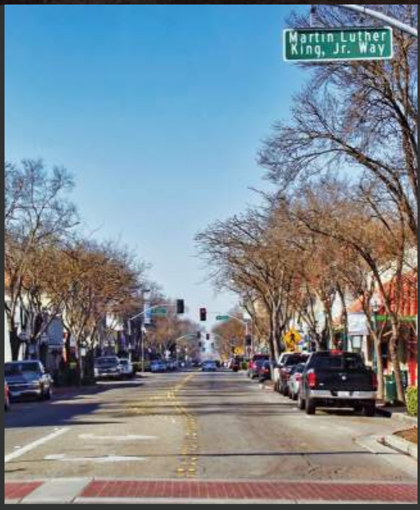
MERCED SGMA

Merced Groundwater Subbasin

GROUNDWATER SUSTAINABILITY PLAN

Water Year 2021 Annual Report

Image courtesy: Veronica Adrover/UC Merced



April 2022

MERCED GROUNDWATER SUBBASIN GROUNDWATER SUSTAINABILITY PLAN:

WATER YEAR 2021 ANNUAL REPORT

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ACRONYMS

Acronym	Definition
AFY	Acre-Feet per Year
AWMP	Agricultural Water Management Plan
BHMWC	Buchanan Hollow Mutual Water Company
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CEQA	California Environmental Quality Act
CFS	cubic feet per second
CWC	California Water Code
CWD	Chowchilla Water District
DDW	Division of Drinking Water
DPR	Department of Pesticide Regulation
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
ESJWQC	East San Joaquin Water Quality Coalition
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater dependent ecosystems
GICIMA	Groundwater Elevation Monitoring Groundwater Information Center Interactive Mapping Application
GPS	global positioning system
GQTMP	Groundwater Quality Trend Monitoring Program
GRAT	Groundwater Recharge Assessment Tool
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
ILRP	Irrigated Lands Regulatory Program
IRWM	Integrated Regional Water Management
IWFM	Integrated Water Flow Model
LGAWD	Le Grand Athlone Water District
LIDAR	Light Detection and Ranging
LPMWC	La Paloma Mutual Water Company
MAF	million acre-feet
MAR	managed aquifer recharge
MCL	Maximum Contaminant Level
MCWD	Merquin County Water District
MID	Merced Irrigation District
MIUGSA	Merced Irrigation-Urban Groundwater Sustainability
MSGSA	Merced Subbasin Groundwater Sustainability Agency
NASA	National Aeronautics and Space Administration
NRCS	National Agricultural Statistics Service
PRISM	Precipitation-Elevation Regressions on Independent Slopes Model
PVC	polyvinyl chloride
PWS	Public Water Supply
SAGBI	Soil Agricultural Groundwater Banking Index
SDAC	Severely Disadvantaged Community

SGC	Stakeholder Guidance Committee
SGM	Sustainable Groundwater Management
SGMA	Sustainable Groundwater Management Act
SMCL	secondary maximum contaminant level
SWD	Stevinson Water District
TAF	thousand acre-feet
TIWD	Turner Island Water District
TIWD GSA-1	Turner Island Water District Groundwater Sustainability Agency #1
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WY	water year

EXECUTIVE SUMMARY

The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement a GSP for the Subbasin: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

On January 28, 2022, DWR completed its review and evaluation of the Merced Subbasin GSP and made a determination that it is "incomplete." The three GSAs are working collaboratively to respond to DWR's comments and engage stakeholders and members of the public to address three identified deficiencies by July 27, 2022 (the end of the 180-day period allowed by GSP Regulations). Sustainable management criteria for some sustainability indicators may be revised. For the purpose of this Annual Report, recent observations are compared against the published sustainable management criteria in the original 2020 GSP.

California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. The first Annual Report provided an update on Subbasin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019), while the second Annual Report provided an update for water year 2020 (October 1, 2019 – September 30, 2020). This Annual Report covers water year 2021 (October 1, 2020 – September 30, 2021). CWC §356.2 requires annual reports include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report. Table ES-1 provides a summary of the definition of undesirable results and summary of compliance with the sustainability management criteria.

DWR has not yet published a San Joaquin Valley Water Year Index value for 2021, but with 1.3 MAF of summed runoff reported in the San Joaquin Valley Water Year Type Index (DWR, 2022b), it has been assumed to be a critically dry year for the purpose of this annual report. Given the drought conditions in WY 2021, the Subbasin experienced greater demand on the groundwater system.

Table ES-1-1: Summary of Sustainable Management Criteria

Sustainability Indicator	Minimum Threshold (MT)	Measurable Objective (MO)	Undesirable Result	WY 2021 Annual Report Status
Groundwater Levels	Depth of shallowest well in a 2-mile radius of each representative well or minimum pre-January 1, 2015, elevation	Projected average future groundwater level under sustainable yield modeling simulation	Greater than 25% of representative wells fall below MT in 2 consecutive wet, above normal, or below normal years[1]	No wells fell below MT. 11 of 21 wells fell below MO.
Groundwater Storage	Not applicable - not present and not likely to occur in the Subbasin due to the significant volumes of freshwater in storage			
Seawater Intrusion	Not applicable - not present and not likely to occur due to the distance between the Subbasin and the Pacific Ocean (and Sacramento-San Joaquin Delta)			
Degraded Water Quality	1,000 mg/L TDS	500 mg/L TDS	At least 25% of representative wells exceed MT for 2 consecutive years	Insufficient data to evaluate thresholds.
Land Subsidence	-0.75 ft/year	-0.25 ft/year	Exceedance of MT at 3 or more representative sites for 2 consecutive years	No sites exceeded MT. 2 of 4 sites exceeded MO.
Depletions of Interconnected Surface Waters	Groundwater levels used as a proxy for this sustainability indicator			

1. *Water year types based on San Joaquin Valley Water Year Index.*

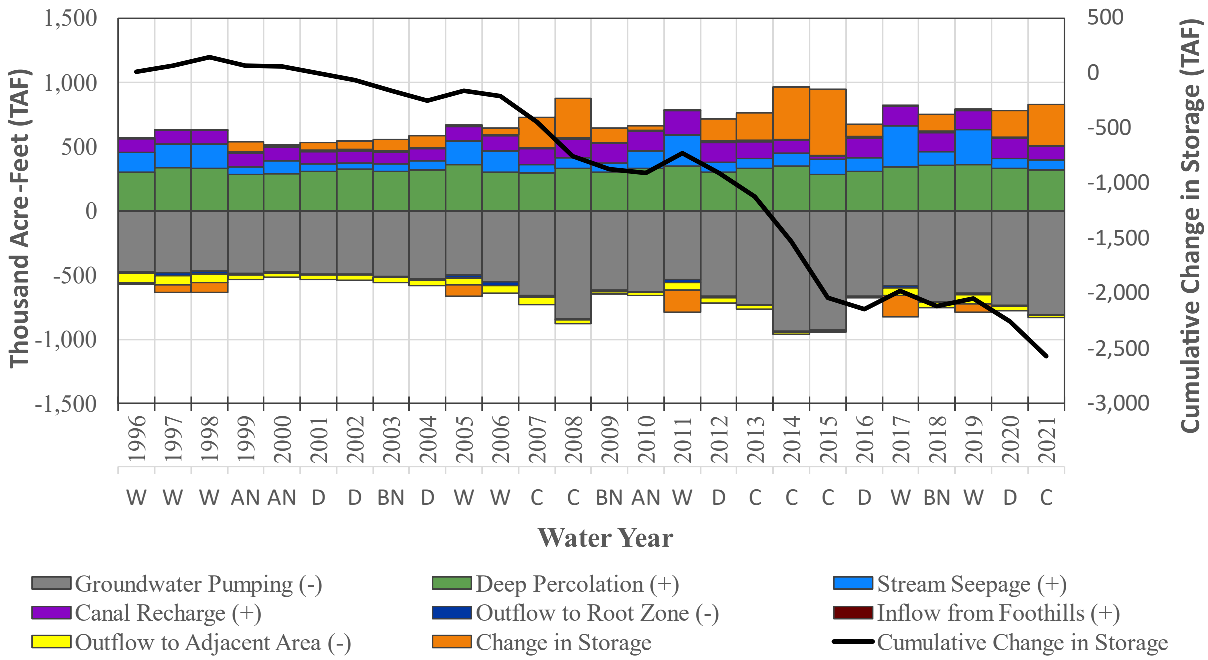
Groundwater Levels

Generally, groundwater level declines were observed in water year 2021. Based on data from 10 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was -0.5 ft from fall 2020 to fall 2021. Based on data from 8 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was -10.2 ft from fall 2020 to fall 2021. Based on data from 10 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -5.4 ft from fall 2020 to fall 2021. Hydrographs and contour maps of groundwater elevation can be found in **Appendix A** and **Appendix B**, respectively.

Groundwater Storage

The Merced Water Resources Model (MercedWRM) was updated with recent hydrologic and Subbasin operation information from water year 2021 to estimate historical change in storage of the Merced Subbasin. The cumulative change in storage during the updated historical water budget period of water years 2006-2021 was estimated as -2.41 MAF, or an average reduction of 151 thousand acre-feet (TAF) per year. During year 2021, the cumulative change in storage was estimated as -321 TAF. Figure ES-1 shows the cumulative change in storage against annual groundwater uses developed in the water budget and water year type.

Figure ES-1: Historical Annual Water Budget and Cumulative Change in Storage



Notes:

"Change in Storage" is placed on the chart to balance the water budget. For instance, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.

Water year types based on San Joaquin Valley Water Year Index (DWR, 2022a), *but 2021 has been assumed to be "C" (critically dry) due to runoff values below the previous threshold for critically dry years while waiting for DWR to publish a final 2021 value.*

Land Subsidence

Subsidence remains an ongoing concern in the Subbasin. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the US Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded semiannually in July and December of each year to monitor ongoing subsidence since 2011. Subsidence values in the last year have remained below the minimum threshold (-0.75 ft/year), but two of four representative sites were above the long-term measurable objective (-0.25 ft/year) from December 2020 to December 2021.

Groundwater Quality

The GSAs established a minimum threshold of 1,000 mg/L of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. Only one TDS measurement was recorded in WY 2021 and it did not exceed the MT or MO. During the development of the Annual Report, Electrical Conductivity (EC) data were pursued via coordination with the East San Joaquin Water Quality Coalition (ESJWQC). EC can be used to estimate TDS. EC may be considered in future reporting as a potential monitoring data source.

In addition to monitoring for TDS, the GSAs are conducting water quality coordination activities for other water quality constituents. These activities include review of monitoring reports published by other monitoring programs as well as compiling data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), Department of Toxic Substances Control (DTSC), and GeoTracker to the Groundwater Ambient Monitoring and Assessment (GAMA) database. The purpose of these reviews is to monitor the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL) or secondary maximum contaminant levels (SMCL). The GSAs have collected information from GAMA and will use this information to document regional groundwater quality and to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality as part of the GSP 5-year update.

Plan Implementation Progress

The GSAs made meaningful progress in GSP implementation in 2021 despite challenges presented by COVID-19 and critical dry year conditions.

Implementation of Projects

The GSP identifies 12 priority projects. Seven projects are considered complete. For most of the remaining five projects, project proponents are actively seeking funding, including a Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant application submitted to DWR in late February 2022. Updates to specific projects are described in Section 3.3 of this annual report.

Implementation of Management Actions

The Merced Subbasin GSP includes two Management Actions. For the **water allocation framework**, an Ad Hoc Working Group was previously established with GSA staff and representatives to conduct discussions on an initial framework. Ad hoc committee level discussions are ongoing. It is anticipated that allocation framework discussions at GSA Board and public meetings will occur starting in late 2022. The **MSGSA Demand Reduction Program** is in the process of development in recognition of the need to reduce groundwater pumping in the Subbasin. The MSGSA approved an objective that by water year 2025, the consumption of groundwater within the MSGSA will be reduced by a minimum of 15,000 AF annually, with this minimum to be increased annually thereafter. MSGSA has adopted a Two Phased GSP Implementation Approach, focusing on land repurposing as a near-term option to achieve the Water Year 2025 objective, combined with importing surface water in the GSA (flood waters or purchased water).

Additional Implementation Support Activities

In addition to projects and management actions, the GSAs undertook a number of activities to support GSP implementation. This included updating the MercedWRM model with the most recent monitoring data, completing development of a Data Gaps Plan, and continuing development of a remote-sensing decision support tool. The GSAs also pivoted to virtual Coordination Committee and Stakeholder Advisory Committee meetings which were held quarterly in 2021. A solicitation process was conducted to re-establish a Stakeholder Advisory Committee focused on GSP implementation.

After receiving funding through a Proposition 68 Sustainable Groundwater Management (SGM) Implementation Grant, the GSAs began implementation of two priority GSP projects ("El Nido Conveyance

System Improvements" project and "LGAWD Intertie and Recharge Project" [Phase 1]) that will improve groundwater levels in the southern portion of the Merced Subbasin through direct and in-lieu groundwater recharge, while also reducing flood risk to underrepresented communities.

At the end of February 2022, the GSAs submitted an application and spending plan to DWR for an anticipated $7.6 million of grant funding for up to 19 projects in the Merced Subbasin that cover both planning and implementation projects, including several groundwater recharge projects, filling data gaps, modeling work, and other demand reduction activities.

MIUGSA began hosting meetings for a MIUGSA-specific stakeholder group called the "Stakeholder Guidance Committee" with the purpose of developing rules, regulations, and guidelines for implementation within MIUGSA. Draft recommendations were presented to MIUGSA's Stakeholder Guidance Committee and the MIUGSA Board in March 2022. MIUGSA anticipates drafting rules and regulations, and policies to be considered for adoption in the following water year.

Activities Anticipated for the Coming Year

The Merced GSAs intend to continue activities necessary to implement the GSP and put the basin on a path toward sustainable management. A key effort anticipated in 2022 includes updating the GSP, which was determined on January 28, 2022 by DWR to be "incomplete." The three GSAs are already working collaboratively to respond to DWR's comments and engage stakeholders and members of the public to address three identified deficiencies by July 27, 2022 (the end of the 180-day period allowed by GSP regulations). Other activities anticipated for 2022 include implementation of the Data Gaps Plan (e.g., incorporating additional wells into the monitoring network and pursuing funding for installation of new wells), completing development of the Remote-Sensing Decision Support Tool, and making progress on a plan for pumping reductions and a water allocation framework.

1. INTRODUCTION

The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement the GSP: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

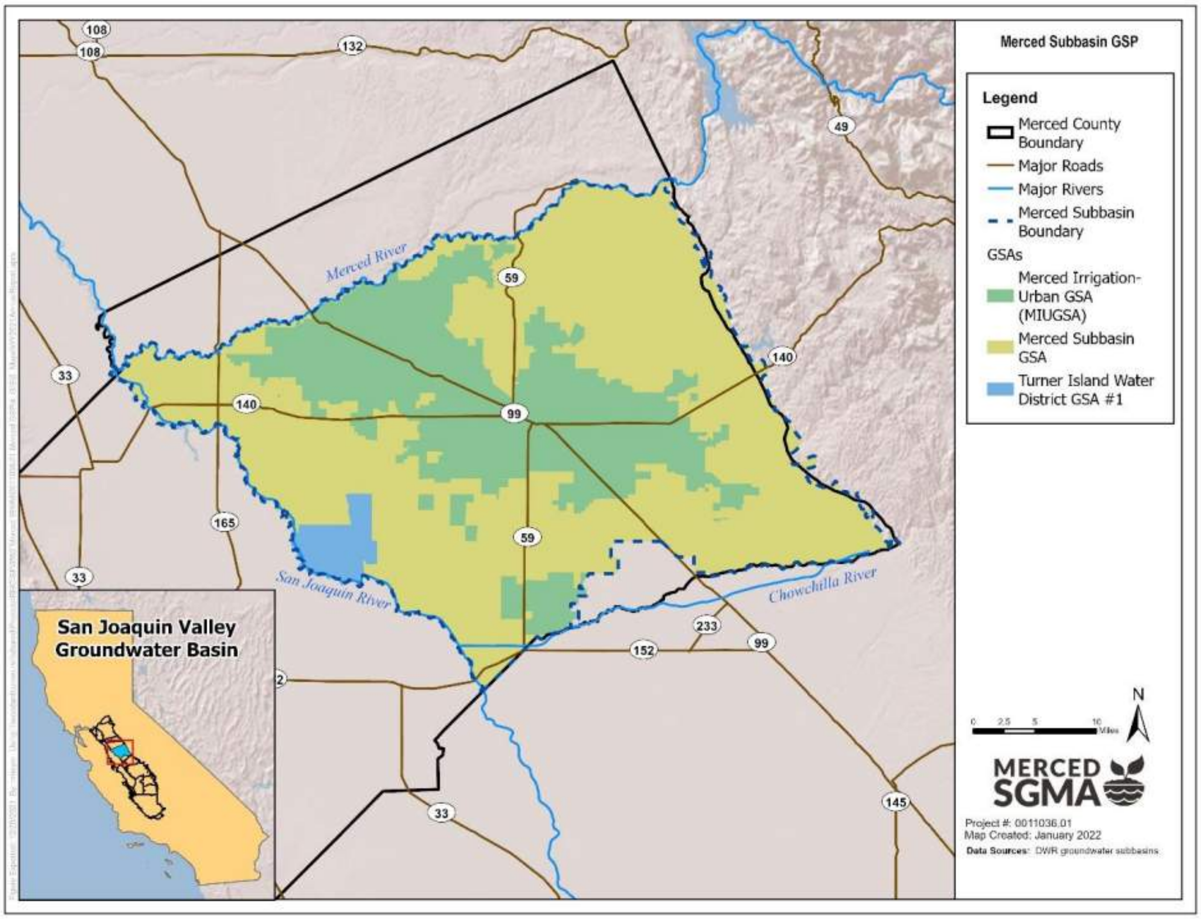
California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. The first Annual Report was submitted on March 31, 2020 and provided an update on basin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019), while the second Annual Report was submitted on March 31, 2021 and provided an update for water year 2020 (October 1, 2019 – September 30, 2020). This Annual Report covers water year 2021 (October 1, 2020 – September 30, 2021). CWC §356.2 requires annual reports to include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report.

The annual report is organized into two sections: Basin Settings and Plan Implementation. The Basin Settings section provides updates to water budgets and other basinwide information for water year 2021. The Plan Implementation section discusses progress on implementation of the GSP since the second Annual Report was submitted with a focus on updates on the status of projects and management actions identified in the GSP.

Figure 1-1 shows a map of the Merced Subbasin and the extent of the three GSAs. An inset map shows the location of the Merced Subbasin within the larger San Joaquin Valley Groundwater Basin located in the Central Valley of California. A more detailed description of the Merced Subbasin can be found in the GSP's Section 1.2 (Plan Area) and Section 2.1 (Hydrogeologic Conceptual Model).

On January 28, 2022, DWR completed its review and evaluation of the Merced Subbasin GSP and made a determination that it is "incomplete". The three GSAs are working collaboratively to respond to DWR's comments and engage stakeholders and members of the public to address three identified deficiencies by July 27, 2022 (the end of the 180-day period allowed by GSP Regulations). Sustainable management criteria for some sustainability indicators may be revised. For the purpose of this Annual Report, recent observations are compared against the published sustainable management criteria in the original 2020 GSP.

Figure 1-1: Location Map



2. BASIN SETTING

2.1 Groundwater Elevations

According to DWR's San Joaquin Valley Water Year Index, the previous water year (2020) was classified as a dry year (DWR, 2022a). DWR has not yet published a final index value for 2021, but with 1.3 MAF of runoff reported in the San Joaquin Valley Water Year Type Index (DWR, 2022b), it has been assumed to be a critically dry year[1] for the purpose of this annual report. Generally, groundwater levels declined during water year 2020 for the Above and Outside Corcoran Clay Principal Aquifers while they stayed approximately the same in the Below Corcoran Clay Principal Aquifer. No groundwater levels fell below the minimum threshold at representative wells and thus no undesirable results were triggered according to the sustainable management criteria set in the GSP. The GSP defines undesirable results as "during GSP implementation when November groundwater levels at greater than 25 percent of representative monitoring wells (at least 7 of 25) fall below their minimum thresholds for two consecutive years where both years are categorized hydrologically as below normal, above normal, or wet."

Generally, groundwater levels declined during water year 2021. Based on data from 10 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was -0.5 ft from fall 2020 to fall 2021. Based on data from 8 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was -10.2 ft from fall 2020 to fall 2021.[2] Based on data from 10 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -5.4 ft/yr from fall 2020 to fall 2021. These values do not take into account that monitoring wells are not evenly distributed throughout the Subbasin, but the overall values still function to provide an overview of trends based on available data. Figure 2-1 shows the location of the wells in the Merced Subbasin GSP monitoring network for groundwater levels. Individual hydrographs for these wells can be found in **Appendix A**. All available data are shown, except for measurements flagged for quality control reasons. Hydrographs for representative monitoring wells also display the minimum threshold and measurable objective that were developed in Chapter 3 (Sustainability Indicators) of the GSP. The hydrographs also show a water year type indicator according to the San Joaquin Valley Water Year Hydrologic Classification Index. As previously stated, at the time of publishing, DWR has not yet announced the water year type designation for 2021, but for the purpose of this annual report it has been estimated to be "C" (critically dry). Monitoring network data have been uploaded to the Merced data management system and SGMA Portal.

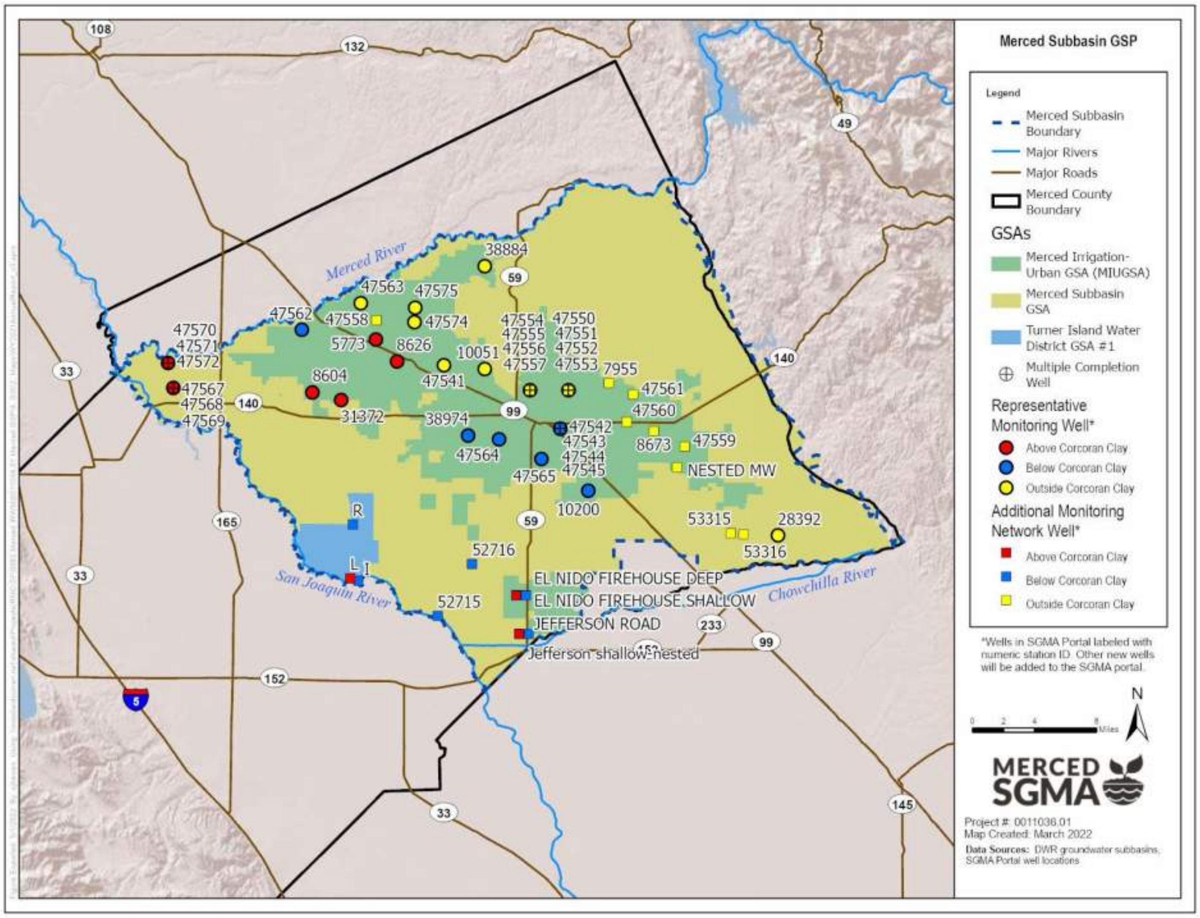
The following wells located in TIWD GSA-1 are anticipated to be added to the groundwater level monitoring network in the upcoming water year, pending site visit reviews to confirm well accessibility for ongoing future monitoring:

- Well "R", located in the northern portion of TIWD GSA-1 and completed within the Below Corcoran Clay Principal Aquifer.
- Well "I", located along the southern edge of TIWD GSA-1 and completed within the Below Corcoran Clay Principal Aquifer.
- Well "L", located along the southern edge of TIWD GSA-1 and completed within the Above Corcoran Clay Principal Aquifer.

[1] Runoff (unimpaired flow) of equal to or less than 2.1 MAF is considered hydrologically "critically dry".

[2] Monitoring well station ID 52715 is excluded from this average because it experienced a decrease in groundwater levels of 127.6 ft from fall 2020 to fall 2021 and otherwise dragged down the average across nine wells from -10.2 ft to -23.3 ft.

Figure 2-1: Groundwater Level Monitoring Network



Appendix B shows contour maps of seasonal high (spring) and seasonal low (fall) groundwater elevations for each of the three principal aquifers for fall 2020, spring 2021, and fall 2021. Groundwater level data were obtained from the SGMA Data Viewer and GSP monitoring network for groundwater levels[3]. Groundwater levels reported by both monitoring network wells and other voluntary wells in the Merced, Turlock, Delta-Mendota, Chowchilla, and Madera Subbasins were used to develop contours. Measurements from neighboring subbasins were included to provide spatial coverage for contoured groundwater levels along the edges of the Merced Subbasin. The contour maps for the Above Corcoran Clay and Outside Corcoran Clay Principal Aquifers show hatched areas labeled "Area of increased uncertainty due to data limitations" which indicate regions with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due to the data limitations. The GSP identifies this as a data gap and the GSAs

[3] TIWD GSA-1 also provided additional static water level measurements for wells within the GSA boundary that are not part of the SGMA Data Viewer system. The first year of monitoring data from new monitoring wells added last year in the El Nido and Planada regions has not yet been uploaded to the SGMA Data Viewer but was used in the development of this Annual Report. MIUGSA plans to upload ongoing collected data from the El Nido and Planada sites to the SGMA Data Viewer starting in WY 2022.

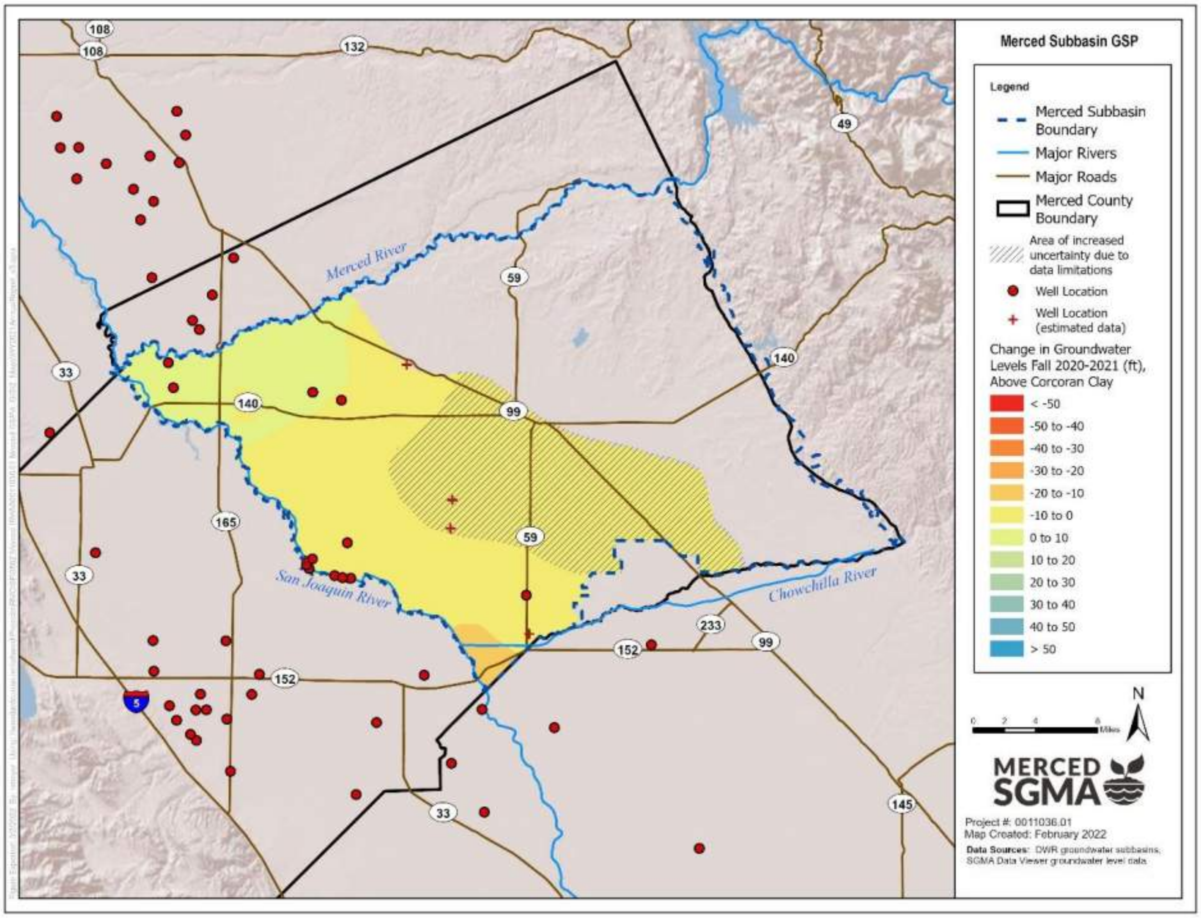
are in the process of implementing recommendations from a recently completed Data Gaps Plan to address critical data gaps in the basin.

Groundwater level contours at 20-foot intervals were developed using an interpolation method of inverse distance weighting, with local averaging performed to generate smoother contour lines. Groundwater level measurements were classified as spring if they were recorded in the month of March (± 5 days) and classified as fall if they were recorded in the month of October (± 5 days). Contour maps for each season and principal aquifer can be found in **Appendix B**.

Many voluntary wells do not consistently report groundwater elevations each spring and fall. In some cases, measurements for monitoring network wells were discounted due to nearby pumping or another data quality flag. A multiple linear regression tool was applied to estimate the groundwater elevations for the missing seasons for wells with missing seasonal data located within the Merced Subbasin. The estimate is necessary to provide consistent results between time periods, despite variability in available data. The multiple linear regression was applied separately at each well for fall and spring measurements where there were several years of historical data for each respective season. The multiple linear regression methodology makes use of groundwater trends throughout each aquifer, historical observed data at the well being analyzed, as well as other observations such as water storage changes from the NASA Gravity Recovery and Climate Experiment, soil moisture from the Global Land Data Assimilation System, or the Palmer Drought Severity Index (BYU Hydroinformatics Laboratory, n.d.). Wells at which groundwater elevation was estimated for the purpose of developing contours are called out in the contour maps in **Appendix B**. All other data points use observed data.

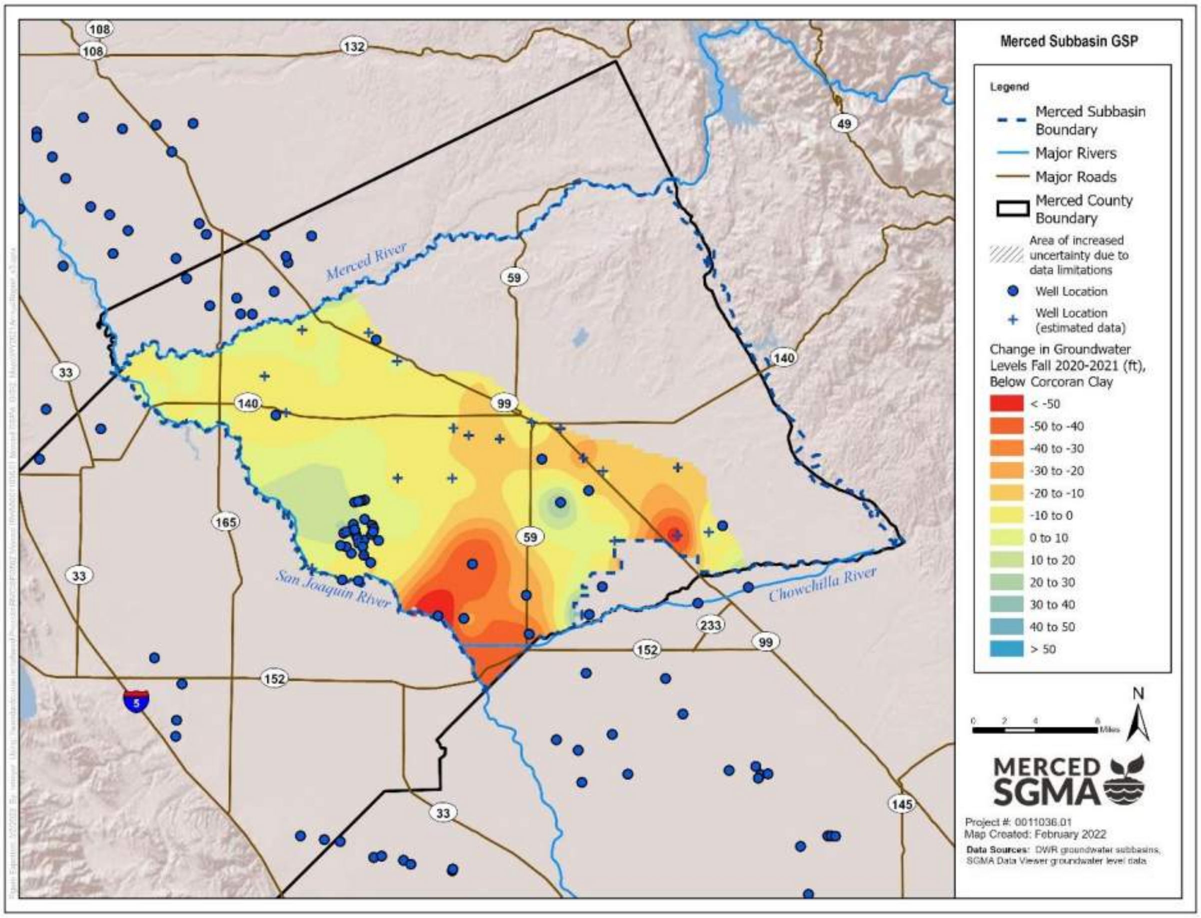
Figure 2-2 through Figure 2-4 show the total change in groundwater levels between fall 2020 and fall 2021 for each principal aquifer, based on comparing the interpolated groundwater level surfaces. The Above Corcoran Clay Principal Aquifer generally shows a slight net decrease in groundwater levels throughout most of the aquifer. The Below Corcoran Clay Principal Aquifer shows moderate increases in groundwater levels in the western portion, with decreases in the southern and eastern portions of the principal aquifer. In the Outside Corcoran Clay Principal Aquifer, groundwater levels were found to decrease across most of the aquifer.

Figure 2-2: Total Change in Groundwater Levels Fall 2020 to Fall 2021, Above Corcoran Clay



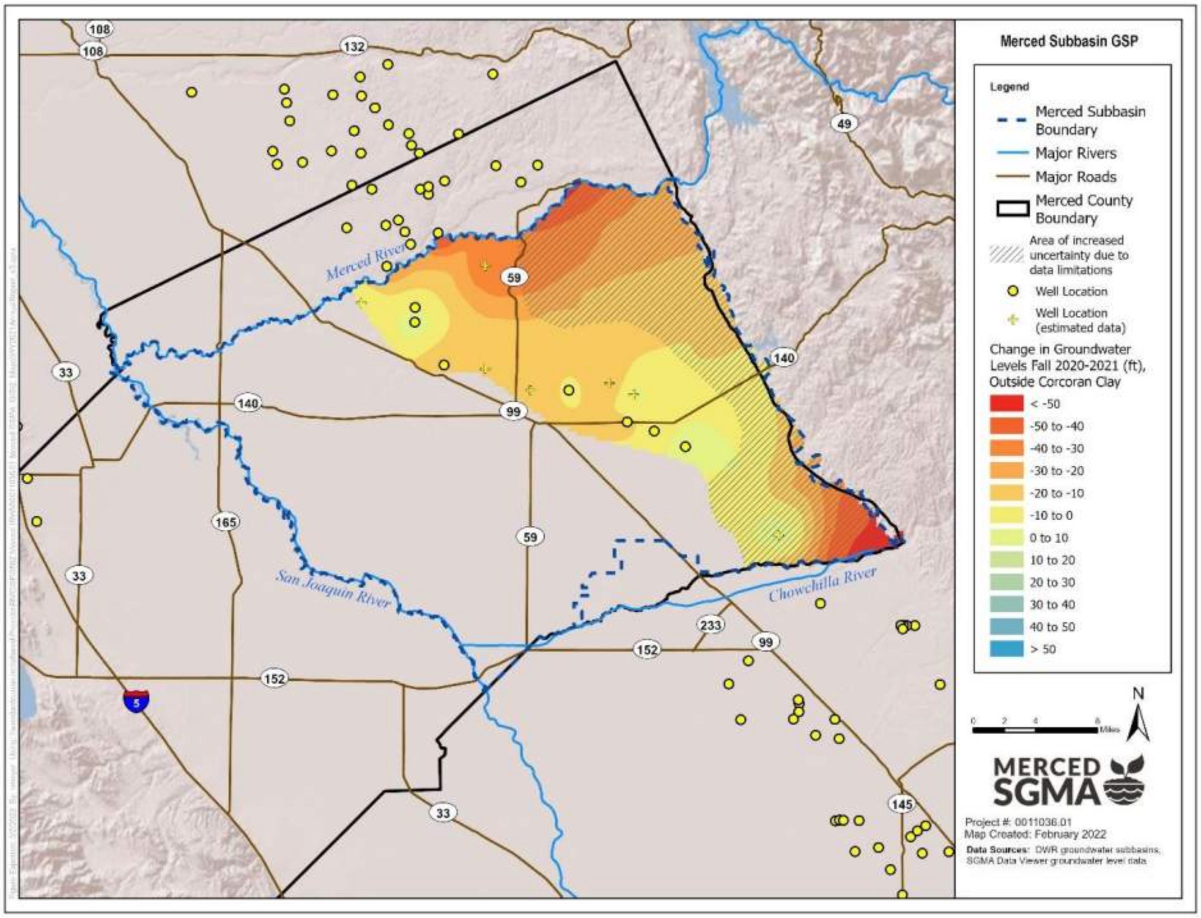
1. *For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.*
2. *The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan as of 2022.*

Figure 2-3: Total Change in Groundwater Levels Fall 2020 to Fall 2021, Below Corcoran Clay



1. *For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.*

Figure 2-4: Total Change in Groundwater Levels Fall 2020 to Fall 2021, Outside Corcoran Clay



1. *For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.*
2. *The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan as of 2022.*

Table 2-1 lists the representative monitoring wells for the sustainability indicator of chronic lowering of groundwater levels, with a comparison of fall 2021 groundwater elevations against minimum threshold, measurable objective, and interim milestone 2025 elevations.

Table 2-1: Groundwater Elevation at Representative Monitoring Wells

State Well ID	Site Code	Station ID	Principal Aquifer	Fall 2021 GW Elevation[1]	Minimum Threshold Elevation[1]	Measurable Objective Elevation[1]	Interim Milestone 2025[1]
06S12E33D001M	373732N1206679W001	5773	Above	45.5	-102.5	50.4	46.5
07S11E15H001M	373243N1207424W001	8604	Above	59.4	-112.0	63.6	31.2
07S12E03F001M	373532N1206432W001	8626	Above	32.1[2]	4.9	41.5	41.5
07S11E24A001M	373166N1207091W001	31372	Above	54.3	-27.2	54.9	50.8
07S10E17D003M	373278N1209054W002	47569	Above	65.9	-43.0	66.3	70.2
07S10E06K002M	373510N1209113W001	47571	Above	60.9	-39.8	63.6	49.9
08S14E15R002M	372335N1204199W001	10200	Below	61.1	-52.8	5.5	5.5
07S13E32H001M	372838N1205602W001	38974	Below	74.1	-55.6	34.3	34.3
07S14E35E001M	372904N1204207W001	47542	Below	63.4	-31.1	10.4	10.4
06S11E27F001M	373821N1207551W001	47562	Below	64.2[3]	-107.2	69.0	58.8
07S13E34G001M	372806N1205241W001	47564	Below	63.8[2]	-50.3	21.8	-101.5
08S14E06G001M	372617N1204747W001	47565	Below	53.0	-15.1	12.5	12.5
07S13E09A001M	373457N1205429W001	10051	Outside	57.6[3]	-27.5	34.0	34.0
08S16E34J001M	371902N1201985W001	28392	Outside	N/A[4]	-88.5	-51.9	-51.9
06S13E04H001M	374421N1205407W001	38884	Outside	63.3	-35.7	70.8	69.3
07S12E07C001M	373496N1205890W001	47541	Outside	25.8	14.7	39.7	39.7
07S14E16F004M	373260N1204432W004	47553	Outside	74.4	-21.1	14.9	61.2
07S13E13H004M	373260N1204880W004	47557	Outside	59.0	-23.2	9.2	9.2
06S12E17M001M	374074N1206859W001	47563	Outside	55.5[3]	-126.5	68.5	29.4
06S12E23P001M	370000N1200000W001	47574	Outside	55.8	-75.0	46.9	46.9
06S12E23C001M	370000N1200000W002	47575	Outside	51.3	-89.0	58.7	58.7

1. *All elevations reported in feet above sea level, datum NAVD88.*
2. *Station IDs 8626 and 47564 had a QA flag of "Other" with no other comments provided.*
3. *Station IDs 47562, 10051, and 47563 had a QA flag of "Oil or foreign substance in casing". Oil layer depths were not measured and thus an adjusted water surface elevation cannot be estimated.*
4. *Station ID 28392 was not recorded in water year 2021.*

2.2 Groundwater Extractions

Table 2-2 summarizes monthly groundwater extractions for water year 2021 by water use sector and method of measurement. Groundwater extraction data were requested from groundwater agencies located in the Merced Subbasin, listed below:

- City of Atwater
- City of Livingston
- City of Merced
- Merced Irrigation District (MID)
- Turner Island Water District GSA #1
- Stevinson Water District
- Merquin County Water District
- Planada Community Services District
- Lone Tree Mutual Water Company
- American Water, Meadowbrook
- Winton Water and Sanitary District
- Le Grand Community Services District
- Merced National Wildlife Refuge

All reported values from agencies were directly measured. Data are a mixture of metered data and some data from pump tests using run time data. Quantitative estimates of accuracy of measurement (e.g., by percentage or +/- AF) were requested from each agency but not provided by all. Directly measured data are expected to have a qualitative high level of accuracy.

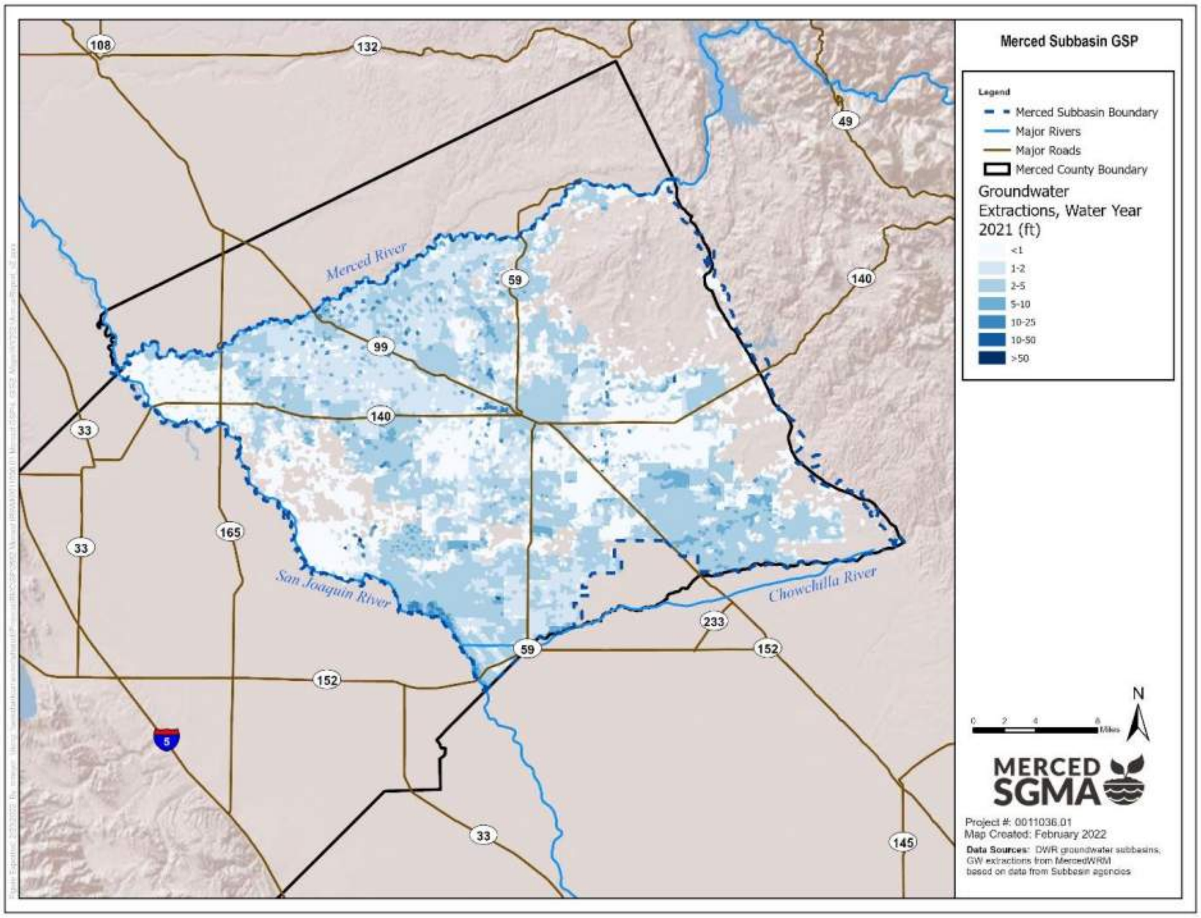
Groundwater extractions from private irrigators and domestic wells are estimated by the Merced Water Resources Model (MercedWRM) based on factors including land use, evapotranspiration, and population. Details about the MercedWRM can be found in the GSP, while recent updates to the model can be found in Section 3.5.2 of this annual report. A map illustrating the general location and volume of groundwater extractions as estimated by the MercedWRM for water year 2021 can be found in Figure 2-5. These estimated data are expected to have a qualitative medium level of accuracy.

Table 2-2: Monthly Groundwater Extractions (in AF), Water Year 2021

Month	Sector						Total
	Agriculture		Urban		Habitat[4]		
	Agency Pumping 1	Private Pumping 2	Agency Pumping 1	Private Pumping 3	Direct[4]	Estimated 4	
Oct-2020	1,655	42,326	3,730	804	1,773	125	50,413
Nov-2020	842	2,183	2,737	642	1,921	399	8,724
Dec-2020	131	0	2,287	515	1,833	412	5,178
Jan-2021	738	0	2,173	488	2,020	412	5,831
Feb-2021	741	0	2,108	485	1,329	200	4,861
Mar-2021	2,797	45,133	2,613	540	1,360	324	52,767
Apr-2021	4,873	74,193	3,431	742	477	240	83,955
May-2021	15,996	61,719	4,277	904	502	83	83,480
Jun-2021	20,963	107,258	4,516	941	453	83	134,215
Jul-2021	22,776	111,187	4,891	1,043	574	83	140,553
Aug-2021	11,602	120,516	4,641	1,089	386	83	138,316
Sep-2021	5,825	80,821	4,088	981	662	83	92,461
TOTAL	**88,937**	**645,337**	**41,491**	**9,172**	**13,290**	**2,527**	**800,754**

1. *"Agency Pumping" indicates direct measurements of volumes of pumped groundwater reported by agricultural purveyors and urban water suppliers. Directly measured data are expected to have a qualitative high level of accuracy.*
2. *"Private Pumping" for the agricultural sector is estimated by the MercedWRM based on land use and evapotranspiration data. See Section 3.5.3 - MercedWRM Update (Water Year 2021). These estimated data are expected to have a qualitative medium level of accuracy.*
3. *"Private Pumping" for the urban sector (primarily from domestic wells in rural regions) is estimated by the MercedWRM based on census data for population multiplied by a volumetric water use factor averaged from the urban regions. See Section 3.5.3 - MercedWRM Update (Water Year 2021). These estimated data are expected to have a qualitative medium level of accuracy.*
4. *The "Habitat" sector includes directly measured volumes of groundwater extractions at Merced National Wildlife Refuge within the Merced Unit of the refuge. Directly measured data are expected to have a qualitative high level of accuracy. The Merced National Wildlife Refuge also provided some estimated groundwater extractions from the Arena Plains and Snobird Units of the refuge. These estimated data are expected to have a qualitative medium level of accuracy. Groundwater pumping for other wetland/habitat areas are included in the "Agriculture" sector due to a lack of information for demands from these wetlands/habitat areas. Demands were estimated based on DWR land use categorizations of native vegetation or agricultural land.*

Figure 2-5: Map of Groundwater Extractions (Water Year 2021)



2.3 Surface Water Supply

SGMA requires that the GSP annual report tabulate "*Surface water supply used* *<u>or available for use</u>*…" (emphasis added, CCR §356.2 [b] [3]). Table 2-3 summarizes total monthly surface water available for use for water year 2021, broken down by method of measurement. These tables report total surface water diversions and not surface water used, which is difficult to parse out by sector. Direct measurements were provided by MID, Stevinson Water District, TIWD, and Lone Tree Mutual Water Company. Directly measured data are expected to have a qualitative high level of accuracy. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under both the agricultural and habitat sectors. Diversions made by Lone Tree Mutual Water Company are exclusively flood flow diversions.

Note also that there are several riparian diverters in the Subbasin whose diversions have not been captured for the purpose of the annual report because they divert a relatively small volume of surface water compared to the diversions made by agencies. It is anticipated that some of these data will be incorporated into future reports, as data will become available as a result of increased compliance with Senate Bill 88 (2015).

Table 2-3: Monthly Surface Water Available for Use (in AF), Water Year 2021

Month	Method of Measurement[1]	Total
	Direct	
Oct-2020	32,727	32,727
Nov-2020	3,897	3,897
Dec-2020	3,216	3,216
Jan-2021	2,339	2,339
Feb-2021	4,589	4,589
Mar-2021	19,006	19,006
Apr-2021	42,588	42,588
May-2021	61,154	61,154
Jun-2021	66,671	66,671
Jul-2021	73,506	73,506
Aug-2021	61,439	61,439
Sep-2021	39,477	39,477
TOTAL	**410,608**	**410,608**

1. *This table reports total surface water diversions and not surface water used due to data limitations. Both surface diversions and surface water used are difficult to parse out by sector as well. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under the agriculture and habitat sectors.*

2.4 Total Water Use

Per SGMA requirement, Table 2-4 summarizes monthly combined groundwater use (Table 2-2) and surface water available for use (Table 2-3) for water year 2021 by water use sector and method of measurement. The same qualifications for method of measurement and sector of use apply from Table 2-2 and Table 2-3.

Table 2-4: Monthly Total Water Use, Water Year 2021

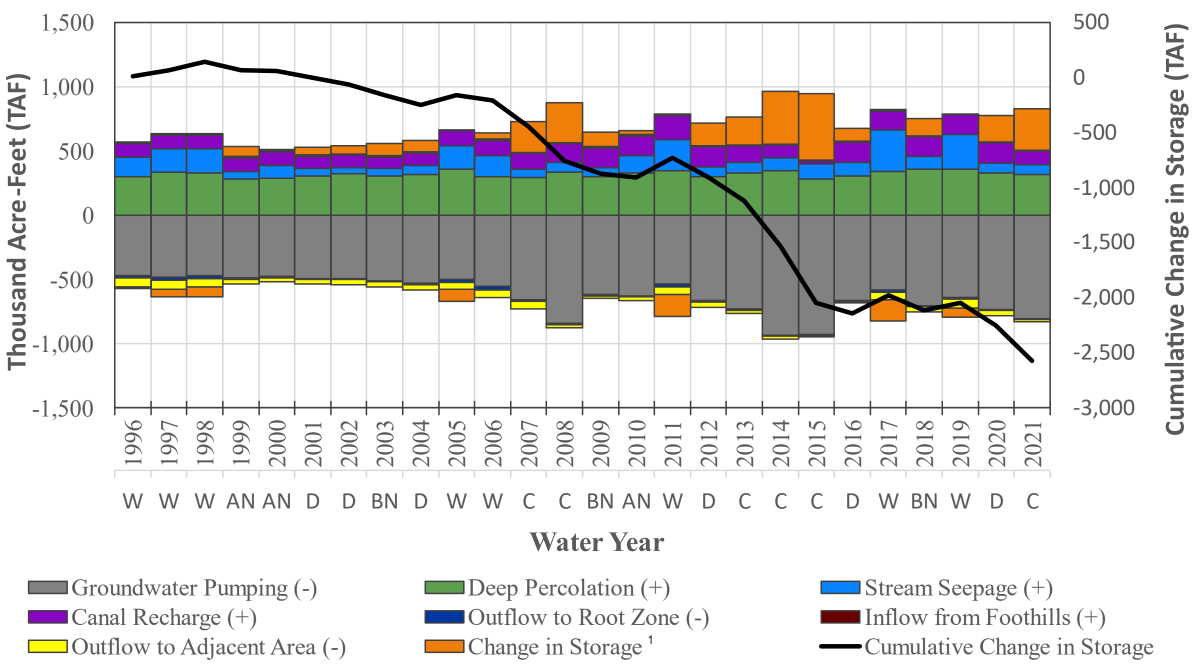
Month	Sector						Total
	Agriculture		Urban		Habitat		
	Direct[1]	Estimate[2]	Direct	Estimate[2]	Direct	Estimate	
Oct-2020	34,382	42,326	3,730	804	1,773	125	83,140
Nov-2020	4,738	2,183	2,737	642	1,921	399	12,620
Dec-2020	3,347	0	2,287	515	1,833	412	8,394
Jan-2021	3,077	0	2,173	488	2,020	412	8,169
Feb-2021	5,330	0	2,108	485	1,329	200	9,450
Mar-2021	21,803	45,133	2,613	540	1,360	324	71,773
Apr-2021	47,461	74,193	3,431	742	477	240	126,543
May-2021	77,149	61,719	4,277	904	502	83	144,634
Jun-2021	87,634	107,258	4,516	941	453	83	200,886
Jul-2021	96,282	111,187	4,891	1,043	574	83	214,060
Aug-2021	73,040	120,516	4,641	1,089	386	83	199,755
Sep-2021	45,302	80,821	4,088	981	662	83	131,938
TOTAL	**499,546**	**645,337**	**41,491**	**9,172**	**13,290**	**2,527**	**1,211,362**

1. *Surface water diversions have been reported under the category of Agriculture, Direct. As described in Table 2-3, this includes total surface water diversions and not surface water used, and cannot be accurately measured between the agriculture and habitat sectors. Surface water diversions account for approximately 80% of this column.*
2. *See Table 2-2 for more detailed notes on groundwater pumping estimates.*

2.5 Change in Groundwater Storage

The Merced Water Resources Model (MercedWRM) was used to estimate historical change in groundwater storage in the Merced Subbasin from water years 1996-2020 for the Merced GSP and subsequent annual reports and then extended through 2021 to support quantification of storage change for this annual report. See Section 3.5.2 for more information about the recent model update for this annual report. Note that the time period of 2006-2015 was originally selected as the historical water budget time period reported in the Merced GSP as representative of average precipitation and capturing recent Subbasin operations. After extending the historical water budget through water year 2021, the current (2021) total fresh groundwater storage was estimated as 45.4 MAF and the cumulative change in storage from water years 2006-2021 was estimated as -2.41 MAF, or an average reduction of 151 TAF per year. During water year 2021, the change in storage was estimated as a reduction of 321 TAF, which exceeds the average by approximately 170 TAF. Figure 2-6 shows the cumulative change in storage for 1996-2021 against groundwater uses developed in the water budget and water year type.

Figure 2-6: Historical Annual Water Budget – Groundwater System, Merced Subbasin



1. *"Change in Storage" is placed on the chart to balance the water budget. For example, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.*
Source: Water year types based on San Joaquin Valley Water Year Index (DWR, 2022a)*, but 2021 has been assumed to be "C" (critically dry) due to runoff values below the previous threshold for dry years while waiting for DWR to publish a final 2021 value.*

Sustainable management criteria were not developed for this sustainability indicator because significant and unreasonable reduction of groundwater storage is not present and not likely to occur in the Subbasin. The 2006-2021 cumulative change in storage described above, which includes both representative dry and wet years, reflects a rate of overdraft of approximately 0.3 percent of total freshwater storage per year. It is not reasonable to expect that the available groundwater in storage would be exhausted.

Figure 2-7 through Figure 2-9 show the total change in groundwater storage by principal aquifer for water year 2021 in a spatial format as estimated by outputs from the MercedWRM. The change in storage is shown in units of feet. The MercedWRM calculates a change in volume per area of each model element. Since the model elements vary in size, visually displaying a map of volume change per model element is not spatially intuitive, so the results have been normalized to show change in depth by dividing the volume by area per model element.

Change in groundwater storage is a function of changes in groundwater levels and physical properties of the aquifer. As such, it would be expected that areas with increases in groundwater storage would also have increases in groundwater levels in Figures 2-2 through 2-4 and that areas with decreases in groundwater storage would also have decreases in groundwater levels. While this is true in many cases, it is not true in all cases due to uncertainties in the underlying data. Uncertainties in the change in groundwater storage are associated with the MercedWRM, while uncertainties in the change in groundwater levels are associated with limited data points and individual data points that may be impacted by nearby pumping or otherwise provide non-representative values. It is useful to look at these figures together to better understand patterns of change in groundwater levels and storage.

Net Subbasin storage decreased during the 2021 water year and the figures below primarily show corresponding areas of relative decrease in storage (negative change in depth shown in green shades). The Above Corcoran Clay shows a few small pockets of relatively small increase in storage (positive change in depth shown in blue shades).

Figure 2-7: Change in Storage Water Year 2021 (AF), Above Corcoran Clay

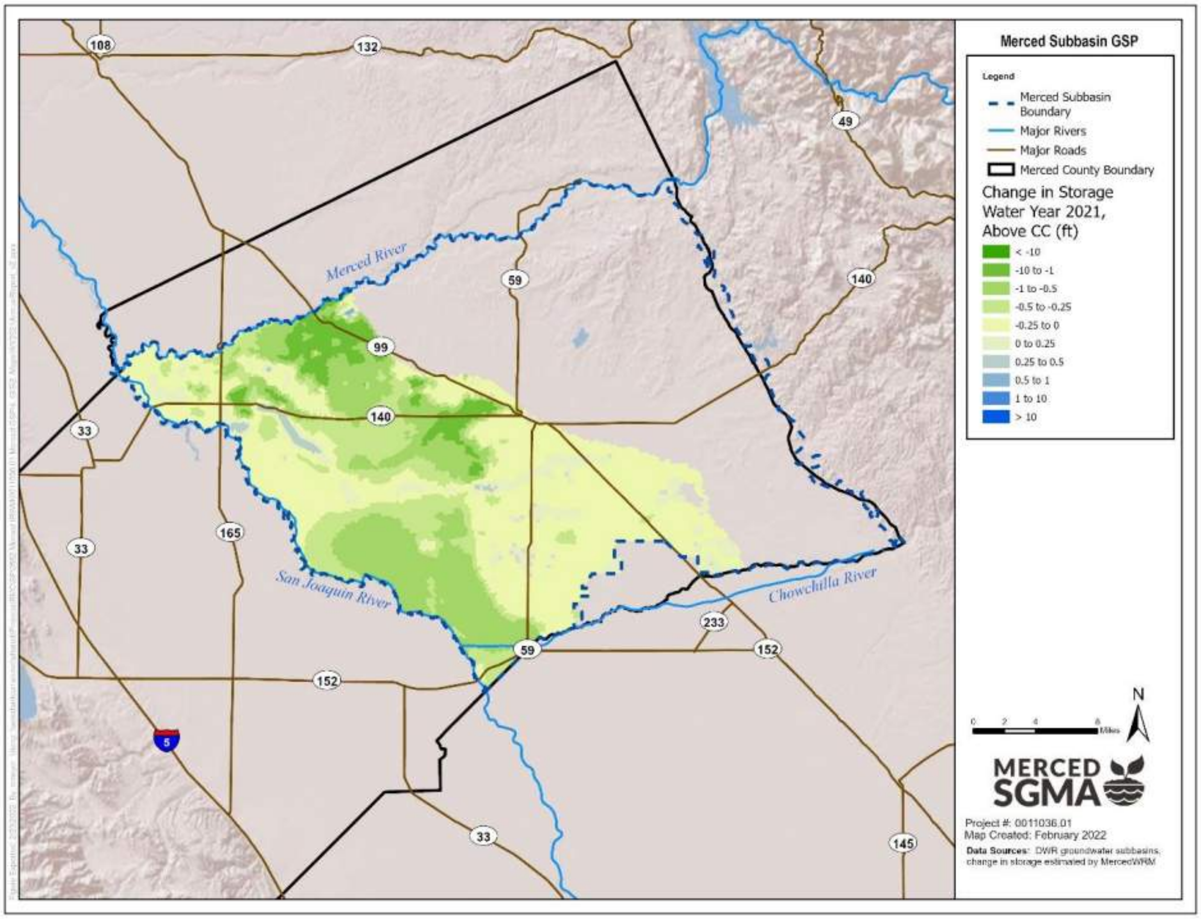


Figure 2-8: Change in Storage Water Year 2021 (AF), Below Corcoran Clay

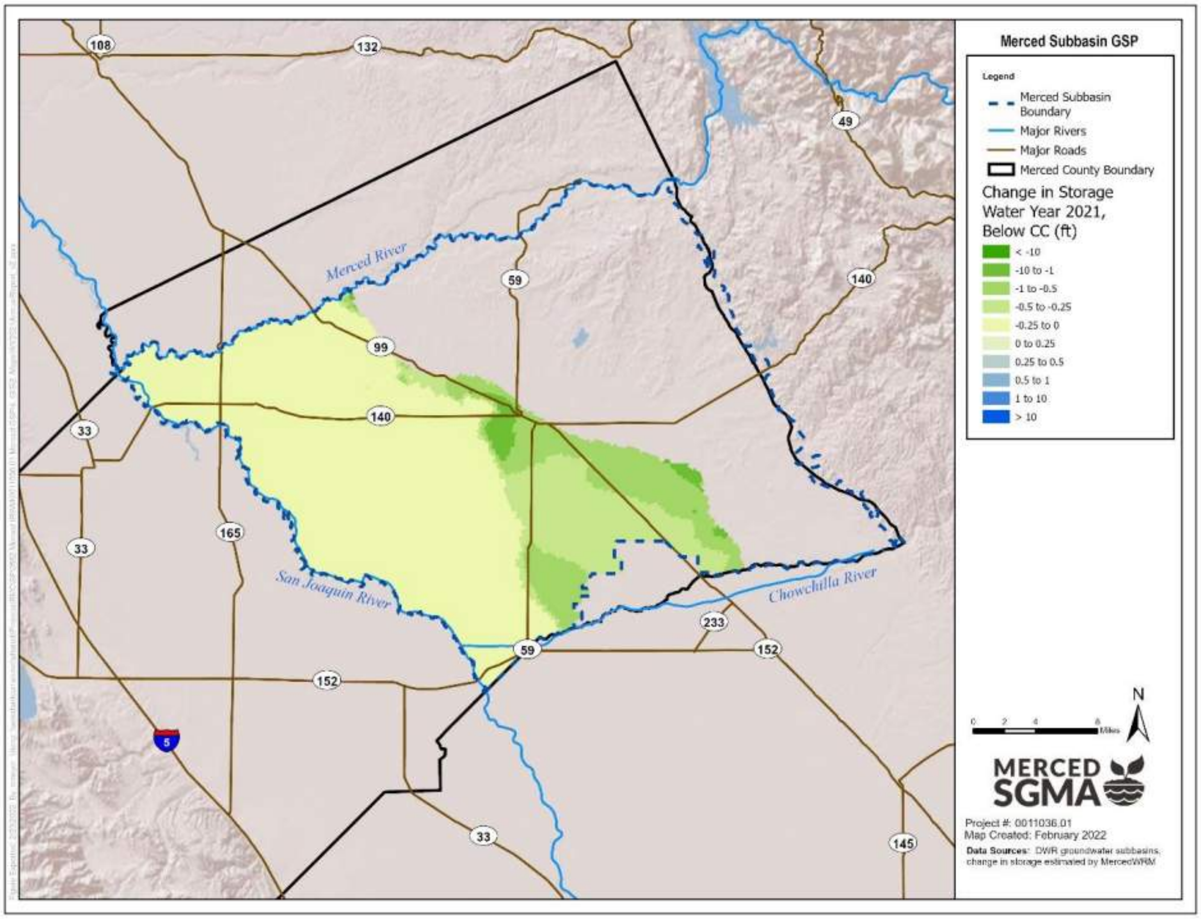
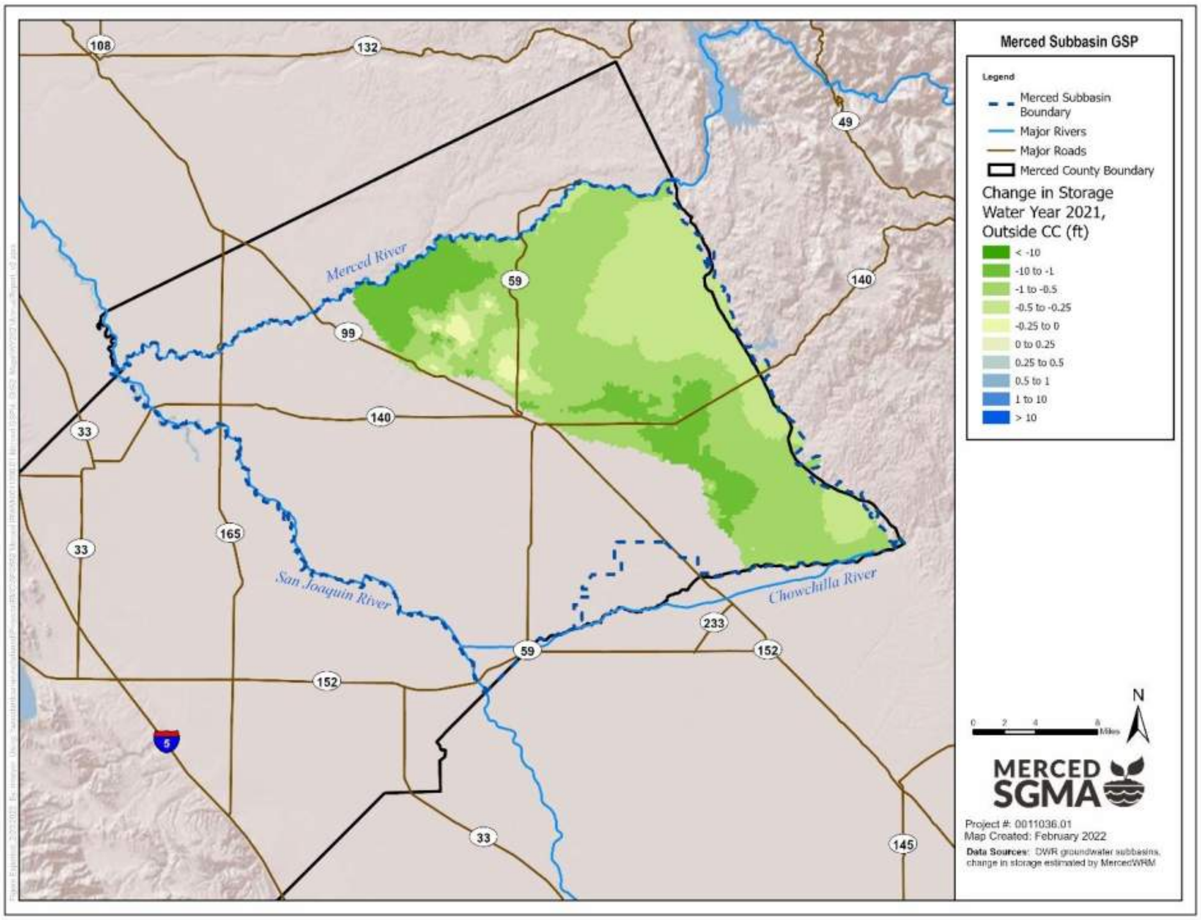


Figure 2-9: Change in Storage Water Year 2021 (AF), Outside Corcoran Clay



1. *The eastern portion of the Outside Corcoran Clay Principal Aquifer is a region with a relatively lower density of monitoring wells and thus higher level of uncertainty due the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan as of 2022.*

2.6 Land Subsidence

This section provides maps of the most recent subsidence measurements taken in and around the Subbasin and compares them to the GSP's sustainable management criteria. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the US Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded semiannually in July and December of each year to monitor ongoing subsidence since 2011. Figure 2-10 shows the total subsidence occurring from December 2020 to December 2021. Figure 2-11 shows the average subsidence occurring from December 2012 through December 2021. December 2012 is shown as the starting point rather than December 2011 when USBR monitoring began due to many additional data points added in December 2012 that were not recorded in December 2011.

Figure 2-10: Total Subsidence December 2020 to December 2021

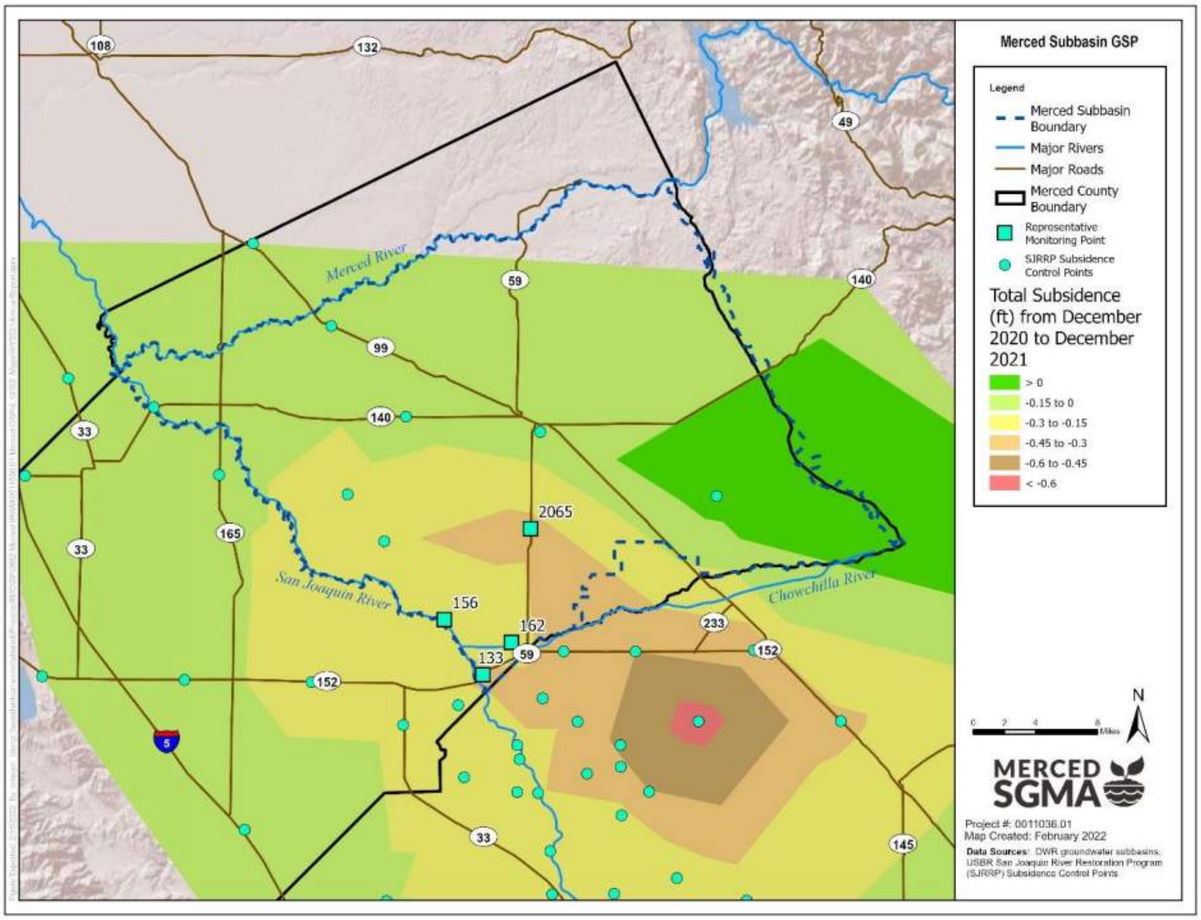
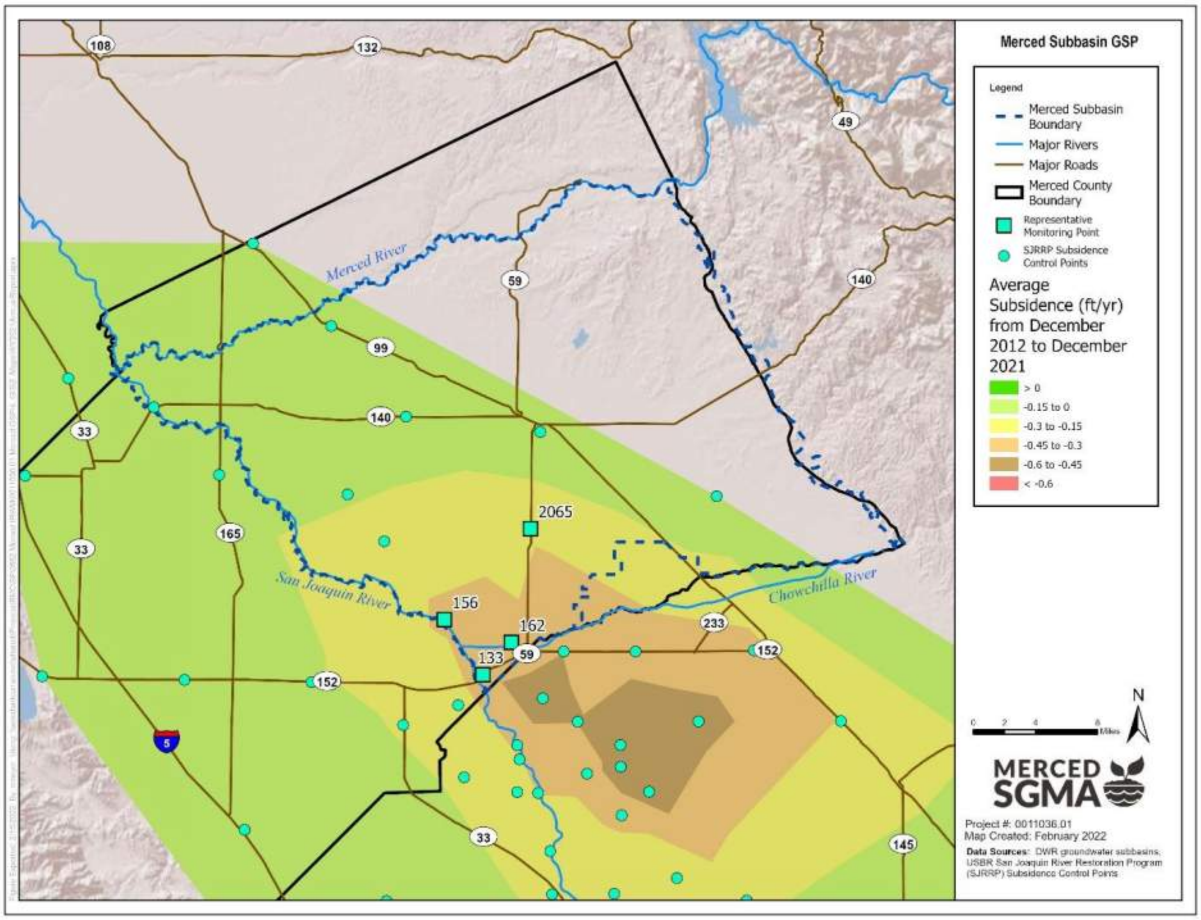


Figure 2-11: Average Subsidence Rate December 2012 to December 2021



In the GSP, the GSAs established a minimum threshold of -0.75 ft/year at four representative monitoring stations based on data review of subsidence between 2011 and 2018. The measurable objective and all interim milestones are -0.25 ft/year of subsidence. The GSP identifies undesirable results for subsidence as "exceedances of minimum threshold rates of land subsidence at three or more monitoring sites out of four for two consecutive years, where both years are categorized hydrologically as below normal, above normal, or wet".

As shown in Table 2-5, subsidence values in the last four years have not exceeded the minimum threshold (i.e., the magnitude of subsidence is less than the minimum threshold). In eight cases in the last four years, the magnitude of annual subsidence has exceeded the long-term measurable objective (i.e., the magnitude of subsidence is greater than the measurable objective; Stations 133 and 156 in 2017-18, all four stations in 2019-2020, and Stations 133 and 2065 in 2020-21). Work is currently underway to better understand how to stabilize subsidence in the Subbasin. Subsidence is a gradual process that takes time to develop and time to halt. As a result, some level of future subsidence, likely at rates similar to those currently experienced, is likely to be underway already and will not be able to be prevented.

Table 2-5: Subsidence at Representative Monitoring Stations

Point ID	Station Name	Subsidence (ft)				Minimum Threshold (ft/yr)	Measurable Objective / Interim Milestone (ft/yr)
		Dec 2017 - Dec 2018	Dec 2018 - Dec 2019	Dec 2019 - Dec 2020	Dec 2020 - Dec 2021		
133	H 1235 RESET	-0.30	-0.24	-0.39	-0.33	-0.75	-0.25
162	RBF 1057	-0.17	-0.10	-0.26	-0.19	-0.75	-0.25
2065	W 938 RESET	-0.17	-0.14	-0.30	-0.35	-0.75	-0.25
156	W 990 CADWR	-0.32	-0.07	-0.28	-0.23	-0.75	-0.25

2.7 Groundwater Quality

In addition to comparing water quality monitoring to the GSP's interim milestones and other sustainable management criteria, this section provides a summary of ongoing water quality coordination activities being conducted by the GSAs.

2.7.1 Representative Monitoring

In the GSP, the GSAs established a minimum threshold of 1,000 mg/L of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. Undesirable results are defined in the GSP as "during GSP implementation when at least 25 percent of representative monitoring wells (5 of 19 sites) exceed the minimum threshold for degraded water quality for two consecutive years."

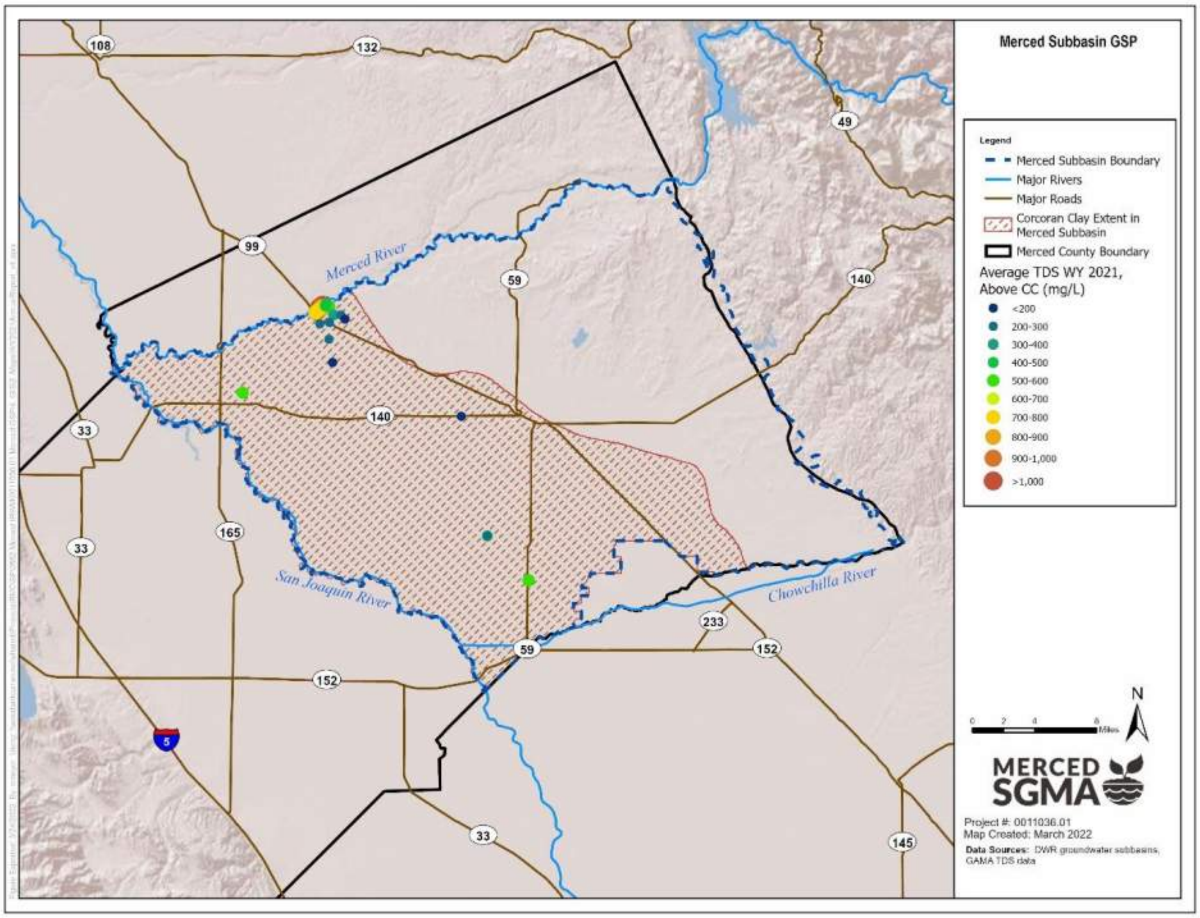
Figure 2-12 through Figure 2-14 show the spatial distribution of TDS concentration measurements in the three principal aquifers based on TDS and electrical conductivity (EC) data reported in the Groundwater Ambient Monitoring & Assessment (GAMA) database within water year 2021 for wells in the Merced Subbasin monitoring network (including more than just representative wells).[4] EC measurements were converted to estimates of TDS only if TDS samples were not measured directly during water year 2021. Figure 2-15 shows concentrations for which the principal aquifer is unknown due to a lack of well construction data (e.g., lacking total well depth or screened interval). The GSP monitoring network includes both designated representative wells as well as any Public Water Supply (PWS) wells that report data to the Division of Drinking Water (DDW).

While elevated TDS concentrations (greater than 1,000 mg/L) were observed in monitoring data for water year 2021, they were confirmed to be at three locations where either raw water was measured at a municipal well before treatment or samples were collected at environmental monitoring wells monitored by regulated facilities. The Merced GSP also describes that there are pockets of the Subbasin known to have such elevated concentrations and water use behaviors have already shifted to accommodate these concentrations. For example, agriculture has focused on more salt-tolerant crops, and more saline water supplies are blended with less saline water supplies. As a result, TDS concentrations in excess of 1,000 mg/L where currently experienced are not unexpected. There is, however, a desire on the part of Subbasin stakeholders to limit

[4] TDS concentration was estimated using the University of California Agriculture and Natural Resources salinity unit conversion formula of TDS (mg/L) = EC (µS/cm) * 0.640.

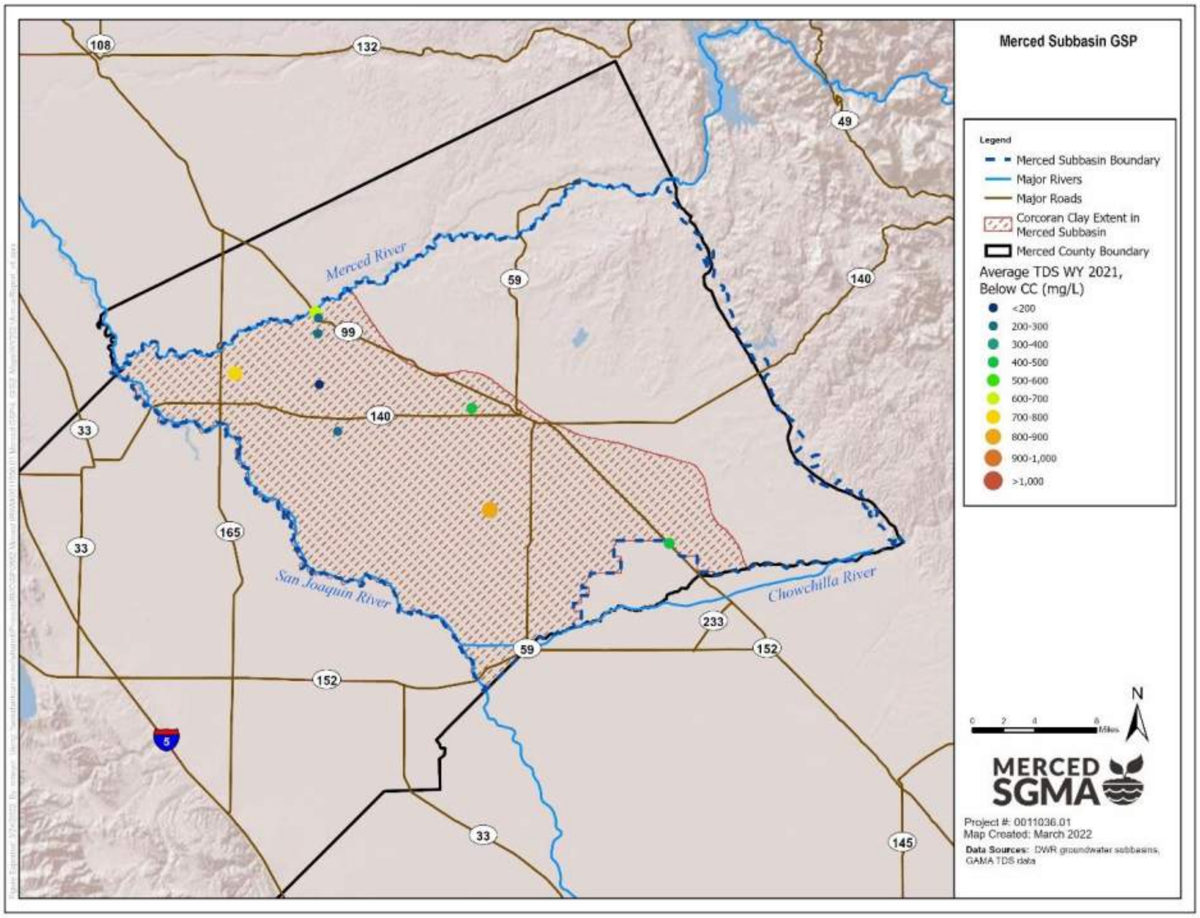
increases in salinity in parts of the Subbasin where TDS is below 1,000 mg/L to prevent undesirable results such as requirements to change cropping, blending supplies, etc.

Figure 2-12: Average TDS Concentration Water Year 2021, Above Corcoran Clay Principal Aquifer



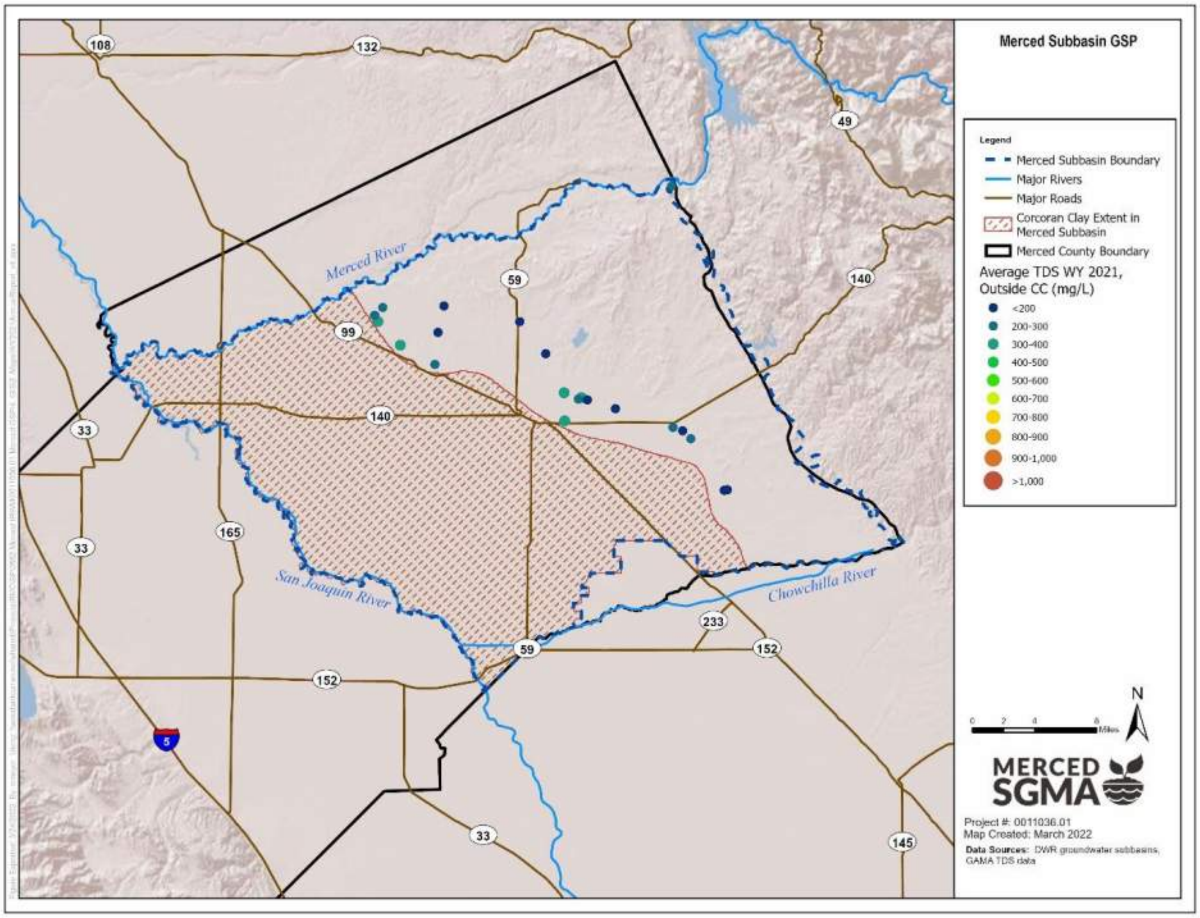
1. *Some TDS values are estimated based on EC measurements.*

Figure 2-13: Average TDS Concentration Water Year 2021, Below Corcoran Clay Principal Aquifer



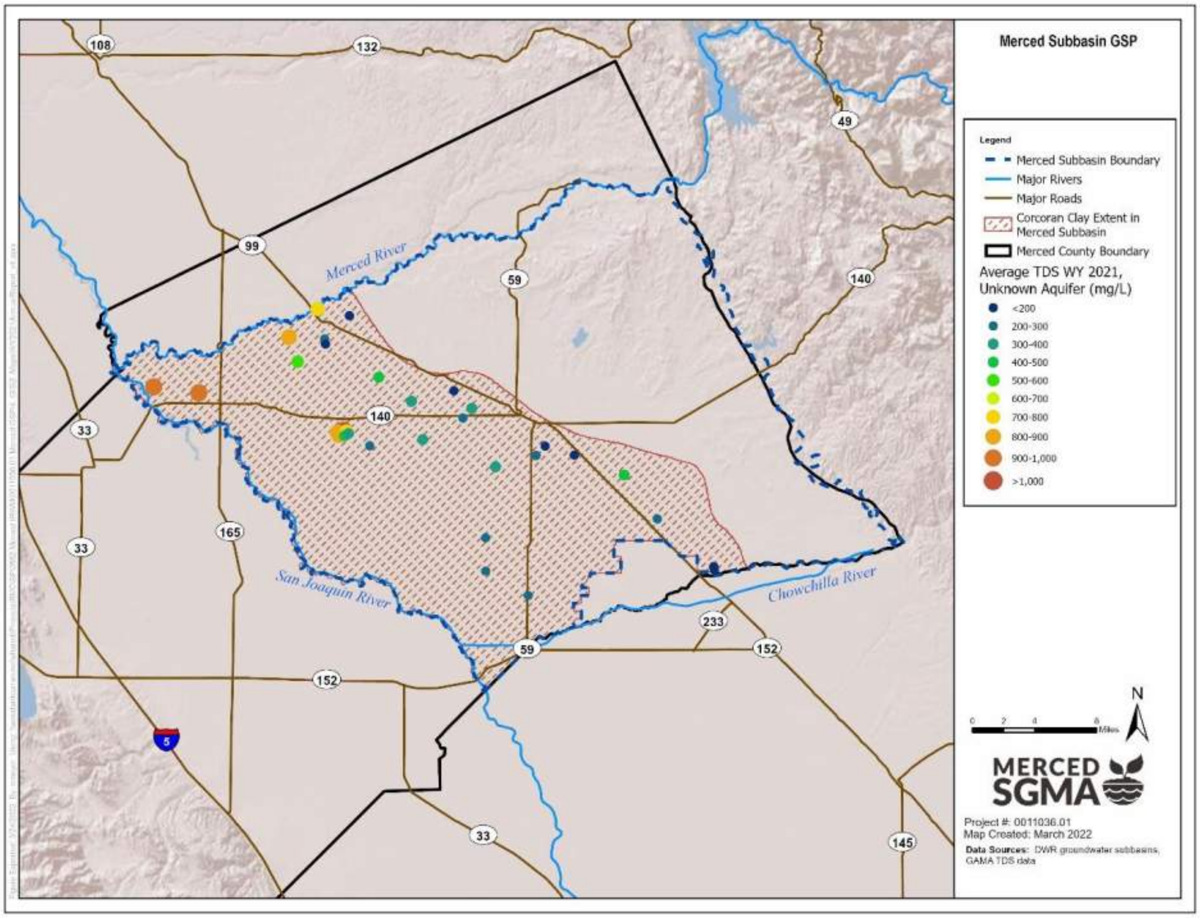
1. *Some TDS values are estimated based on EC measurements.*

Figure 2-14: Average TDS Concentration Water Year 2021, Outside Corcoran Clay Principal Aquifer



1. *Some TDS values are estimated based on EC measurements.*

Figure 2-15: Average TDS Concentration Water Year 2021, Unknown Principal Aquifer



1. *Some TDS values are estimated based on EC measurements.*

The East San Joaquin Water Quality Coalition (ESJWQC) is a group of agricultural interests and growers formed to represent dischargers who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne, and Mariposa Counties, as well as portions of Calaveras County. The ESJWQC has developed a Groundwater Quality Trend Monitoring Program (GQTMP) as part of the Irrigated Lands Regulatory Program (ILRP), which includes a targeted set of domestic wells (denoted as principal wells) supplemented by public water system wells (denoted as complementary wells) (ESJWQC, 2018). There are currently eight principal wells and 14 complementary wells in the Merced Subbasin that are designated as representative monitoring wells in the Merced GSP at which sustainable management criteria are established (shown in Table 2-6).

In 2021, ESJWQC completed a Five-Year Assessment Report which included results of samples collected in 2020; the report was published as part of the Central Valley Groundwater Monitoring Collaborative Five-Year Assessment Report (Central Valley Groundwater Monitoring Collaboriatve, 2021). Data were submitted to GAMA. ESJWQC monitors EC @ 25°C, pH, dissolved oxygen (DO), temperature, and nitrate + nitrate as N annually. TDS and other constituents are monitored every five years. Sixteen new wells were added to the network in 2020. Of these, two are located within the Merced Subbasin: ESJQC00022 is located completed within the Above Corcoran Clay principal aquifer and ESJQC00030 is completed within the Below Corcoran Clay principal aquifer. Both wells have been added to the Merced GSP's representative monitoring network for water quality.

For all but the most recently installed principal wells, TDS was last recorded in October 2018. More recent EC field measurements collected by the ESJWQC were used to estimate TDS for informational purposes. The most recent TDS observations (whether direct or estimated) for Merced GSP representative wells are summarized in Table 2-6. None of the wells with reported data have measured or estimated TDS concentrations above the minimum threshold. Four wells show an estimated TDS concentration that is above the measurable objective and interim milestones. Note that for the 14 complementary wells (identified with GQTMP Well ID beginning with "C"), only one (C49) had TDS data reported in GAMA for the reporting period.

TDS is measured by ESJWQC every five years, though the definition of undesirable results in the Merced GSP is based on the assumption that measurements will be recorded annually. Because ESJWQC is already collecting samples and testing for nitrate annually, the Merced GSAs are considering providing support to the GQTM to expand monitoring to include TDS on an annual basis. Alternatively, EC may be considered in future reporting as a potential monitoring data source.

Table 2-6: TDS Concentrations at Representative Monitoring Wells

GQTMP Well ID	GAMA Well ID	EC (µS/cm)	TDS (mg/L)	Date of Measurement [b]	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
P06	AGC100012331-ESJQC00006	307	196 [a]	8/5/2020	1,000	500	Outside Corcoran Clay
P07	AGC100012331-ESJQC00007	304	195 [a]	7/28/2021	1,000	500	Below Corcoran Clay
P08	AGC100012331-ESJQC00008	464	297 [a]	7/28/2021	1,000	500	Outside Corcoran Clay
P09	AGC100012331-ESJQC00009	656	420 [a]	7/28/2021	1,000	500	Below Corcoran Clay
P10	AGC100012331-ESJQC00010	1,389	889 [a]	7/28/2021	1,000	500	Below Corcoran Clay
P19	AGC100012331-ESJQC00019	1,246	797 [a]	7/28/2021	1,000	500	Below Corcoran Clay
ESJQC00022 [c]	AGC100012331-ESJQC00022 [c]	835	534 [a,c]	7/27/2021	1,000	500	Above Corcoran Clay
ESJQC00030 [c]	AGC100012331-ESJQC00030 [c]	769	492 [a,c]	7/27/2021	1,000	500	Below Corcoran Clay
C35	2400172-001		362	1/22/2009	1,000	500	Above Corcoran Clay
C41	2400220-001	930	595 [a]	3/5/2008	1,000	500	Above Corcoran Clay
C45	2400089-001				1,000	500	Above Corcoran Clay
C38	2410004-011		250	6/9/2020	1,000	500	Below Corcoran Clay

GQTMP Well ID	GAMA Well ID	EC (µS/cm)	TDS (mg/L)	Date of Measurement [b]	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
C44	2400218-001		320	3/8/2012	1,000	500	Below Corcoran Clay
C40	2410001-006		290	3/16/2006	1,000	500	Outside Corcoran Clay
C42	2400046-002		400	6/28/2016	1,000	500	Outside Corcoran Clay
C43	2410007-005		280	4/9/2019	1,000	500	Outside Corcoran Clay
C46	2410007-002		209	1/31/1991	1,000	500	Outside Corcoran Clay
C47	2400194-001				1,000	500	Outside Corcoran Clay
C39	2400119-001				1,000	500	Outside Corcoran Clay
C48	2410011-005		200	7/30/2019	1,000	500	Outside Corcoran Clay
C49	2400172-012		300	12/16/2020	1,000	500	Unknown
C50	2400079-001		270	2/9/2017	1,000	500	Unknown

a. *TDS concentration was estimated using the University of California Agriculture and Natural Resources salinity unit conversion formula of TDS (mg/L) = EC (µS/cm) * 0.640. Values are presented for informational purposes. The GSAs may consider use of TDS estimates based on EC readings at a later date.*

b. *All 2021 data are shown. If no data for 2021 are available, the most recent measurement of TDS (or TDS estimated from EC) is shown.*

c. *ESJQC00022 and ESJQC00030 were added to the network in 2020 and were sampled for TDS on 8/5/2020. ESJQC00022 was measured at 550 mg/L and ESJQC00030 was measured at 800 mg/L. Due to a reporting time period lag, this information was not presented in the previous water year 2020 report.*

2.7.2 Water Quality Coordination Activities

In addition to monitoring for TDS (see Section 2.7.1 - Representative Monitoring), the GSAs are conducting water quality coordination activities to address other water quality constituents. These activities include review of monitoring reports published by other monitoring programs as well as compiling data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), Department of Toxic Substances Control (DTSC), and GeoTracker to the GAMA database. The purpose of these reviews is to evaluate the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL)[5] or secondary maximum contaminant levels (SMCL)[6].

Established in 2000, the GAMA Program monitors groundwater quality throughout California. GAMA is intended to create a comprehensive groundwater monitoring program throughout the state and increase public availability and access to groundwater quality and contamination information. Agencies submit data

[5] MCLs are drinking water standards that are adopted as regulations and describe the highest level of a contaminant allowed in drinking water, based on health risks and also detectability, treatability, as well as the costs of treatment.

[6] Secondary MCLs are established by the USEPA and then adopted by the SWRCB. The secondary MCL is a Secondary Drinking Water Standard that is established for aesthetic reasons such as taste, odor, and color and is not based on public health concerns.

from monitoring wells for 244 constituents. GAMA data for the Merced Subbasin contains wells monitored or regulated by the DDW, DPR, DWR, USGS, and environmental monitoring wells monitored by regulated facilities. The GSAs have collected information from GAMA and will use this information to document regional groundwater quality and to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality as part of the GSP 5-year update.

3. PLAN IMPLEMENTATION PROGRESS

3.1 Overview of Implementation Support Activities

This section of the Annual Report provides updates on projects, and management actions, and other implementation support activities.

3.2 Interim Milestones

Interim Milestones were identified in Chapter 3 (Sustainable Management Criteria) of the GSP for all Sustainability Indicators and provided in tabular form for Groundwater Elevations and Groundwater Quality Sustainability Indicators (see Tables 3-1 and 3-2 in GSP). These Interim Milestones are anticipated to be achieved over the course of GSP implementation in increments of five years, pursuant to the CCR definition "*Target values representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan*" [CCR Title 23, Division 2, §351(q)]. Progress toward achieving Interim Milestones since submitting the 2019 GSP are provided in Sections 2.1 (Groundwater Elevations), 2.6 (Land Subsidence), and 2.7 (Groundwater Quality). Further updates are expected in the first Five Year Assessment for the Merced Subbasin GSP, with status checks provided in future annual reporting.

3.3 Implementation of Projects

The GSP identifies twelve priority projects. These were selected for inclusion in the GSP based on their ability to address a list of priorities identified by the Stakeholder Advisory and Coordination Committee members and the public. These priorities are listed in Chapter 6 (Projects and Management Actions to Achieve Sustainability Goal) in the GSP. The priorities are:

- Addressing Disadvantaged Communities (DACs) and or Severely Disadvantaged Communities (SDACs)
- Addressing areas with known data gaps
- Providing basin-wide benefits (i.e., benefits all GSAs)
- Addressing a subsidence area
- Focusing on recharge
- Focusing on conveyance
- Addressing and or prioritizing drinking water
- Addressing and or prioritizing water for habitat
- Focusing on monitoring, reporting, and data modeling activities for data collection to be gathered in the first 5 years
- Providing incentives to reduce pumping and to capture surface water (e.g., including flood flows)
- Including projects that are beyond planning phase
- Including projects that already have a dedicated funding mechanism
- Including projects that are identified as priority projects by at least one GSA

Seven of the twelve priority projects are considered complete (see Table 3-1). For most of the remaining five projects, project proponents are actively seeking funding, including a Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant application submitted to DWR in late February 2022. Table 3-2 provides a summary of updated project information for the five ongoing priority projects since the previous annual report, as provided by project proponents.

Table 3-1: Completed Projects

Project Name	Project Update Description
Project 1: Planada Groundwater Recharge Basin Pilot Project	Cone Penetration Tests did not show favorable geologic conditions for a recharge basin; Pursuing alternative approaches to a traditional recharge basin, like installation of dry well(s). Proposed permanent monitoring well installed in September 2020. This well has been added to the Merced Subbasin's Monitoring Network.
Project 2: El Nido Groundwater Monitoring Wells	All planned well site installations have been completed. These wells have been added to the Merced Subbasin's Monitoring Network.
Project 3: Meadowbrook Water System Intertie Feasibility Study	Study completed in January 2021.
Project 8: Merced Groundwater Subbasin LIDAR	Funding for this project was awarded under the Proposition 1 Round 1 IRWM Implementation Grant in 2020. LIDAR data was collected in December 2020 and will be used in conjunction with weather forecast data to predict local stormflows from rainfall events.
Project 9: Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD	The study has been completed. The GSAs received Proposition 68 Implementation Grant funding for the phase 1 portion of this work in 2021. An additional phase of work is part of the February 2022 application for the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant.
Project 11: Mini-Big Conveyance Project	Combined with Project 9 Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD due to substantial overlap in scope.
Project 12: Streamlining Permitting for Replacing SubCorcoran Wells	The study has been completed and is being used to support well permitting from below to above the Corcoran Clay in the Subsidence area.

Table 3-2: Description of Project Implementation Updates

Project Name	Project Update Description
Project 4: Merquin County Water District Recharge Basin	This basin has not been constructed nor have design documents been completed. Merquin County Water District (MCWD) has very constrained financial resources and cannot proceed with the project without significant grant funding which has not been forthcoming to date. MCWD is evaluating ways to provide groundwater recharge to the District and may proceed with a project once resources are available. Note - MCWD is currently pursuing funding for a separate "Sustainable Yield Management Plan and Plan Implementation" project as part of the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant submitted to DWR in late February 2022. This study is anticipated to support implementation of 666 AFY groundwater recharge project.
Project 5: Merced Irrigation District to Lone Tree Mutual Water Company Conveyance Canal	All land rights (easements or fee title) have been obtained and pre-construction site preparations are being made. The construction window is March 2022 – March 2023.
Project 6: Merced IRWM Region Climate Change Modeling	No update of information in 2019 GSP to report at this time.
Project 7: Merced Region Water Use Efficiency Program	No update of information in 2019 GSP to report at this time.
Project 10: Vander Woude Dairy Offstream Temporary Storage	This project is included in the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant submitted to DWR in late February 2022 and reflects some minor modifications to what was initially proposed in the GSP. The project will build a 30-acre storage reservoir with a capacity of 250 acre-feet (AF). The project will divert flood water from Mariposa and Owens Creeks and store it or later use to meet crop demand. It's estimated the reservoir would be filled 3 times per year for an estimated yield of 750 AFY. In addition, the project would permanently fallow 30-acres of productive farmland that has a crop demand of 150 AFY. The total project yield is 900 AFY.

3.4 Implementation of Management Actions

The Merced Subbasin GSP includes two Management Actions. This has not changed as of the current Annual Reporting period. The two Management Actions are:

- Management Action 1: Water Allocation Framework
- Management Action 2: MSGSA Demand Reduction Program

Water Allocation Framework: An Ad Hoc Coordination Committee Working Group supported by GSA staff, was previously established to conduct discussions on an initial framework. Discussions are ongoing. It is anticipated that allocation framework discussions at GSA Board and public meetings will occur starting in late 2022.

MSGSA Demand Reduction Program: The MSGSA has initiated a demand reduction program in recognition of the need to reduce groundwater pumping in the subbasin. On July 8, 2021, the MSGSA Board approved Resolution 2021-01 which described an objective that by Water Year 2025, the consumption use of groundwater within the MSGSA will be reduced by a minimum of 15,000 AF annually, with this minimum to be increased annually thereafter. The MSGSA has adopted a Two Phased GSP Implementation Approach, focusing on land repurposing as a near-term option to achieve the Water Year 2025 objective, combined with importing surface water in the GSA (flood waters or purchased water). Starting in 2026, MSGSA expects to implement an allocation approach in combination with the continued land repurposing/fallowing and imported surface water. Development of this program is still ongoing: the GSA will continue to conduct analyses, develop policies, adopt procedures, establish monitoring and reporting tools, and conduct outreach.

3.5 Additional Implementation Support Activities

Additional activities have taken place within or just after the Annual Reporting period that contribute to the overall GSP implementation progress. These are described below in Section 3.5.1 which includes various grant-funded activities, Section 3.5.2 for other implementation activities, and Section 3.5.3 which includes the MercedWRM update for water year 2021.

3.5.1 Grant-Funded Activities

Data Gaps Plan: The Merced Subbasin was awarded a Proposition 68 SGM Grant Program Planning Grant which was contracted with DWR in May 2020. The grant funded a GSP Development Project for Addressing Critical Data Gaps which consists of developing a Data Gaps Plan, upgrading & incorporating existing wells into the monitoring network, installing new well(s) in critical locations, and stakeholder outreach. The Data Gaps Plan document was completed in July 2021 and provides tools to prioritize filling the data gaps and identifies implementation procedures necessary to fill such gaps. The Data Gaps Plan does not attempt to completely fill all identified gaps, but rather acts as a starting point and guidance framework for ongoing efforts to do so. The GSAs are currently engaged with both expanding the monitoring network using existing wells and also pursuing grant and technical support services funding to drill new wells.

Remote Sensing Decision Support Tool: Using funding from the Proposition 68 SGM Grant Program Planning Grant, the GSAs are currently developing a remote-sensing decision support tool that can be used to support basin management by quantifying net groundwater use within the Merced Subbasin. Remote-sensing technology will be used to estimate monthly crop evapotranspiration (ETc) at the field scale and combined with data on surface water use to estimate groundwater use.

Proposition 68 SGM Grant Program Implementation Grant: The Merced Subbasin received Proposition 68 SGM Grant Program Implementation Grant in 2021 for two projects described below.

The “El Nido Conveyance System Improvements” project will provide conveyance improvements at four existing siphons/pipelines in MID’s El Nido Conveyance System to allow more surface water to be diverted from the Mariposa Creek to the El Nido area, an Underrepresented Community[1] suffering from declining groundwater levels and subsidence. Survey and design work began in August 2021. Construction improvements began in January 2022 and are expected to conclude in March 2022.

The separate "LGAWD Intertie and Recharge Project" (Phase 1) is expected to begin construction in summer 2022. Phase 2 is part of the 2022 grant application mentioned below. The project in its entirety will create a new surface water supply by capturing and storing floodwaters that would otherwise be lost by constructing an approximately 2-mile canal to connect MID's Booster Lateral 3 to Dutchman Creek and construct a 10-acre groundwater recharge basin in Le Grand.

Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant: At the end of February 2022, the GSAs submitted an application and spending plan to DWR for a cumulative approximately $13.7 million of grant funding for 18 projects (see Table 3-3). DWR expects to provide a maximum of $7.6 million per critically overdrafted groundwater basin as part of a non-competitive process, but asked for a spending plan with a minimum of $10 million of potential projects. Projects in the Merced Subbasin application cover both planning and implementation projects, including several groundwater recharge projects, filling data gaps, modeling work, and other demand reduction activities. For Round 1, DWR expects to make final awards in March/April 2022 and execute grant agreements in May 2022 (DWR, 2021).

The GSAs intend to move to a "living list" of GSP Implementation projects that will include the projects in Table 3-3 as new GSP projects. It is expected that the living project list will be described in more detail at a later date.

[1] Underrepresented Communities are defined by the SGM Grant Program as a DAC, SDAC, or EDA; Tribal Lands/Tribes; California Communities Environmental Health Screening Tool Classified DACs (EnvDACs); and Fringe Communities.

Table 3-3: Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant

Project Name	Description	Grant Funding Request
LeGrand-Athlone Water District Intertie Canal - Phase 2	The proposed Le Grand-Athlone Water District (LGAWD) Intertie and Recharge Project Component (Project Component) completes Phase 2 of the LGAWD Intertie Canal. The LGAWD Intertie Canal would capture and store floodwaters by constructing an approximately 2-mile canal to connect MID's Booster Lateral 3 to Dutchman Creek northeast of Santa Fe Road. The new Intertie Canal would be built to convey 125 cubic feet per second (cfs) of floodwater for Flood Managed Aquifer Recharge (Flood-MAR) on approximately 40,000 acres of productive farmland in the Merced Subbasin.	$1,000,000
Merced Subbasin Integrated Managed Aquifer Recharge Evaluation Tool (MercedMAR)	The Merced Subbasin Integrated Managed Aquifer Recharge (MAR) Evaluation Tool ("MercedMAR") is an extension and integration of existing Merced models, including the Merced WRM and GRAT, to support exploration of groundwater recharge in the Merced Subbasin. The goal of the tool is to provide a one-stop shop tool and resources for decision makers (including Groundwater Sustainability Agency representatives, surface water operators, growers, drinking water users, domestic well owners, and other stakeholders) to implement and optimize MAR to benefit disadvantaged communities (DACs), growers, the ecosystem, GDEs, and the Subbasin's groundwater health. Additionally, MercedMAR will be used to support benefits and impacts of recharge to the shallow domestic well owners. The integrated tool can also enable the GSAs to account for allocation of recharge credits appropriately and support a basin-wide FloodMAR program.	$725,000
Vander Dussen Subsidence Priority Area Flood-MAR Project	The Vander Dussen Subsidence Priority Area Project (Project) will build a 1.25 mile earthen canal from Merced Irrigation District's El Nido Canal to and 685-acres of agricultural fields, of which approximately 325-acres are located within Sandy Mush Mutual Water Company and 333-acres in the Madera County GSA. With 90 days of flood flows, the 20 cfs canal will yield ~3,600 AF of recharge.	$798,735
Vander Woude Storage Reservoir	The project will build a 30-acre storage reservoir with a capacity of 250 AF. The project will divert flood water from Mariposa and Owens Creeks and store it or later use to meet crop demand. It's estimated the reservoir would be filled 3 times per year for an estimated yield of 750 AFY. In addition, the project would permanently fallow 30-acres of productive farmland that has a crop demand of 150 AFY. The total project yield is 900 AFY.	$300,000

Project Name	Description	Grant Funding Request
Filling Data Gaps Identified in Data Gaps Plan	The Merced GSP identifies areas of data gaps in the Merced Subbasin in regard to a lack of understanding of groundwater levels in poorly monitored portions of the subbasin, partially due to unequal spatial representation of monitoring wells and a lack of understanding of shallow groundwater conditions near groundwater dependent ecosystems and rivers, mainly due to a lack of monitoring wells near such areas. Filling these gaps will help to improve scientific understanding, support ongoing basin management and policy making and can be used in developing future updates to the GSP.	$400,000
Amsterdam Water District Surface Water Conveyance and Recharge Project	The Amsterdam Water District Project is composed of 5 project components with an estimated benefit of 6,580 AFY. The Bert Crane Pipeline component would build approximately 1-mile of 21" PVC pipeline to convey surface water from Canal Creek to an existing 125 AF irrigation reservoir. The project would also build 3 recharge ponds totaling approximately 53-acres - Mark Couchman 8-acre recharge pond, Bert Crane 25-acre recharge pond, and Craig Johnson 20-acre recharge pond.	$100,000
GSP Project 31: Crocker Dam Modification	This project encompasses installation of automatic gates at MID's Crocker Dam, located just west of Merced at the bifurcation of Black Rascal Creek and Bear Creek. The automatic gates would allow for MID to remotely operate the dam and adaptively manage the flows in Bear Creek/Black Rascal Creek. This project will provide construction of groundwater recharge conveyance system infrastructure and also provide flood protection, climate change mitigation, reduction in potential evacuation events, increased water reliability, recreational opportunities, and habitat creation.	$1,500,000
G Ranch Groundwater Recharge, Habitat Enhancement & Floodplain Expansion Project - Planning	La Paloma Mutual Water Company (LPMWC) proposes a planning study to eventually develop the G Ranch Groundwater Recharge & Ecosystem Enhancement Project. The planning Project would consist of the planning, design, and environmental permitting of the combination of groundwater recharge ponds and floodplain re-establishment. The ponds would be designed to enhance the Pacific Flyway wetland habitat. The project would be located on approximately 439 acres within the G-Ranch property. This project would enhance 270-acres of existing wetlands and re-establish the remaining 169 acres of double-cropped farmland to floodplains. The entire project would be utilized for habitat enhancement and groundwater recharge, providing additional wetland habitat for migrating waterfowl.	$250,000
Merquin County Water District (MCWD)	The Sustainable Yield Management Plan will provide an average of up to 666 AF per year of groundwater recharge outside the normal irrigation season (April through September). The	$66,000

Project Name	Description	Grant Funding Request
Sustainable Yield Management Plan and Plan Implementation	management plan would also include: (1) Study of groundwater gradients and determination of optimal locations for recharge facilities, (2) Irrigation season water routing of surface water and groundwater to minimize salinity of delivered water, (3) Evaluation of optimal location for installation of replacement groundwater pumping wells to operate during seasons with little or no surface water, (4) Evaluation of need for pipeline interconnects between laterals to optimize water operations when minimal surface water is available, and (5 Estimation of long-term groundwater recharge needed for MCWD to be sustainable. In addition to the management plan would be an implementation plan that would: (1) Identify up to 300 acres of land where recharge activities could be conducted, (2) Execute agreements with landowners to allow recharge activities, (3) Install flowmeters, piezometers, and survey reference elevations to measure water, and (4) Measure surface water and groundwater quality.	
Purdy Project (E. Purdy, W. Purdy, and Kevin Recharge Basins) (Project No. 38)	Project No. 38 will recharge stormwater on 195.8 acres of farmland which includes three adjacent areas, the 80-acre East Purdy Recharge Area, the 39-acre West Purdy Recharge Area, and the 76.8-acre West Kevin Recharge Area. The project will have the capacity to recharge up to 1,400 acre-feet/year of storm event run off captured during above normal and wet hydrologic year types by SWD distribution facilities and the East Side Canal assuming a two-month period of operation when stormwater is available for recharge.	$110,400
Purdy Project (East Pike Recharge Basin) (Project No. 37)	Project No. 37 will recharge stormwater on 131.7 acres of farmland, the East Pike Recharge Area. The project will have the capacity to recharge up to 3,100 AFY of storm event runoff captured during above normal and wet hydrologic year types by SWD distribution facilities and the East Side Canal assuming a two-month period of operation during years when storm water is available for recharge. This recharge volume is equivalent to 4.68 inches per day of operation.	$73,750
Buchanan Hollow Mutual Water Company Floodwater Recharge Project	The Project is to complete a Groundwater Recharge and Recovery Suitability Study to determine the suitability of recharge within BHMWC. The Soil Agricultural Groundwater Banking Index (SAGBI) indicates that four areas of the site warrant further investigation. This Grant would fund BHMWC to hire a consulting engineer to fulfill a scope of work describing the suitability to recharge groundwater within BHMWC for subsequent extraction. It is expected the engineer would have approximately 8 geotechnical borings drilled to approximately 50 feet below the ground surface and generate lithologic logs. Soil samples would be analyzed for groundwater recharge suitability,	$26,000

Project Name	Description	Grant Funding Request
	likely moisture content, dry unit weight, grain size distribution, plasticity index, expansion potential, hydraulic conductivity (permeability), direct shear, and corrosion potential.	
G Ranch Groundwater Recharge, Habitat Enhancement & Floodplain Expansion Project - Implementation	La Paloma Mutual Water Company (LPMWC) proposes the Groundwater Recharge & Ecosystem Enhancement Project. The project would consist of the implementation and construction of groundwater recharge ponds. The ponds would be designed to enhance the Pacific Flyway wetland habitat. The project would be located on approximately 439 acres within the G-Ranch property. This project would enhance 270-acres of existing wetlands and re-establish the remaining 169 acres of double-cropped farmland to floodplains. The entire project would be utilized for habitat enhancement and groundwater recharge, providing additional wetland habitat for migrating waterfowl.	$750,000
Turner Island Water District (TIWD) Water Conservation	This project would consist of the construction of a surface water reservoir and installation of pumps/piping to return water to the head of the TIWD system. This would reduce strain on our growers' operations and allow us to limit the pumping of wells. Based on this limited pumping, it is believed that this storage/return system could save 1,500 AF or more per year in groundwater extractions. This number does not reflect the ability for this reservoir to capture wet year water and stored for later use, which could be incredibly beneficial in further reducing demand on TIWD wells, potentially to the tune of an additional 750-1,000 AF per year.	$1,000,000
TIWD Shallow Well Drilling	Many of TIWD's wells are screened below the Corcoran Clay. Pumping from this aquifer is more likely to result in land subsidence issues, compared to pumping from the aquifer above the Corcoran Clay. This project would entail the construction of wells, screened above the Corcoran Clay to minimize subsidence impacts. This would require the scoping of the locations of the wells to ensure good production, followed by the drilling and installation of new wells at those desired locations. These shallow wells would be intended to replace existing deeper wells.	$500,000
MIUGSA Groundwater Extraction Measurement Program	Within MIUGSA, the total number of active production wells, and related extraction is currently estimated through modeling and water budget calculations. This project would include in the installation of flow measurement devices throughout MIUGSAs, with the primary goal of collecting accurate groundwater extraction data from within the GSA. According to Merced County Department of Environmental Health records, approximately 400 irrigation wells were installed between 1996 and August 2018. Of these, approximately 276 irrigation wells were located within a	$1,500,000

Project Name	Description	Grant Funding Request
	DAC Tract, Block, or Place. As part of the 2021 SGMA Implementation Grant, MIUGSA is proposing the installation of up to 200 flow meters on production wells within MIUGSA's boundaries.	
Deadman Creek Canal Off Stream Storage and Recharge	A 675-acre-foot storage and regulating reservoir situated on 160 acres (gross) and an 80-acre Recharge project which will be built in stages following the separate estimated Spring 2022 completion of the 2-mile-long 100 CFS Deadman Creek Canal linking Deadman Creek and the terminus ends of MID's Benedict and CaseBeer canals with Lone Tree MWC's Fenceline Canal. The project will allow for acceptance of MID in-season flows when available.	$1,000,000
Tri City's Water Recharge/Underground Storage Feasibility	Tri City's Project will perform geo technical analysis to determine FloodMAR recharge feasibility and aquifer conditions to determine if a suitable aquifer or geological feature exists beneath the surface to store recharged water. Also, the study will analyze the ability to recharge outside of Corcoran Clay to benefit sub-Corcoran water levels further west in the basin.	$3,500,000

3.5.2 Other Implementation Activities

GSP Implementation Coordination: The GSAs pivoted to virtual Coordination Committee and Stakeholder Advisory Committee meetings which were held quarterly in WY 2021. A solicitation process was conducted in early 2021 to re-establish a Stakeholder Advisory Committee focused on GSP implementation. Stakeholder Advisory Committee presentation and discussion topics have included a SGMA and GSP overview, status of ongoing projects (e.g., Data Gaps Plan), updates on the ongoing drought, and collection of feedback on grant application projects.

MIUGSA Development of Guidelines for GSP Implementation: In June 2021, MIUGSA published a Public Involvement Plan and formed a Stakeholder Guidance Committee (SGC) to "facilitate communication, provide for the dissemination of information and involvement" (MIUGSA, 2021) between the Committee and the MIUGSA Board during the implementation of the GSP. The SGC met three times during the fall of 2021 to provide input on draft water management actions, such as methods to monitor groundwater use, a water use accounting system for tracking water use and trading water, water allocation approaches and rules, and enforcement and penalties for overuse. Draft recommendations were presented to MIUGSA's Stakeholder Guidance Committee and the MIUGSA Board in March 2022. It is anticipated that MIUGSA will develop and adopt Rules and Regulations, and various policies during water year 2022.

3.5.3 MercedWRM Update (Water Year 2021)

The MercedWRM was originally developed and calibrated to model historical groundwater storage from water years (WY) 1996-2015, updated with WY 2015-2019 data in the 2020 annual report, and updated with WY 2020 data in the 2021 report. The model was updated for the current annual report to reflect more recent data. Data from WY 2021 were collected from the same public and private sources that had provided the historical data through WY 2020 used in the GSP and previous annual reports. The historical water budget was extended through WY 2021, including an updated estimate of the change in groundwater storage reflecting the latest data.

The WY 2021 continuation of the historical water budget is intended to further evaluate the aquifer system under a variety of hydrological and anthropogenic conditions. The full annual groundwater budget for WY 1996-2021 is shown earlier in Figure 2-6.

<u>Data Sources</u>

Data were requested and received from the following entities in the Subbasin to complete the MercedWRM update:

Agricultural and Environmental Water Purveyors

- Merced Irrigation District
- Stevinson Water District
- Merquin County Water District
- Turner Island Water District
- Lone Tree Mutual Water Company
- Merced National Wildlife Refuge

Municipal Water Purveyors

- City of Merced
- City of Atwater
- City of Livingston
- Le Grand Community Services District
- Planada Community Services District
- Winton Water and Sanitary District
- California American Water, Meadowbrook

Additional publicly-available data were downloaded to complete the MercedWRM update:

State

- DWR SGMA Data Viewer
- DWR California Data Exchange Center (CDEC)

Federal

- United States Department of Agriculture, Natural Resources Conservation Service, National Agricultural Statistics Service (NRCS): CropScape
- United States Geological Survey (USGS) National Water Information System
- United States Census

Other

- Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) Climate Group, Oregon State University

Updated Components

The above data sources provided the necessary data to allow the historical model run reflects the most recent conditions. The following components of the model were updated for the annual report.

Surface Water Diversions and Deliveries: Monthly surface water diversions and deliveries were provided for October 2020 through September 2021 by Merced Irrigation District, Turner Island Water District, Stevinson Water District, Merquin County Water District, and Lone Tree Mutual Water Company. MID deliveries were aggregated at the subregional level for both in- and out-of-district sales, whereas the other water agencies were summarized within their boundaries.

Groundwater Pumping: Groundwater extractions from October 2020 to September 2021 were provided by all agricultural and municipal entities listed in Section 2.2. Agency pumping by MID and TIWD were simulated using measured data at each production well whereas other agencies have pumping aggregated evenly across their institutional boundaries based on aggregate reported data. Pumping estimates were made for private agriculture and domestic wells based on land use type and population.

Population: The City of Merced's population was pulled from a summary generated by the city based on California Department of Finance data. For the City of Atwater and the City of Livingston, populations were updated based on data publicly available from the US Census online database (2020 actual and 2021 estimate prepared by US Census Bureau). Rural populations updates for previous model updates have typically been extracted from census block data. However, at the time of the model update, these had not yet been updated based on the most recent 2020 data due to pandemic-related staffing issues at the US Census Bureau. For this model update, populations were projected based on historical trends.

Land Use: Each element within the MercedWRM is comprised of some fraction of 14 land uses, including 11 agricultural crop categories, native vegetation, riparian vegetation, and urban. For the 2021 update, the model utilizes annual data based on the NRCS CropScape program which provides data throughout the model domain on a gridded resolution of 30 meters.

Precipitation: Monthly precipitation into the Subbasin and its watersheds was derived on a four-kilometer grid using the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) dataset available online from Oregon State University through a partnership the NRCS National Water and Climate Center.

Streamflow: Monthly inflow to the Merced Subbasin was downloaded for the San Joaquin River from the USGS and from CDEC for Merced River, Bear Creek, Owens Creek, and Mariposa Creek. Chowchilla River flows were estimated based on similar months and water year types from historical USGS gauge data. Non-gauged tributaries into the Subbasin were estimated internally by the model using the Integrated Water Flow Model (IWFM) small-watershed package.

Boundary Conditions: Groundwater elevation contours were downloaded from DWR's SGMA Data Viewer for fall 2020 and spring 2021 and used to update the assumed groundwater elevation boundary conditions in the model. As groundwater level contours are only available in semiannual intervals, intermediary months were estimated though linear interpolation.

Canal Recharge: The MercedWRM estimates MID canal recharge based on historical monthly diversions and the water year index. An in-depth analysis of MID operations and surficial water budgets was developed as part of MID's 2020 Agricultural Water Management Plan (AWMP) which was adopted in July 2021 (MID, 2021). As a result, the MercedWRM may be updated with further refined datasets in the future. SWD and TIWD have also estimated seepage from unlined canals due to their conveyance of developed supply as described in the GSP Section 6.2.

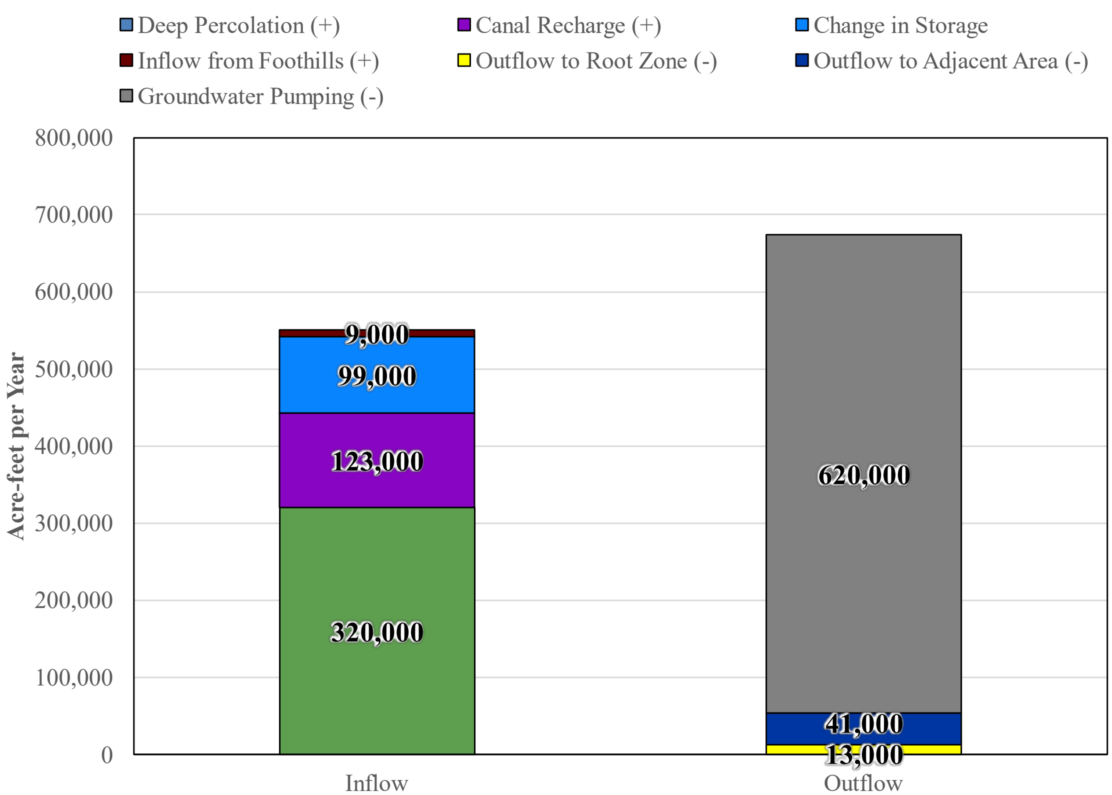
Interbasin Flows: The MercedWRM simulates groundwater flow between the Merced Subbasin and the neighboring subbasins to the north (Turlock), west (Delta-Mendota) and south (Chowchilla). The rate and direction of this interbasin subsurface flow depends on the groundwater operations and levels during the historical and projected periods on both sides of the boundary. The MercedWRM has been calibrated using limited available data for areas in the vicinity of the boundaries in neighboring subbasins. During the development of the Merced Subbasin GSP, there was no information on the projected conditions from the neighboring subbasins. Modeling for the Merced GSP shows net flows from the Merced Subbasin to the Turlock Subbasin. The neighboring subbasins have either completed their GSP or just recently completed their GSP as of January 31, 2022; thus, it is expected that additional data and/or assumptions on the groundwater operations will be available from the neighboring subbasins for future updates of the model and assessments of the Merced Subbasin sustainability conditions. Interbasin coordination meetings have been held with all three surrounding subbasins and coordination agreements have been put in place with the Turlock and Chowchilla Subbasins to facilitate such exchange of data and information. Additionally, the GSAs are pursuing grant funding (Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant submitted February 2022) for a Merced Subbasin Integrated Managed Aquifer

Recharge (MAR) Evaluation Tool ("MercedMAR") which will involve MercedWRM enhancements that update subsurface flows to/from Turlock, Delta Mendota, and Chowchilla subbasins.

Results

Evaluation of the 2021 water year (Figure 3-1) shows that the Merced Subbasin experienced net 551,000 AF of inflows and 674,000 AF of outflow. Deep percolation from rainfall and irrigation applied water (320,000 AFY) is the largest contributor of groundwater inflow, followed by net-recharge from the stream and canal systems (246,000 AFY), and net-subsurface inflows from local subbasins and the Sierra Nevada foothills (9,000 AFY). On average, groundwater production (620,000 AFY) accounts for the greatest outflow from the Merced Subbasin, followed by outflow to adjacent areas (41,000 AFY) and outflow to root zone (13,000 AFY).

Figure 3-1: Annual Estimated Groundwater Budget 2021, Merced Subbasin



3.6 Activities Anticipated for the Coming Year

The Merced GSAs intend to continue activities necessary to implement the GSP and put the basin on a path toward sustainable management through the activities described in the subsections below.

GSP Updates

A key effort anticipated in 2022 includes updating the GSP which was determined by DWR on January 28, 2022 to be "incomplete". The three GSAs are already working collaboratively to respond to DWR's comments and engage stakeholders and members of the public to address three identified deficiencies by July 27, 2022 (the end of the 180-day period allowed by GSP Regulations).

Project Implementation

Implementation of Proposition 68 grant-funded activities continues. The GSAs plan to begin implementation of the Data Gaps Plan (e.g., incorporating additional wells into the monitoring network and pursuing funding for installation of new wells) as well as complete development of the Remote-Sensing Decision Support Tool. The "El Nido Conveyance System Improvements" project is nearing construction completion in March 2022. The "LGAWD Intertie and Recharge Project" (Phase 1) is expected to begin construction in summer 2022.

Once DWR determines which projects from the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant will be funded (expected March/April 2022), the GSAs intend to coordinate with DWR to execute grant agreements and then begin associated activities as soon as grant agreements are in place.

Water Allocation & Demand Reduction

All three GSAs plan to continue making progress on a plan for pumping reductions and a water allocation framework, through ongoing Ad Hoc Coordination Committee Working Group meetings and expected framework discussions at GSA Board and public meetings expected in late 2022 and into 2023.

The MSGSA will continue developing the Demand Reduction Program, by conducting analyses, developing additional policies, adopting procedures, establishing monitoring and reporting tools, and conducting outreach. The MSGSA will focus on implementing the Two Phased GSP Implementation Approach which was adopted via resolution in November 2021. Phase 1 activities include the development of a Land Repurposing Program, a Proposition 218 proceeding to fund Phase 1 activities, and public engagement on allocation related discussions.

It is anticipated that MIUGSA will develop and adopt Rules and Regulations, and various policies for implementation of the Merced GSP within MIUGSA's boundaries during water year 2022.

4. REFERENCES

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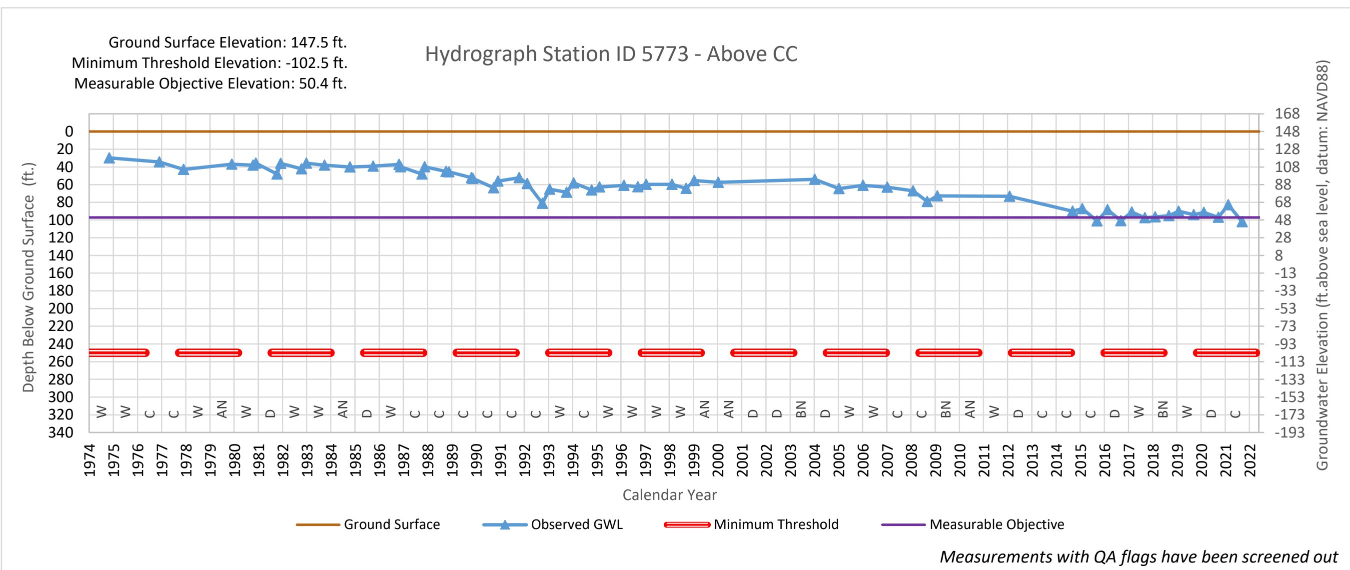
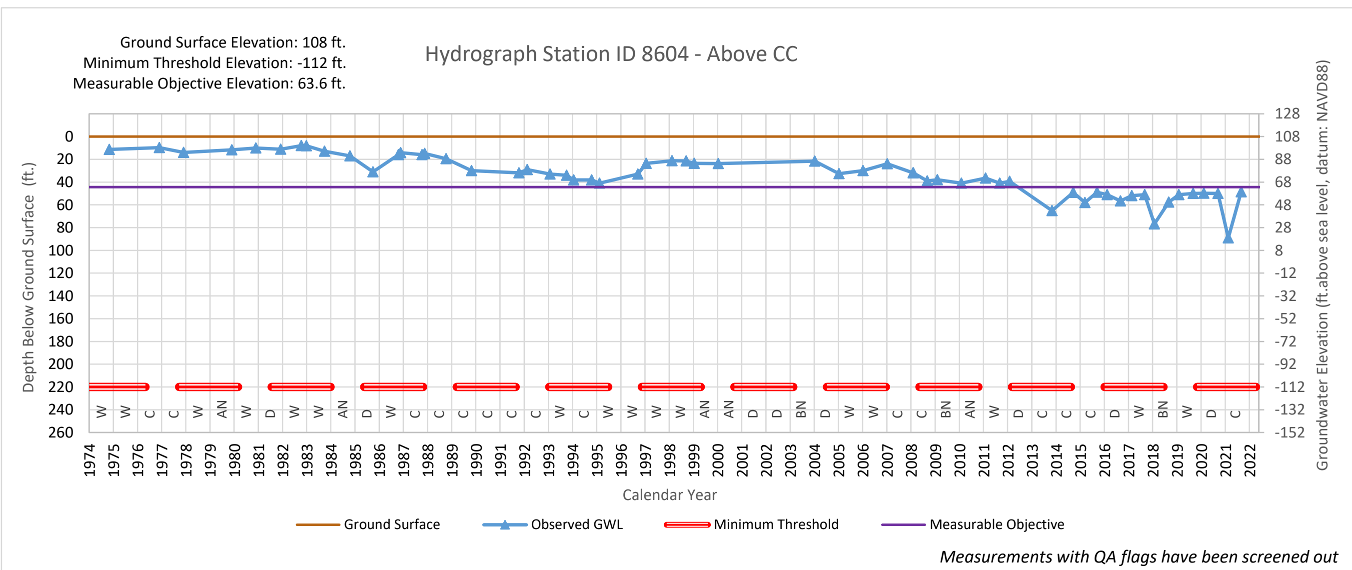
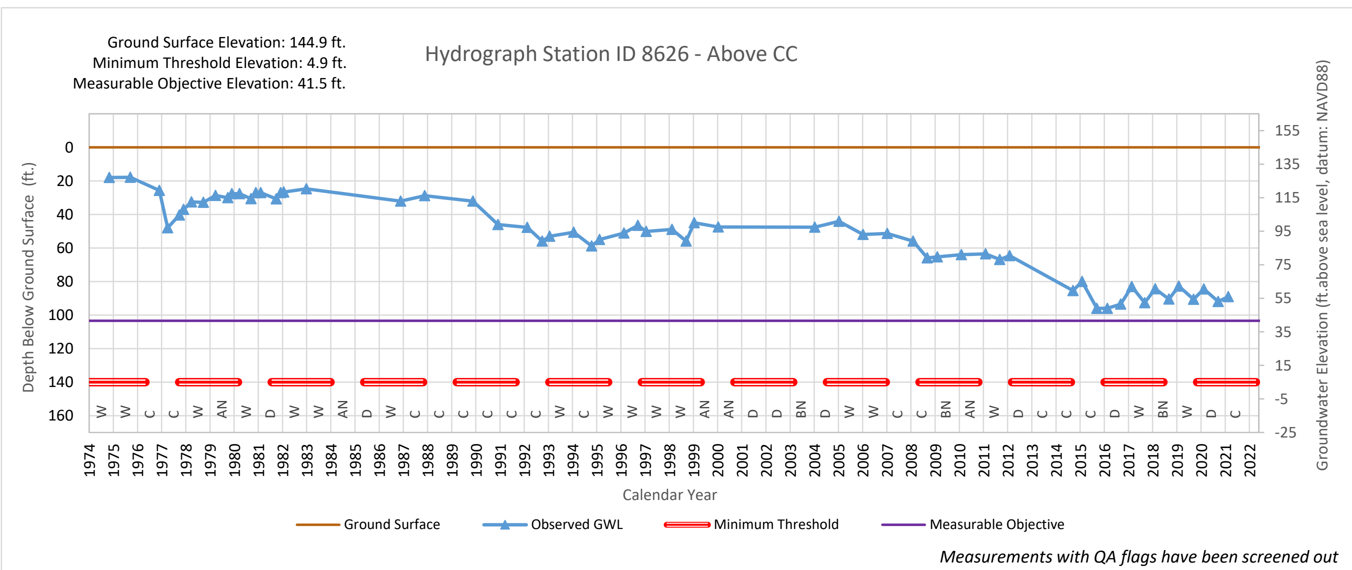
Woodard & Curran

APPENDIX A: HYDROGRAPHS

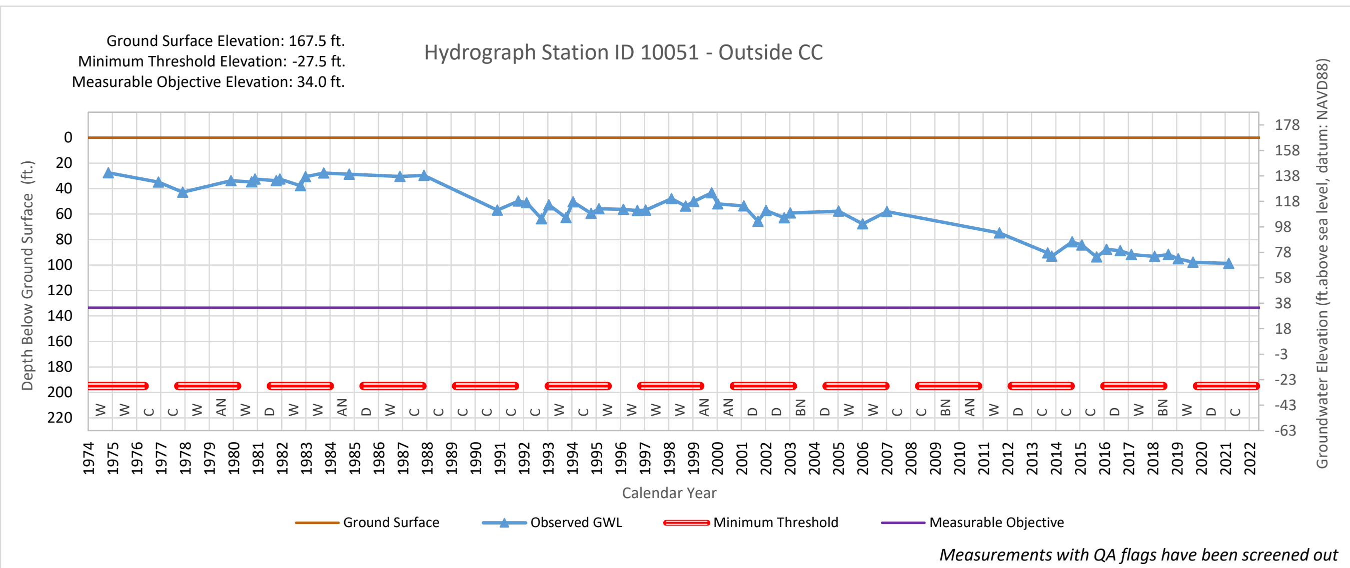

Ground Surface Elevation: 147.5 ft.
Minimum Threshold Elevation: -102.5 ft.
Measurable Objective Elevation: 50.4 ft.
Hydrograph Station ID 5773 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

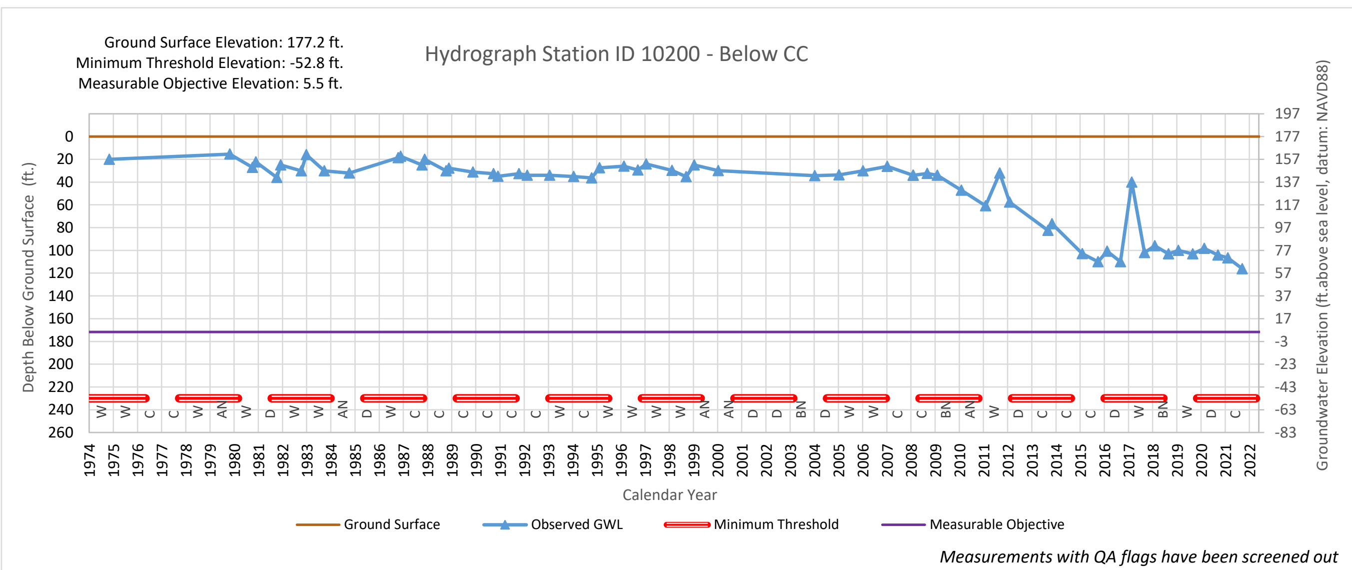


Ground Surface Elevation: 108 ft.
Minimum Threshold Elevation: -112 ft.
Measurable Objective Elevation: 63.6 ft.
Hydrograph Station ID 8604 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

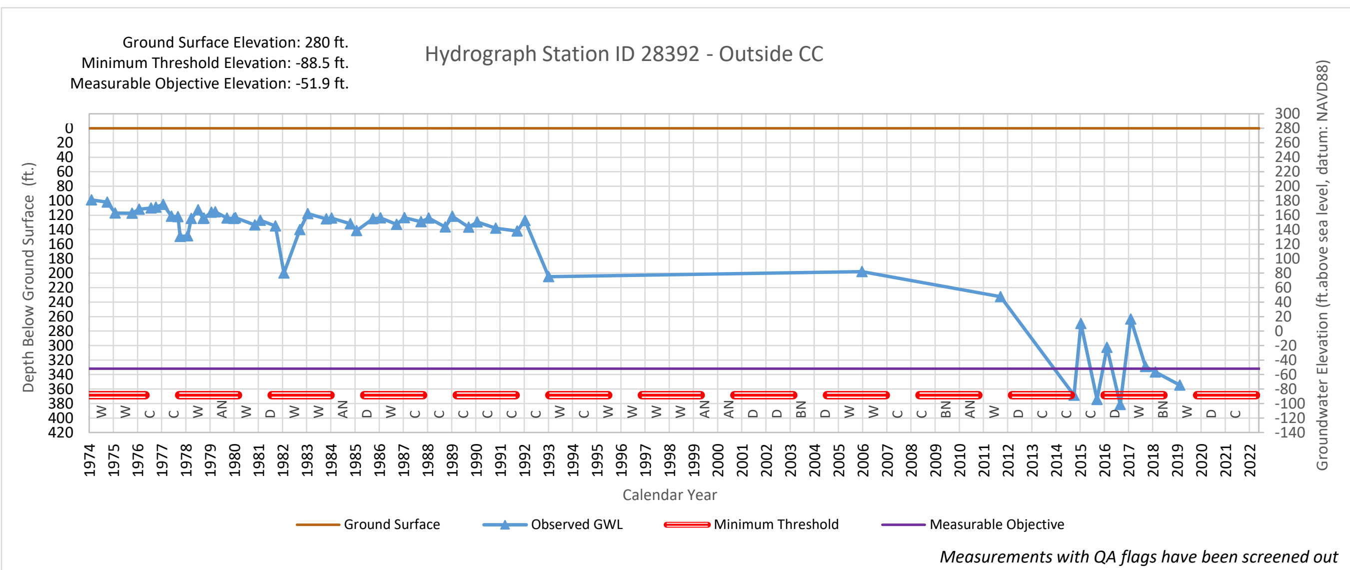


Ground Surface Elevation: 144.9 ft.
Minimum Threshold Elevation: 4.9 ft.
Measurable Objective Elevation: 41.5 ft.
Hydrograph Station ID 8626 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

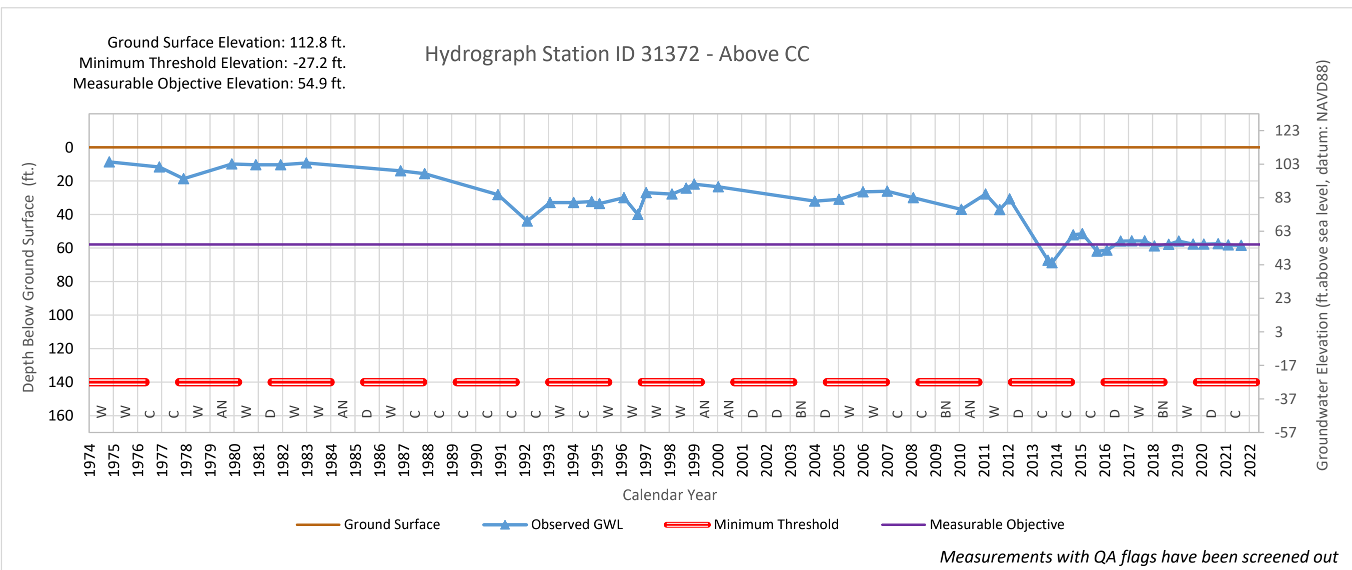

Ground Surface Elevation: 167.5 ft.
Minimum Threshold Elevation: -27.5 ft.
Measurable Objective Elevation: 34.0 ft.
Hydrograph Station ID 10051 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



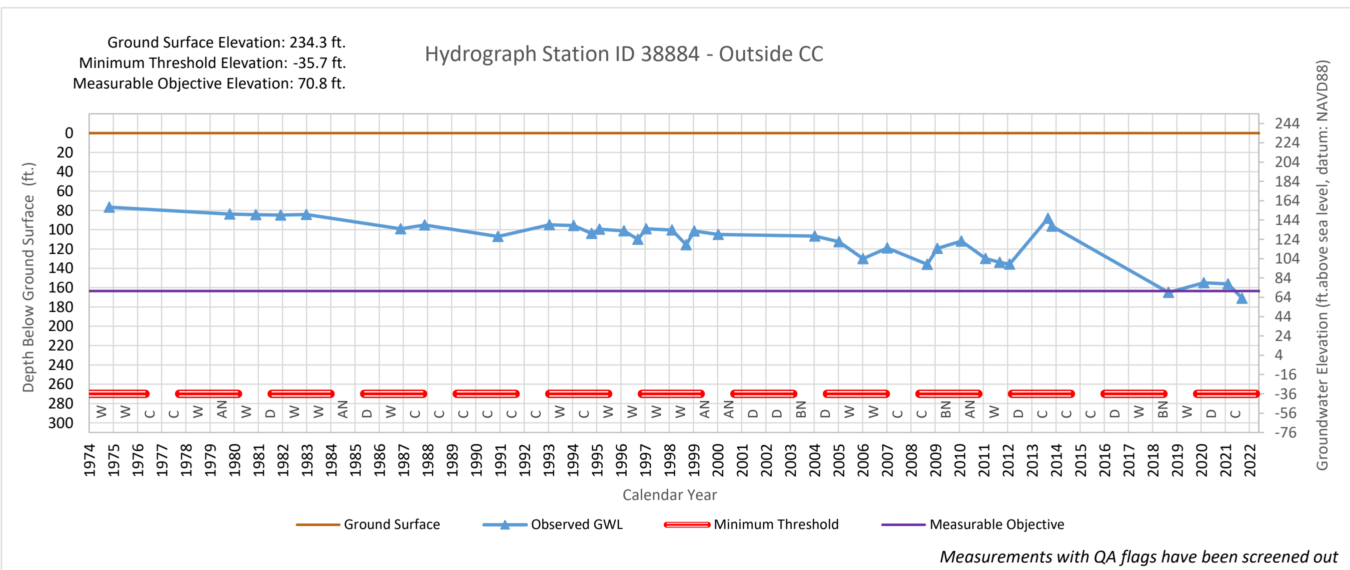
Ground Surface Elevation: 177.2 ft.
Minimum Threshold Elevation: -52.8 ft.
Measurable Objective Elevation: 5.5 ft.
Hydrograph Station ID 10200 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



Ground Surface Elevation: 280 ft.
Minimum Threshold Elevation: -88.5 ft.
Measurable Objective Elevation: -51.9 ft.
Hydrograph Station ID 28392 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



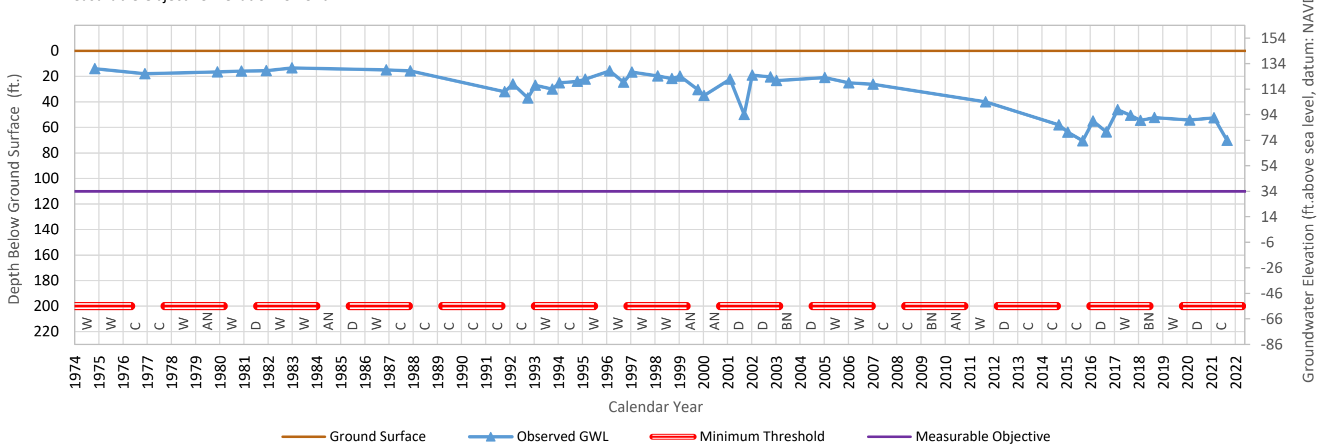
Ground Surface Elevation: 112.8 ft.
Minimum Threshold Elevation: -27.2 ft.
Measurable Objective Elevation: 54.9 ft.
Hydrograph Station ID 31372 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



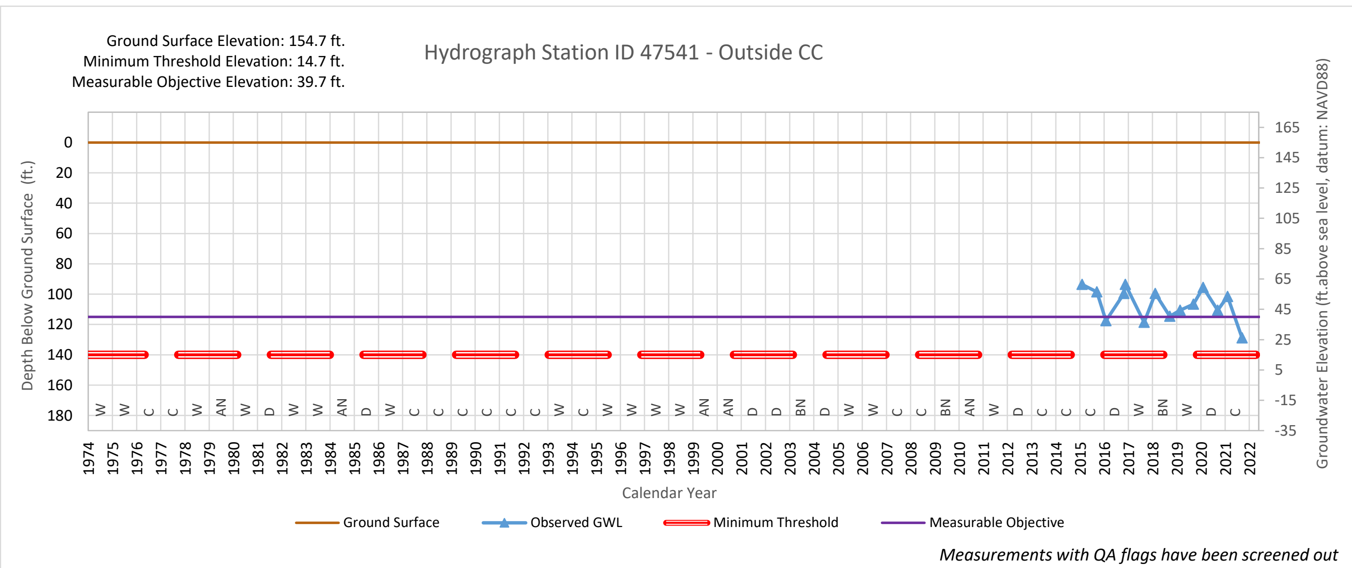
Ground Surface Elevation: 234.3 ft.
Minimum Threshold Elevation: -35.7 ft.
Measurable Objective Elevation: 70.8 ft.
Hydrograph Station ID 38884 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

Ground Surface Elevation: 144.4 ft.
Minimum Threshold Elevation: -55.6 ft.
Measurable Objective Elevation: 34.3 ft.

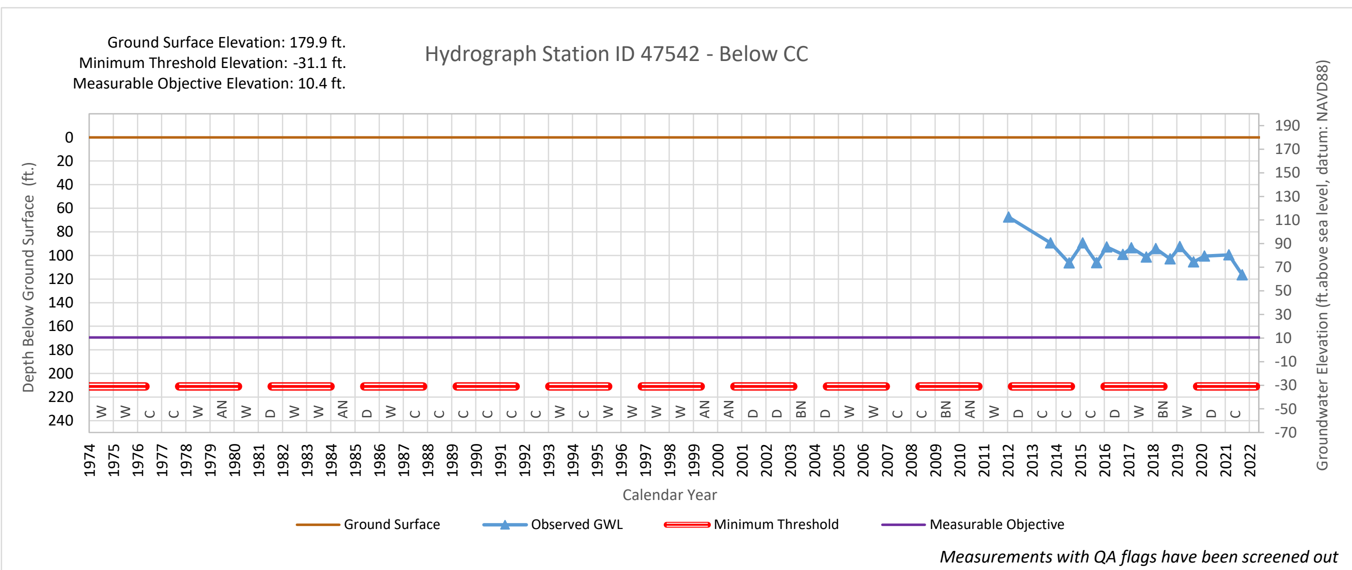
Hydrograph Station ID 38974 - Below CC



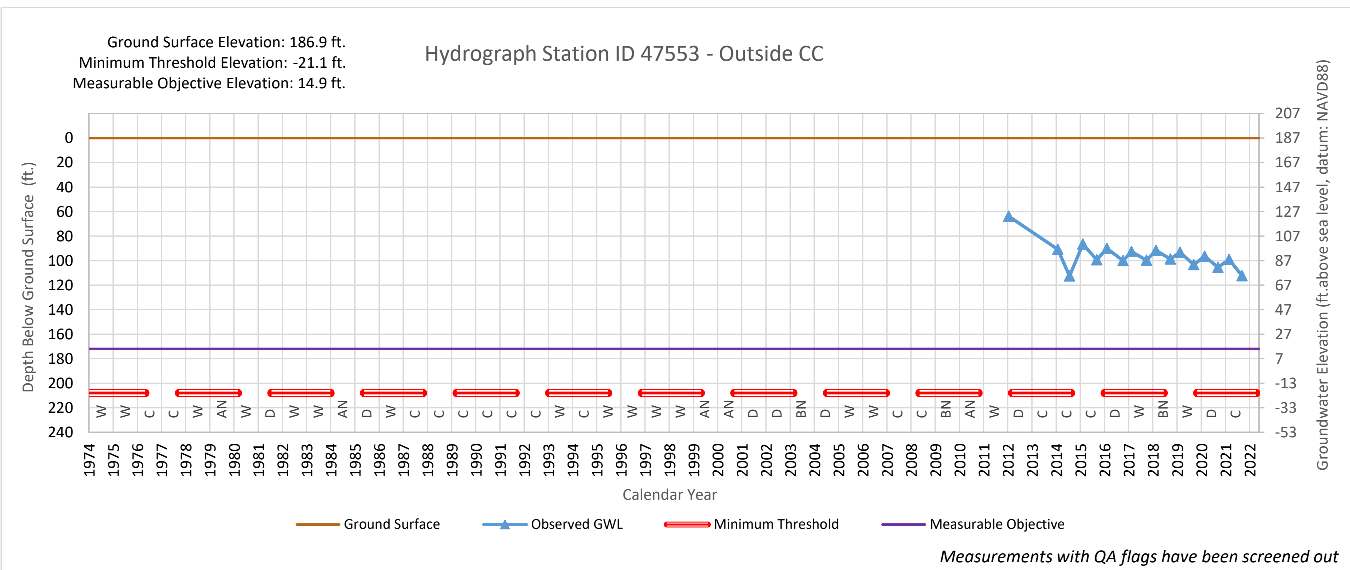
Measurements with QA flags have been screened out



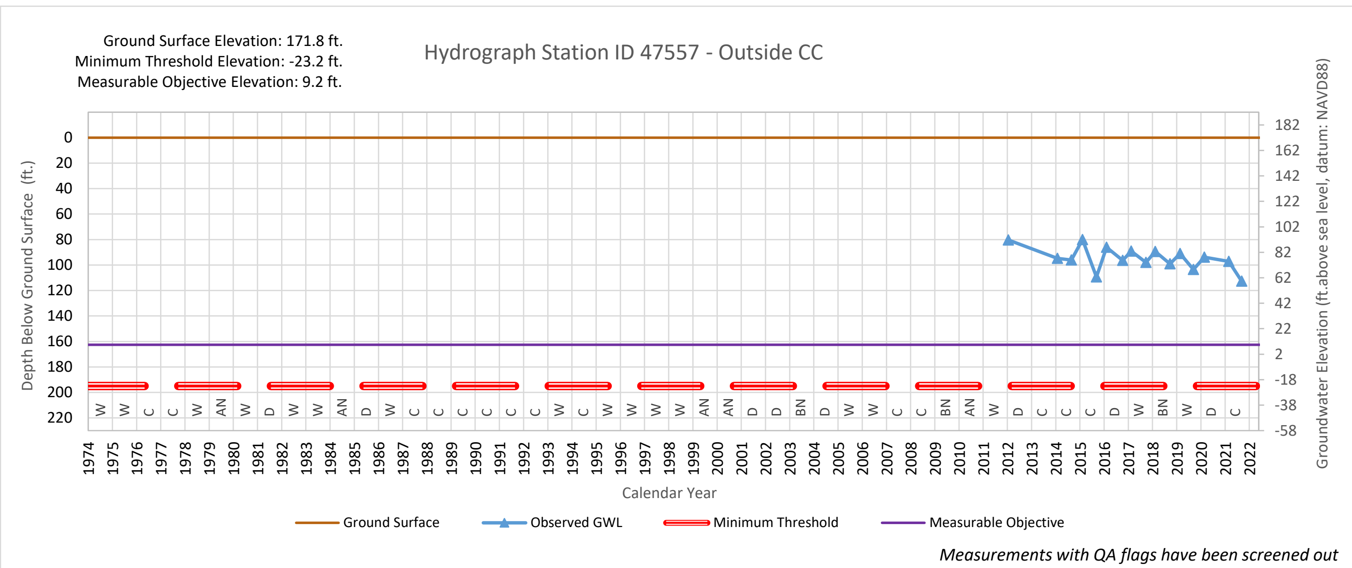
Ground Surface Elevation: 154.7 ft.
Minimum Threshold Elevation: 14.7 ft.
Measurable Objective Elevation: 39.7 ft.
Hydrograph Station ID 47541 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



Ground Surface Elevation: 179.9 ft.
Minimum Threshold Elevation: -31.1 ft.
Measurable Objective Elevation: 10.4 ft.
Hydrograph Station ID 47542 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

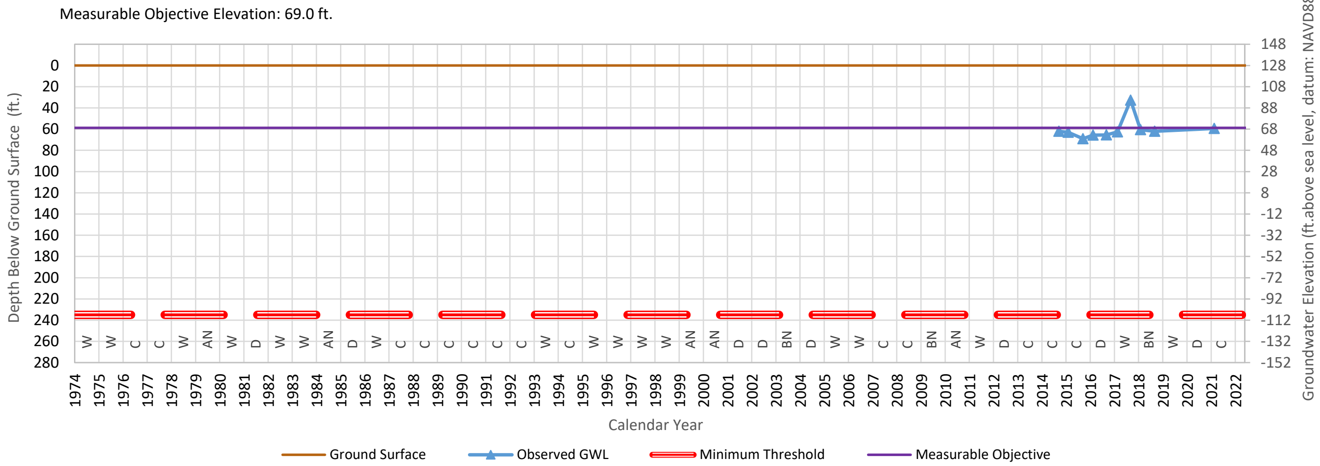


Ground Surface Elevation: 186.9 ft.
Minimum Threshold Elevation: -21.1 ft.
Measurable Objective Elevation: 14.9 ft.
Hydrograph Station ID 47553 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



Ground Surface Elevation: 171.8 ft.
Minimum Threshold Elevation: -23.2 ft.
Measurable Objective Elevation: 9.2 ft.
Hydrograph Station ID 47557 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

Ground Surface Elevation: 127.8 ft.
Minimum Threshold Elevation: -107.2 ft.
Measurable Objective Elevation: 69.0 ft.



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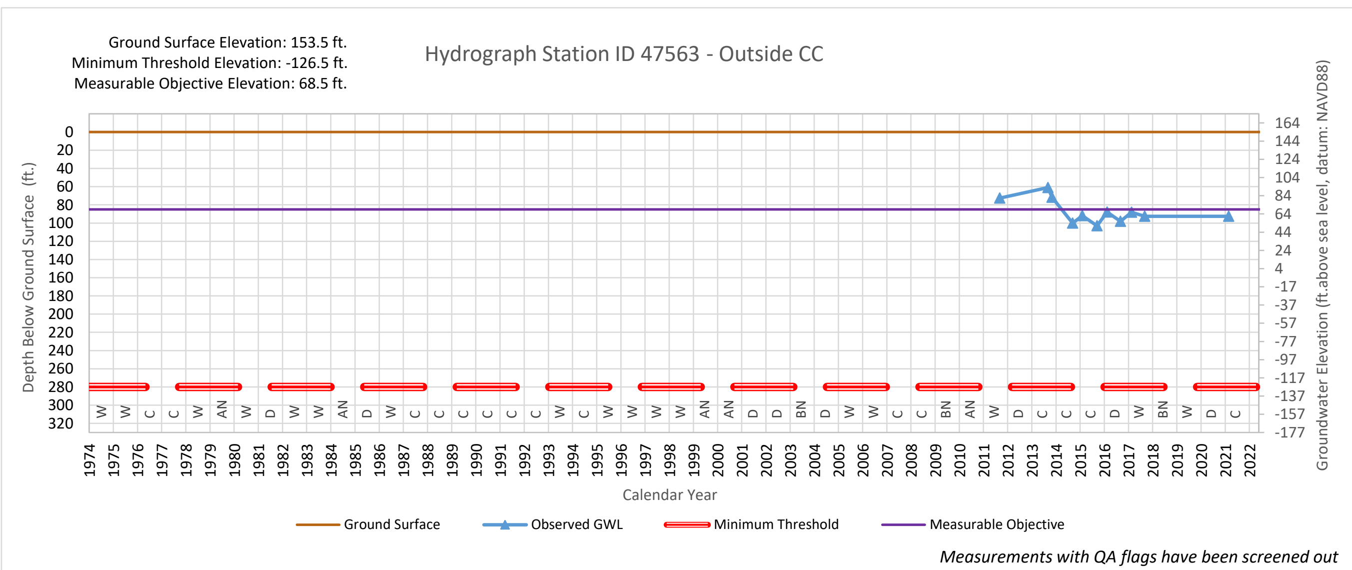
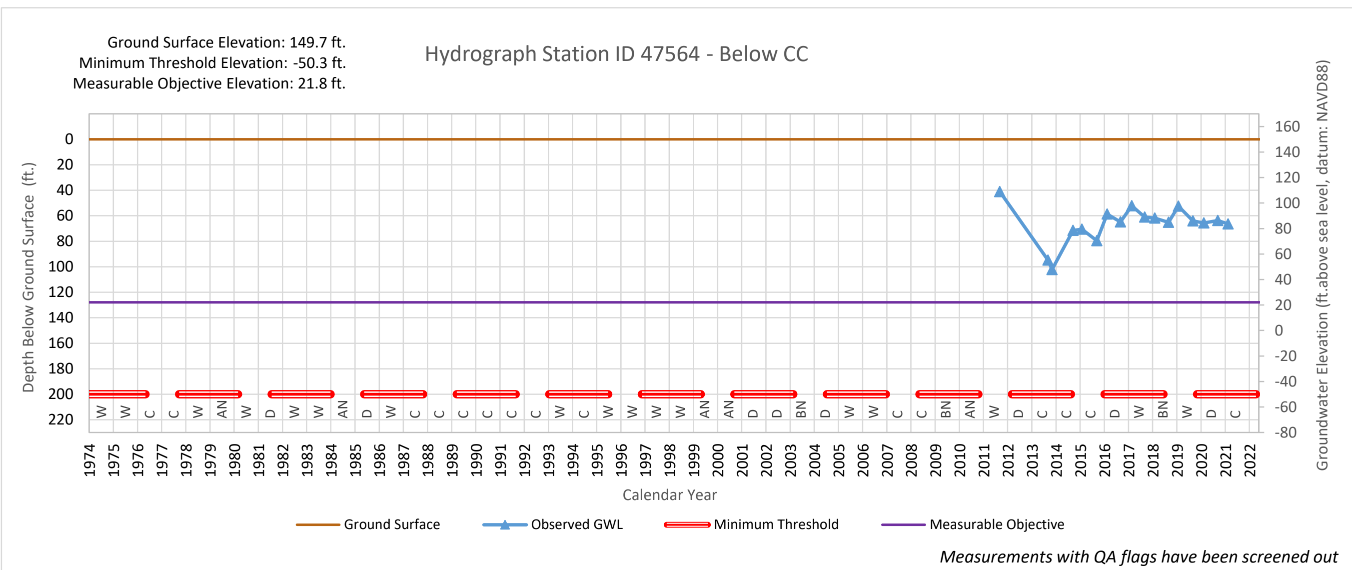
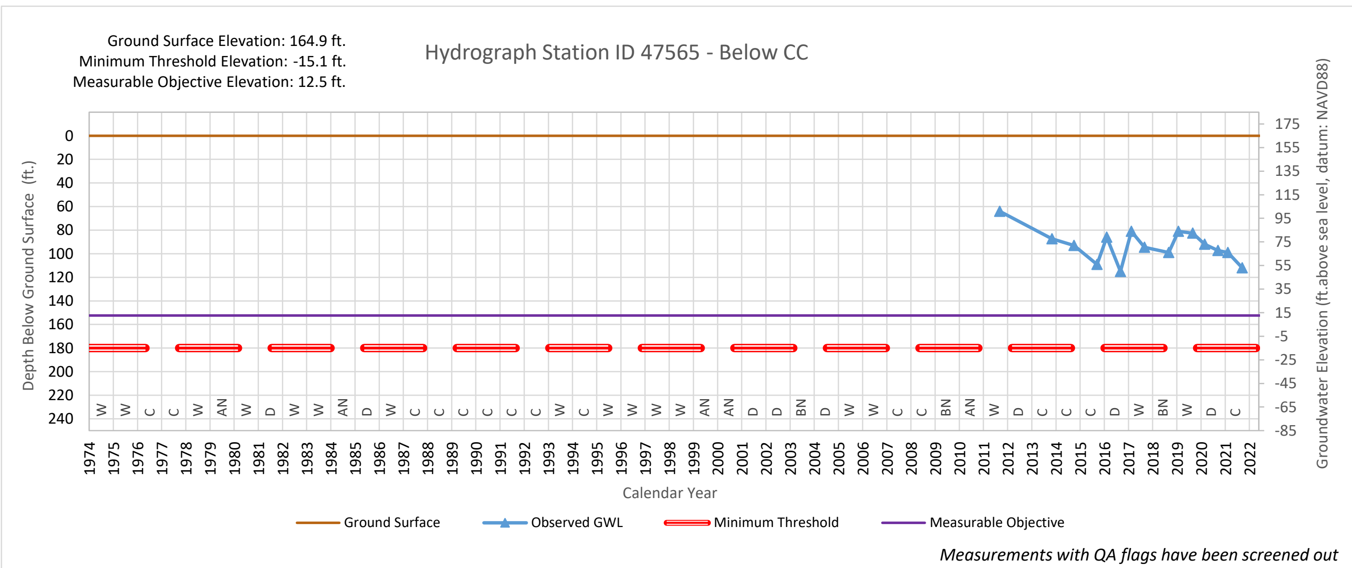
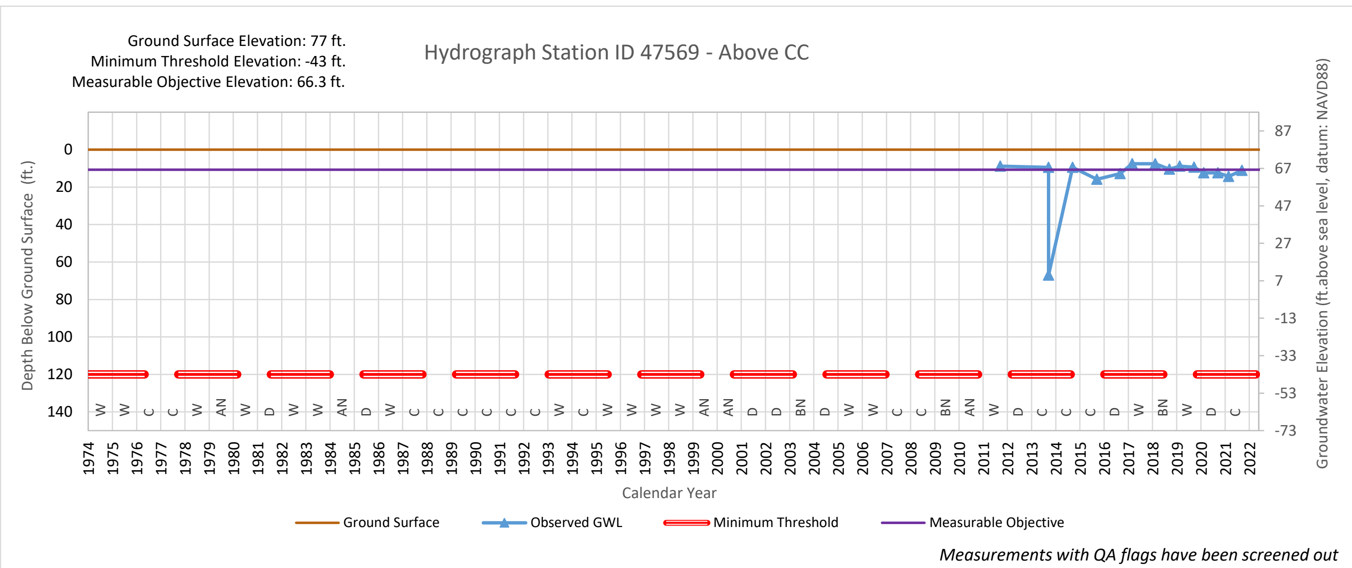


Ground Surface Elevation: 153.5 ft.
Minimum Threshold Elevation: -126.5 ft.
Measurable Objective Elevation: 68.5 ft.
Hydrograph Station ID 47563 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

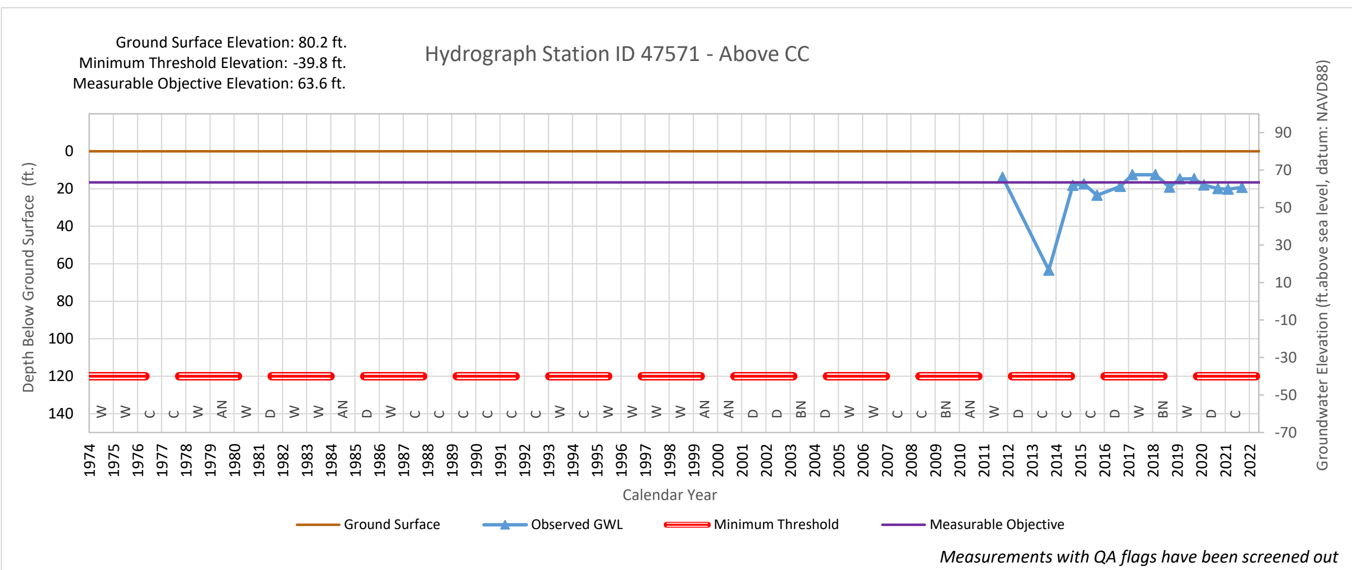


Ground Surface Elevation: 149.7 ft.
Minimum Threshold Elevation: -50.3 ft.
Measurable Objective Elevation: 21.8 ft.
Hydrograph Station ID 47564 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

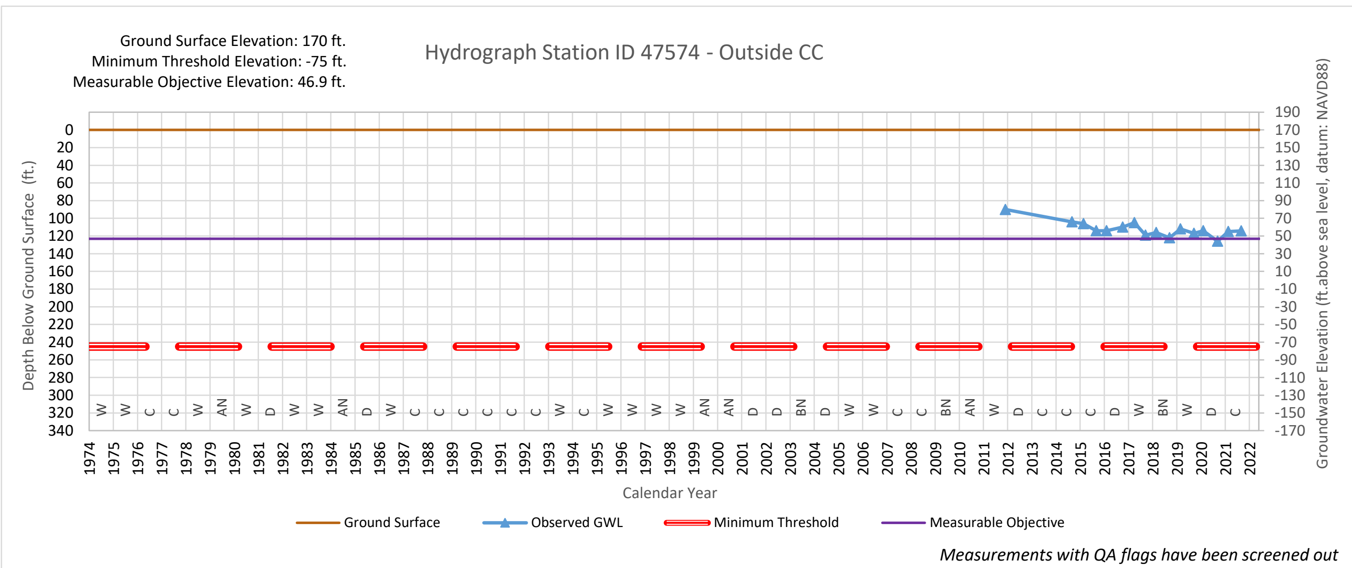

Ground Surface Elevation: 164.9 ft.
Minimum Threshold Elevation: -15.1 ft.
Measurable Objective Elevation: 12.5 ft.
Hydrograph Station ID 47565 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



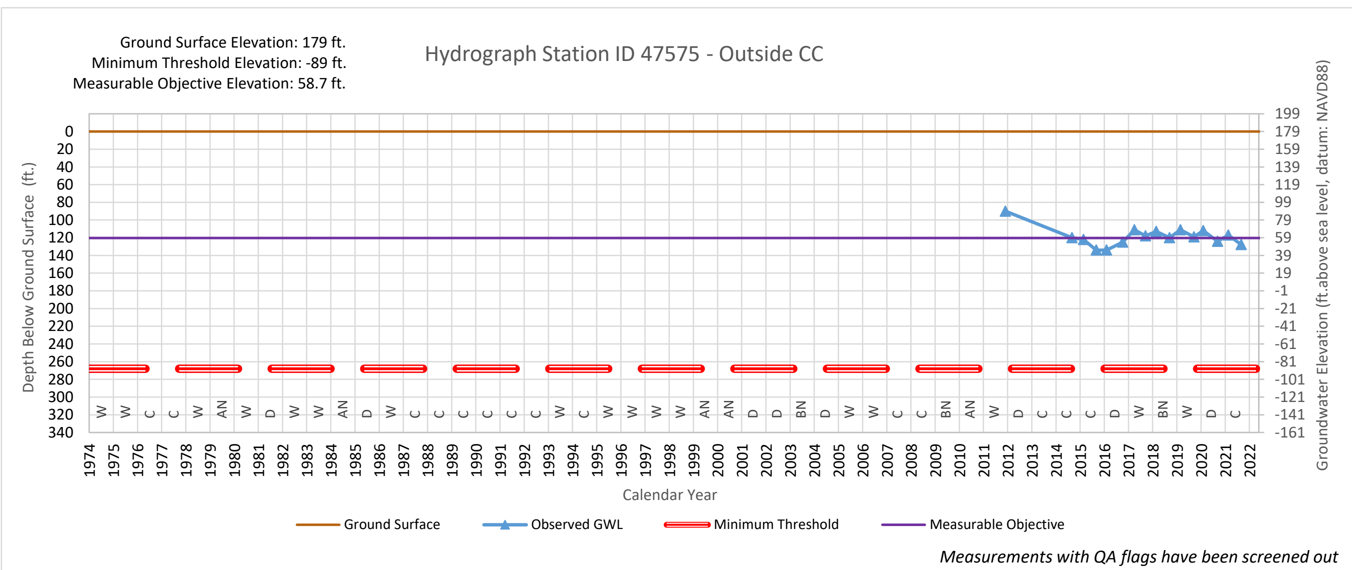
Ground Surface Elevation: 77 ft.
Minimum Threshold Elevation: -43 ft.
Measurable Objective Elevation: 66.3 ft.
Hydrograph Station ID 47569 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

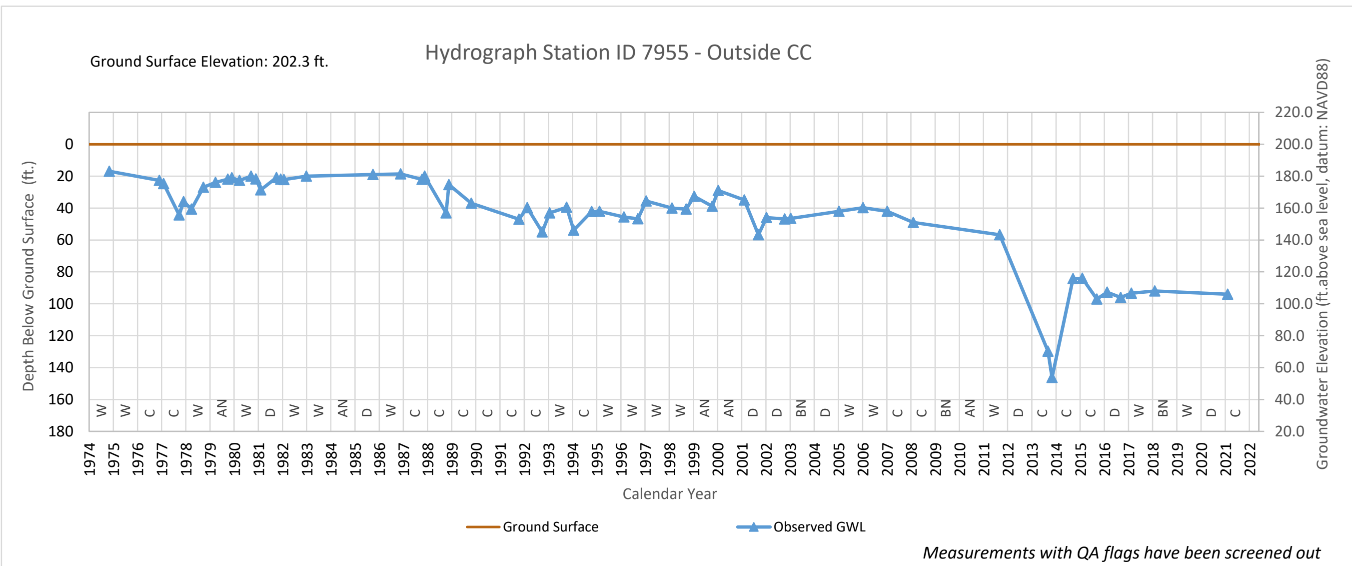


Ground Surface Elevation: 80.2 ft.
Minimum Threshold Elevation: -39.8 ft.
Measurable Objective Elevation: 63.6 ft.
Hydrograph Station ID 47571 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

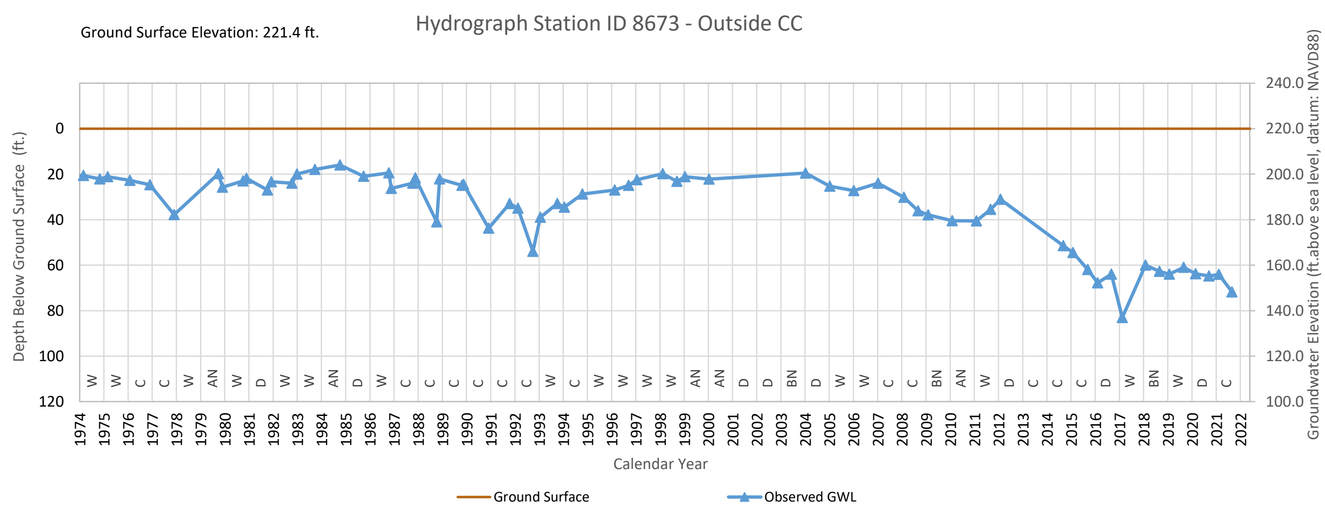


Ground Surface Elevation: 170 ft.
Minimum Threshold Elevation: -75 ft.
Measurable Objective Elevation: 46.9 ft.
Hydrograph Station ID 47574 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out

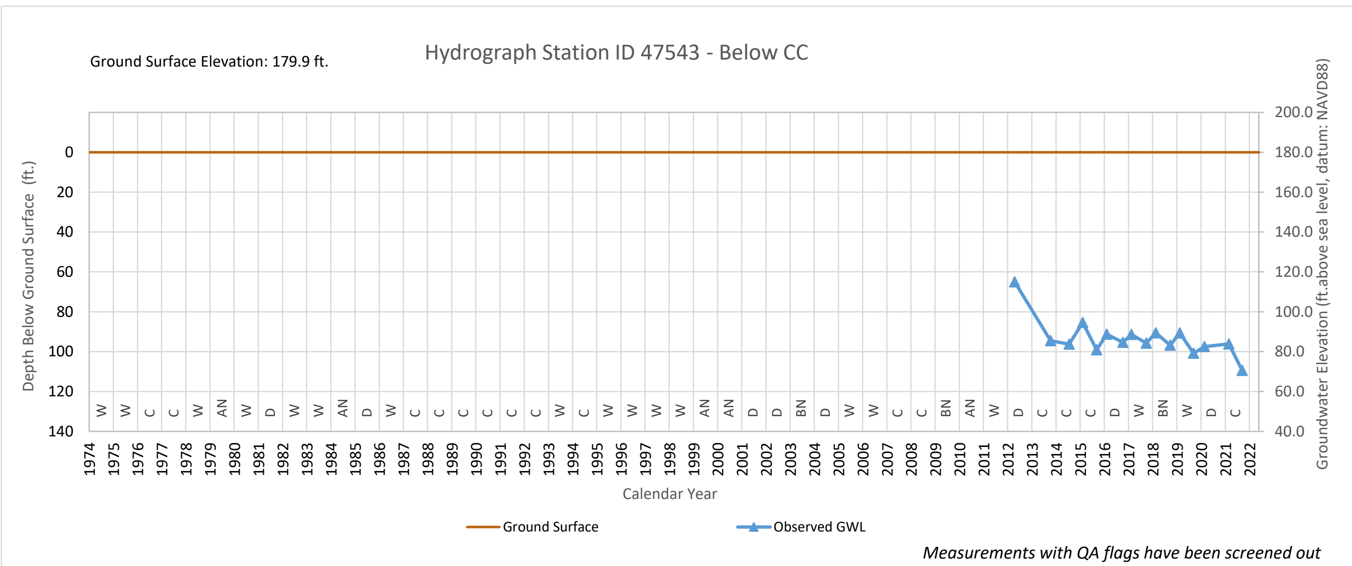

Ground Surface Elevation: 179 ft.
Minimum Threshold Elevation: -89 ft.
Measurable Objective Elevation: 58.7 ft.
Hydrograph Station ID 47575 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Minimum Threshold
Measurable Objective
Measurements with QA flags have been screened out



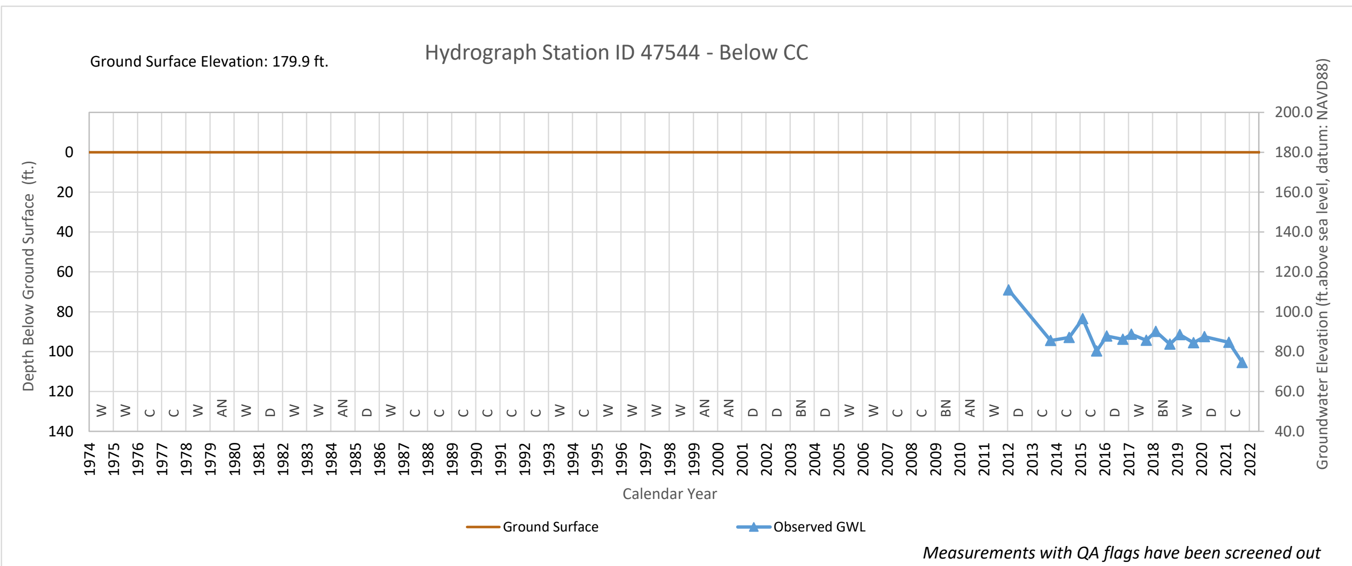
Ground Surface Elevation: 202.3 ft.
Hydrograph Station ID 7955 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



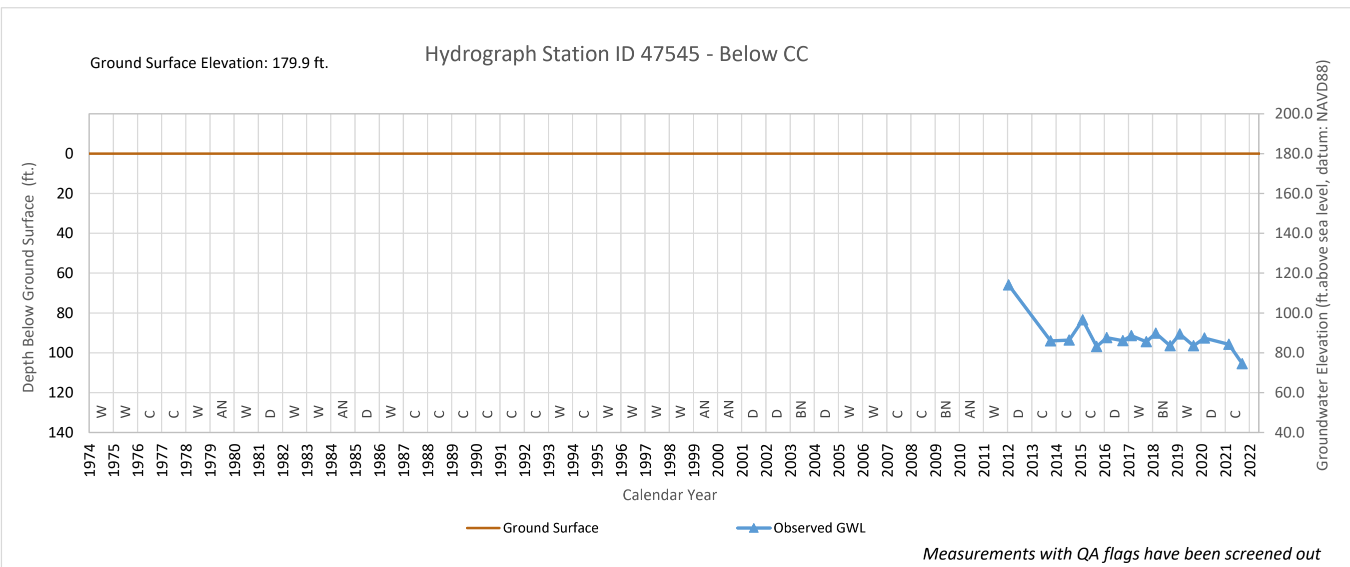
Measurements with QA flags have been screened out



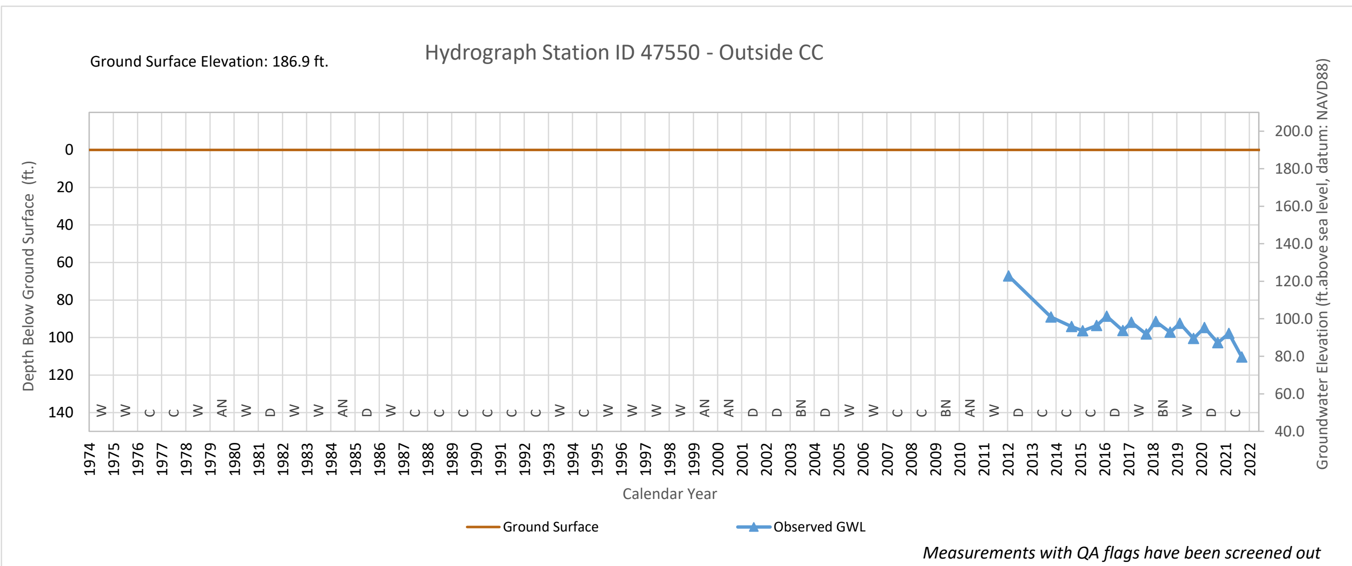
Ground Surface Elevation: 179.9 ft.
Hydrograph Station ID 47543 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



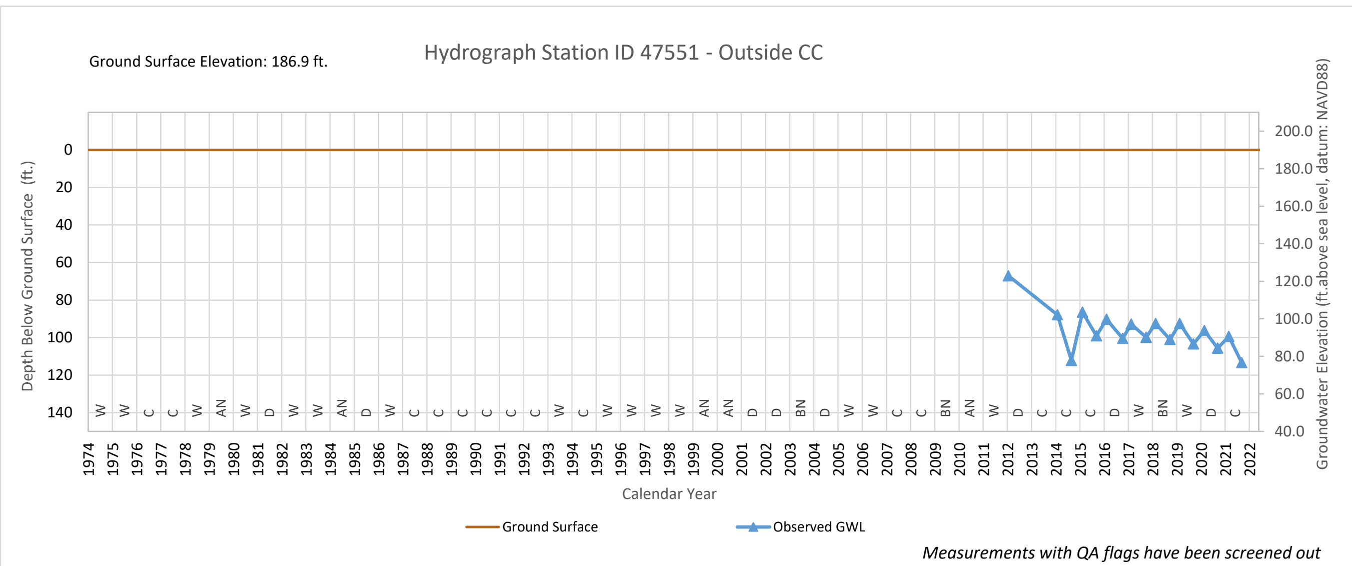
Ground Surface Elevation: 179.9 ft.
Hydrograph Station ID 47544 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W D C
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

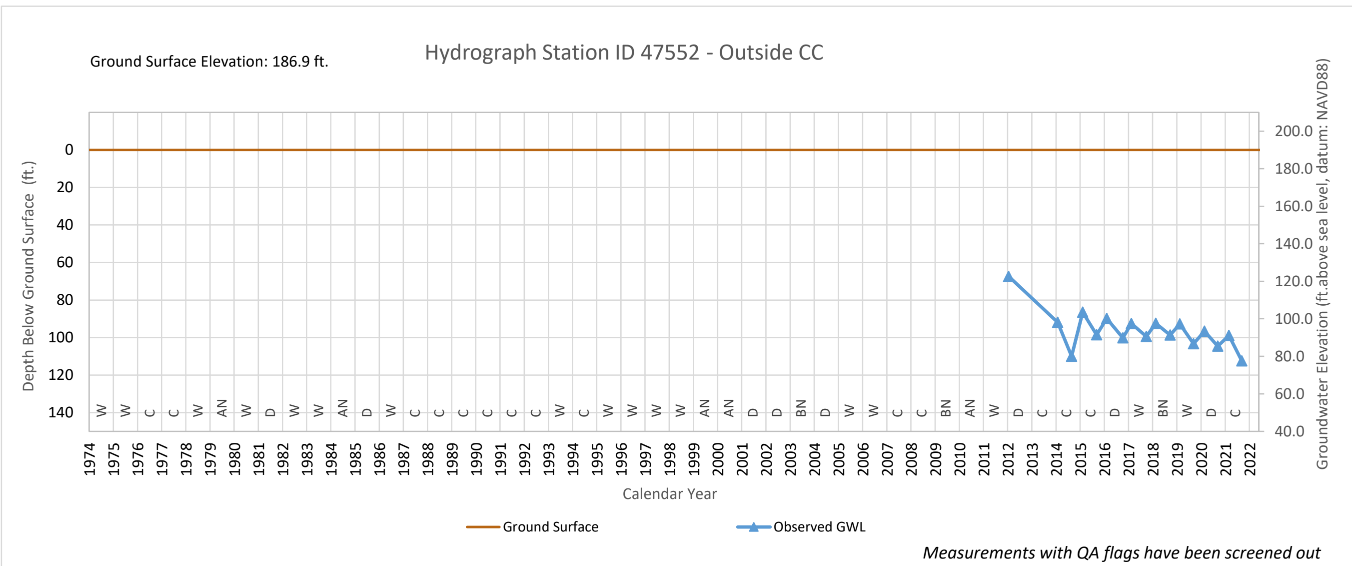


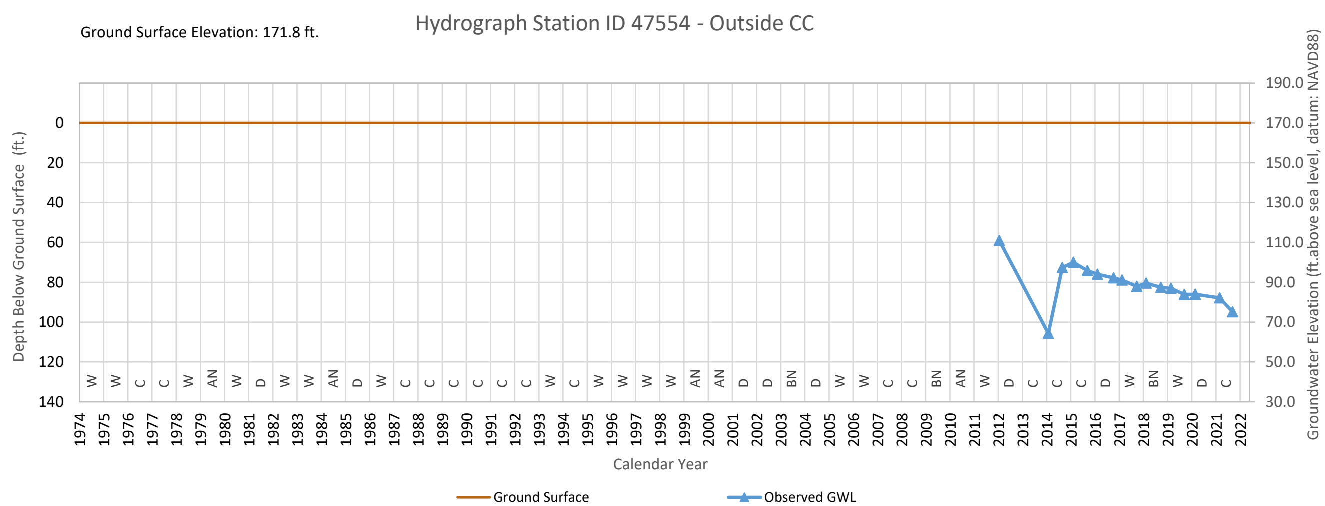
Ground Surface Elevation: 179.9 ft.
Hydrograph Station ID 47545 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



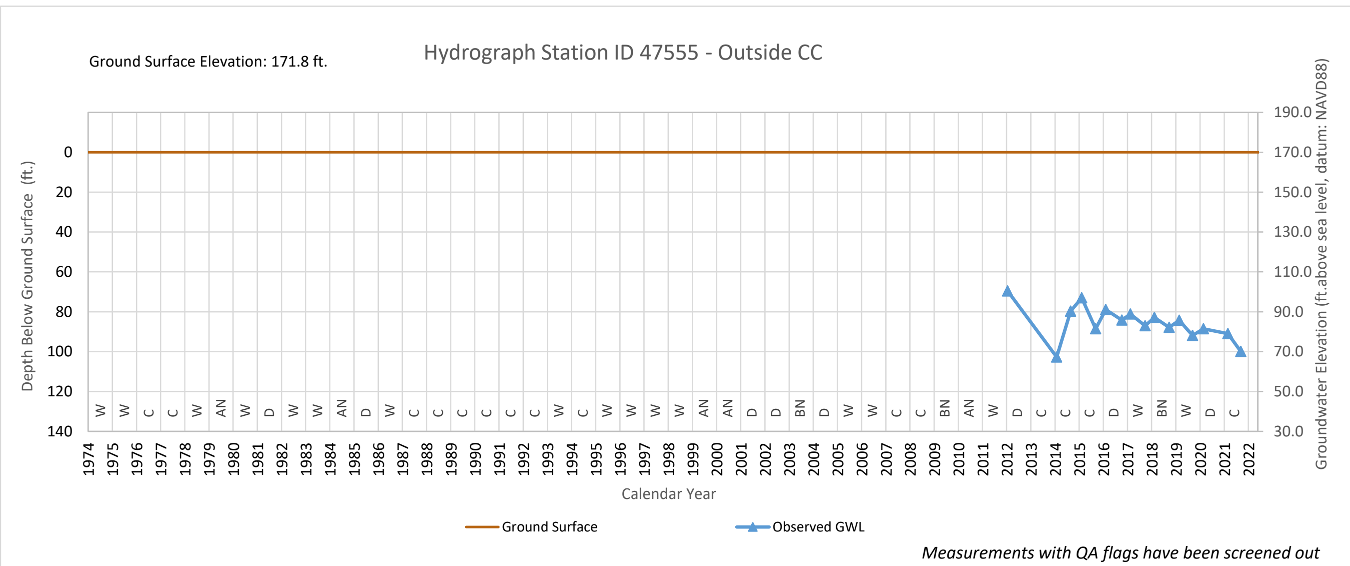
Hydrograph Station ID 47550 - Outside CC
Ground Surface Elevation: 186.9 ft.
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out


Ground Surface Elevation: 186.9 ft.
Hydrograph Station ID 47551 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

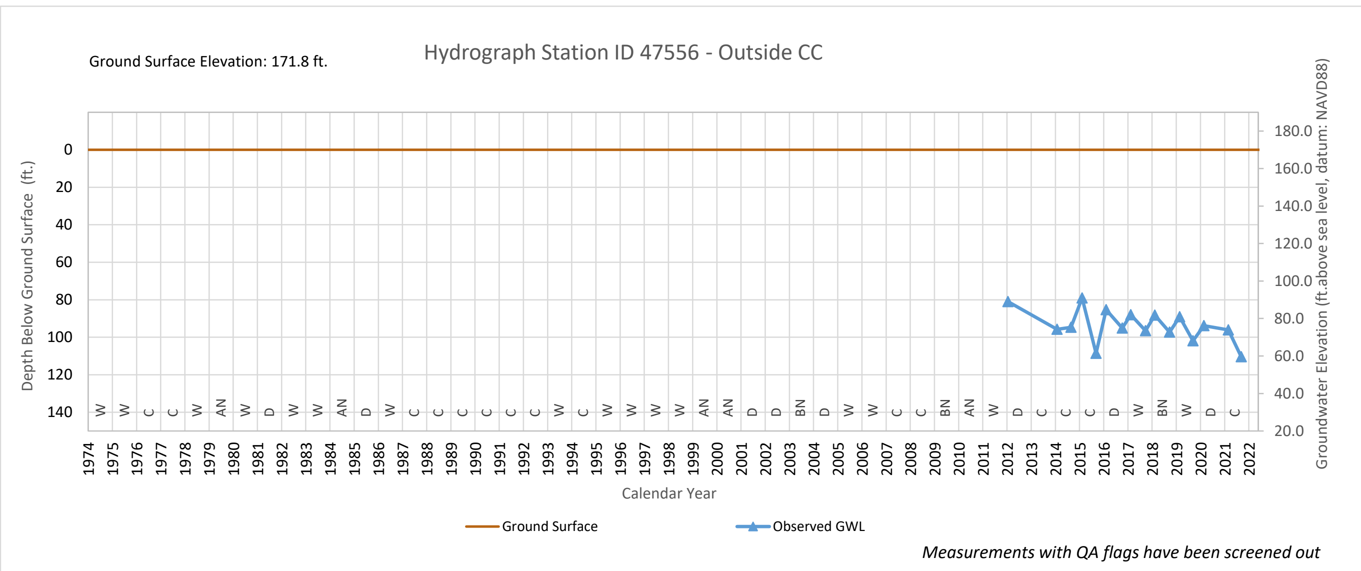

Ground Surface Elevation: 186.9 ft.
Hydrograph Station ID 47552 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



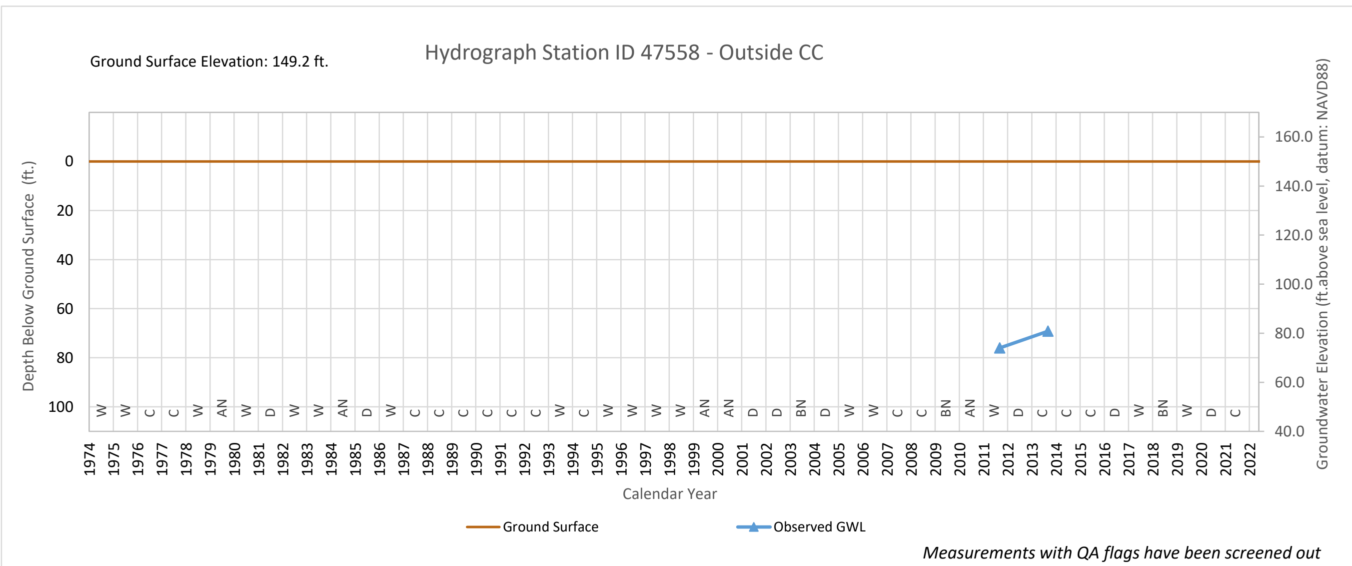
Measurements with QA flags have been screened out



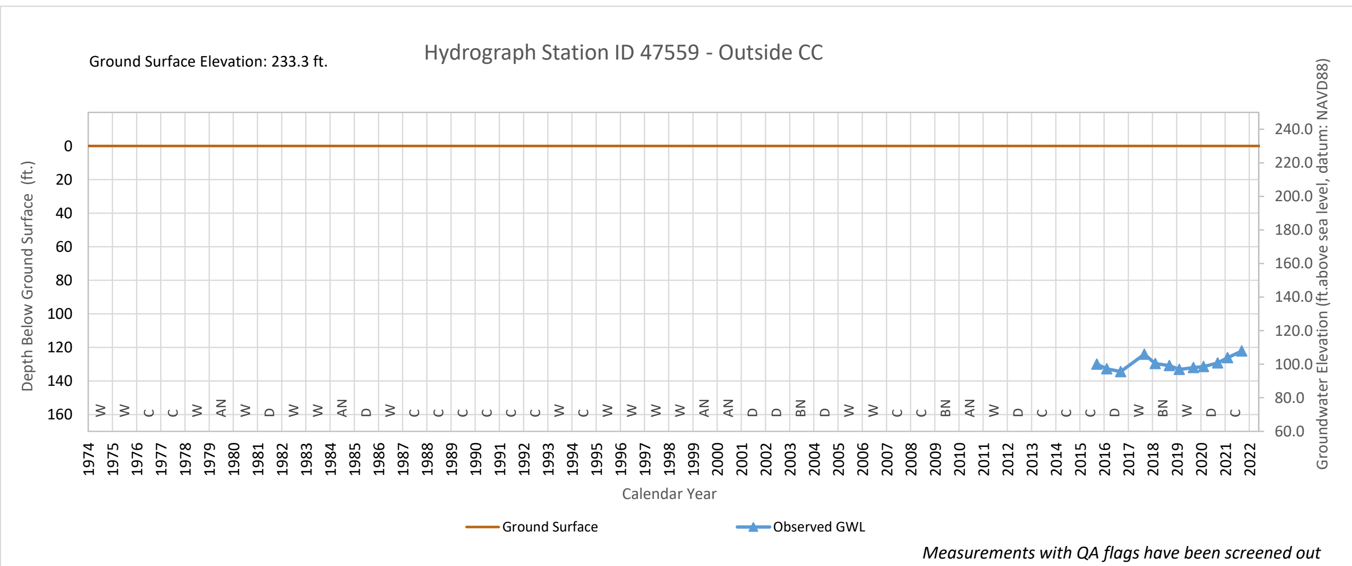
Ground Surface Elevation: 171.8 ft.
Hydrograph Station ID 47555 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



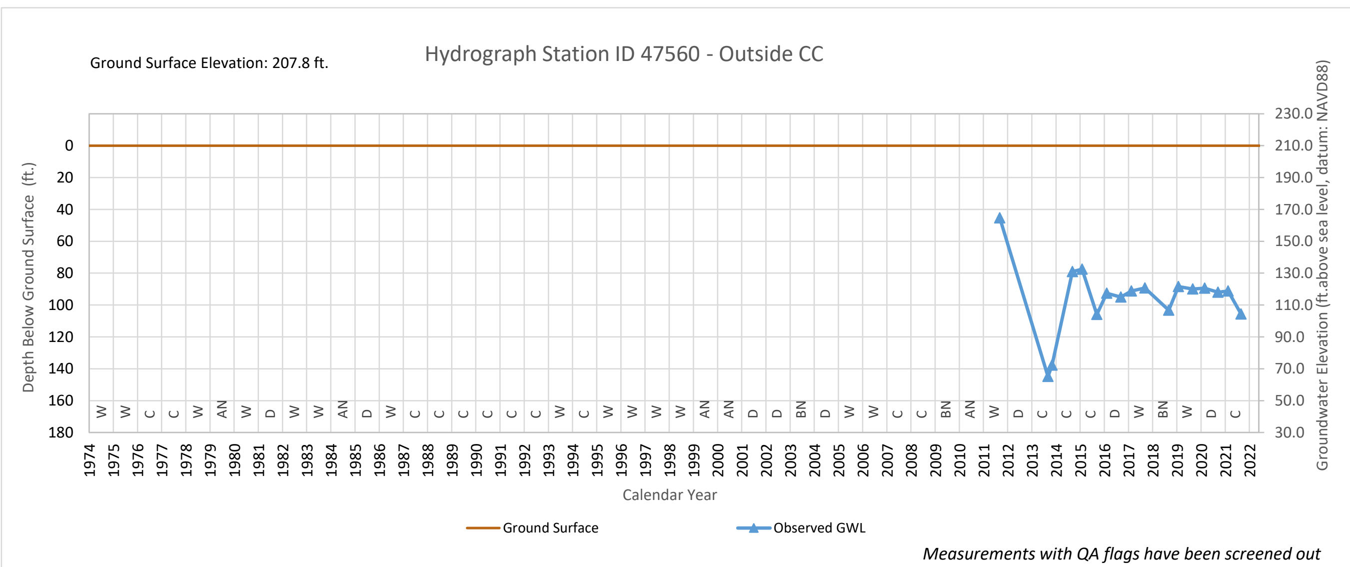
Hydrograph Station ID 47556 - Outside CC
Ground Surface Elevation: 171.8 ft.
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



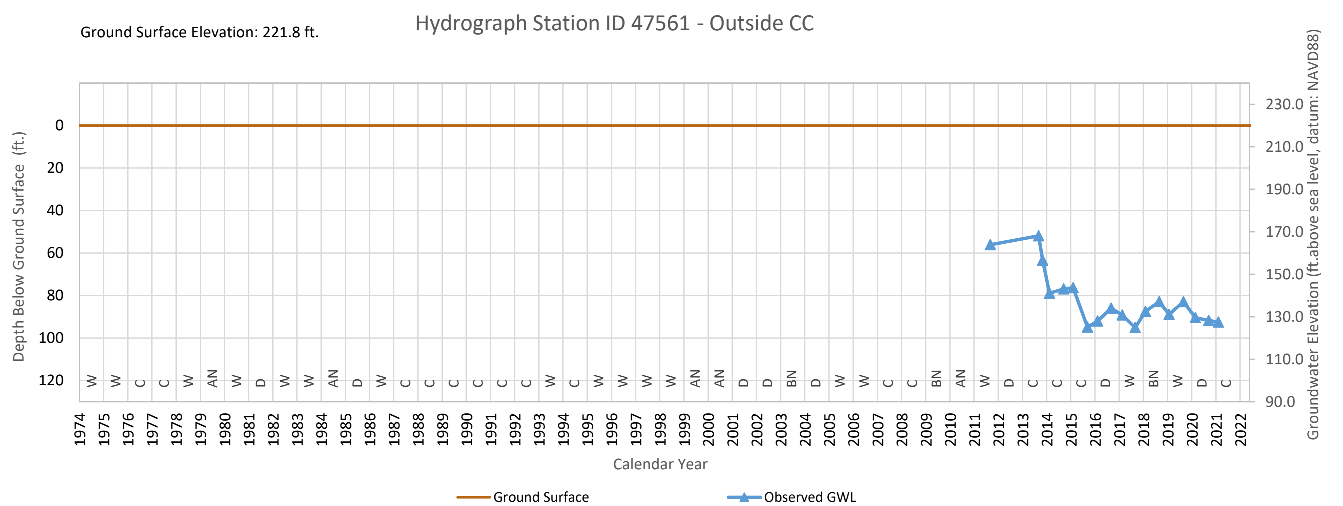
Ground Surface Elevation: 149.2 ft.
Hydrograph Station ID 47558 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



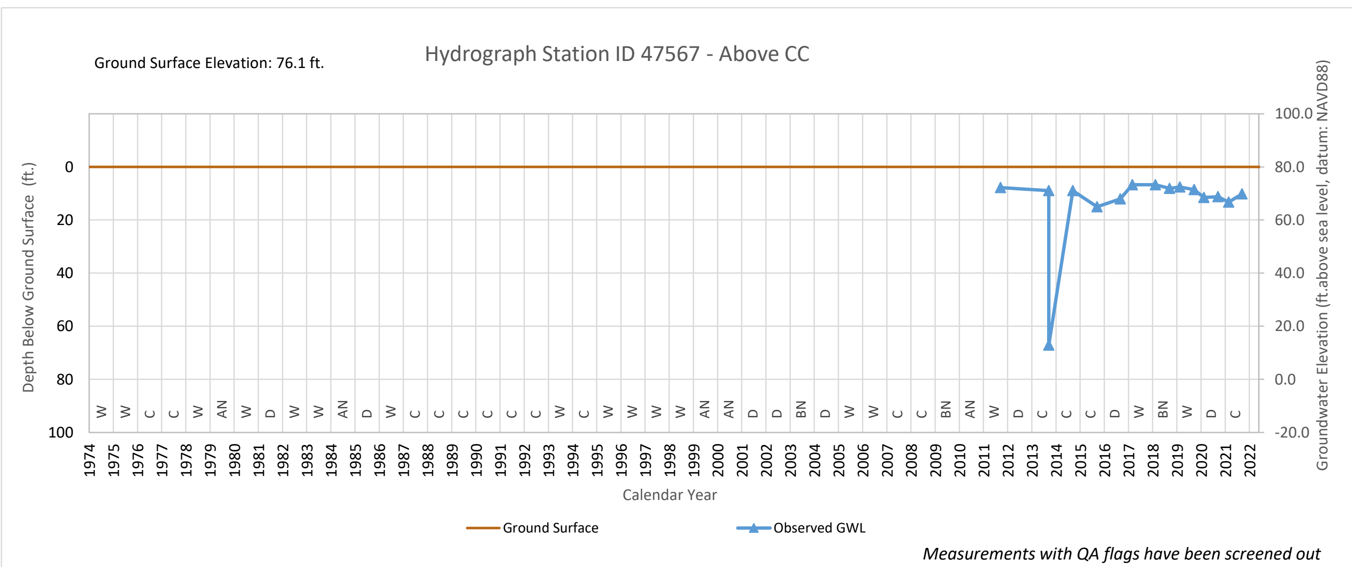
Hydrograph Station ID 47559 - Outside CC
Ground Surface Elevation: 233.3 ft.
Depth Below Ground Surface (ft.)
0
20
40
60
80
100
120
140
160
Groundwater Elevation (ft.above sea level, datum: NAVD88)
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
W W C C W AN W D W W AN D W C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W D C
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



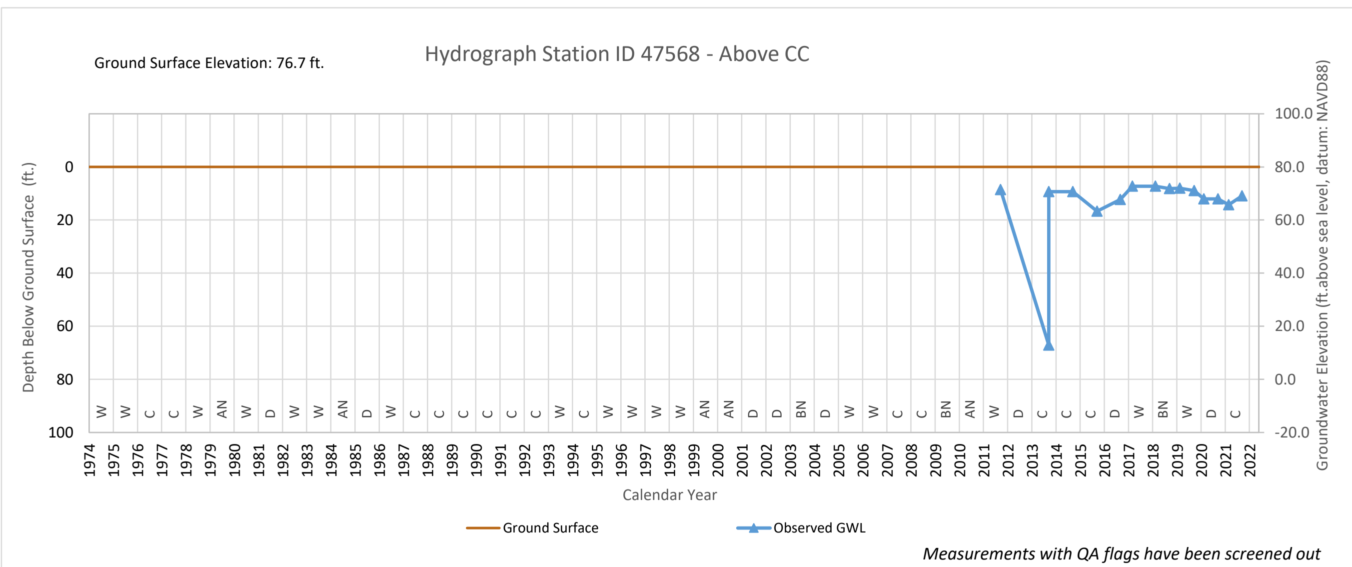
Ground Surface Elevation: 207.8 ft.
Hydrograph Station ID 47560 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



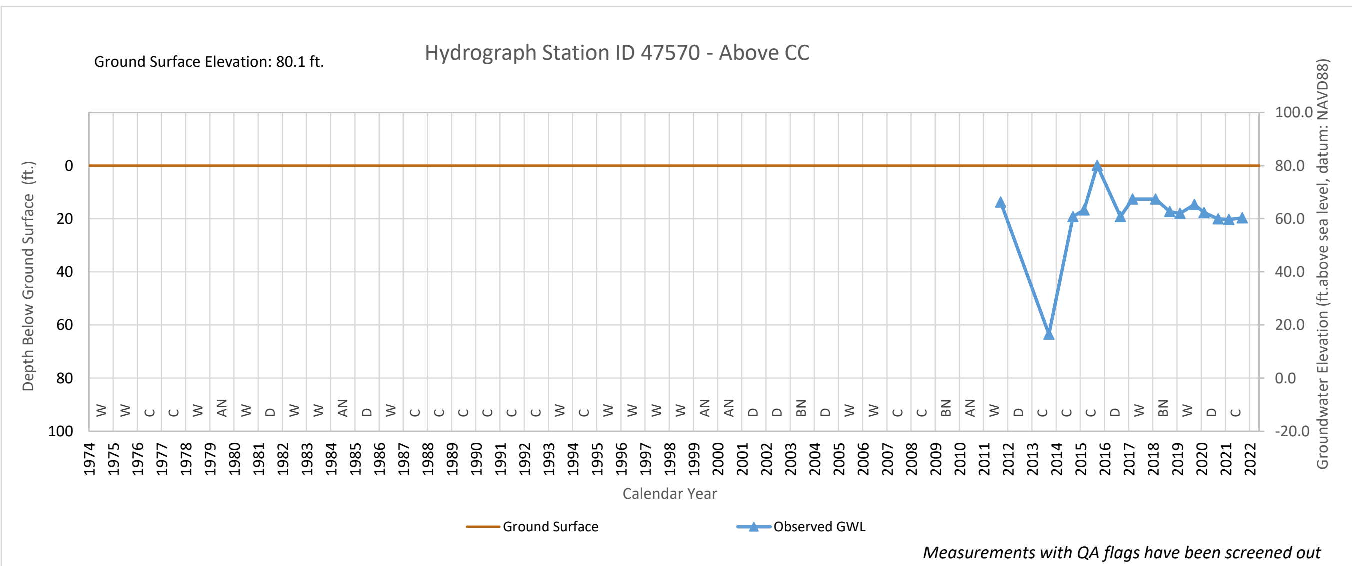
Measurements with QA flags have been screened out



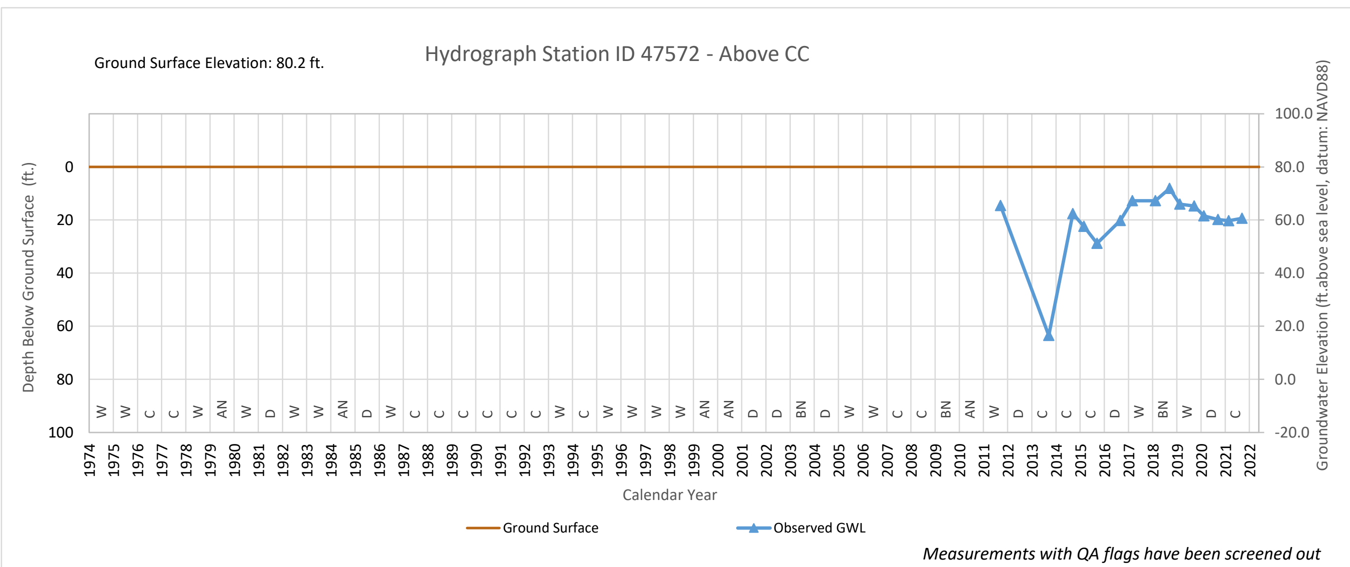
Hydrograph Station ID 47567 - Above CC
Ground Surface Elevation: 76.1 ft.
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

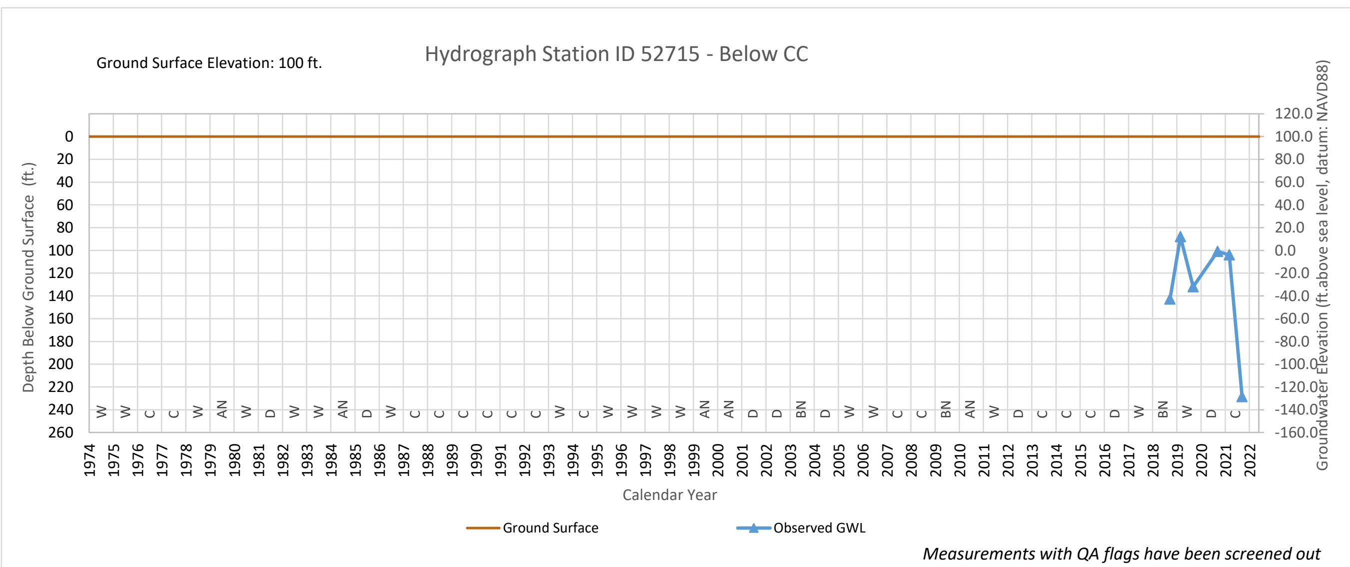


Ground Surface Elevation: 76.7 ft.
Hydrograph Station ID 47568 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

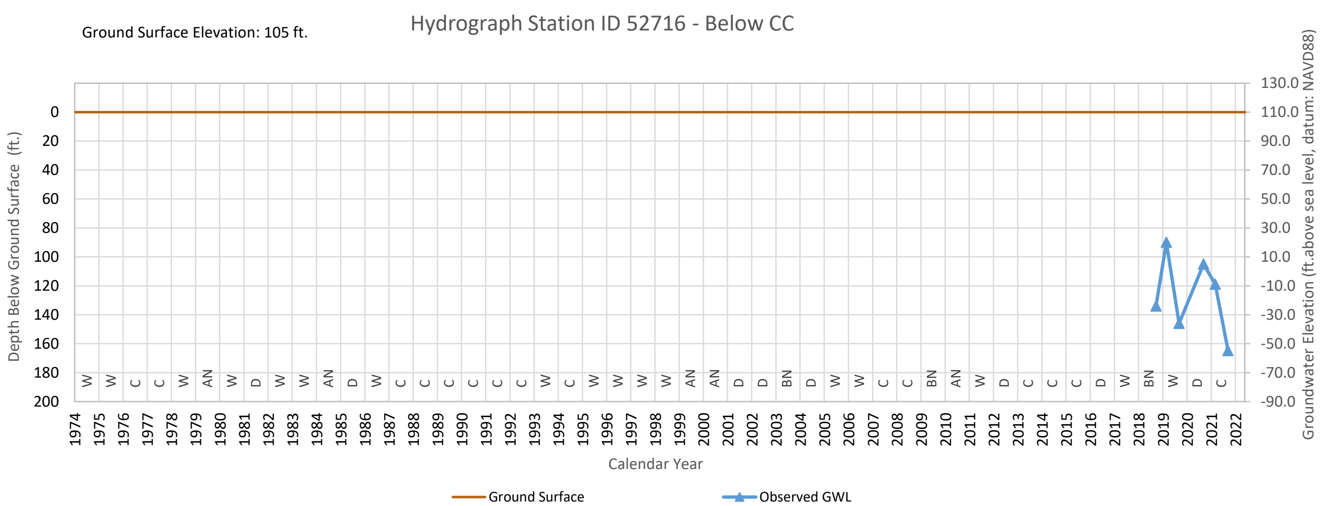


Ground Surface Elevation: 80.1 ft.
Hydrograph Station ID 47570 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

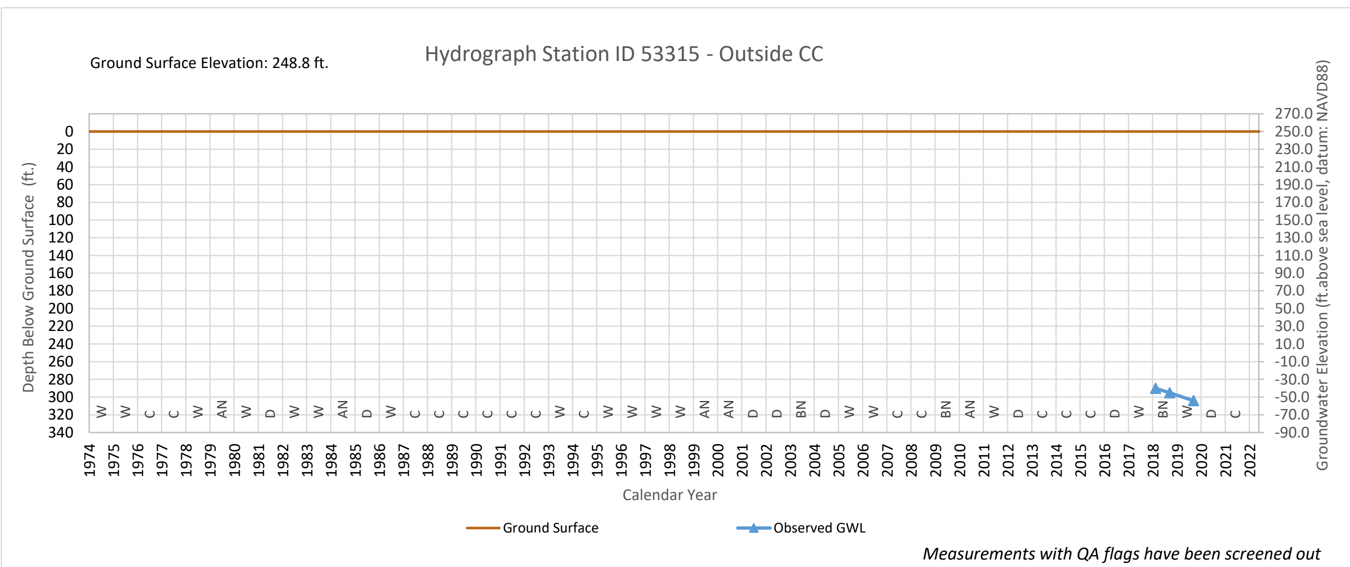

Ground Surface Elevation: 80.2 ft.
Hydrograph Station ID 47572 - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



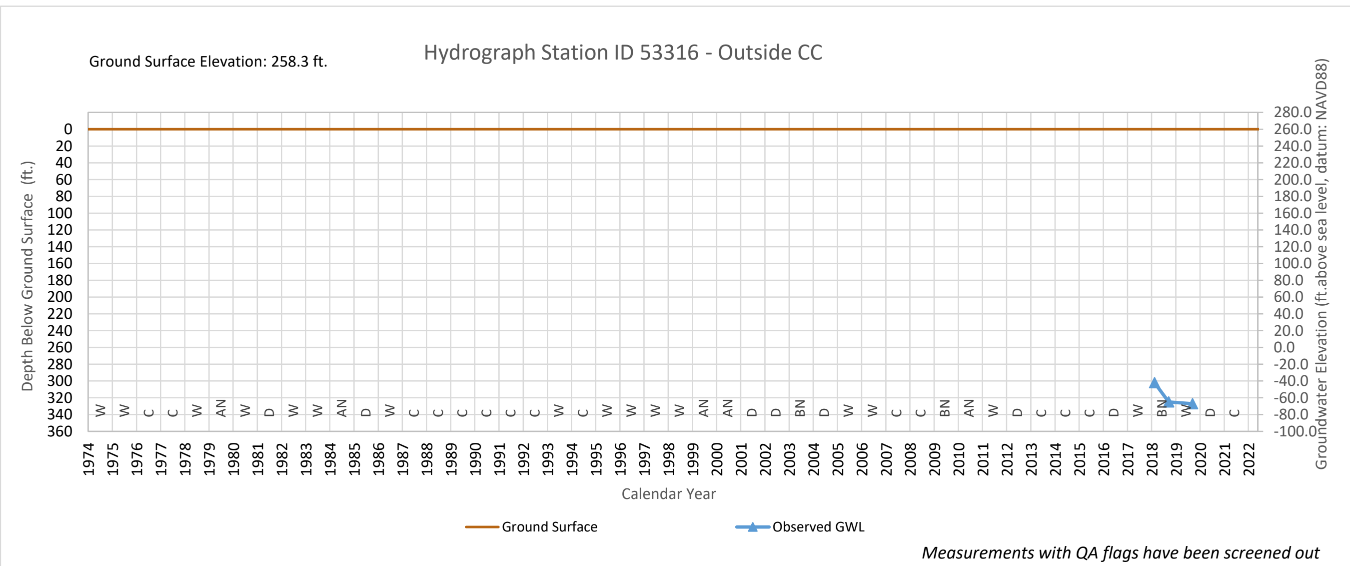
Ground Surface Elevation: 100 ft.
Hydrograph Station ID 52715 - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



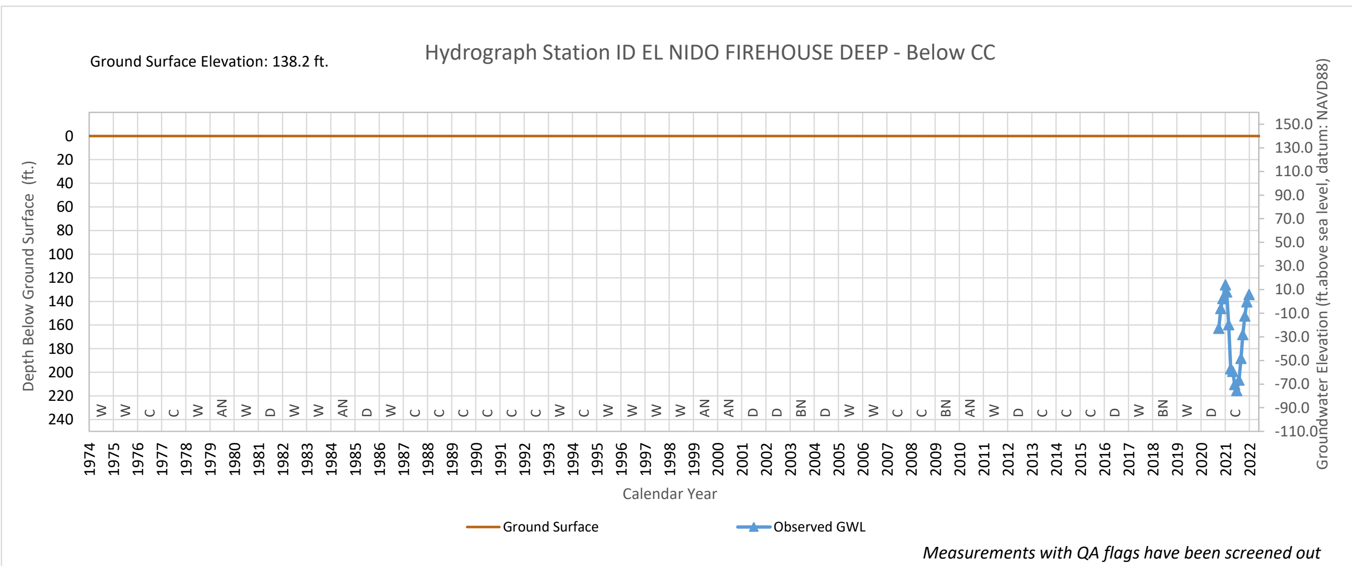
Measurements with QA flags have been screened out



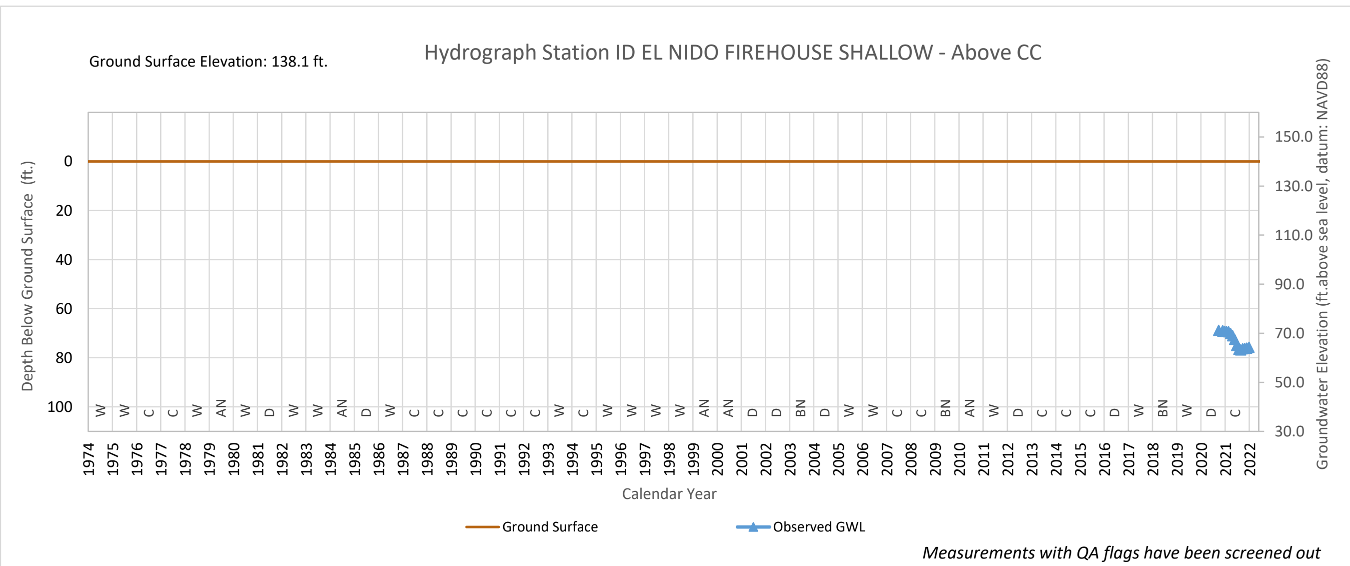
Ground Surface Elevation: 248.8 ft.
Hydrograph Station ID 53315 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

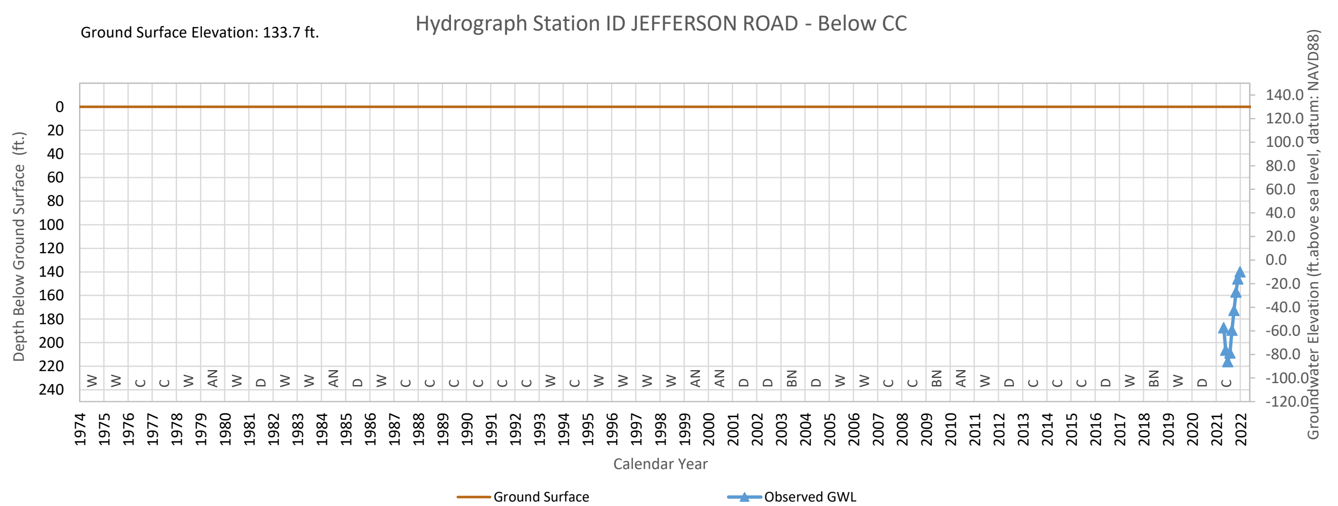


Ground Surface Elevation: 258.3 ft.
Hydrograph Station ID 53316 - Outside CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

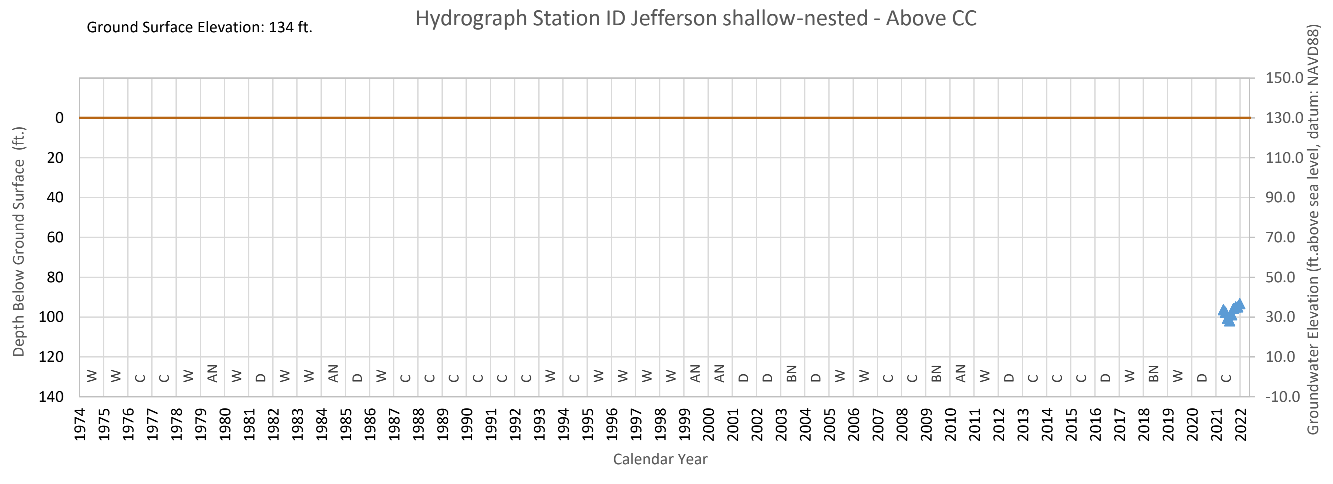


Ground Surface Elevation: 138.2 ft.
Hydrograph Station ID EL NIDO FIREHOUSE DEEP - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

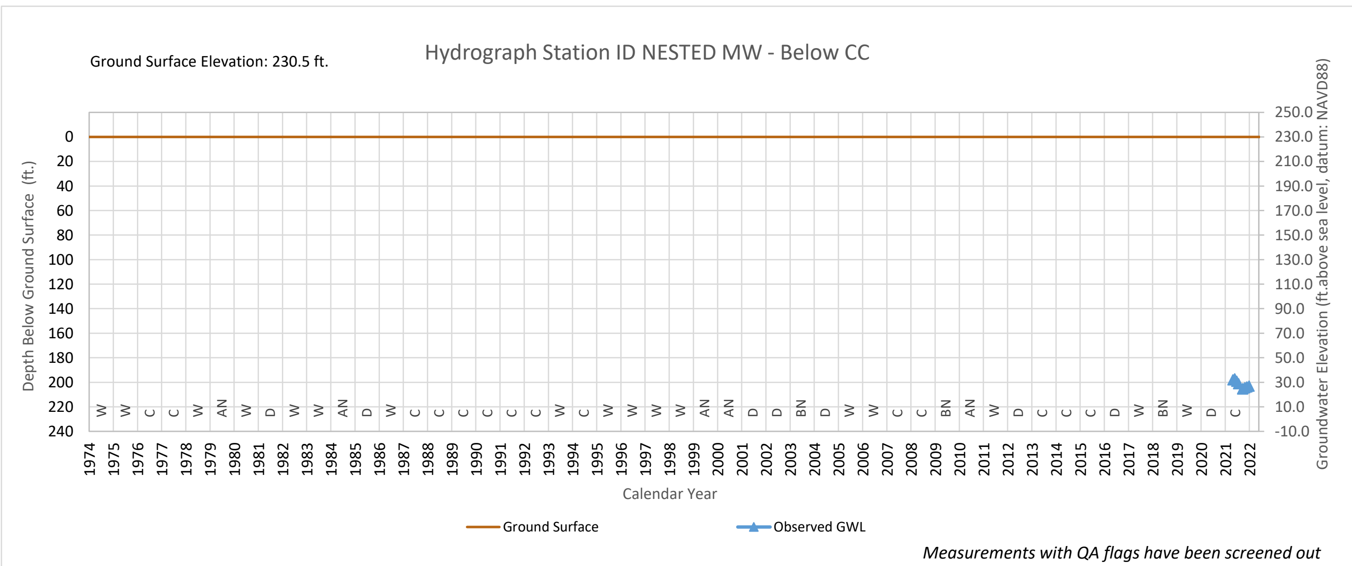

Ground Surface Elevation: 138.1 ft.
Hydrograph Station ID EL NIDO FIREHOUSE SHALLOW - Above CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



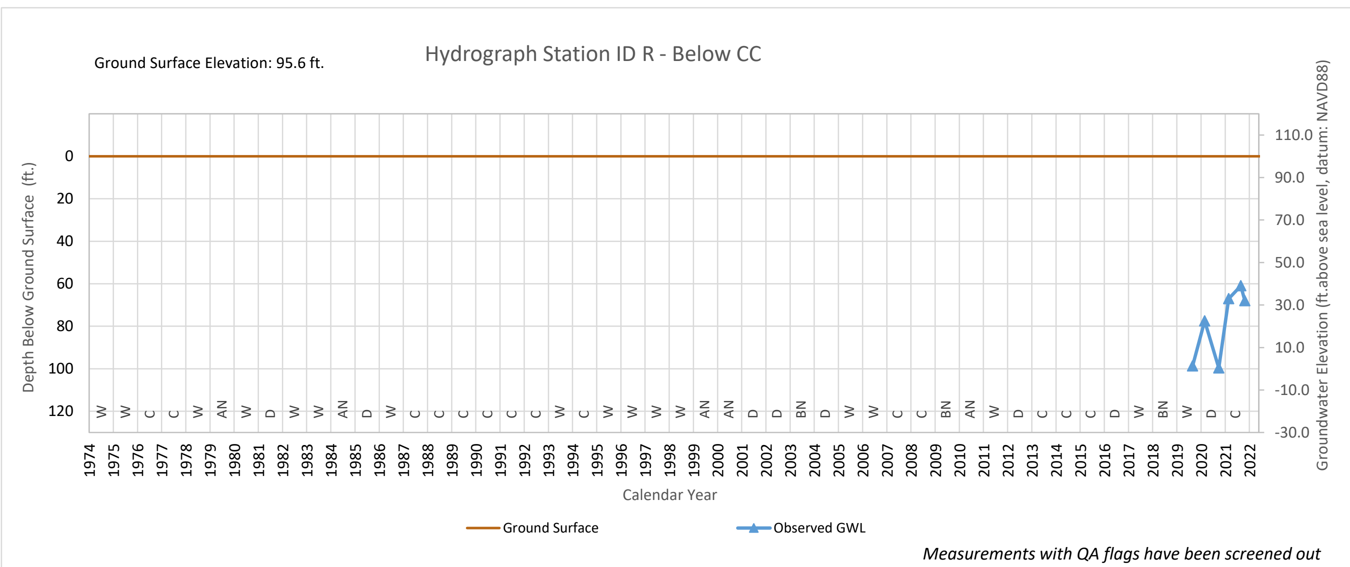
Measurements with QA flags have been screened out



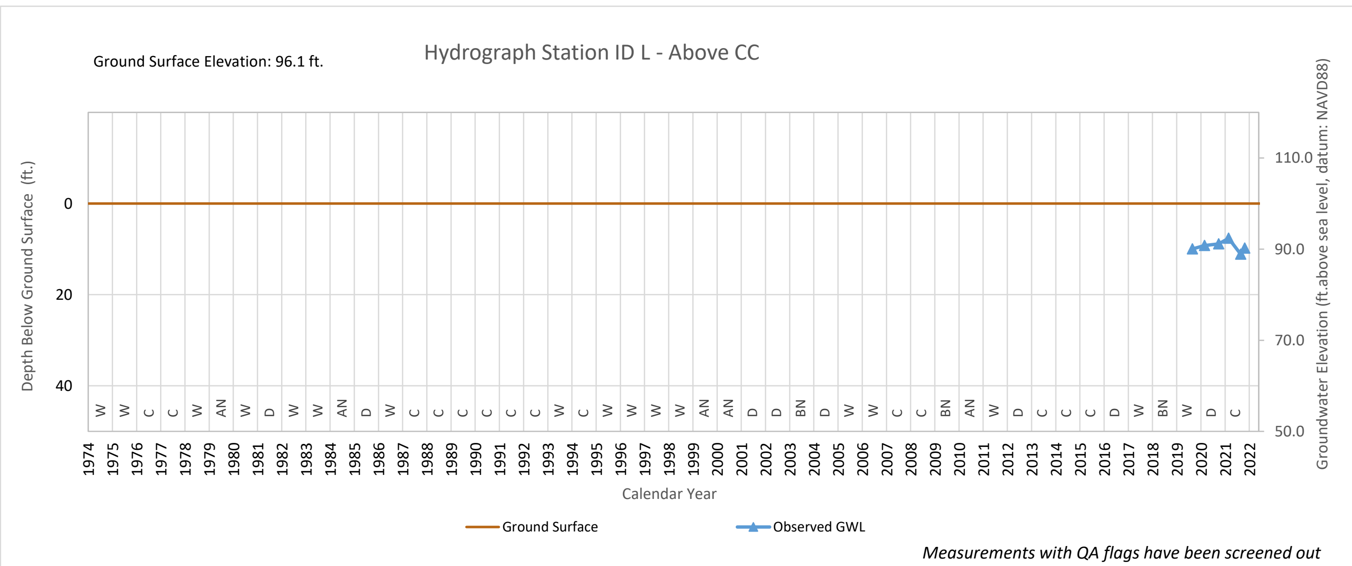
Measurements with QA flags have been screened out



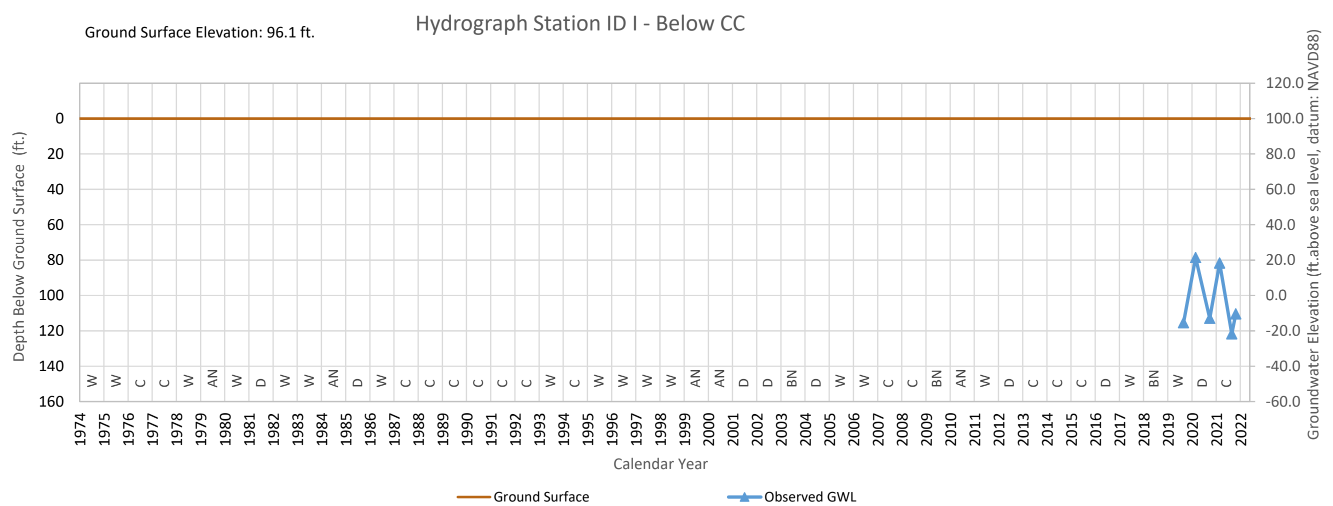
Ground Surface Elevation: 230.5 ft.
Hydrograph Station ID NESTED MW - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



Ground Surface Elevation: 95.6 ft.
Hydrograph Station ID R - Below CC
Depth Below Ground Surface (ft.)
Groundwater Elevation (ft.above sea level, datum: NAVD88)
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out

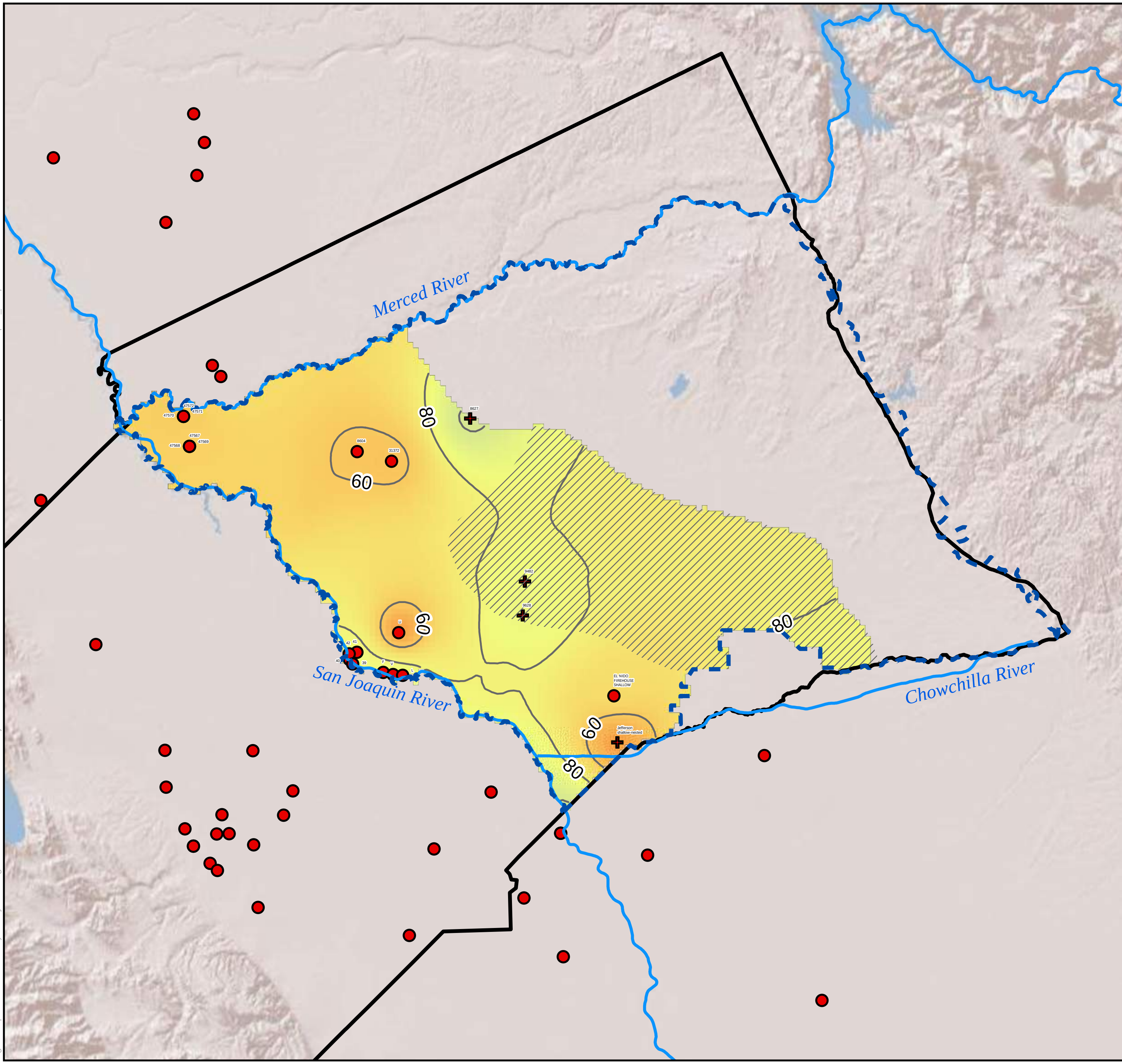


Ground Surface Elevation: 96.1 ft.
Hydrograph Station ID L - Above CC
Depth Below Ground Surface (ft.)
0
20
40
Groundwater Elevation (ft.above sea level, datum: NAVD88)
110.0
90.0
70.0
50.0
W W C C W AN W D W W AN D W C C C C C C C W C W W W W AN AN D D BN D W W C C BN AN W D C C C D W BN W D C
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Calendar Year
Ground Surface
Observed GWL
Measurements with QA flags have been screened out



Measurements with QA flags have been screened out

APPENDIX B: GROUNDWATER LEVEL CONTOUR MAPS



Merced Subbasin GSP

Fall 2020

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer - Above CC

- Above CC
- Above CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

260

-100

*Feet above sea level
Datum: NAVD88

0 2 4 8 Miles

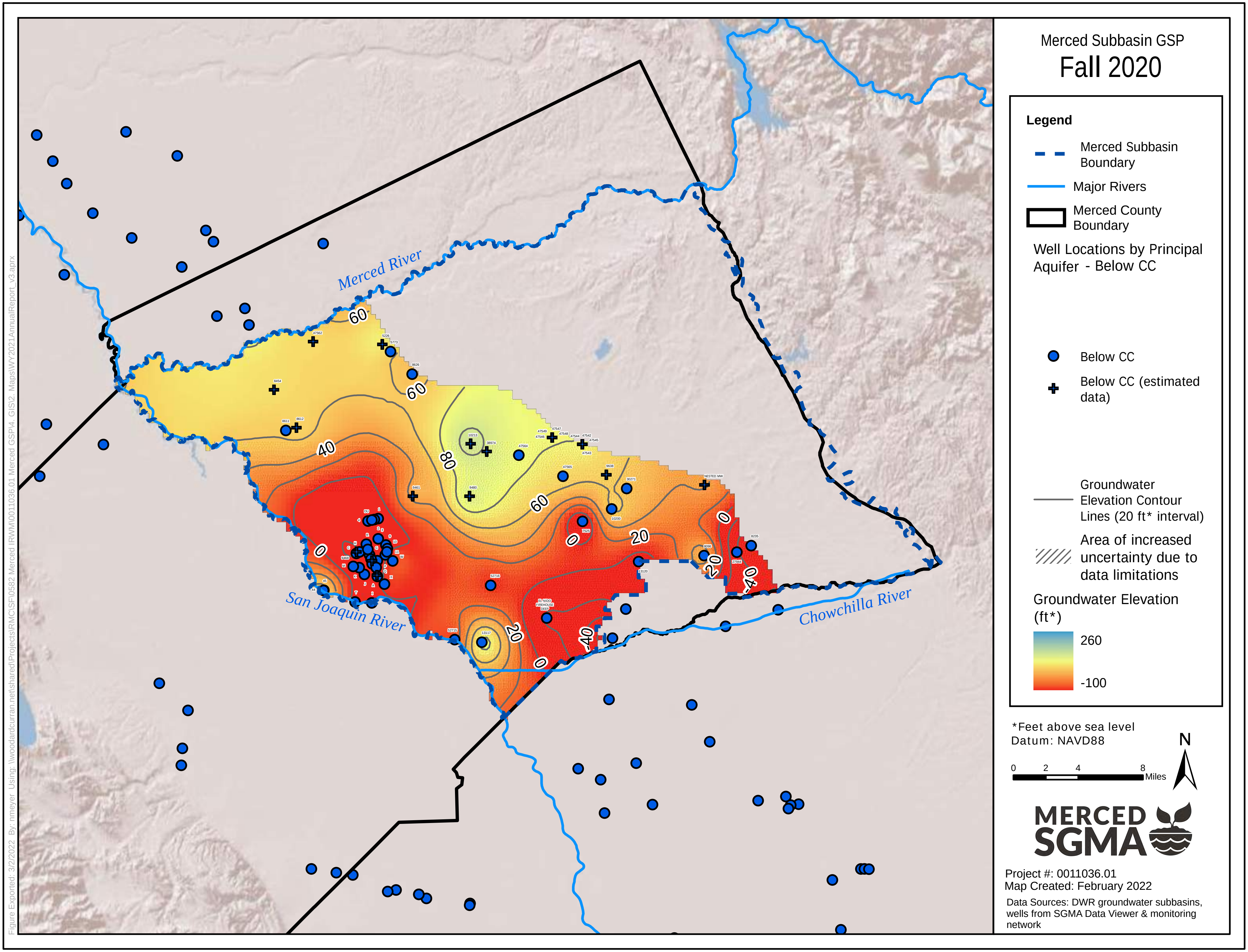
N

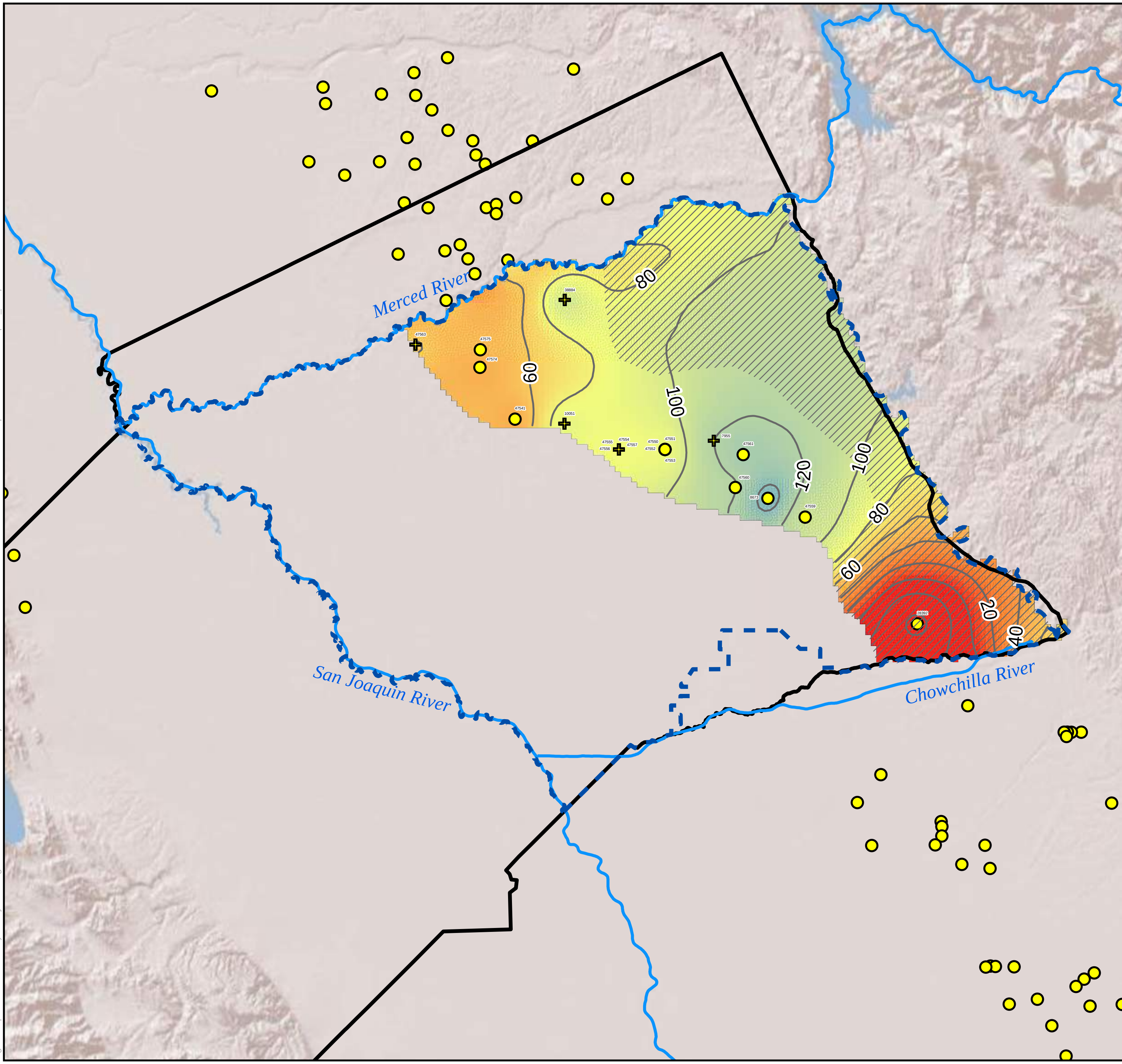
MERCED SGMA

Project #: 0011036.01
Map Created: February 2022

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx


Merced Subbasin GSP
Fall 2020
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer - Below CC
Below CC
Below CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
0 2 4 8 Miles
N
MERCED SGMA
Project #: 0011036.01
Map Created: February 2022
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network
Merced River
San Joaquin River
Chowchilla River
60
60
40
80
60
20
0
0
0
20
-40
20
0
-40
Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx



Merced Subbasin GSP

Fall 2020

Legend

Merced Subbasin Boundary

Major Rivers

Merced County Boundary

Well Locations by Principal Aquifer - Outside CC

Outside CC

Outside CC (estimated data)

Groundwater Elevation Contour Lines (20 ft* interval)

Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

260

-100

*Feet above sea level
Datum: NAVD88

N

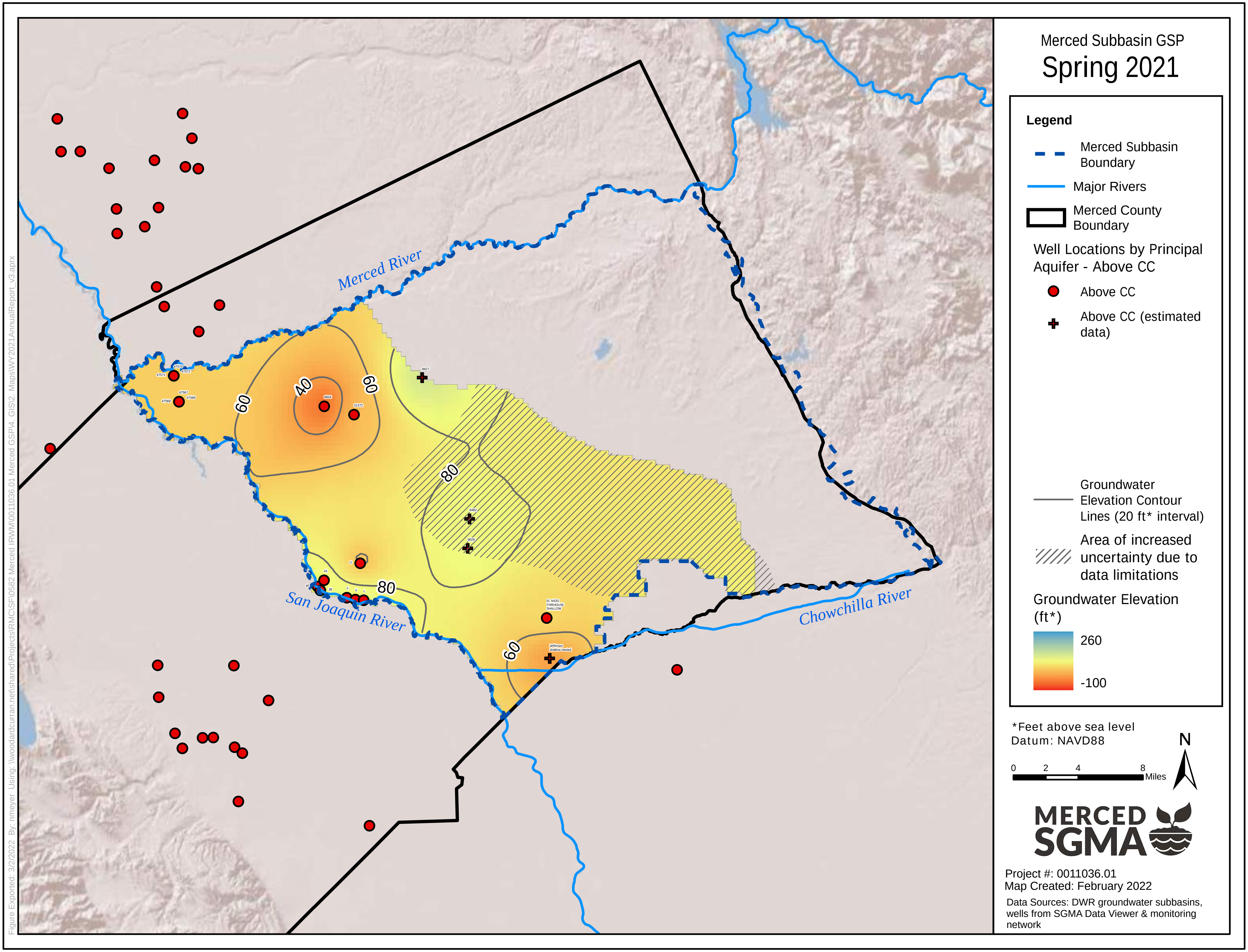
0 2 4 8 Miles

MERCED SGMA

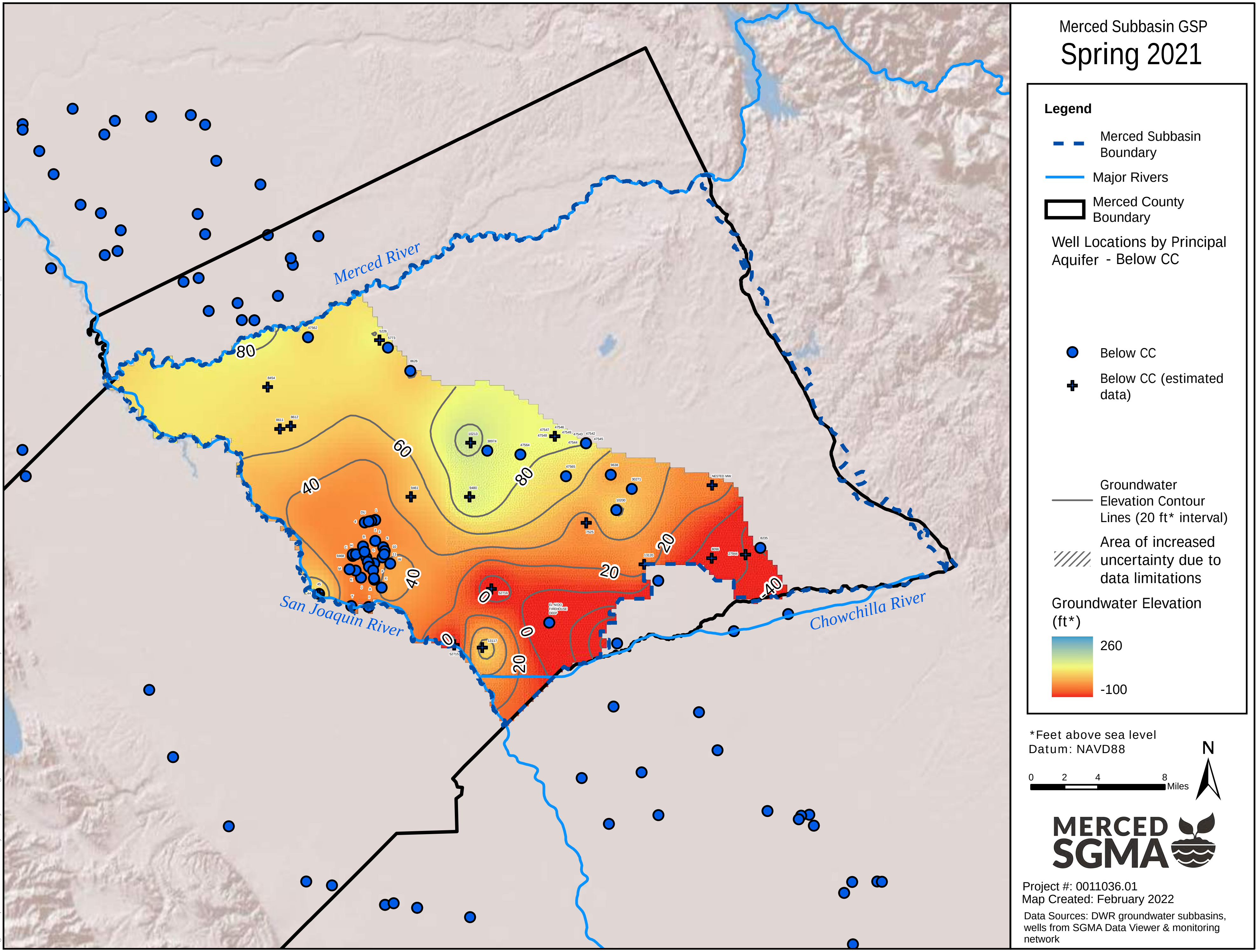
Project #: 0011036.01
Map Created: February 2022

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP4. GIS\2. Maps\WY2021AnnualReport_v3.aprx



Merced Subbasin GSP
Spring 2021
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer - Above CC
Above CC
Above CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
0 2 4 8 Miles
N
MERCED SGMA
Project #: 0011036.01
Map Created: February 2022
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network
Merced River
San Joaquin River
Chowchilla River
40
60
60
60
80
80
60
EL NIDO FIREHOUSE SHALLOW
Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP4. GIS\2. Maps\WY2021AnnualReport_v3.aprx



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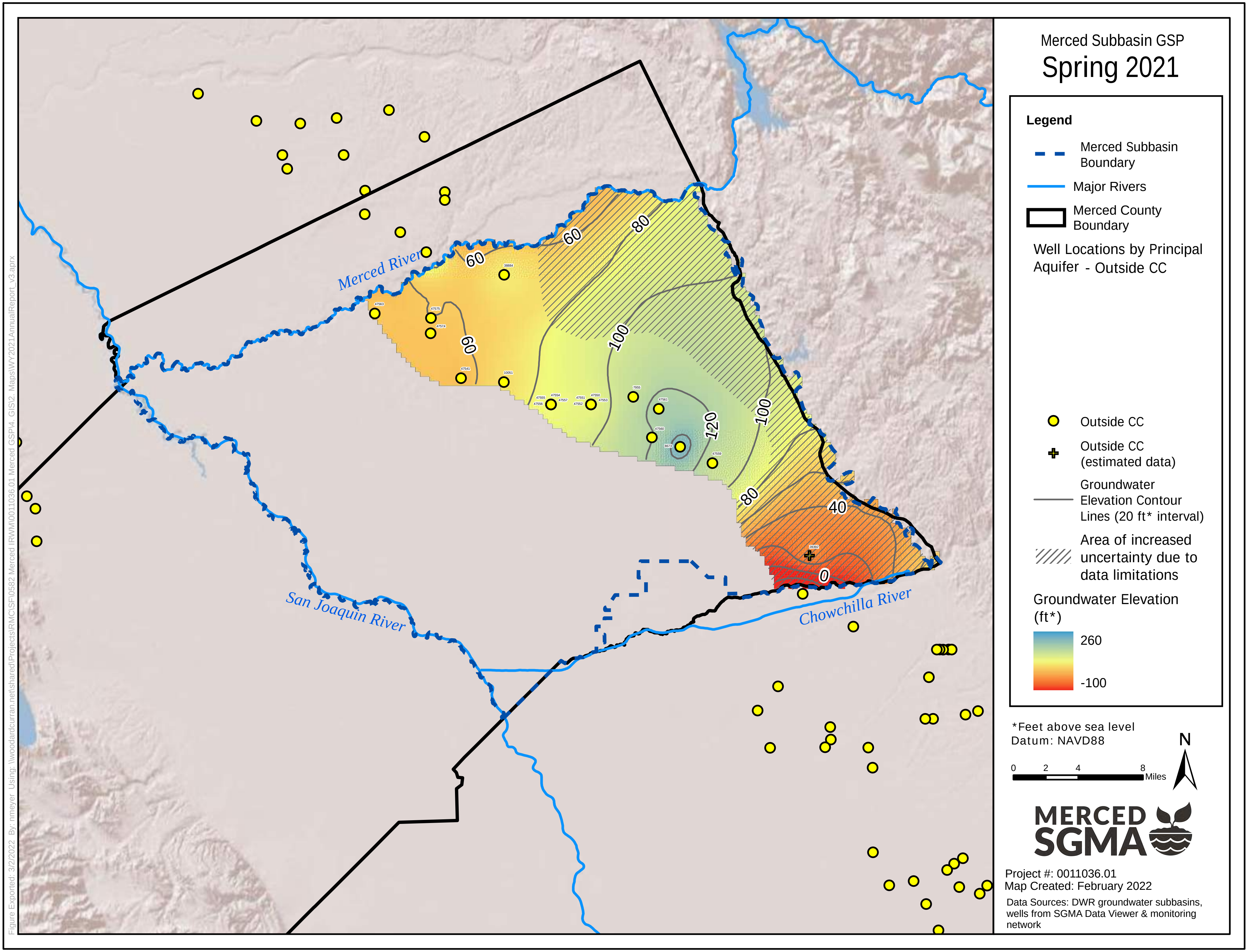
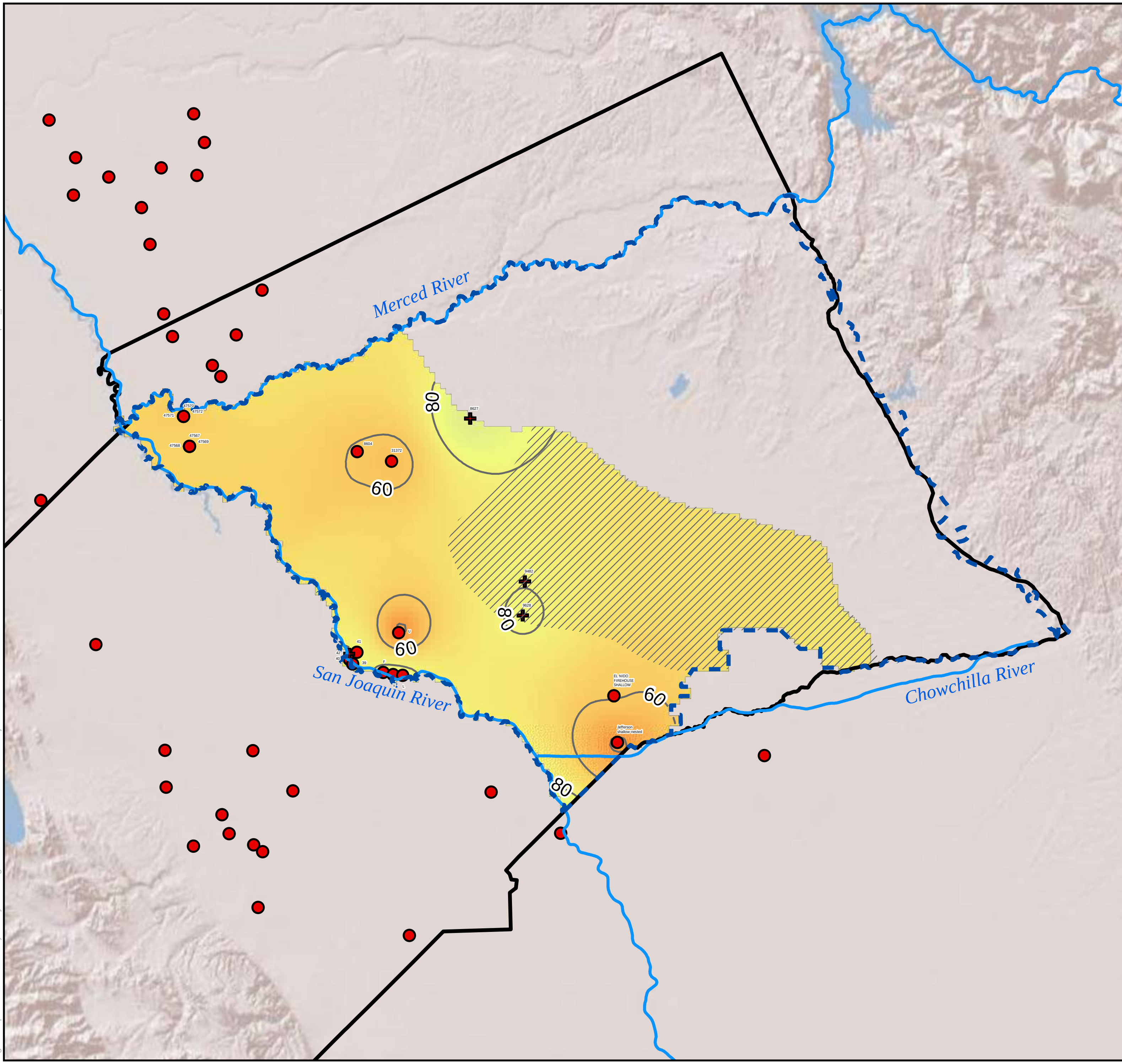


Merced River
San Joaquin River
Chowchilla River
60
60
60
80
100
120
100
80
40
0
Merced Subbasin GSP
Spring 2021
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer - Outside CC
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
0 2 4 8 Miles
N
MERCED SGMA
Project #: 0011036.01
Map Created: February 2022
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network
Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx



Merced Subbasin GSP

Fall 2021

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary

Well Locations by Principal Aquifer - Above CC

- Above CC
- Above CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

260

-100

*Feet above sea level
Datum: NAVD88

N

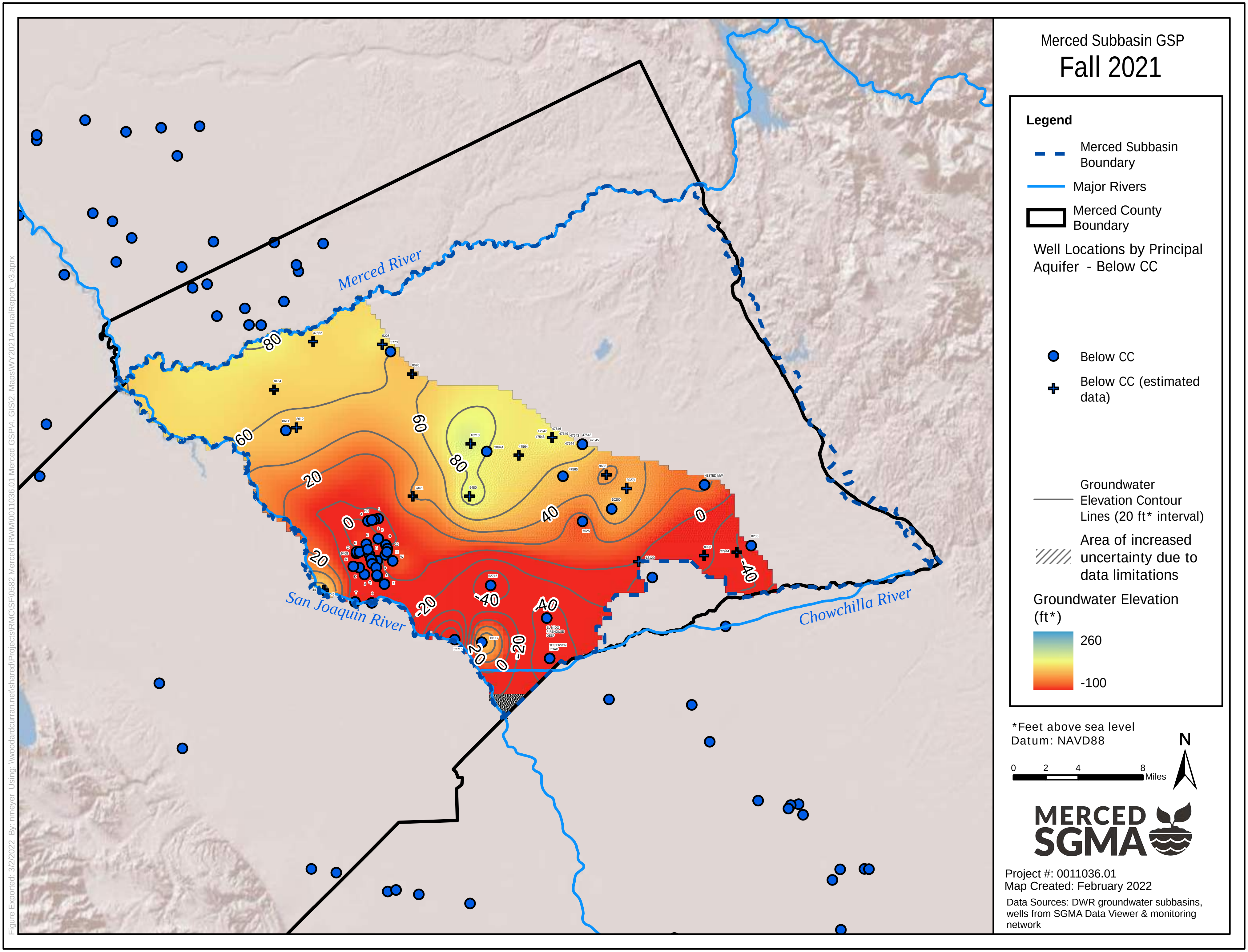
0 2 4 8 Miles

MERCED SGMA

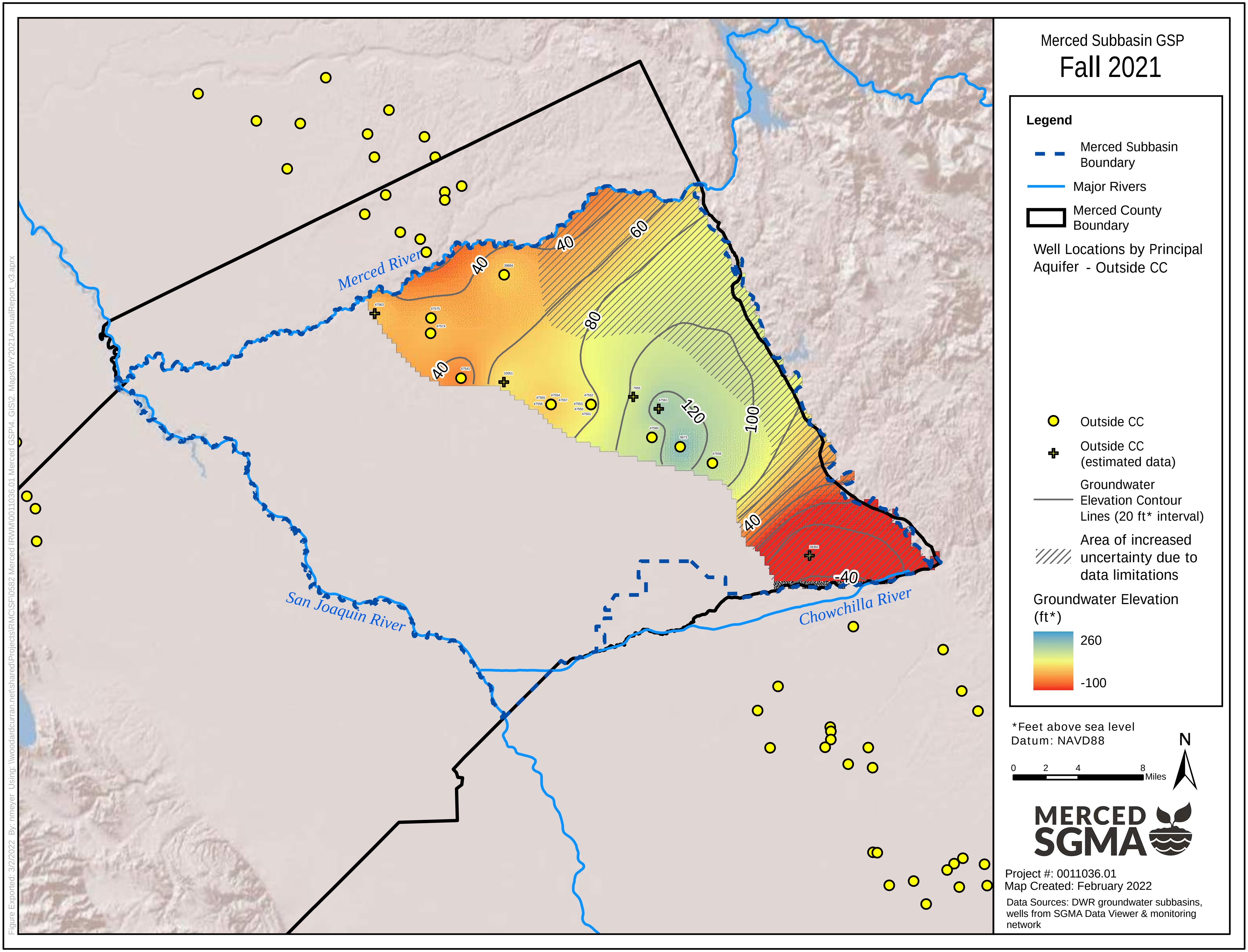
Project #: 0011036.01
Map Created: February 2022

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx



Merced Subbasin GSP
Fall 2021
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer - Below CC
Below CC
Below CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
N
0 2 4 8 Miles
MERCED SGMA
Project #: 0011036.01
Map Created: February 2022
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network
Merced River
San Joaquin River
Chowchilla River
80
60
40
20
0
-20
-40
Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx


Merced Subbasin GSP
Fall 2021
Legend
Merced Subbasin Boundary
Major Rivers
Merced County Boundary
Well Locations by Principal Aquifer - Outside CC
Outside CC
Outside CC (estimated data)
Groundwater Elevation Contour Lines (20 ft* interval)
Area of increased uncertainty due to data limitations
Groundwater Elevation (ft*)
260
-100
*Feet above sea level
Datum: NAVD88
0
2
4
8
Miles
N
MERCED SGMA
Project #: 0011036.01
Map Created: February 2022
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network
Merced River
San Joaquin River
Chowchilla River
40
40
60
80
40
120
100
40
-40
Figure Exported: 3/2/2022 By: nmeyer Using: \\woodardcurran.net\shared\Projects\RMC\SF\0582 Merced IRWM\0011036.01 Merced GSP\4. GIS\2. Maps\WY2021AnnualReport_v3.aprx

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