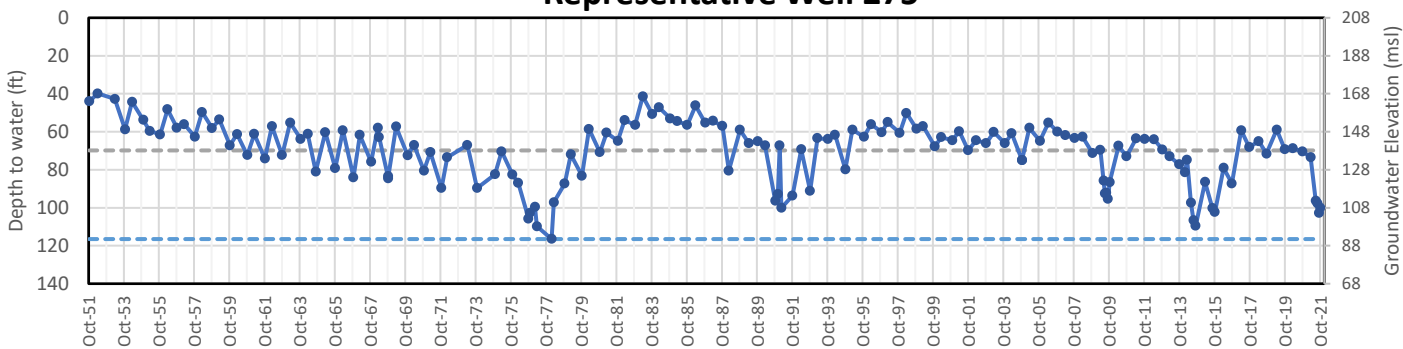


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

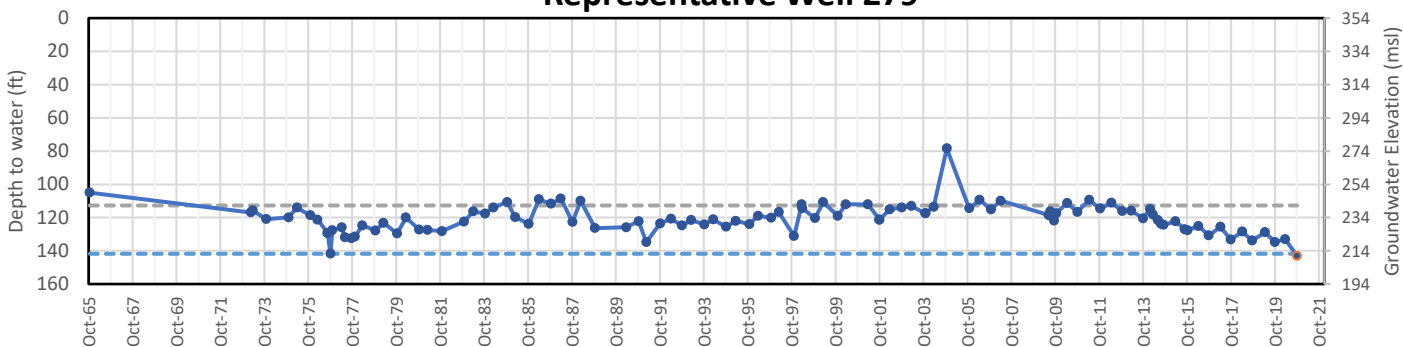
7 OF 8

Minimum Threshold      Measurable Objective      Groundwater Elevation

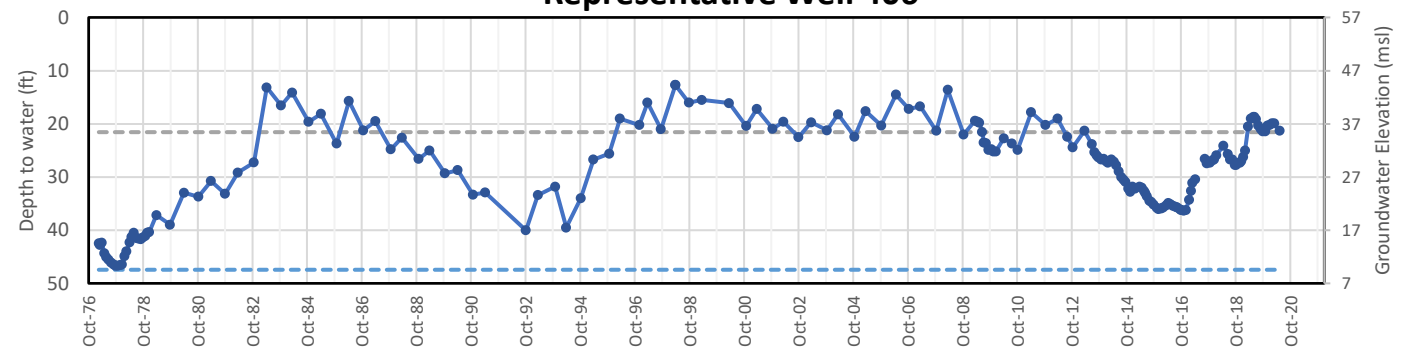
## Representative Well 275



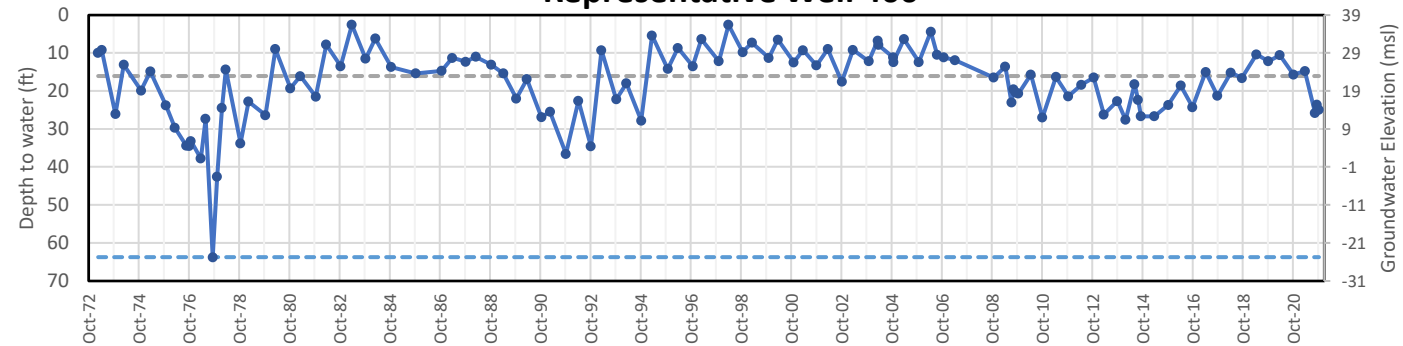
## Representative Well 279



## Representative Well 406



## Representative Well 400

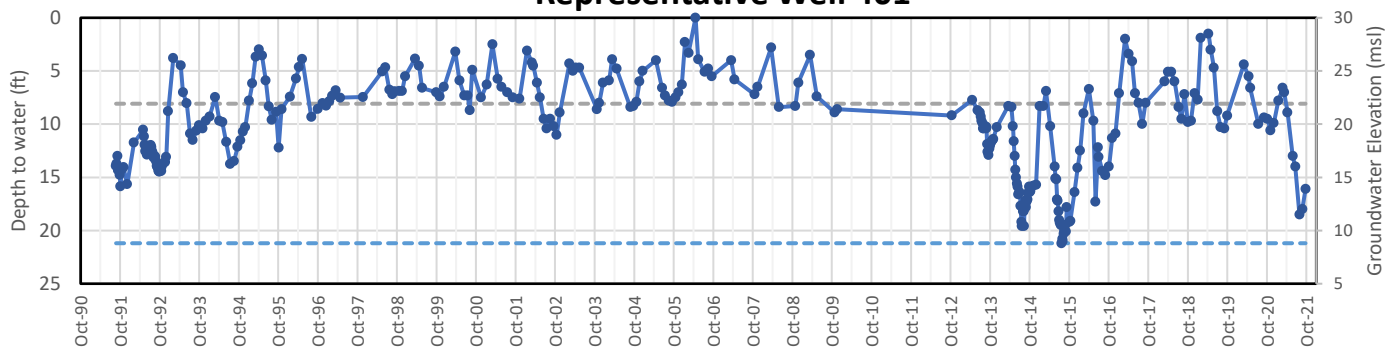


# CENTRAL YOLO REPRESENTATIVE HYDROGRAPHS

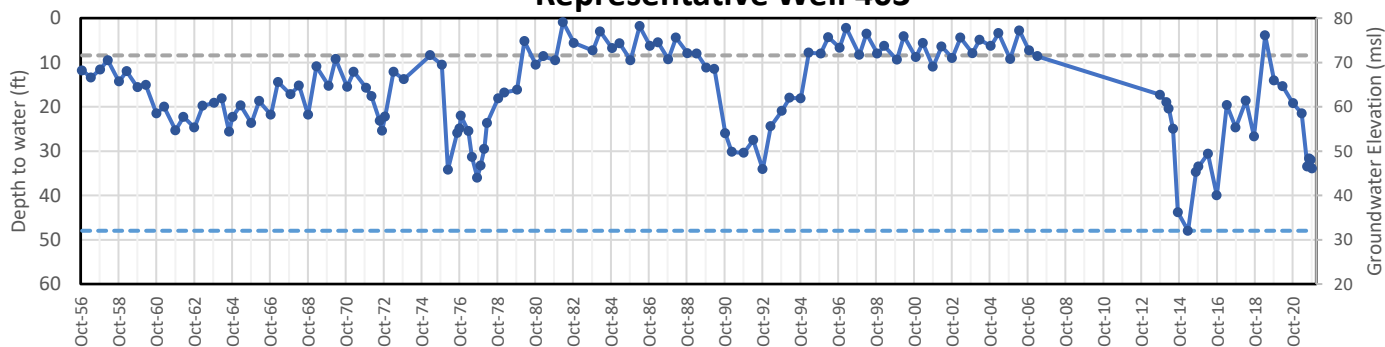
8 OF 8

Minimum Threshold      Measurable Objective      Groundwater Elevation

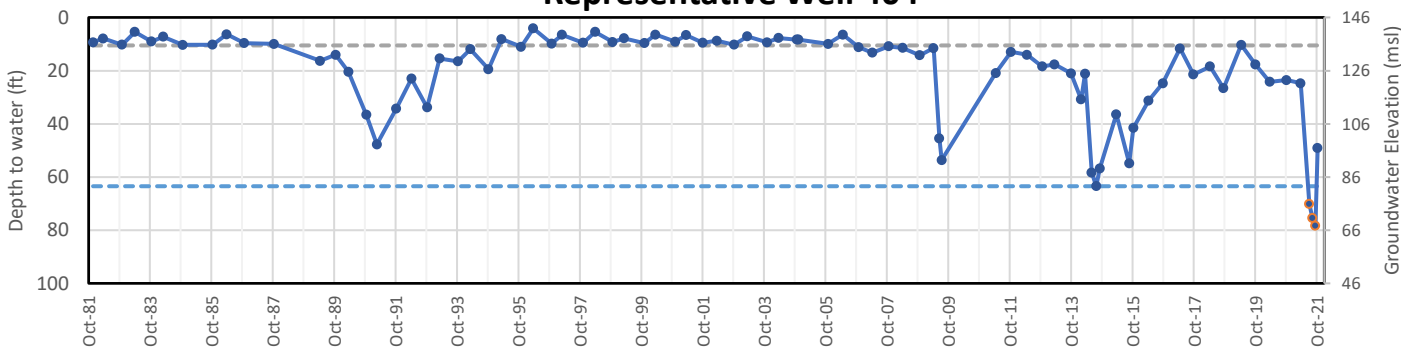
## Representative Well 401



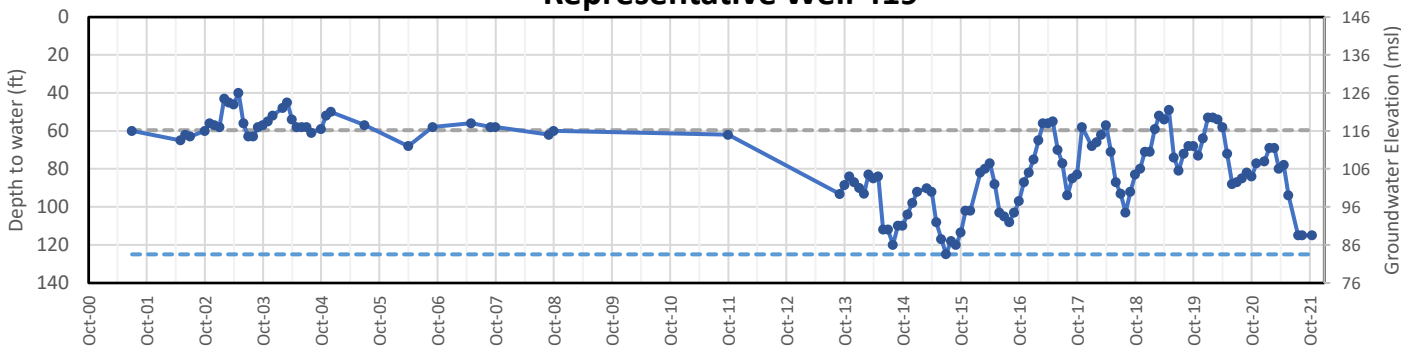
## Representative Well 403



## Representative Well 404



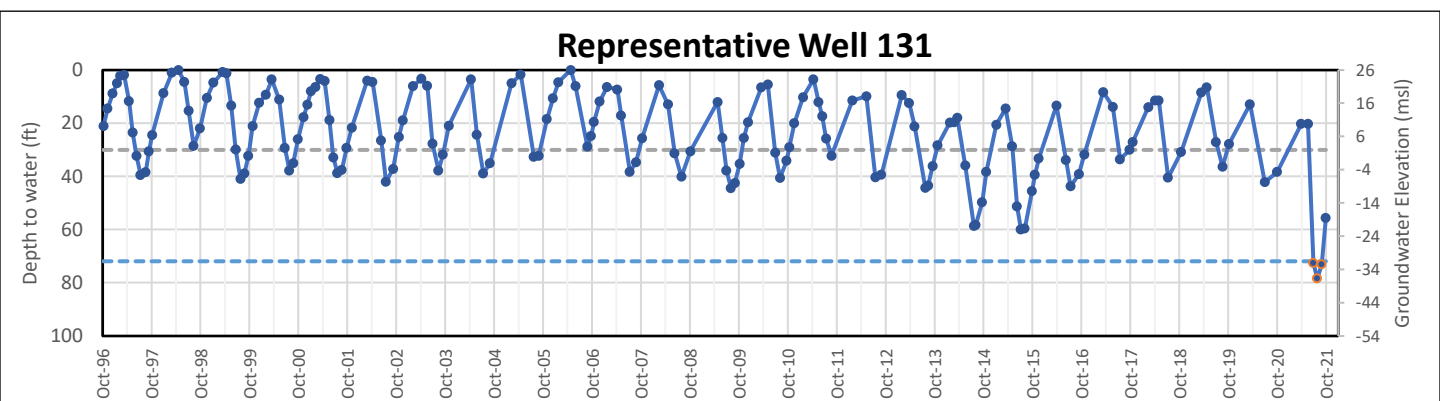
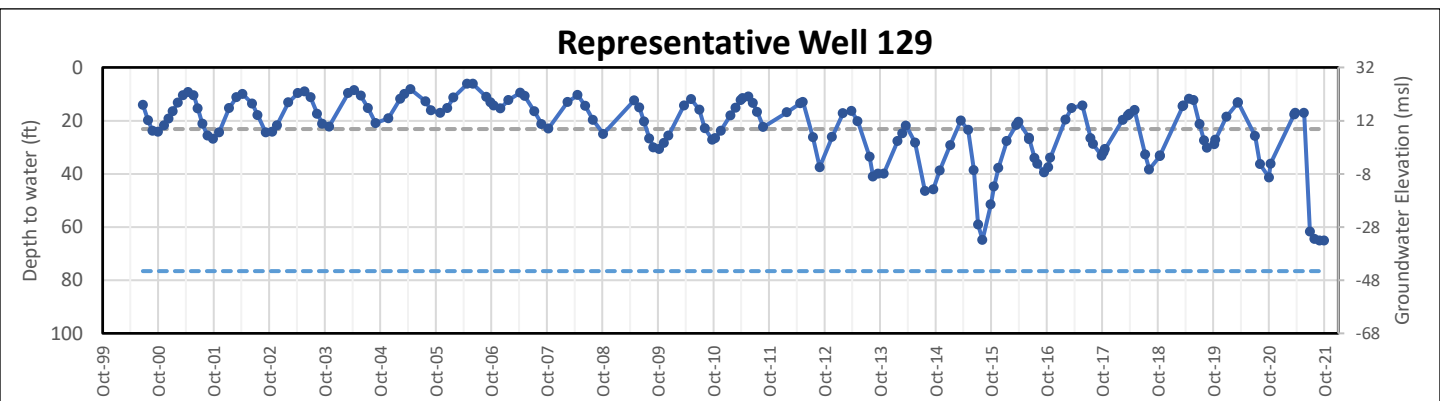
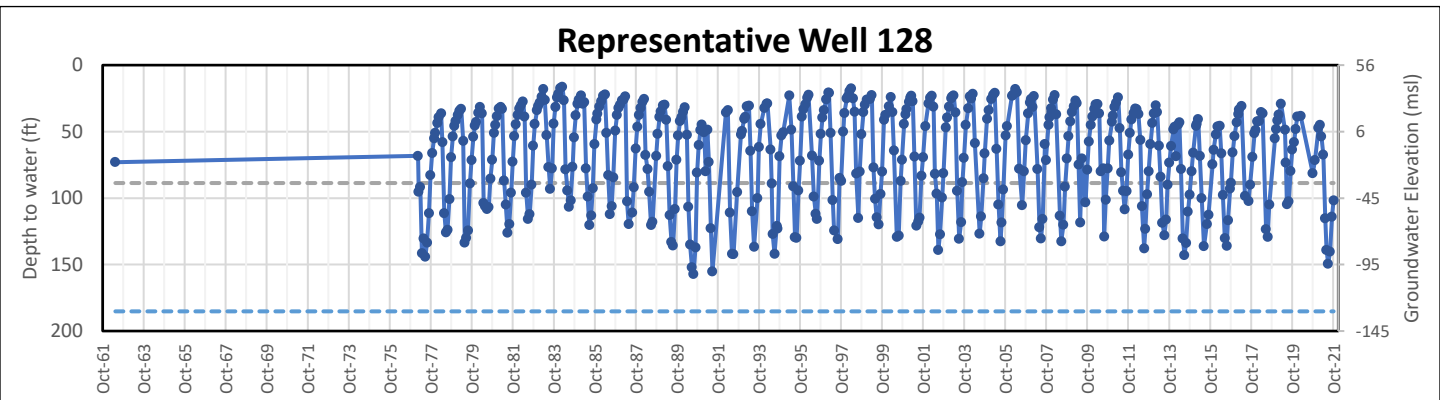
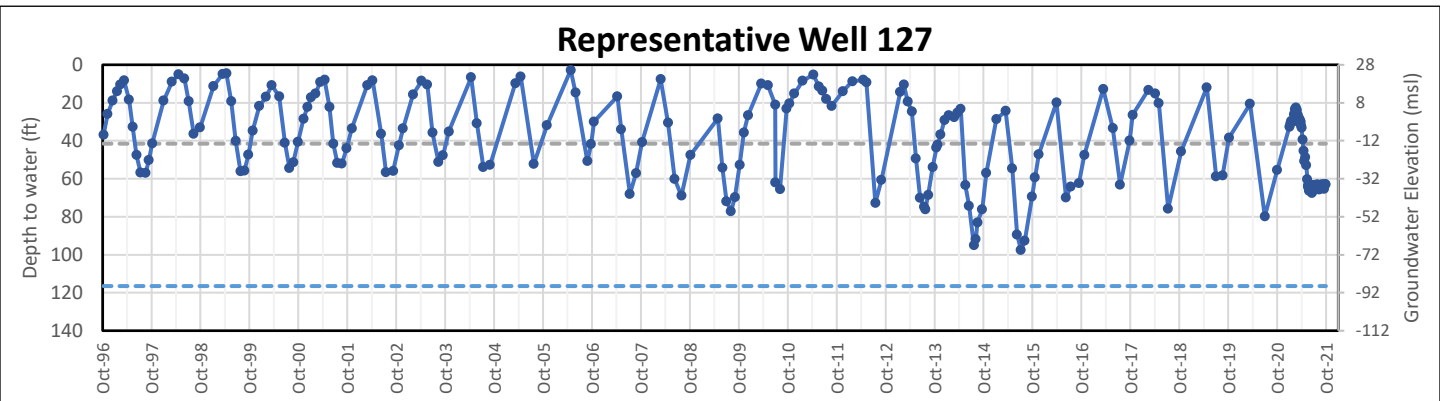
## Representative Well 419





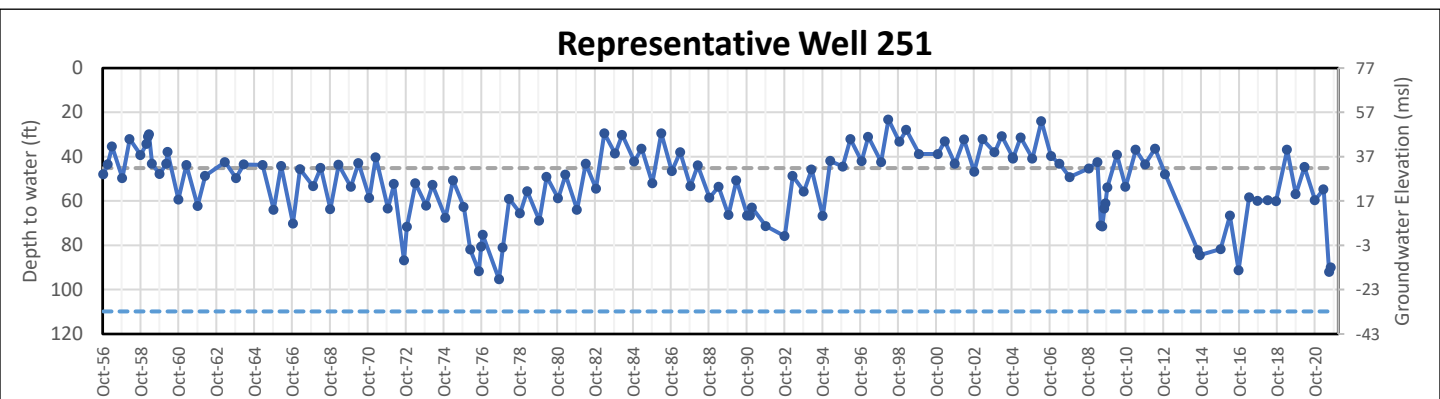
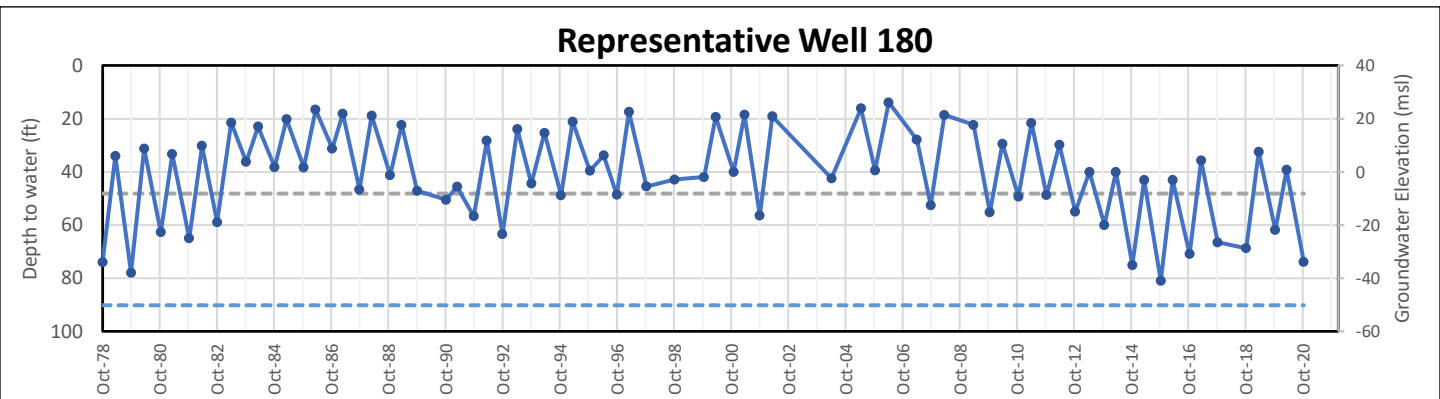
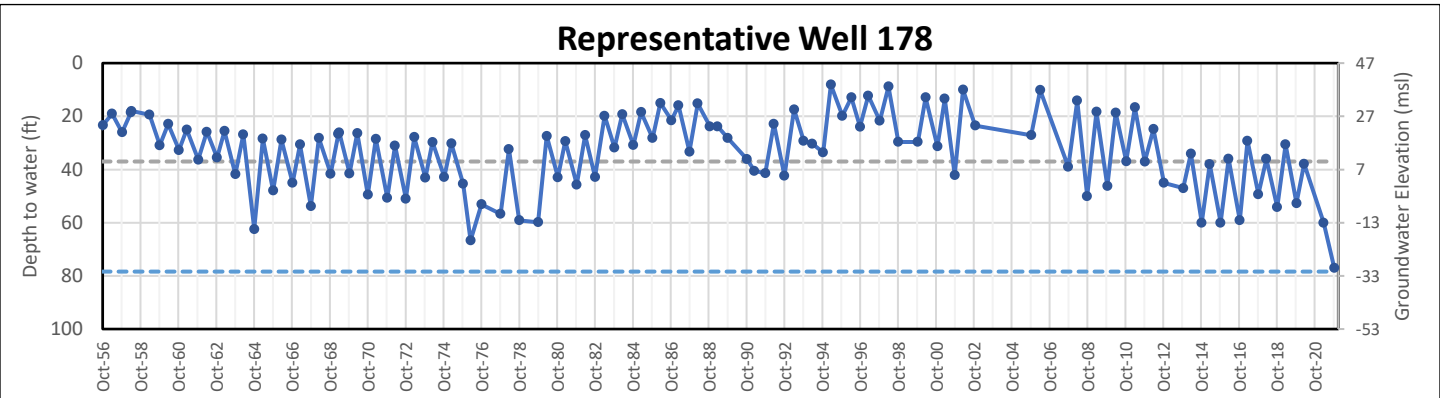
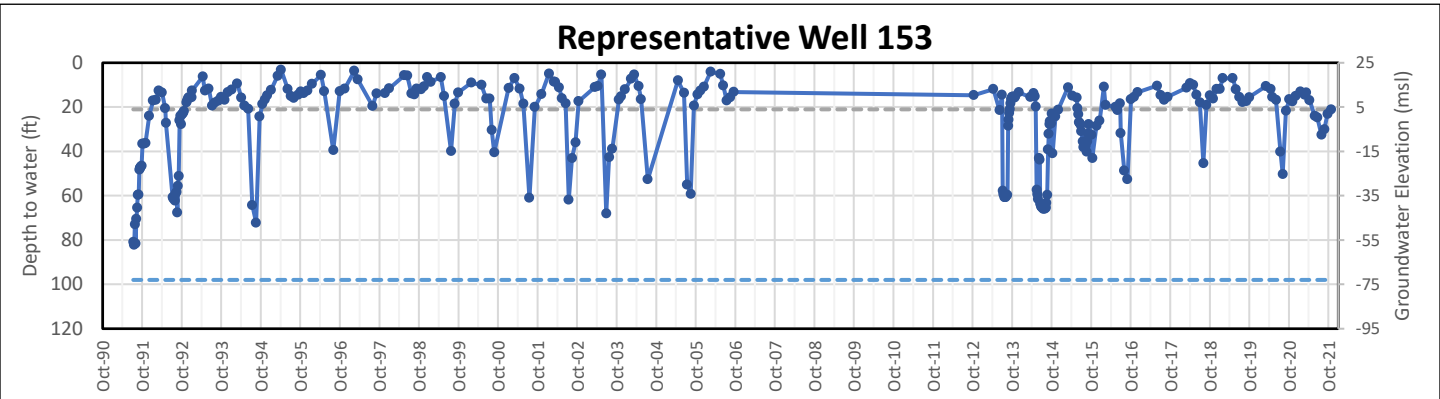
# NORTH YOLO REPRESENTATIVE HYDROGRAPHS

1 OF 4



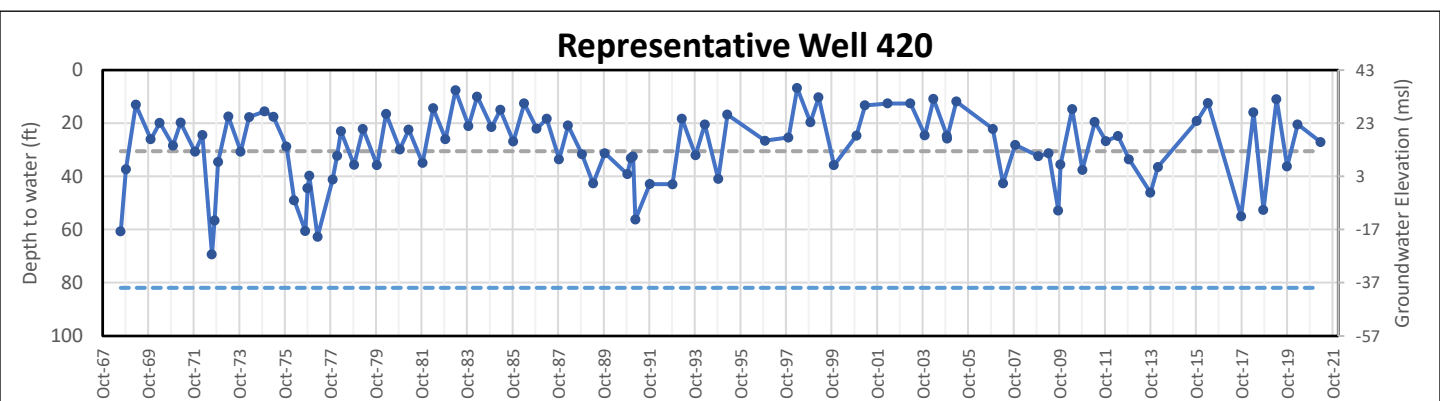
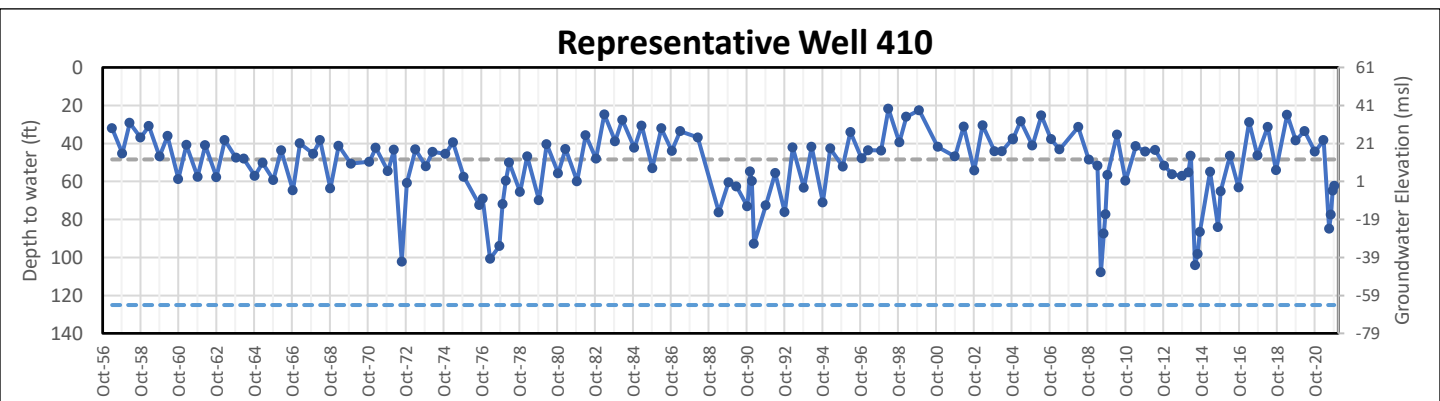
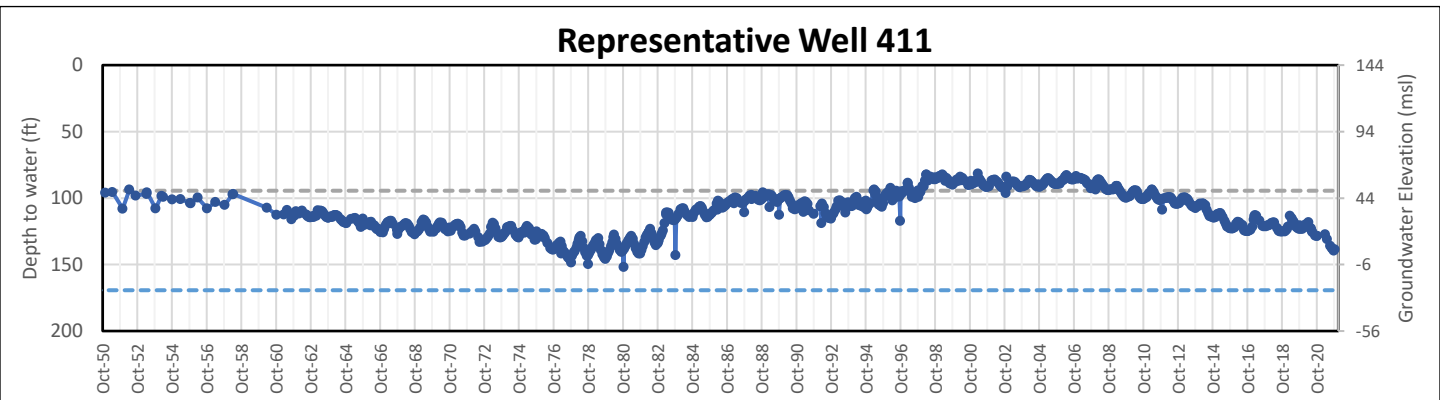
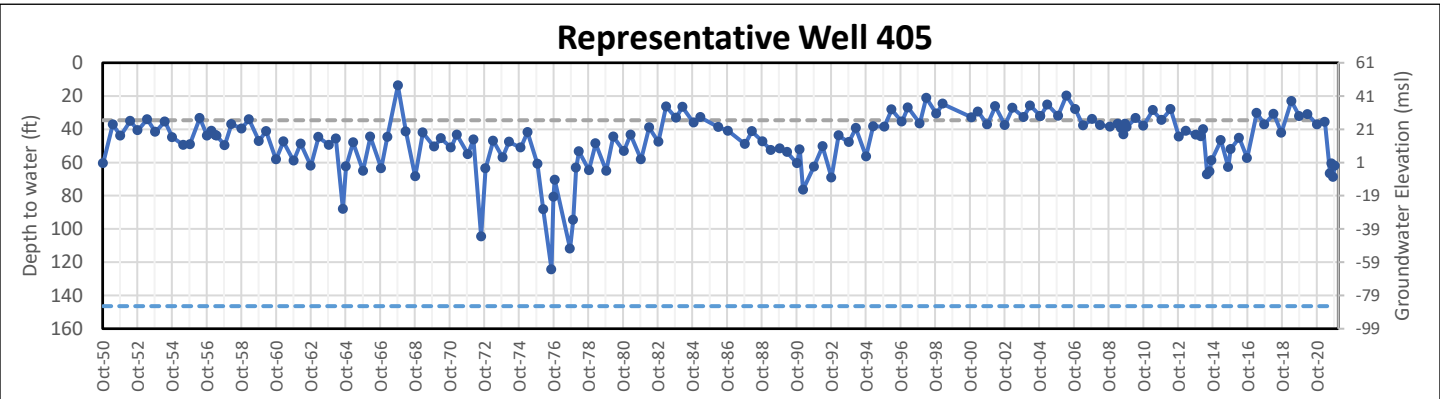
# NORTH YOLO REPRESENTATIVE HYDROGRAPHS

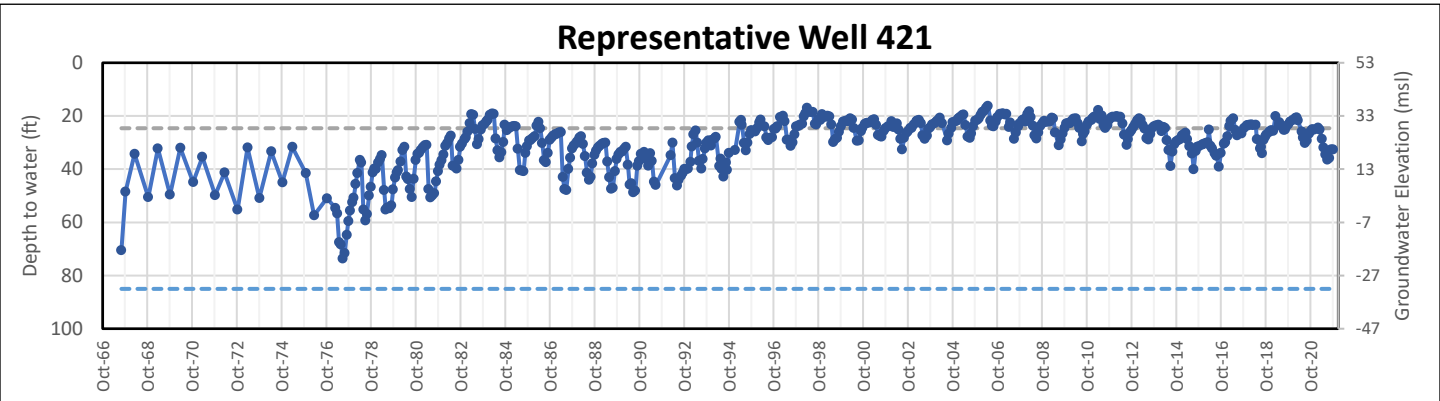
2 OF 4



# NORTH YOLO REPRESENTATIVE HYDROGRAPHS

3 OF 4



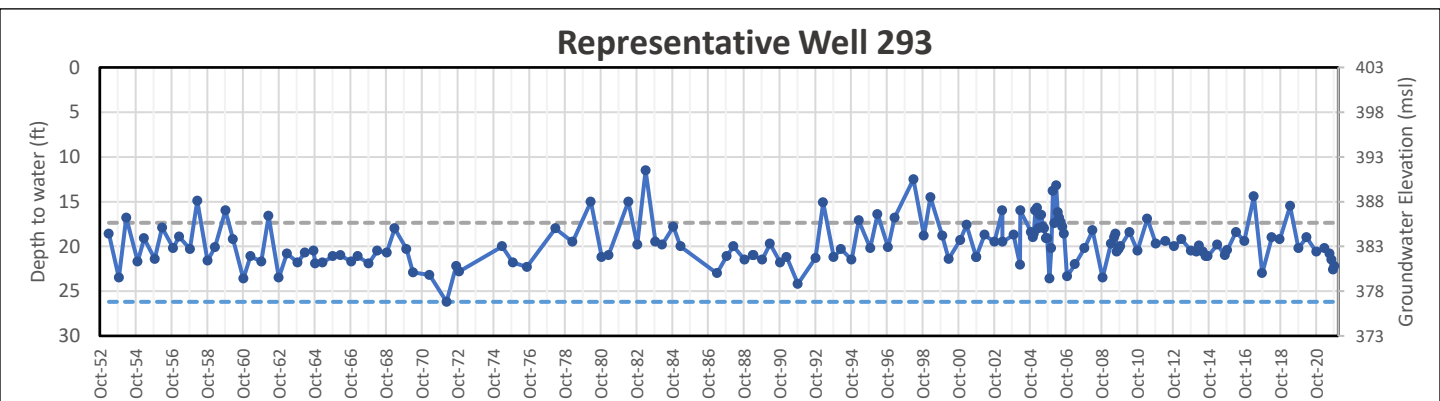
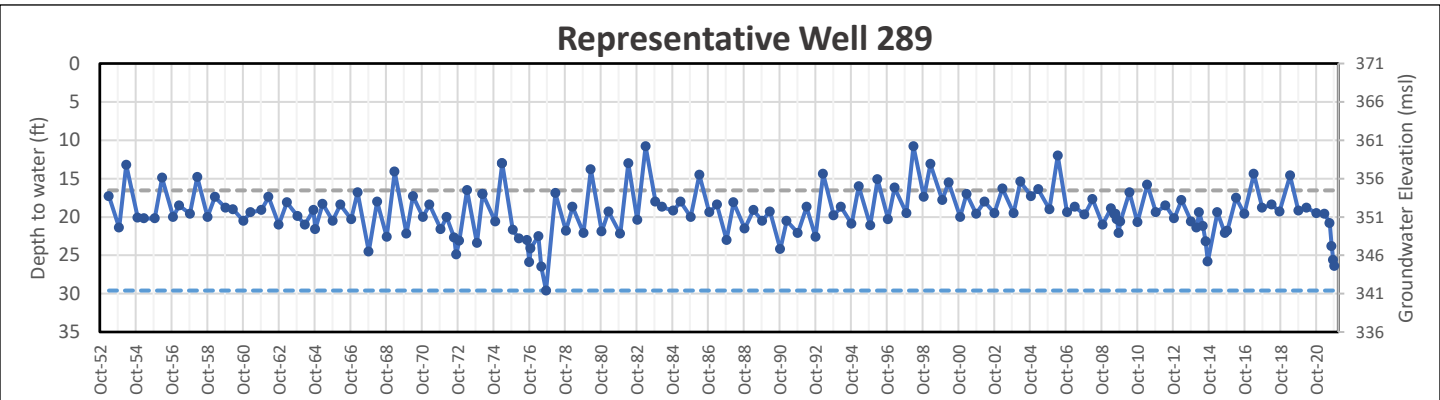
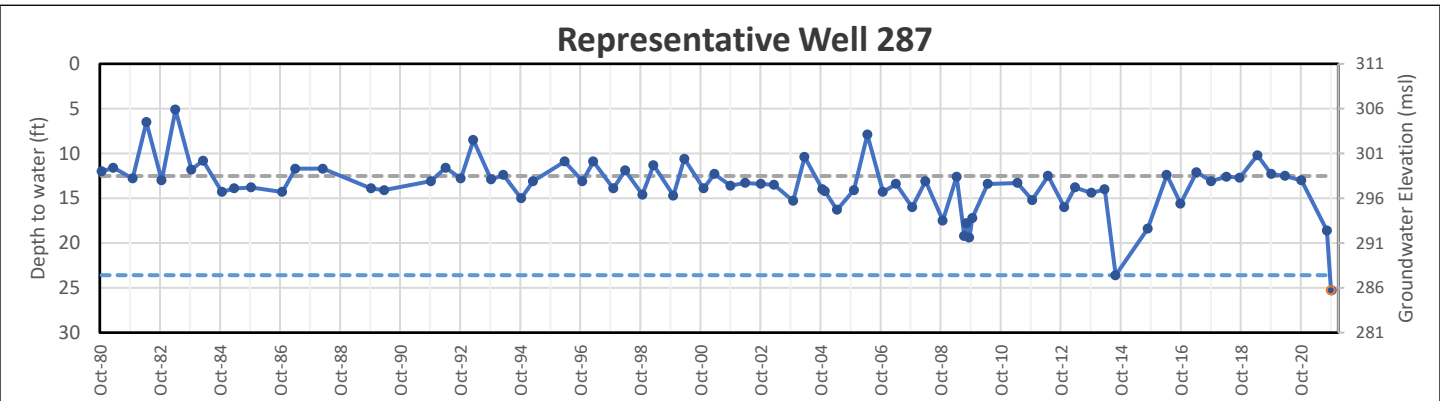




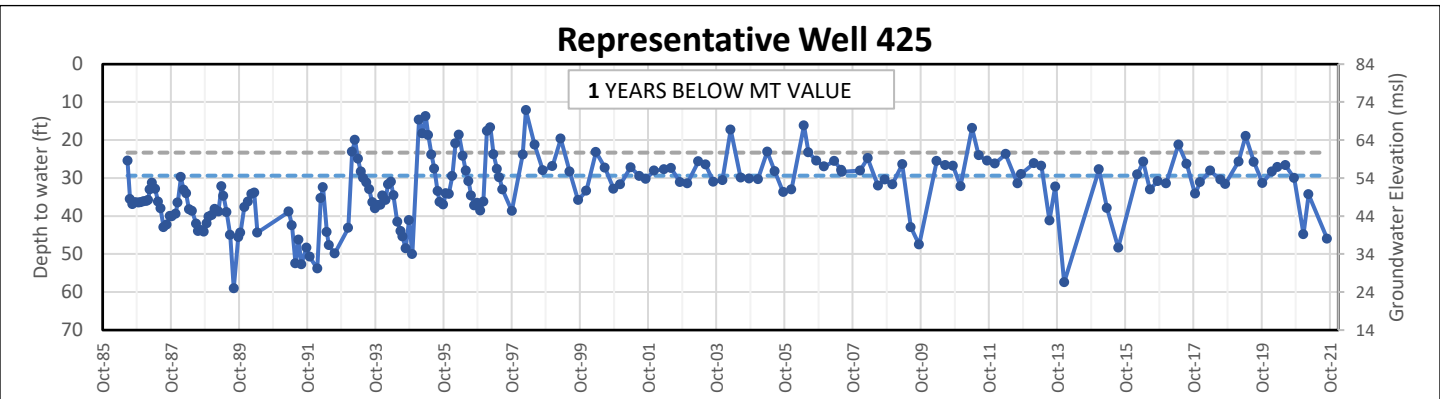
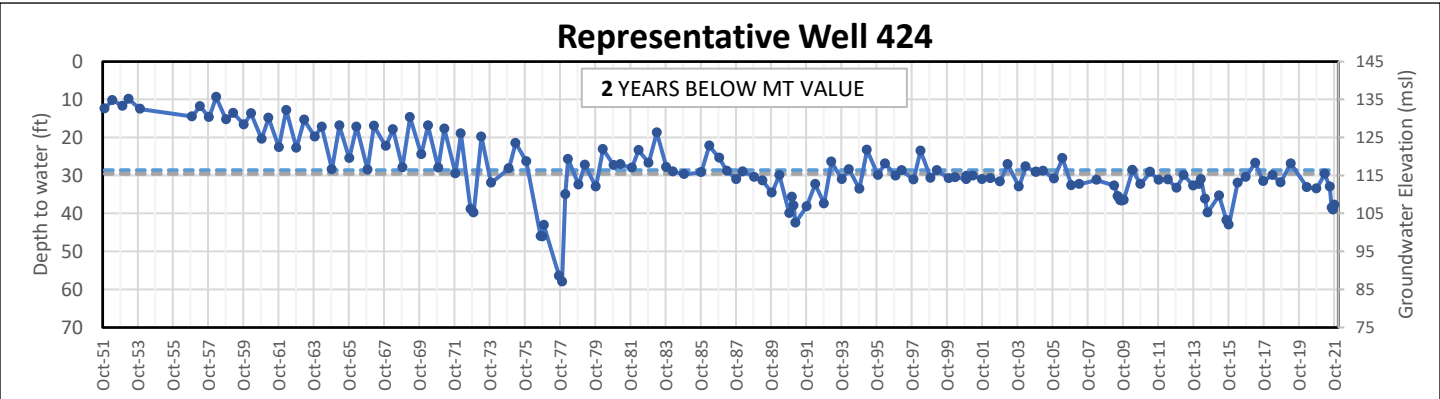
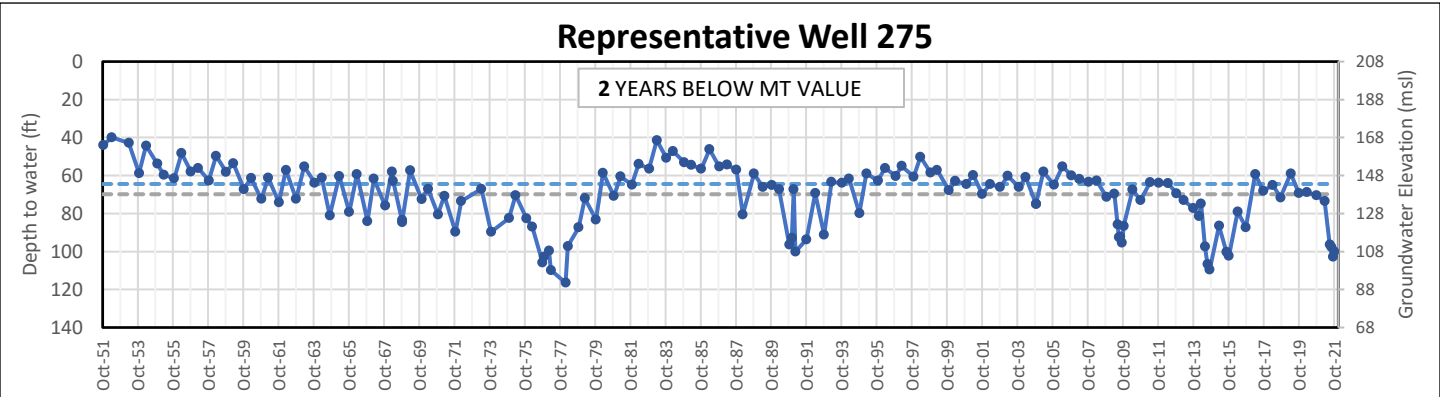
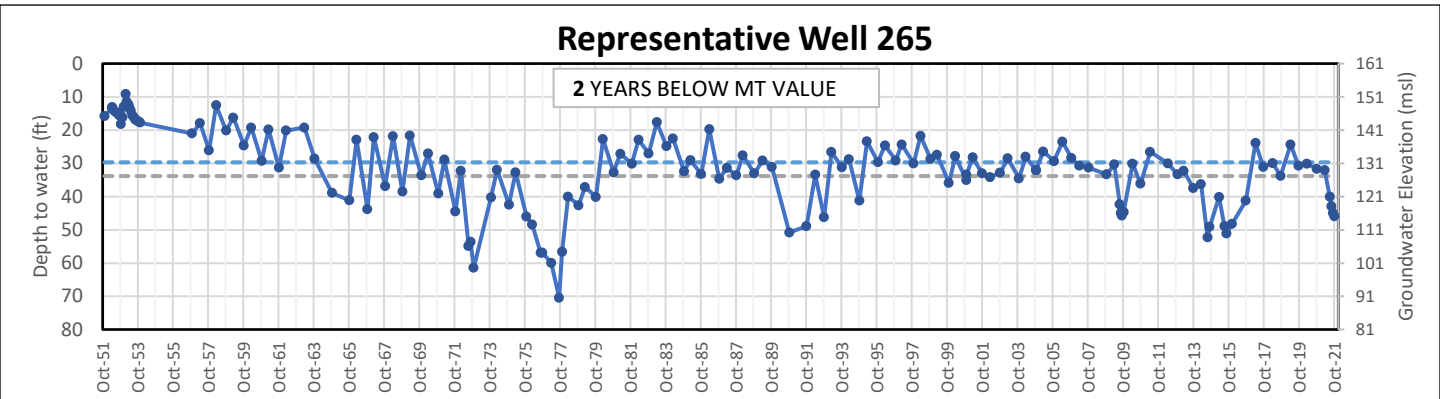
# YOLO SUBBASIN GSP ANNUAL REPORT 2022 ATTACHMENT B

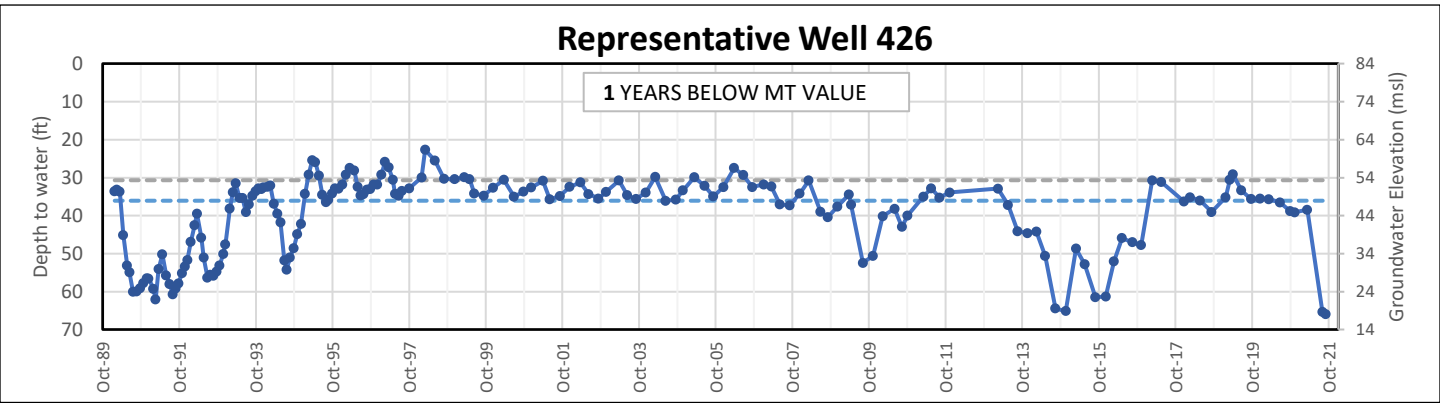
INTERCONNECTED SURFACE WATERS  
REPRESENTATIVE WELL HYDROGRAPHS

# UPPER CACHE CREEK REPRESENTATIVE HYDROGRAPHS



LOWER CACHE CREEK REPRESENTATIVE HYDROGRAPHS





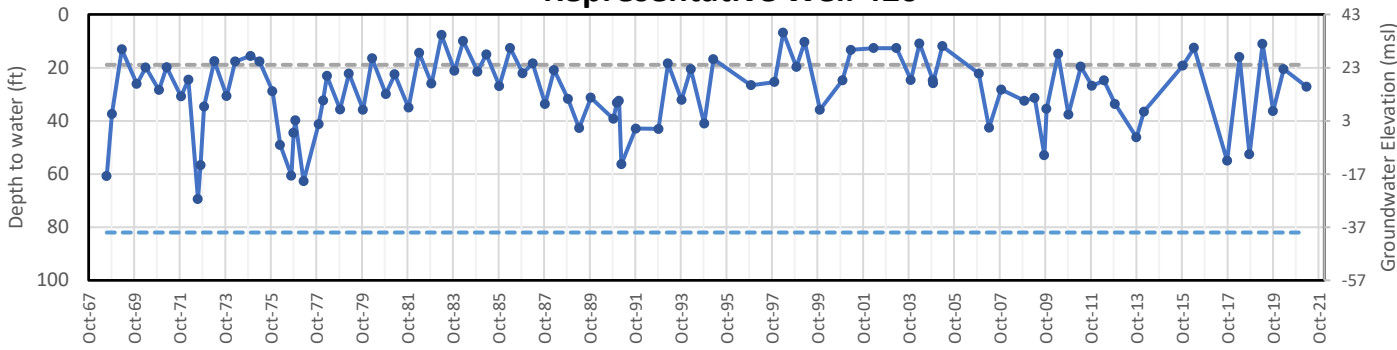


# UPPER SACRAMENTO RIVER REPRESENTATIVE HYDROGRAPHS

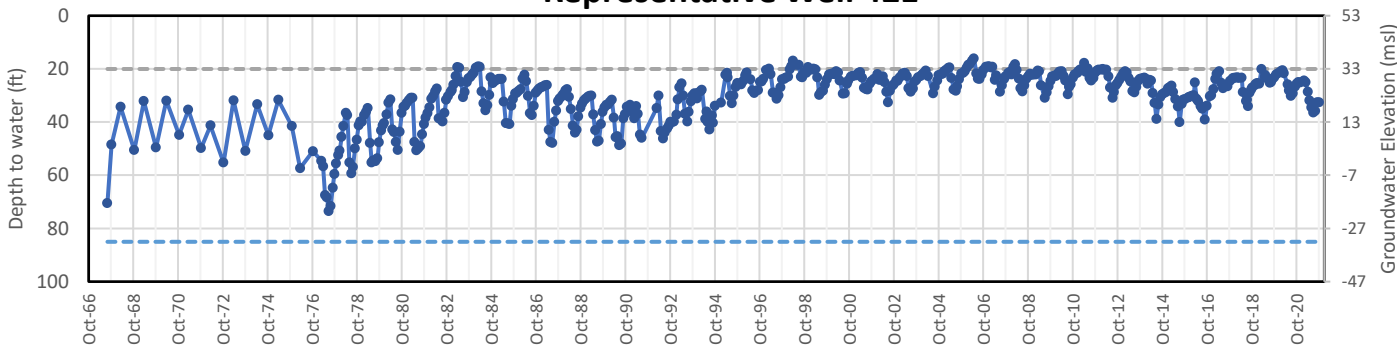
1 OF 1

Minimum Threshold      Measurable Objective      Groundwater Elevation

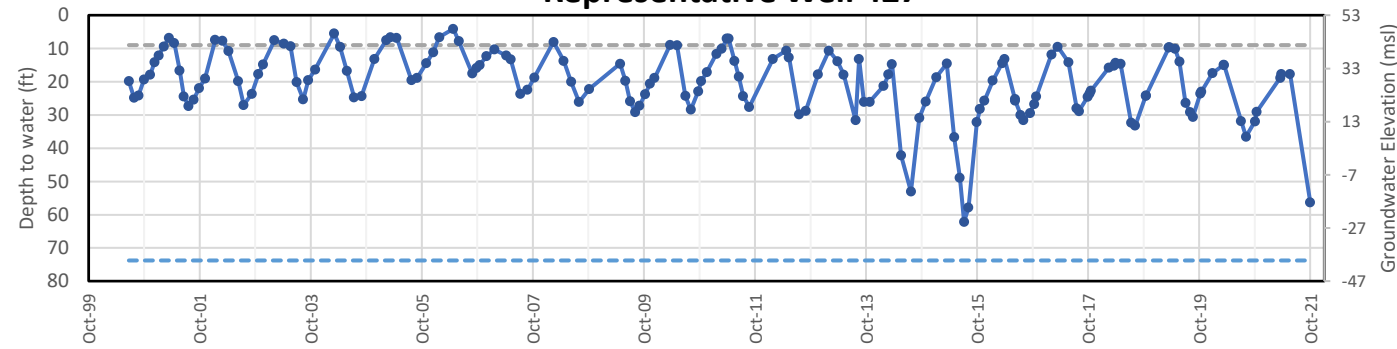
## Representative Well 420



## Representative Well 421



## Representative Well 427

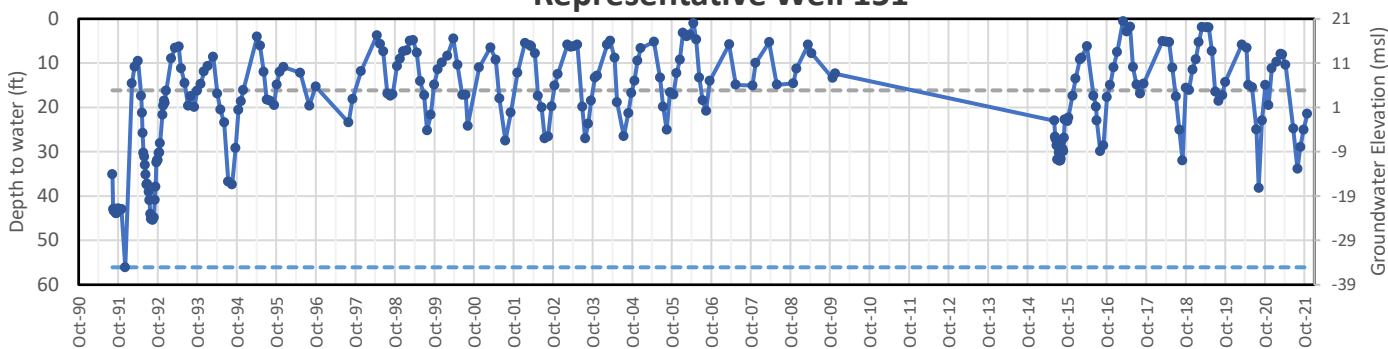


# LOWER SACRAMENTO RIVER REPRESENTATIVE HYDROGRAPHS

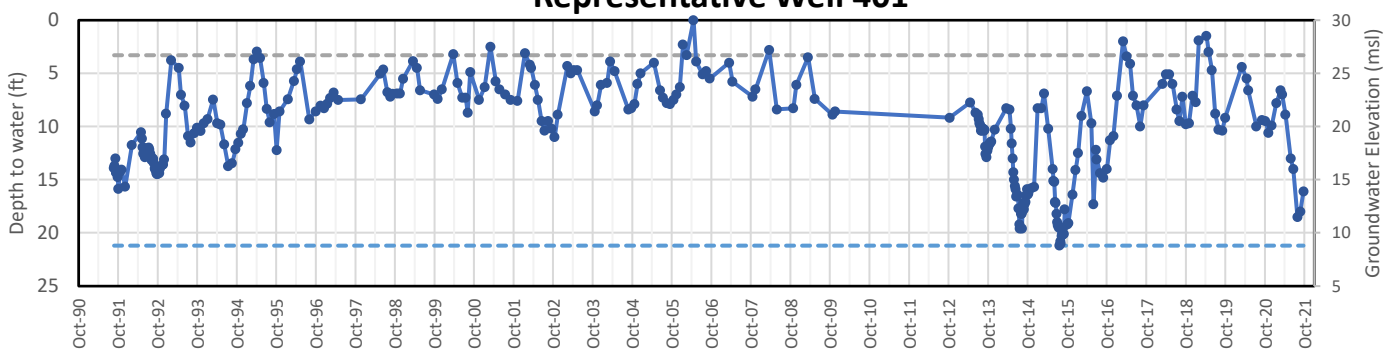
1 OF 1

Minimum Threshold      Measurable Objective      Groundwater Elevation

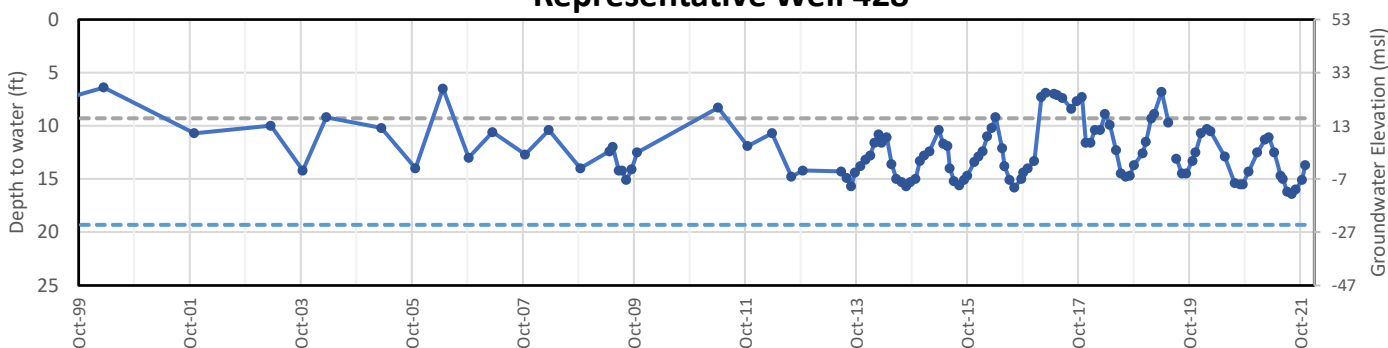
## Representative Well 151



## Representative Well 401



## Representative Well 428



# PUTAH CREEK REPRESENTATIVE HYDROGRAPHS

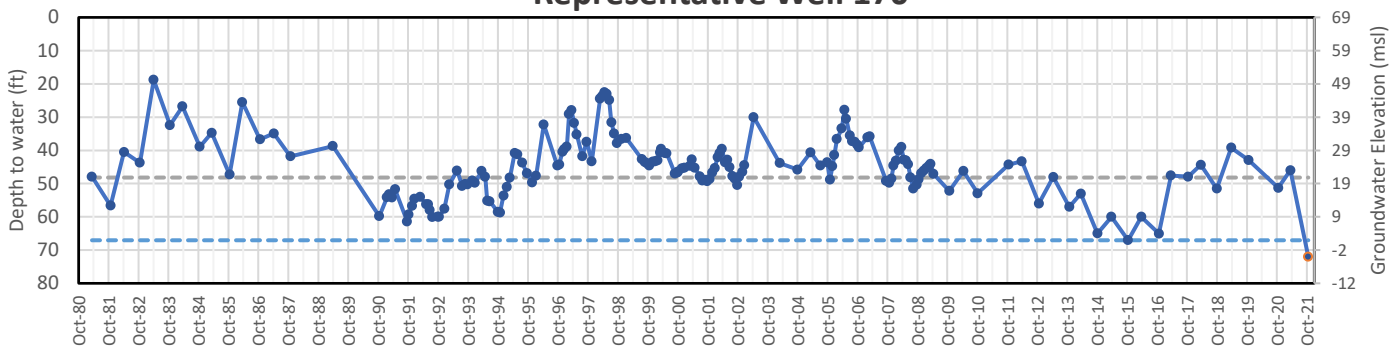
1 OF 1

Minimum Threshold

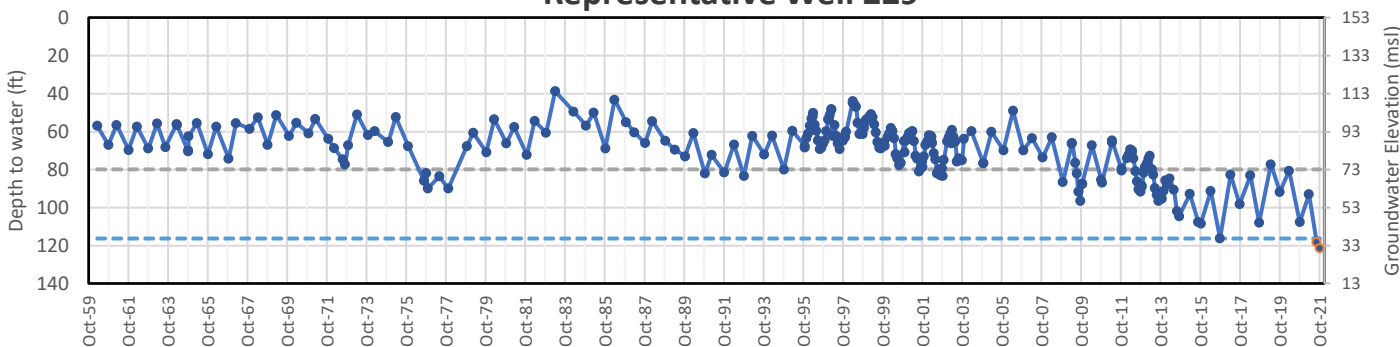
Measurable Objective

Groundwater Elevation

## Representative Well 170



## Representative Well 229



## Representative Well 429

