STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **Gavin Newsom,** *Governor*

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Executive Summary

Water year 2021 (October 1, 2020 to September 30, 2021) was the second driest year on record following the fifth driest year in 2020. Once again, California is experiencing historic drought conditions and a reduction in surface water supplies. In the face of these drought conditions, many water managers have turned to extracting additional groundwater to fulfill their water supply needs. Groundwater conditions in California are reflective of these dynamics, as water levels in nearly two thirds of monitoring wells are below their historical average level, with one in five wells being measured at its historic low in fall of 2021 (**Figure 8**).

As groundwater levels decline, areas in the southern San Joaquin Valley continue to experience land subsidence at rates up to one foot per year and areas on the western side of the Sacramento Valley have begun experiencing land subsidence at rates up to 0.7 feet per year (**Figure 9**). Nearly 1,000 dry well reports were received this water year as the drought ensued, a large increase from the previous water year. Adding to pressure on the resource, higher numbers of new domestic and irrigation wells were installed this water year than any of the previous five water years (**Figures 12 and 14**).

Through near term drought actions and the longer-term implementation of the Sustainable Groundwater Management Act (SGMA), state and local agencies are taking great strides to manage groundwater resources for long-term use, so that groundwater basins can serve as a drought buffer in future years. Groundwater Sustainability Plans are now fully developed, and implementation of these plans has begun in basins covering 98% of the groundwater pumped in the state.

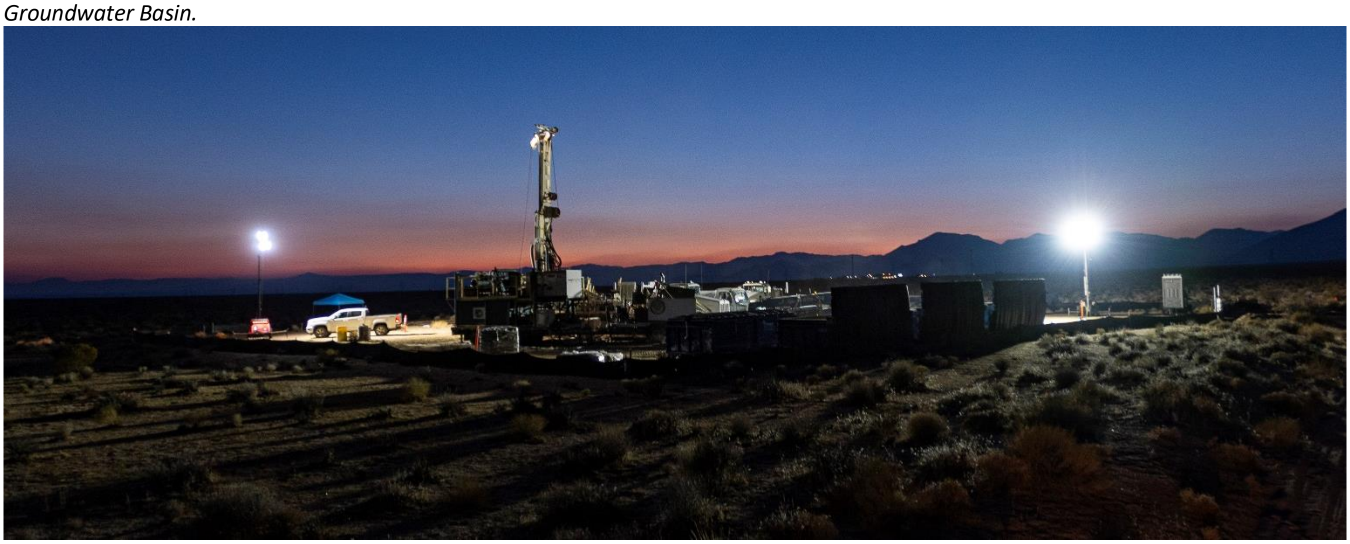
Introduction
This report summarizes groundwater conditions for WY 2021 including groundwater levels, land subsidence, new well installations and reported dry wells throughout California and compares these conditions to other recent years to show how conditions have changed over time.

To view the latest groundwater information, statistics and summaries of groundwater conditions, land subsidence and well infrastructure, visit California' Groundwater Live. On the site, users can view and create customized data summaries with the latest information which is updated weekly in a series of interactive dashboards.

Key Findings

- Increased reliance on groundwater especially during drought years has resulted in the lowering of groundwater levels in some parts of the state (**Figures 3-7**).
- Groundwater conditions in Fall of 2021 show over 62 percent of monitoring wells are below normal levels with nearly one in five (21 percent) being at its all-time low level (**Figure 8**).
- Land subsidence continues to occur in California during WY 2021 **(Figure 9)**, but at a lower rate than the previous drought in 2016 (**Figure 10**).
- More domestic and irrigation wells were installed this year than in any of the previous 5 years. (**Figures 11 through 14**).
- More dry well reports were received over the last year (**Figure 15**) than any of the previous five-years (**Figure 16**).

Photo 1: *DWR Staff and Contractors Work to install a New Well to Monitor Groundwater Conditions in the Indian Wells Valley Groundwater Basin.*



Drought and Groundwater in California
California, as well as the entire Western United States, is experiencing the effects of climate change with extreme weather events that continue to set records. The region faces another significant drought

in the wake of one the driest periods ever recorded as Water Year (WY) 2021 ended with most of the state in an [Extreme or Exceptional Drought] status. WY 2022 began with many cities setting all-time records for the most precipitation ever recorded in one day. As an example, the city of Sacramento set an all-time record with 5.44 inches of rain on October 24, 2021, breaking the previous record set more than 140 years ago (1880, 5.28 inches) and surpassing the total amount of rain that fell in the previous 296 days (4.89 of rainfall in Sacramento between January 1 – October 23).

A wet period remained in place through the end of December 2021 with historic snow fall in the Sierra including over 214 inches or nearly 20 feet of snow, breaking the previous record by nearly three feet and resulting in rising reservoir levels. Unfortunately, a historically dry period has again settled in for the beginning of 2022, continuing the dry WY 2021 trend.

WY 2021 was the second driest year on record (1896 to 2021) for statewide precipitation and was exacerbated by a dry WY 2020. This two-year dry period continues an arid trend California has been experiencing in the 21st century, including the three-year drought of 2007-2009 and the five-year drought of 2012-2016. WY 2017 was California's second wettest on record and ended the drought emergency for many, but not all counties in the state. WY 2018 reverted to dry conditions that were only briefly relieved by a modestly above normal WY 2019.

California's highly variable climate directly influences groundwater use, with more being used when surface water supplies are limited. **Figure 1** (below) displays the annual statewide precipitation in California since 1976. During dry periods, California's groundwater basins, our natural storage infrastructure, are the largest source of stored water used to supply the State.

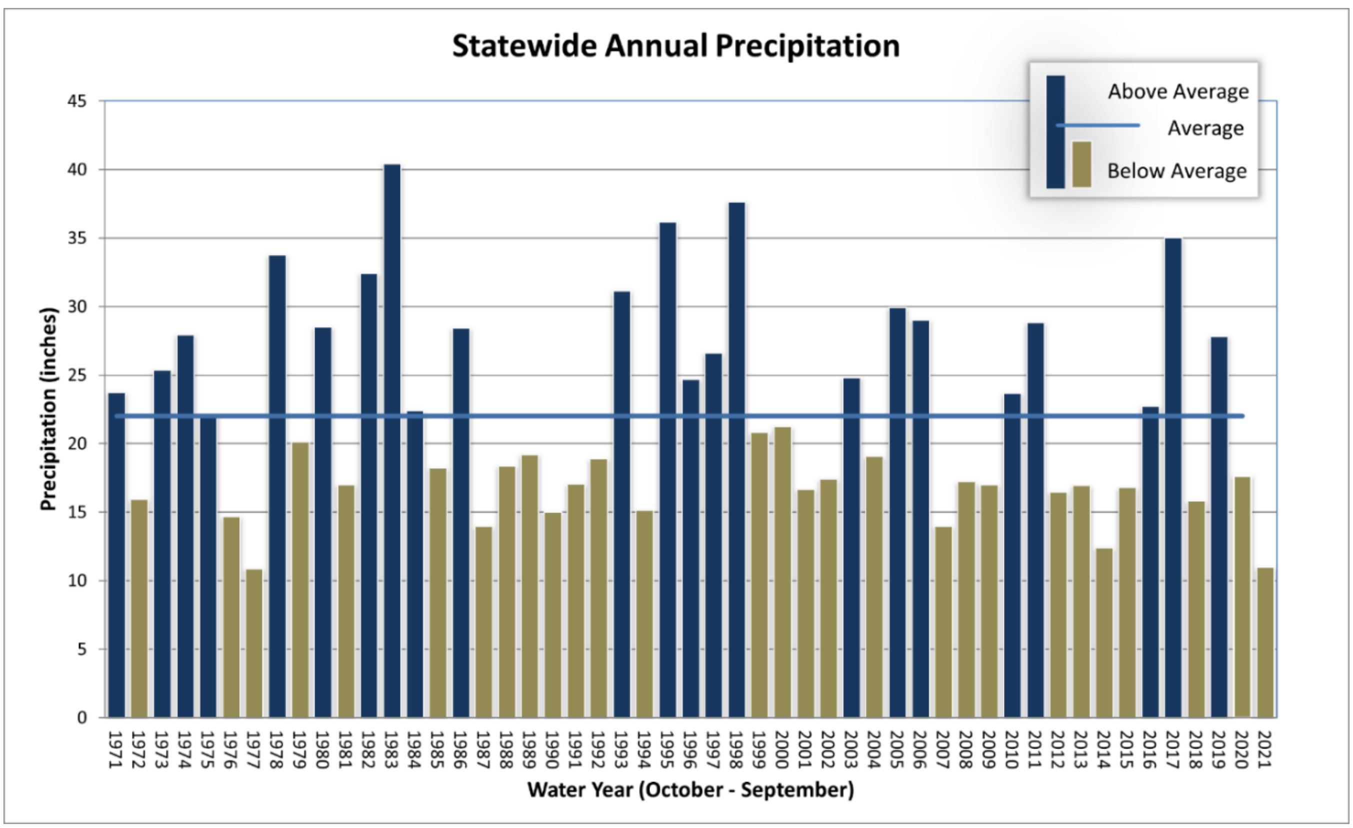


Figure 1: Statewide Annual Precipitation, NOAA National Centers for Environmental Information, ([Climate at Glance: U.S. Time Series, Precipitation]). 2021 Water Year Data uses projected totals based off mean precipitation levels from September 1896 to 2021 means.

While precipitation drives the hydrologic system in California, the snowpack, reservoirs, and groundwater basins provide the State's water storage. The total storage capacity of California's 515 groundwater basins has been estimated to be between 850 and 1,300 million acre-feet (MAF) (California Department of Water Resources 1975). After taking into account that less than half the groundwater is available for use because it is either too deep to be pumped economically or of poor quality, the state's usable groundwater storage is approximately 8 to 12 times larger than the combined storage capacity (50 MAF) of all major reservoirs and 25-85 times larger than the combined storage capacity (15 MAF) of the Snowpack in California (**Figure 2**).

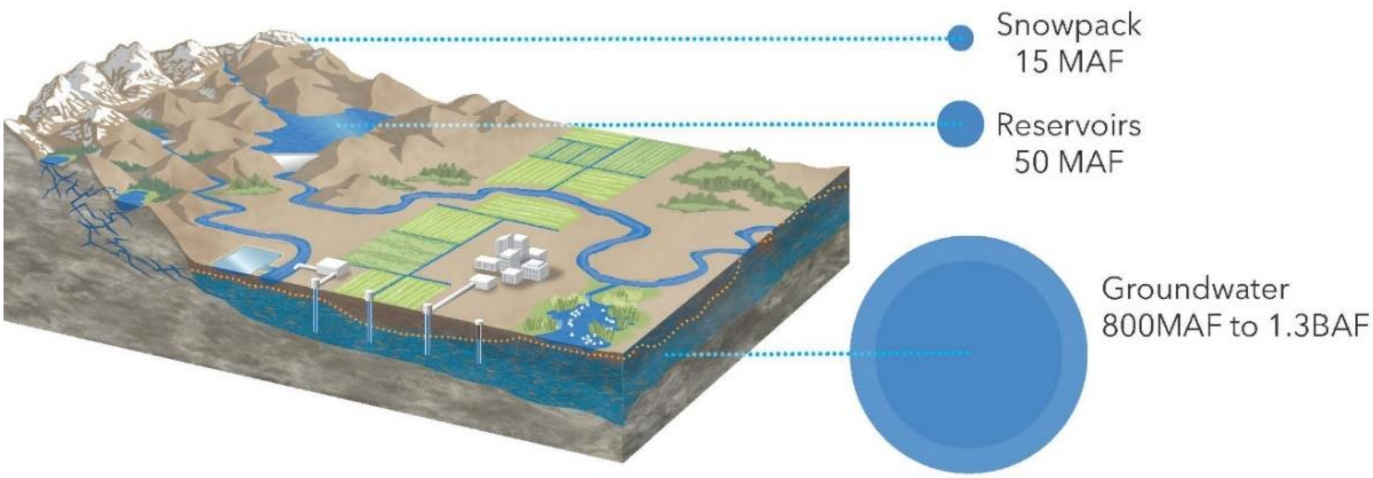


Figure 2: Relative Storage Volumes in Snowpack, Reservoirs, and Groundwater Aquifers.

Groundwater basins act as a buffer between wet and dry periods, balancing out the variability in annual snowpack and reservoir storage by providing additional storage capacity in wet years and additional supply in dry years. Managing and protecting this buffer is especially important as more than 80 percent of Californians depend on groundwater for some portion of their water supply. Some communities rely entirely on groundwater for drinking water, and it is a critical resource for many farms, urban areas, and ecosystems across the State. Snowpack and reservoir storage contribute a large percentage to the State's water supply (DWR Current Conditions); however, in dry years groundwater provides up to 60 percent of California's water supply. Other important pieces of California's water supply portfolio include conservation, desalination, and water reuse.

Impacts such as increased land subsidence and dry wells can occur as groundwater levels decline. Land subsidence has been documented throughout the last century in certain areas of the state resulting in over 30 feet of vertical displacement in localized areas (USGS Land Subsidence) and damage to well heads, levees, flood control structures, water conveyance facilities, highways and other infrastructure. DWR provides subsidence data on the California's Groundwater Live website, and has maintained a dry well reporting system since the last drought period from 2012-2016 in which thousands of dry well reports were received. Historically more new groundwater wells are installed in California during extended dry periods and drought, adding to pressure on the resource. This is due to several factors including wells going dry, concerns about wells going dry, and concerns about increased groundwater regulations.

The Department of Water Resources is committed to assisting state, tribal, and federal partners, local groundwater managers and interested parties learn more about groundwater and cooperatively work to sustain this precious resource for future generations. The Sustainable Groundwater Management

Office provides assistance through technical support, facilitation support, grant funding, and hosts a series of data and tools to support groundwater management. For the latest groundwater conditions across California, please visit California's Groundwater Live. If you are interested in learning more about groundwater in California, we encourage you to read the Department's latest groundwater report California's Groundwater Update 2020.

Photo 2: *DWR Staff Measure the Groundwater Level in a Monitoring Well Located North of Sacramento, California.*

Status of California's Groundwater Conditions

Groundwater Levels

Changes in groundwater levels, especially groundwater level declines during drought, can indicate potential vulnerabilities to groundwater wells and the environment. Groundwater level data also provide valuable information on seasonal fluctuations, long-term changes, and trends in groundwater storage. Groundwater levels are measured on a regular schedule in a variety of groundwater wells located throughout the state with late water year measurements capturing the post-irrigation seasonal low groundwater levels. The data are collected by the Department of Water Resources (DWR) and also reported to DWR by California Statewide Groundwater Elevation Monitoring (CASGEM) Entities, Groundwater Sustainability Agencies implementing the Sustainable Groundwater Management Act (SGMA), local agencies, and private well owners.

The first section of this report uses maps to depict how groundwater levels have changed over time using two different analytical methods. One method, groundwater level change maps, show the change in groundwater levels between two different years, measured in the fall timeframe. The second method uses trend analysis of water levels for wells having at least 10 annual water year's (October to September) measurements over a 20-year period to illustrate the statistical magnitude and direction of groundwater level change (a well's water level increasing or decreasing trend over time).

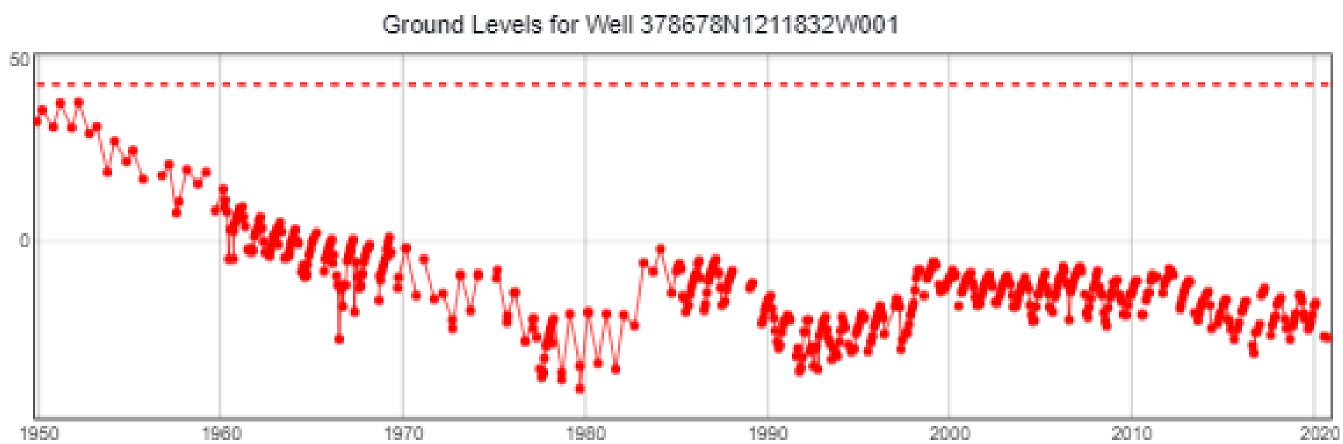
The groundwater level change maps (**Figures 3** - **6**) compare the fall 2021 groundwater level values to the values from fall 2020, 2018, 2016, and 2011 (one, three, five, and ten-year comparisons). The groundwater level change maps display groundwater level increases and decreases in wells and summarize data by hydrologic region. **Table 1** shows a breakdown of the information shown in the groundwater level change maps. Water Year Type as defined by the Sacramento River 8-Station Index, Department of Water Resources, California Data Exchange Center, WSIhist (ca.gov).

Table 1: Statistical Summary of Groundwater Level (GWL) Changes from Fall 2021 (As Shown in Figures 3-6)

Period (Water Year Types)	Total Well Count	Decrease > 25 ft	Decrease 5 to 25 ft	Change +/- 5 ft	Increase 5 to 25 ft	Increase >25 ft
1-Year GWL Change (Critical vs Dry): 2021 compared to 2020	4,743	8.3%	35.7%	48.4%	5.4%	2.2%
3-Year GWL Change (Critical vs Below Normal): 2021 compared to 2018	4,333	9.3%	31.0%	44.0%	12.6%	3.1%
5-Year GWL Change (Critical vs Below Normal): 2021 compared to 2016	4,076	7.0%	26.0%	46.2%	15.8%	4.9%
10-Year GWL Change (Critical vs Wet): 2021 compared to 2011	3,391	27.3%	38.5%	26.1%	5.5%	2.5%

Groundwater level measurements are often plotted on a time-series chart called a hydrograph to show how the groundwater level has changed over time. Below (Photo 3) is an actual hydrograph from a well in San Joaquin County showing groundwater level changes from 1950 to present.

Photo 3: *Example Hydrograph Showing Groundwater Level Changes in a Monitoring Well south of Stockton, California.*



The one-year change map (**Figure 3**) shows more declines than increases in groundwater levels as expected in the second year of statewide drought conditions. Measurements from approximately 44 percent of measured wells show more than five feet of decline in groundwater level, and only seven percent show more than five feet of increase in water levels.

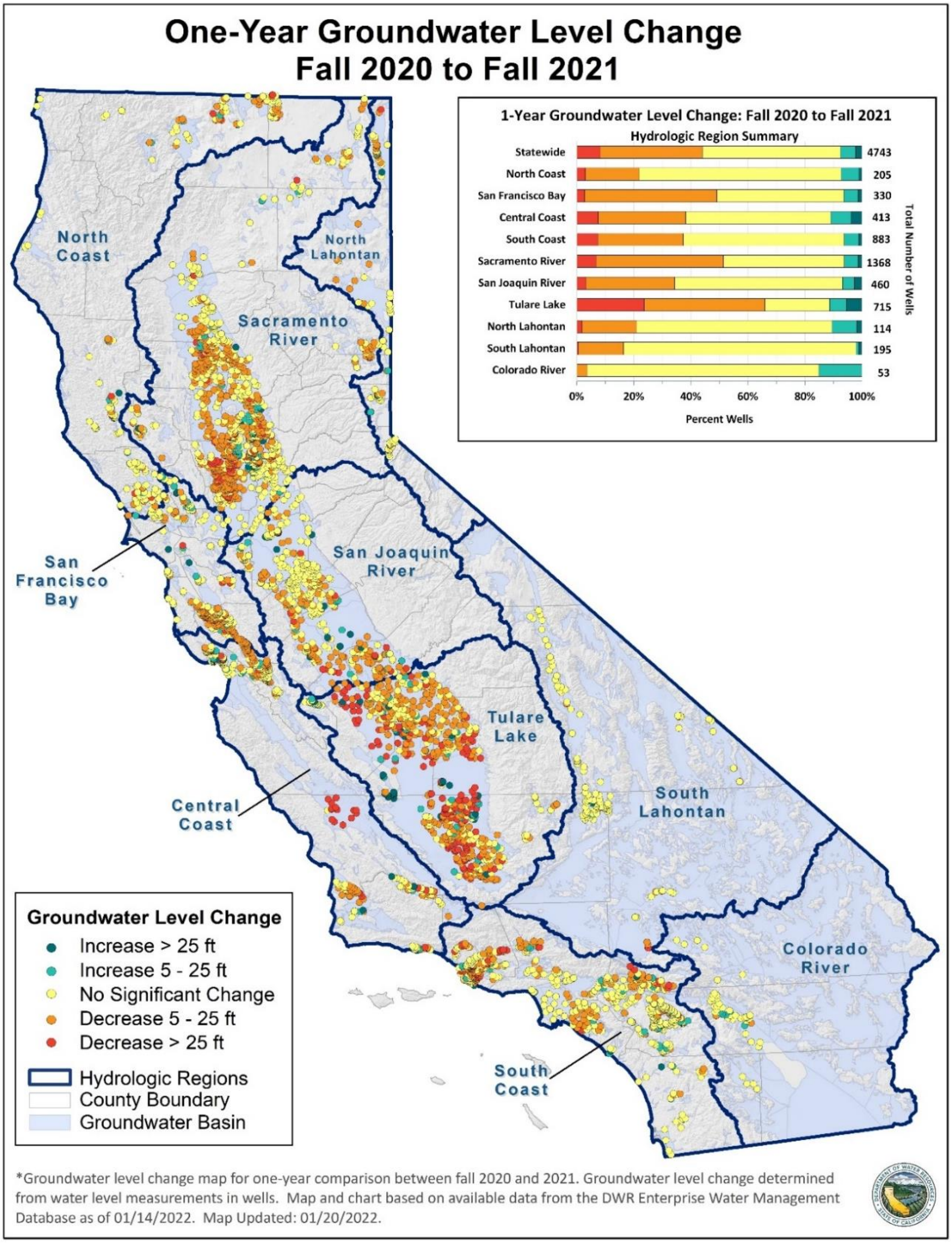


Figure 3: Statewide and Hydrologic Region groundwater level change map for one-year period between Fall 2020 and 2021. See **Table 1** for specific groundwater level statistics. Map and charts based on available data from the DWR Water Data Library as of 01/14/2022.

The three-year change map (**Figure 4)** shows more declines than increases in groundwater levels. Measurements from approximately 38 percent of measured wells show more than five feet of decline in groundwater level, and 16 percent show at least five feet of increase in water levels. Conditions are different in the South Coast Hydrologic Region where 44 percent of groundwater measurements show an increase in groundwater levels greater than five feet.

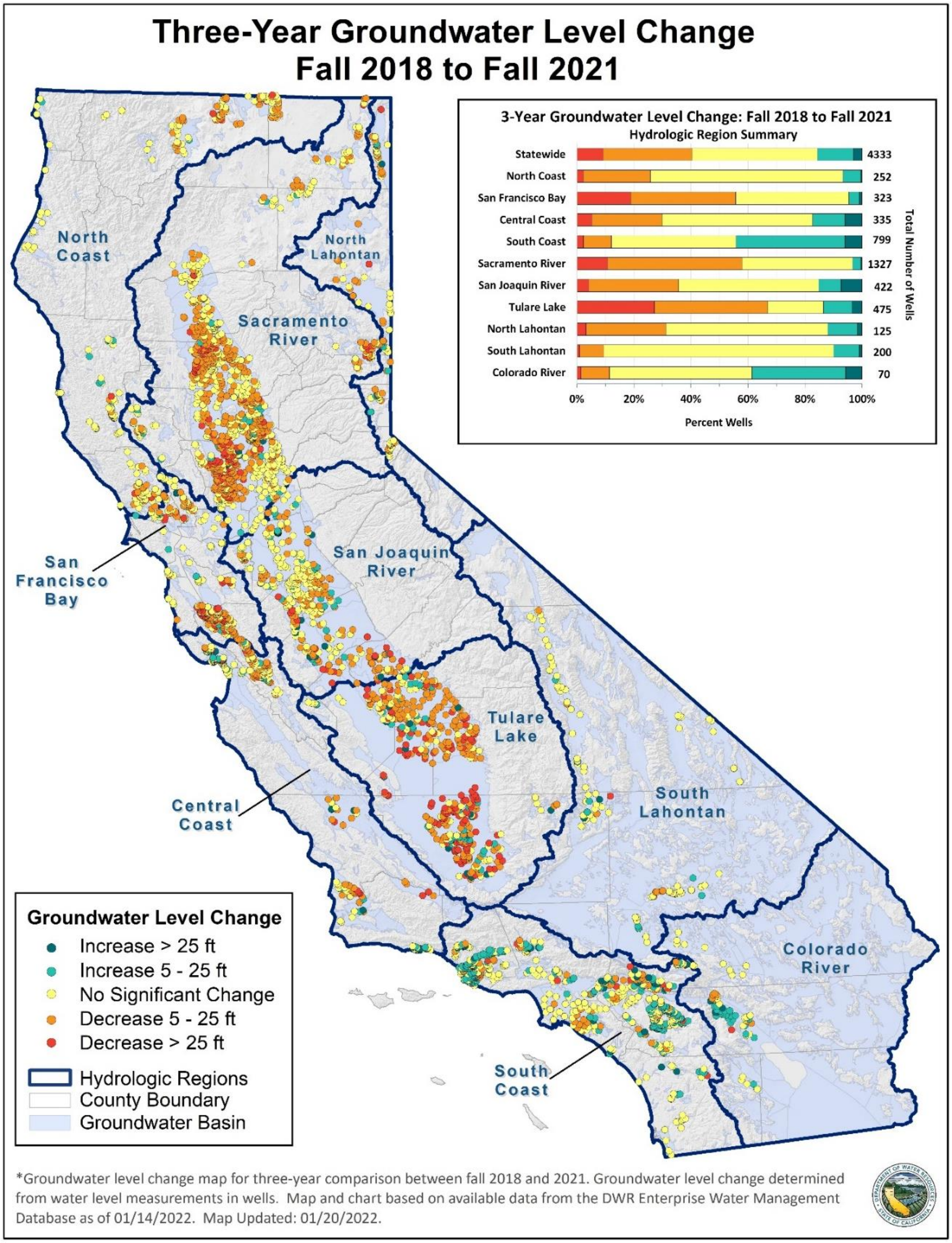


Figure 4: Statewide and Hydrologic Region groundwater level change map for three-year period between Fall 2018 and 2021. See **Table 1** for specific groundwater level statistics. Map and charts based on available data from the DWR Water Data Library as of 01/14/2022.

The five-year change map, which compares the end of the 2012-2016 drought to this current drought (**Figure 5**) shows more declines than increases in water levels even though this time period included three years of above average precipitation. Thirty-one (31) percent of wells experienced more than five feet of decline in groundwater levels, while twenty (20 percent) of wells had increasing water levels. This illustrates the variable nature of groundwater level recovery from the past drought.

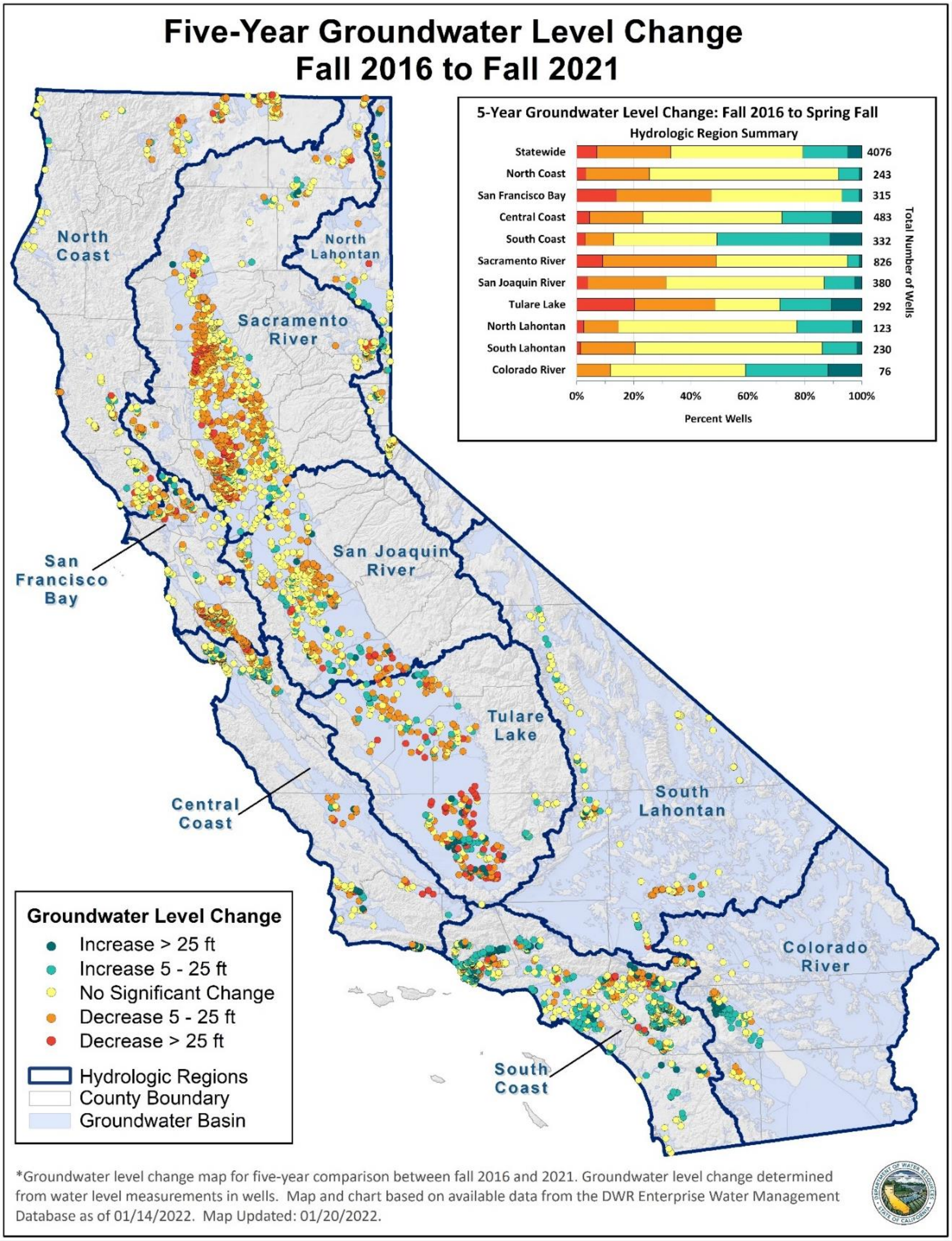


Figure 5: Statewide and Hydrologic Region groundwater level change map for five-year period between Fall 2016 and 2021. See **Table 1** for specific groundwater level statistics. Map and charts based on available data from the DWR Water Data Library as of 01/14/2022.

The 10-year change map, which includes both the 2012-2016 drought and the current drought (**Figure 6**) shows 65 percent of well measurements with greater than five feet of decrease in groundwater levels. This illustrates that many groundwater basins are still well below pre-2012-2016 drought conditions, specifically in the Central Valley.

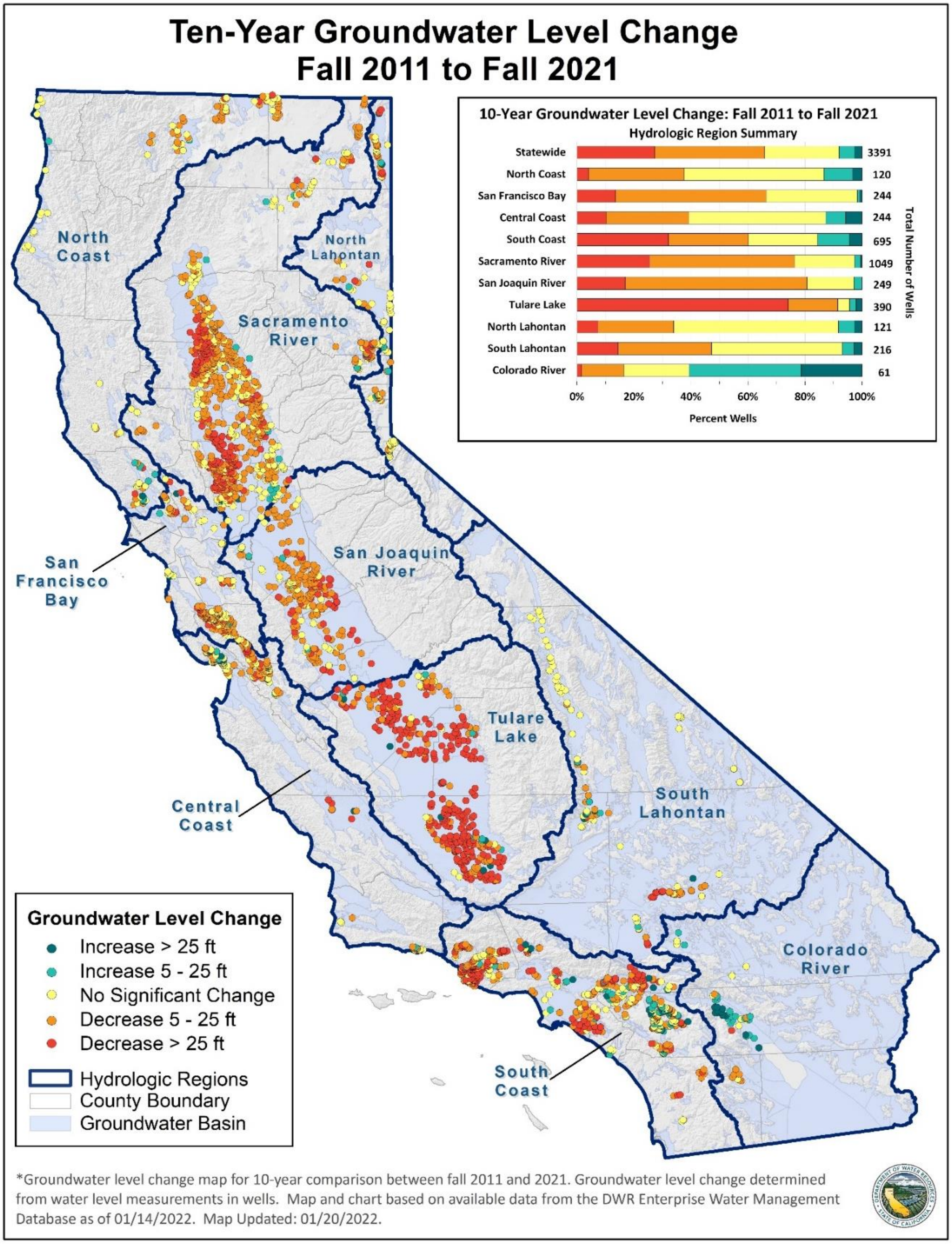


Figure 6: Statewide and Hydrologic Region groundwater level change map for 10-year period between Fall 2011 and 2021. See **Table 1** for specific groundwater level statistics. Map and charts based on available data from the [DWR Water Data Library] as of 09/09/2021.

Figure 7 shows the trend of change, which is the magnitude of decreasing or increasing groundwater levels over the most recent 20 years. The 20-year period (2001-2021) includes droughts from 2001 to 2002, 2007 to 2009, 2012 to 2016, and the current drought spanning years 2020 and 2021. During this 20-year period of stressed water resources and increased groundwater use, water levels in more than 55 percent of statewide wells demonstrate a decreasing trend and just over six percent of wells demonstrate an increasing trend. The percent changes observed from WY 2001 to WY 2021 are summarized in **Table 2**.

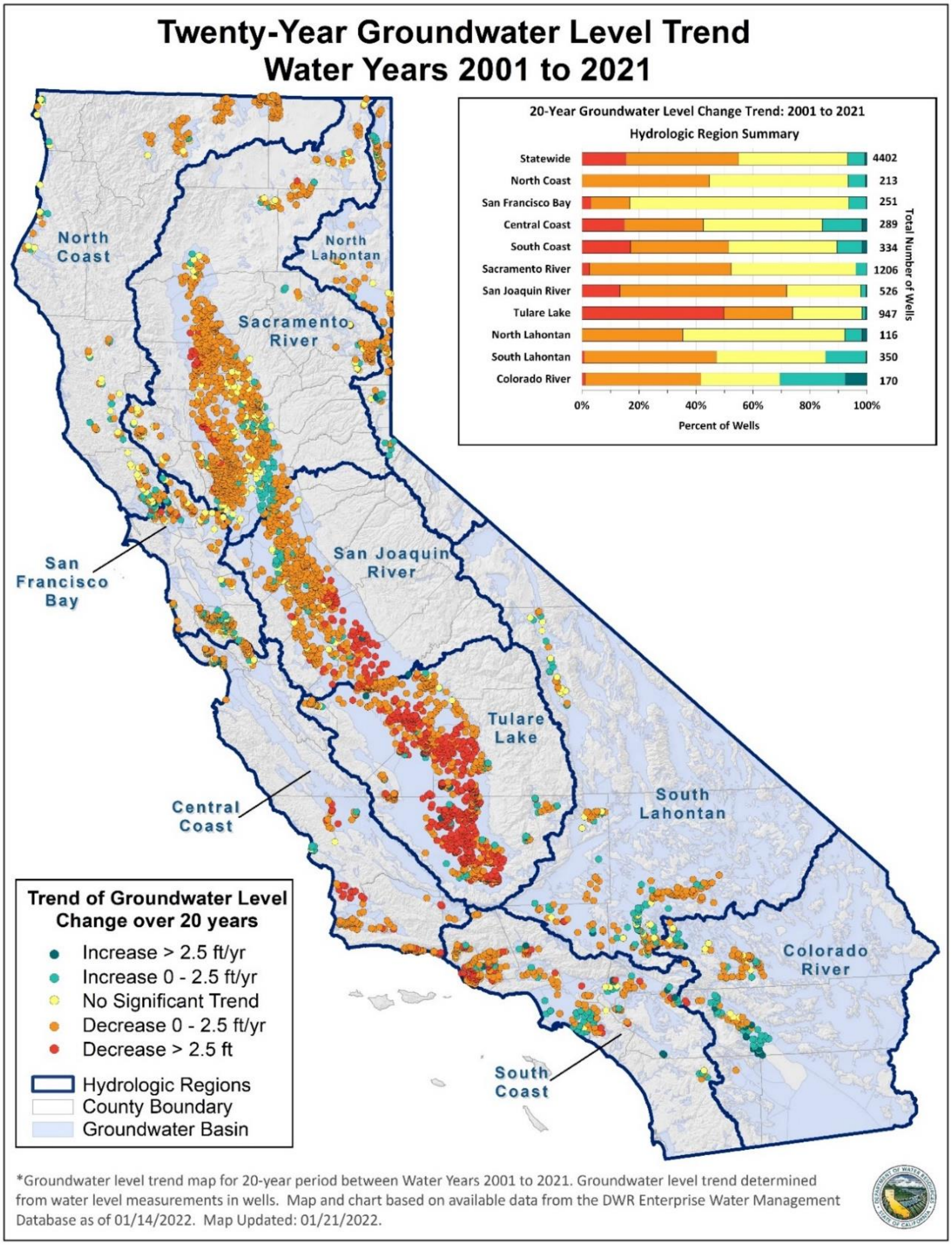


Figure 7: Statewide and Hydrologic Region groundwater level trend analysis map for Water Years 2001-2021. See **Table 2** for specific groundwater level statistics. Map and charts based on available data from the DWR Water Data Library as of 01/14/2022.

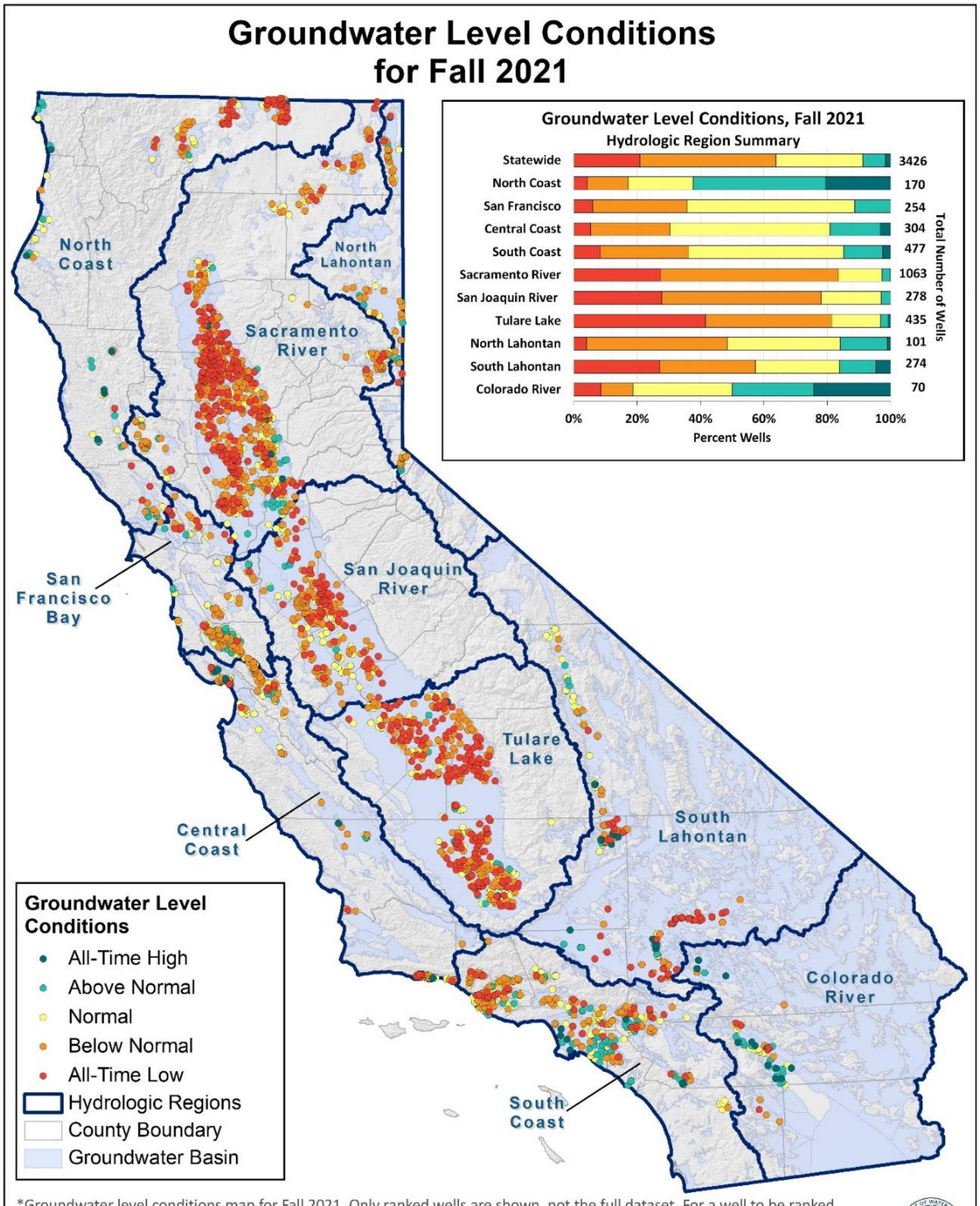
Table 2: Statistical Summary of Groundwater Level Trend Map (**Figure 7**)

Period	Total Well Count	Decrease > 2.5 ft	Decrease 0.01 - 2.5 ft	Change +/- .01 ft	Increase 0.01 - 2.5 ft	Increase > 2.5 ft
20-Year Trend: 2001 to 2021	4,404	15.6%	39.4%	38.3%	5.9%	0.8%

There are several clusters of wells with steep groundwater level declines across the state during the most recent 20-year period. These trends were more pronounced in the southern Central Valley, although the north end of the valley shows a continued decrease of groundwater levels of up to 2.5 feet per year. Areas of steep decline include the western edge of the Sacramento Valley in the Sacramento River Hydrologic Region, the southeastern part of the San Joaquin Valley in the San Joaquin River Hydrologic Region, and most groundwater basins within the Tulare Lake Hydrologic Region. Moderate groundwater level declines are found in the North Coast, North Lahontan, South Coast, and South Lahontan Hydrologic Regions. There are notable increases in groundwater levels in the basins in the southeastern portion of the Sacramento Valley. The Central Coast and Colorado River Hydrologic Regions show the highest overall percentage of wells with groundwater level increases; however, relatively few wells were analyzed in these regions. The San Francisco Bay Hydrologic Region has the most stable groundwater levels of all regions.

Photo 3: New Water Lines are Installed in Tulare County to Connect Impacted Domestic Well Owners to a New Municipal Water System.

Figure 8 shows groundwater level conditions for fall 2021. The dataset shown in this figure uses percentile statistics to determine if groundwater levels are at an all-time low, below normal, normal, above normal, or at an all-time high in monitoring wells. Only wells measured within the last 18 months, and with a periodic of record ten years are shown on the map. For Fall 2021, 3,426 wells met the selection criteria statewide with approximately 63 precent of wells at an all-time low or below normal groundwater levels and approximately 10 percent above normal or at all-time highs (**Table 3**).



*Groundwater level conditions map for Fall 2021. Only ranked wells are shown, not the full dataset. For a well to be ranked, the most recent measurement must have occurred within the last 18 months, and measurements from at least 10 years must exist for that month. Map and chart based on available data from the DWR Enterprise Water Management Database as of 01/14/2022. Map Updated: 01/19/2022.

Figure 8: Statewide and Hydrologic Region groundwater level condition map for Water Years 2001-2021. See **Table 3** for specific groundwater level statistics. Map and charts based on available data from the DWR Water Data Library as of 08/02/2021.

Table 3: Statistical Summary of Groundwater Conditions in comparison to Historical Average (**Figure 8**)

Period	Total Well Count	All-Time Low	Below Normal	Normal	Above Normal	All-time High
As of Fall 2021	3,426	21.6%	40.9%	27.8%	7.8%	1.9%

The Sacramento River hydrologic region has the most wells at an all-time low (291 of the 1,063 wells ranked in Sacramento River), while the Tulare Lake Hydrologic Region has the highest percentage of wells at an all-time low (41 percent of 435 (181) ranked wells in Tulare Lake. The Colorado River hydrologic region has the most and highest percentage of wells at an all-time high (17 of the 70 wells (24 percent) ranked in Colorado River). The Sacramento River hydrologic region has the most total number of wells ranked for Fall 2021 with 1,063 wells.

Land Subsidence

Land subsidence can cause damage to and reduce the capacity of water conveyance infrastructure, reduce groundwater storage extent for future use and cause damage to other critical infrastructure. Vertical ground surface displacement estimates are derived from Interferometric Synthetic Aperture Radar (InSAR) data that are collected by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA, under contract with to the California Department of Water Resources (DWR). DWR has maintained an InSAR dataset for areas of California since the beginning of 2015 and has released annual updates for each water year and will be moving to quarterly reporting of the InSAR data starting in the Summer of 2022. The latest InSAR dataset for Water Year 2021 was released on February 16, 2022. This report includes figures, tables and discussion of land subsidence data for both water year 2021 and the entire InSAR dataset which is referenced as "Since 2015" (a period from January 1, 2015, to September 30, 2021). **Tables 4** and **5** (below) include a summary of vertical displacement observed in the InSAR dataset in feet for Water Year 2021 and Since 2015.

Table 4: Statistical Summary of Annual (Water Year 2021) Land Subsidence (**Figure 10**)

Period	Total Area of Subsidence >0.1 ft (sq miles)	< -1	-1 to -0.8	-0.8 to -0.6	-0.6 to -0.4	-0.4 to -0.2	-0.2 to -0.1
Sept 20 – Oct 21	3,010.21	3.26	158.03	350.87	440.99	932.44	1,124.62

Table 5: Statistical Summary of Cumulative Statewide Land Subsidence since 2015 (**Figure 9**)

Period	Total Area of Subsidence >0.5 ft (sq miles)	< -5	-5 to -4	-4 to -3	-3 to -2	-2 to -1	-1 to -0.5
Jan 15 – Oct 21	2,940.44	16.46	172.21	359.14	436.4	828.65	1,127.58

Two maps have been created to display where land subsidence has occurred and the magnitude for both Water Year 2021 (**Figure 9**) and Since 2015 (**Figure 10**). The total area in square miles for cumulative subsidence is less than the reported total for WY 2021 because the minimum value reported in Table 5 is a higher value (0.5 feet) than for WY 2021 (0.1 feet).

Figure 9 shows the total subsidence (annual rate) of subsidence in feet/year for WY 2021. Annual subsidence is shown as six categories: 0.1-0.2 feet/year, 0.2-0.4 feet/year, 0.4-0.6 feet/year, 0.6-0.8 feet/year, 0.8-1 feet/year, and greater than 1-foot/year.

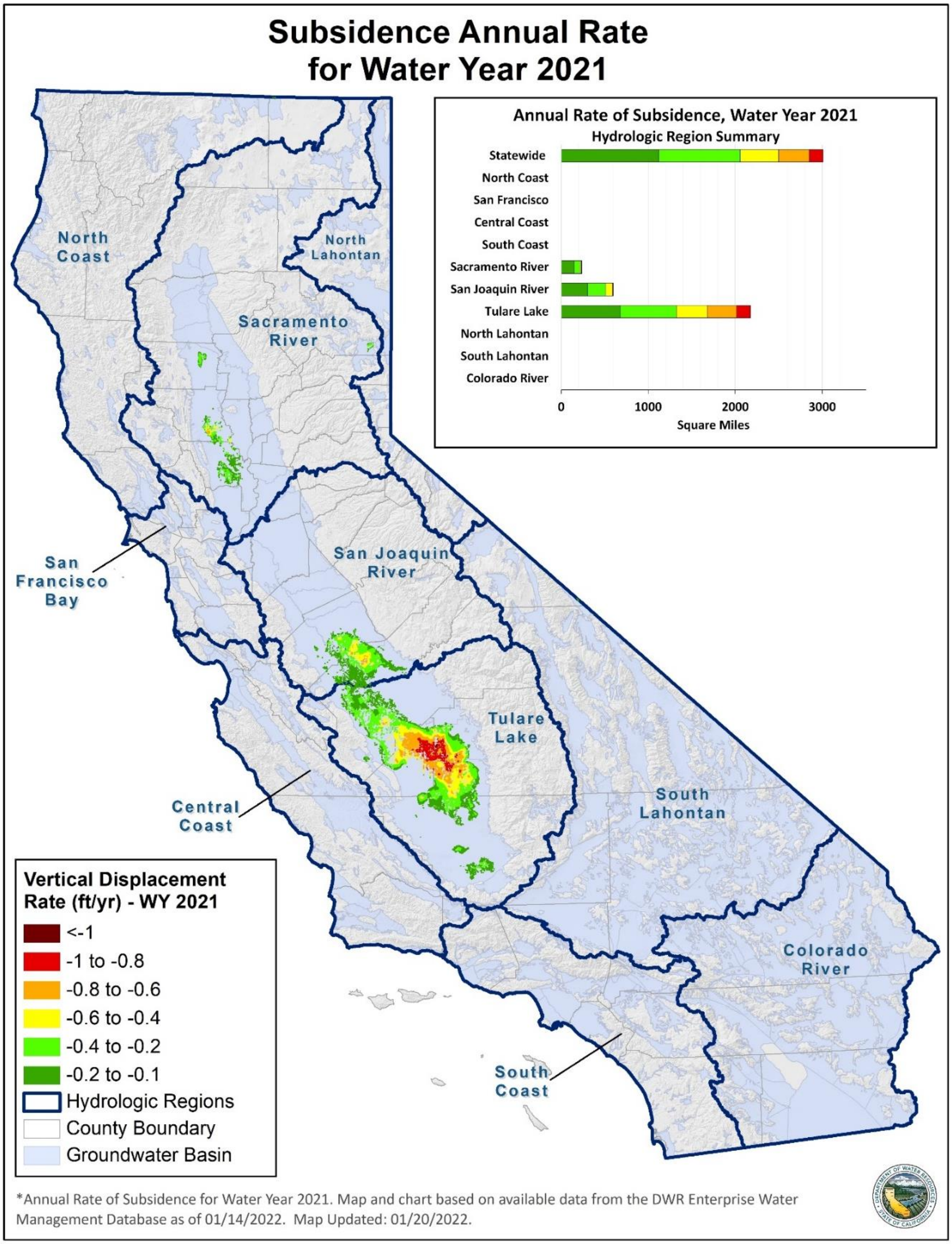


Figure 9: Statewide annual subsidence map for Water Year 2021. See **Table 4** for specific subsidence level statistics. Map and charts based on available data from the CNRA Open Data as of 01/14/2022.

Figure 10 shows total subsidence, in feet, from June 2015 to October 2021. Subsidence of less than 0.5 feet is grey, to show the coverage of the InSAR dataset. The hydrologic region summary chart only represents areas of subsidence with 0.5 feet or more.

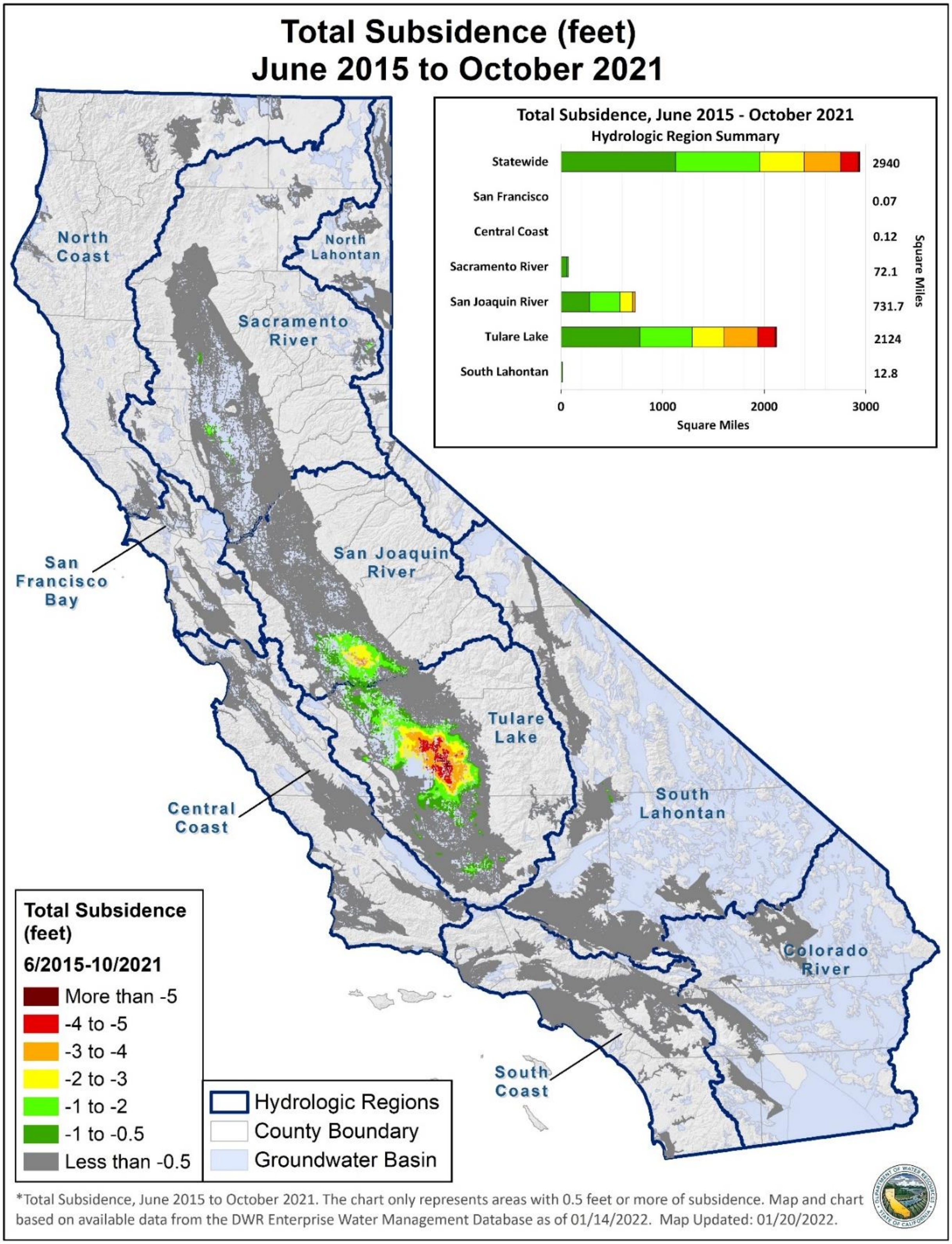


Figure 10: Statewide total subsidence map between June 2015 to October 2021. See **Table 5** for specific subsidence level statistics. Map and charts based on available data from the CNRA Open Data as of 01/14/2022.

Statewide, in WY 2021 a total of 3,010 square miles experienced subsidence greater than 0.1 feet, 1,125 square miles between 0.1-0.2 feet, and 3.3 square miles with greater than 1-foot of subsidence. The Tulare Lake hydrologic region has the most subsidence with 2,175 square miles of subsidence greater than 0.1 feet in WY 2021. Colorado River, North Lahontan, South Coast, Central Coast, and San Francisco hydrologic regions did not have any subsidence of over 0.1 feet in WY 2021.

Well Infrastructure

Many factors influence California's well infrastructure (the number of wells extracting water from the ground) including climate conditions, surface water supplies, groundwater level changes, legislative actions, and local conditions. DWR tracks California's well infrastructure through the receipt of well completion reports which are submitted to the Department through the Online System for Well Completion Reports (OSWCR) when a well is installed, replaced, or destroyed. This report includes a summary of data submitted to OSWCR over the last five water years for wells classified as domestic or irrigation on the well completion report. It is important to note that a WCR has not been submitted for all wells that have been drilled so these numbers are likely lower than the actual number of wells statewide.

This report also includes a five-year summary of dry well reports, another important metric related to California's well infrastructure. The Department operates and maintains the Household Water Supply Shortage Reporting System (Dry Well Reporting) database which receives reports related to dry wells in California including reported dry wells and reports of resolved dry wells. The Dry Well Reporting database is a voluntary effort so the actual numbers of dry wells in California and/or the number of resolved dry wells may be higher than what is reported in the database. For full year-to-year statistics of new domestic wells, irrigation wells and dry well reports over the last 5-years see **Table 6**.

Table 6: Statewide Summary of Newly Installed Domestic and Irrigation Wells and Number of Dry Well Reporting Over Last 5-Years and Total.

	Statewide	5 Year Total	WY 2021	WY 2020	WY 2019	WY 2018	WY 2017
Domestic Wells	272,447	14,399	**3,467**	3,046	2,824	2,245	2,817
Irrigation Wells	58,895	6,757	**1,626**	1,322	1,354	1,033	1,422
Dry Well Reports	3,778	1,283	**953**	84	51	72	123

Domestic Wells

Domestic (household) wells provide water to millions of people throughout California. Over the last water year, 3,467 new domestic wells were installed in California. Over the last five-years, 14,399 domestic wells in total have been installed across the state compared to the 277,447 total number of domestic wells installed since 1977. The year-to-year number of new domestic wells has fluctuated from a low of 2,245 in WY 2018 to a high of 3,467 this water year. For full year-to-year statistics of new domestic wells over the last five-years see **Table 7.** Two maps showing the location and density of newly installed domestic wells per square mile are included in this report: New Domestic Wells WY 2021 **(Figure 11)** and New Domestic Wells WYs 2017-2021 **(Figure 12)**.

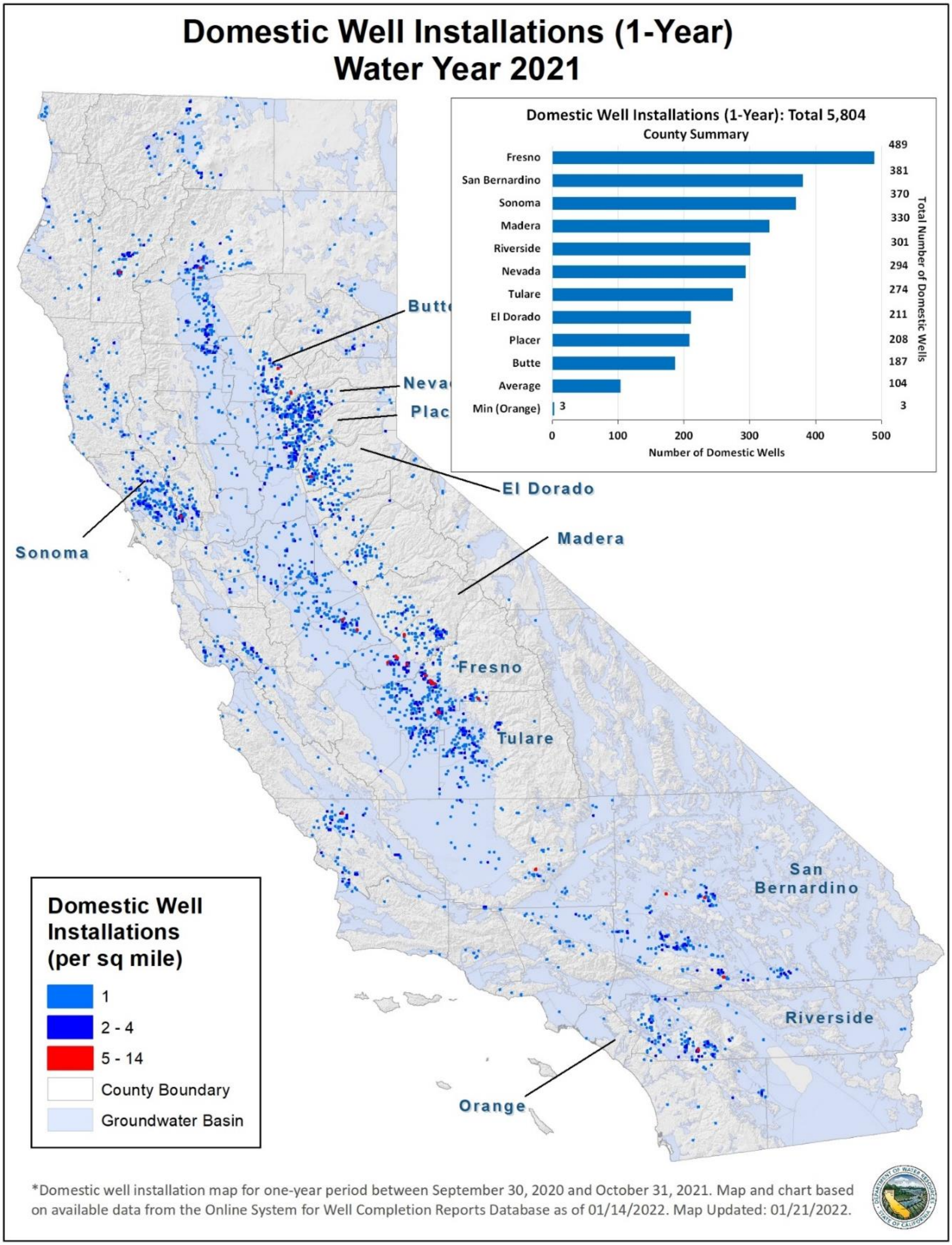


Figure 11: Statewide one-year newly installed domestic wells map for Water Year 2021. See **Table 7** for specific newly installed domestic statistics. Map and charts based on available data from Statewide totals for domestic wells are based on records since 1977 stored in OSWCR as of 01/14/2022.

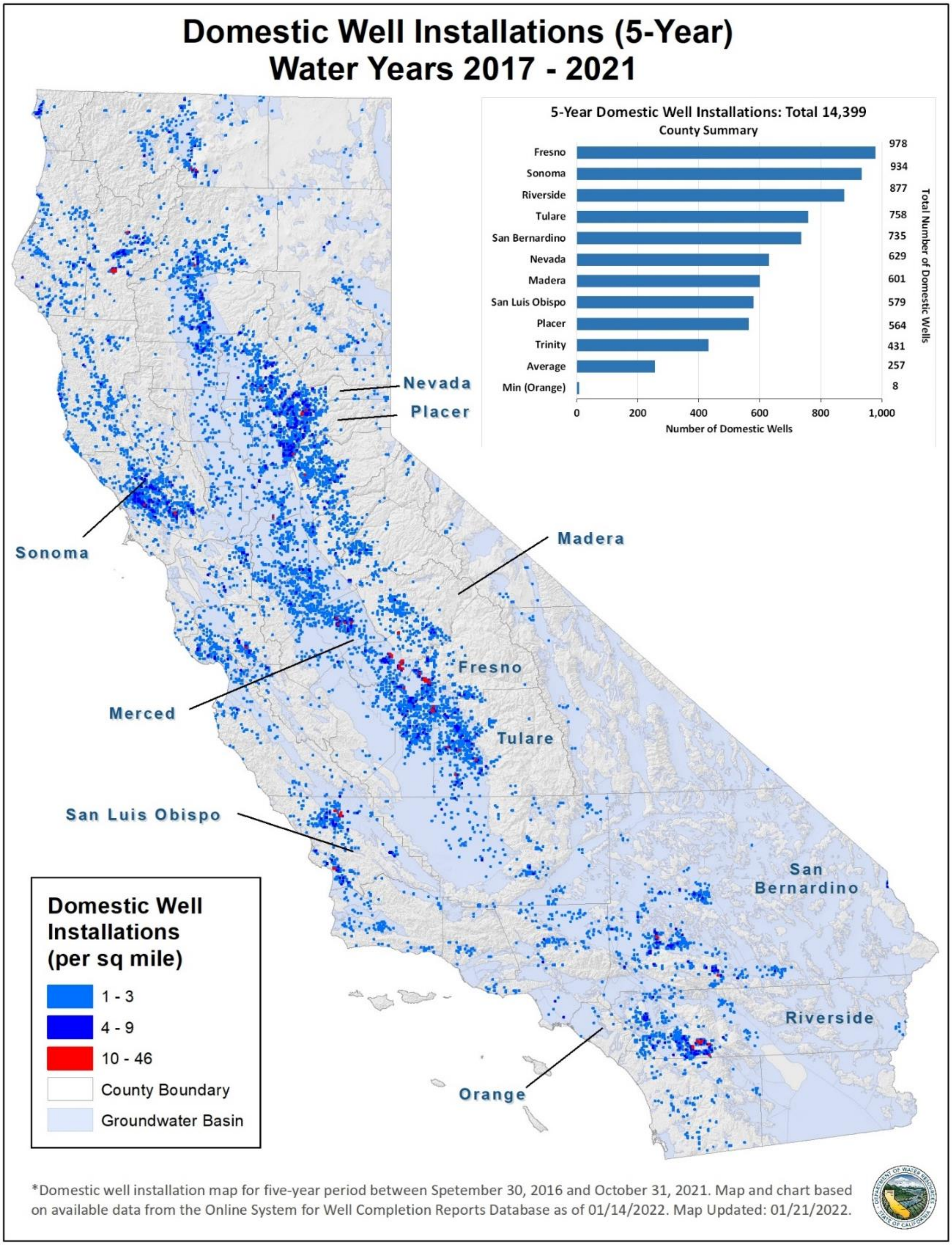


Figure 12: Statewide five-year newly installed domestic wells map for Water Years 2017 - 2021. See **Table 7** for specific newly installed domestic statistics. Map and charts based on available data from Statewide totals for domestic wells are based on records since 1977 stored in OSWCR as of 01/14/2022.

Table 7: Statewide Summary of Newly Installed Domestic and Irrigation Wells and Number of Dry Well Reporting Over Last 5-Years, *Domestic Wells Emphasized*

	Statewide	5 Year Total	WY 2021	WY 2020	WY 2019	WY 2018	WY 2017
Domestic Wells	***272,447***	***14,399***	***3,467***	***3,046***	***2,824***	***2,245***	***2,817***
Irrigation Wells	58,895	6,757	1,626	1,322	1,354	1,033	1,422
Dry Well Reports	3,778	1,283	953	84	51	72	123

The location of new domestic wells installed in California over the last one and five-water years varies throughout the state. Over the last water year, the counties with the highest number of new domestic wells were Fresno (489) and San Bernadino (381). The area with the highest density of new domestic wells was an area in Fresno County just east of Clovis where 14 new domestic wells were installed within one square mile in WY 2021.

The statewide trend over the last five water years for new domestic wells is similar to the one-year trend discussed above with the highest number of new domestic wells installed in Fresno County (978). Sonoma (934), Riverside (877), Tulare (758) and San Bernardino (735) Counties, along with Fresno, comprise the top five counties for most new domestic well installations accounting for nearly 30 percent of all new wells statewide. The area with the highest density of new domestic wells installed over the past five water years is the same area east of Clovis with 46 new domestic wells installed in one square mile.

Irrigation Wells

Irrigation wells typically have higher capacity and pump more groundwater than domestic wells to provide water to farms that feed millions of people throughout California and the world. During WY 2021, 1,626 new irrigation wells were installed in California. Over the last five-years, 6,757 irrigation wells have been installed across the state compared to the 58,845 total number of irrigation wells installed since 1977. The year-to-year number of new irrigation wells has fluctuated from a low of 1,033 in WY 2018 to a high of 1,626 in WY 2021. For full year-to-year statistics of new irrigation wells over the last five-years see **Table 8**. Two maps showing the location and density of newly installed irrigation wells per square mile are included in this report: New Irrigation Wells WY 2021 **(Figure 13)** and New Irrigation Wells WYs 2017-2021 **(Figure 14)**.

Table 8: Statewide Summary of Newly Installed Domestic and Irrigation Wells and Number of Dry Well Reporting Over Last 5-Years, *Irrigation Wells Emphasized*

	Statewide	5 Year Total	WY 2021	WY 2020	WY 2019	WY 2018	WY 2017
Domestic Wells	272,447	14,399	3,467	3,046	2,824	2,245	2,817
Irrigation Wells	***58,895***	***6,757***	***1,626***	***1,322***	***1,354***	***1,033***	***1,422***
Dry Well Reports	3,778	1,283	953	84	51	72	123

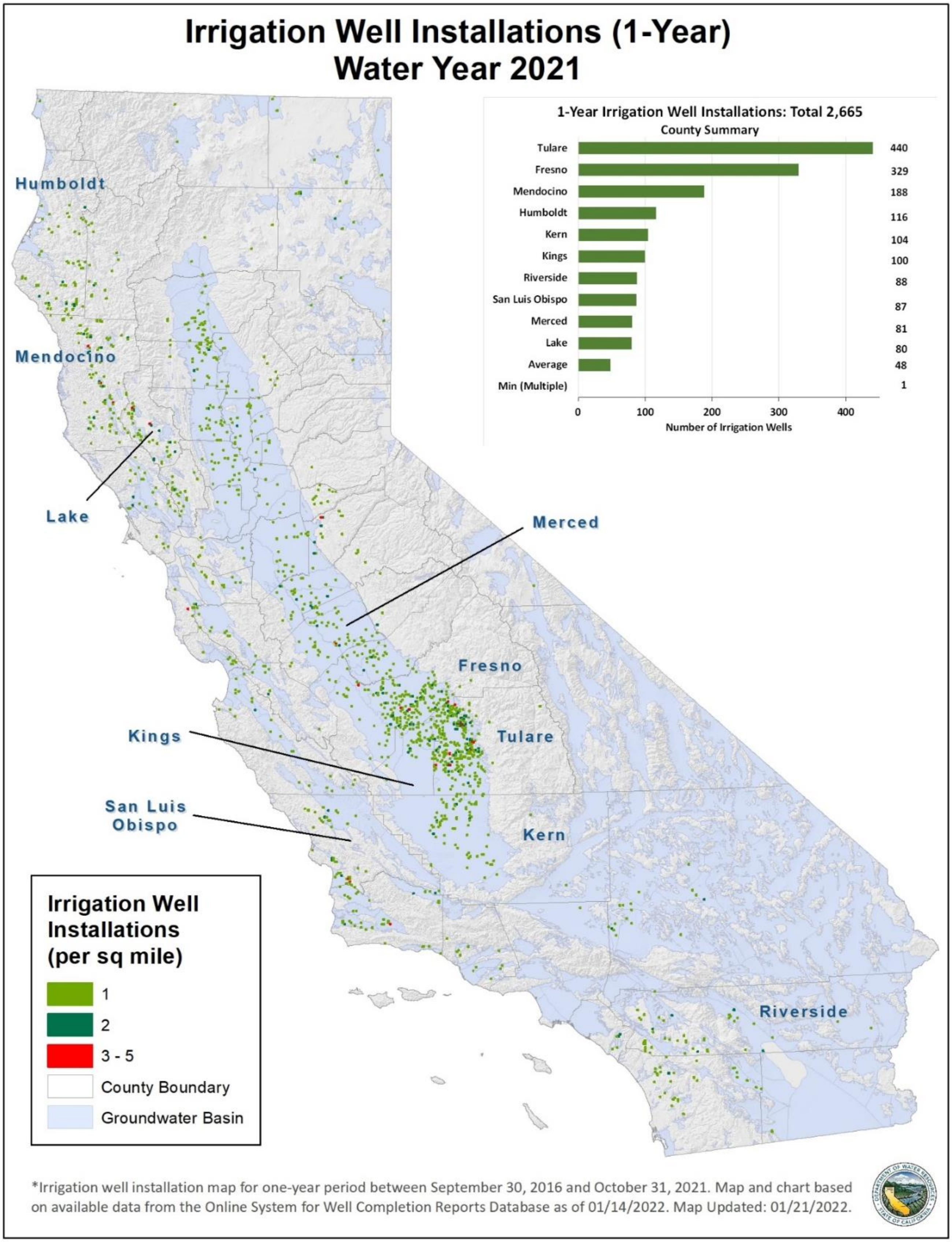


Figure 13: Statewide one-year newly installed irrigation wells map for Water Year 2021. See **Table 8** for specific newly installed irrigation statistics. Map and charts based on available data from Statewide totals for domestic wells are based on records since 1977 stored in OSWCR as of 01/14/2022.

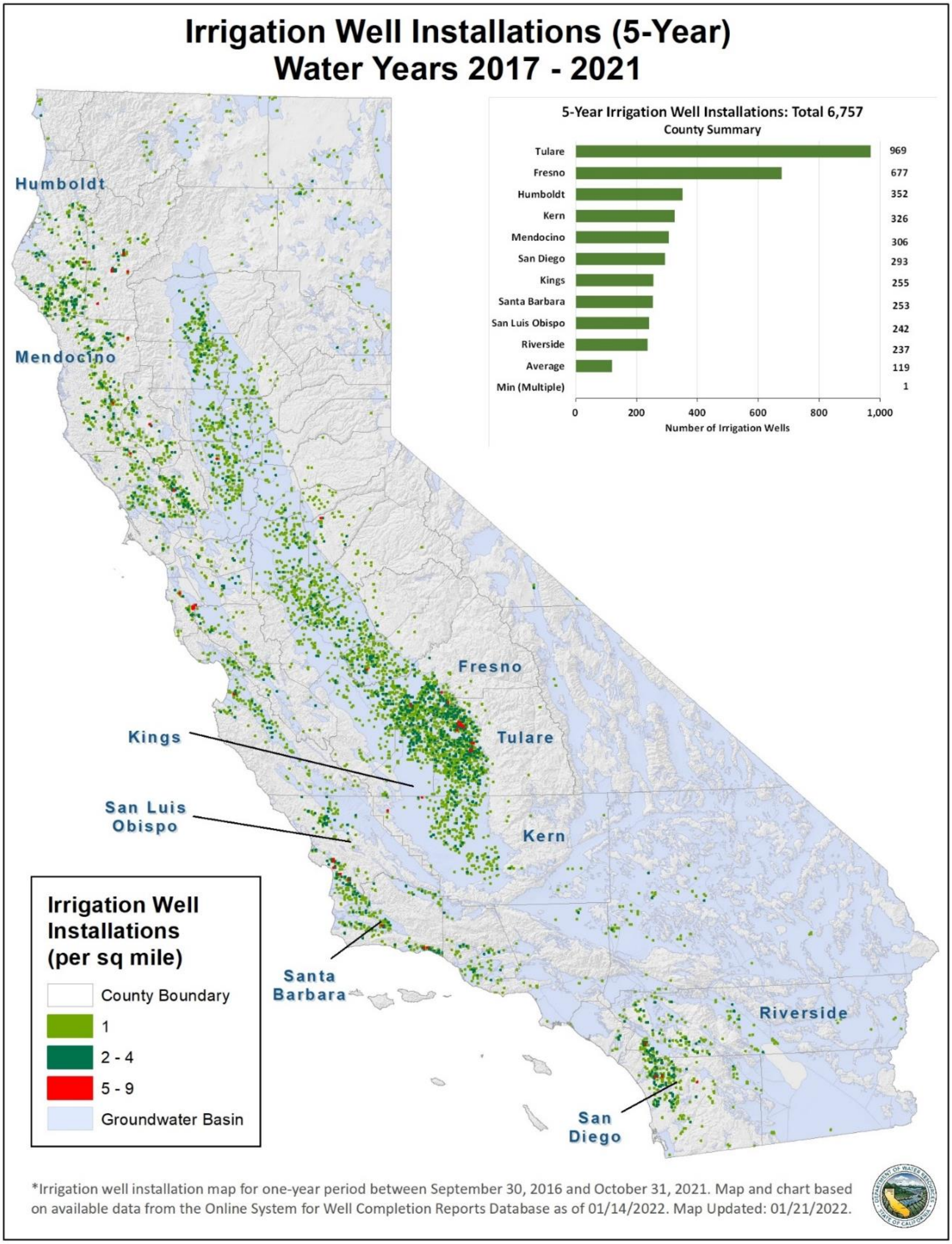


Figure 14: Statewide five-year newly installed irrigation wells map for Water Years 2017 - 2021. See **Table 8** for specific newly installed irrigation statistics. Map and charts based on available data from Statewide totals for irrigation wells are based on records since 1977 stored in OSWCR as of 01/14/2022.

New irrigation wells that have been installed in California are much more concentrated than domestic wells. Within the last water year, Tulare County (440) had more new irrigation wells installed than any other county in the state accounting for approximately one out of every six (17 percent). Neighboring Fresno County (329) and Mendocino County (188) rank 2nd and 3rd. These three counties combined account for nearly 36 percent of all new irrigation wells, or more than one out of every three new irrigation wells installed in WY 2021. In contrast, nearly one third of California counties had less than 10 new irrigation wells installed this year. Three locations in the state saw the highest local density of new irrigation wells, with five wells installed within one square mile. Just one of these locations was in the agricultural-rich yet Critically Overdrafted Central Valley in Tulare County near Exeter while the others were located in a rural part of Calaveras County near Paloma and on the east side of Clear Lake near Lucerne.

The statewide trend for new irrigation well installation over the past five water years shows two counties have had the highest number of new irrigation wells, Tulare (969) and Fresno (677). Nearly 25 percent of all irrigation wells installed in California over the last five years were in these two counties (1,646). This is more than the combined total of 40 other counties (1,633) or 70 percent of counties in the state over this period. There were three locations in the state which saw the highest local density of new irrigation wells with nine wells being installed within one square mile within the last five water years. None of these locations were in Tulare or Kings Counties, instead they were located near Menlo Park in San Mateo County, near St. Helena in Napa County and near Hayfork in Trinity County. This high density of irrigation wells in a small area will likely impact local groundwater conditions.

Dry Well Reporting

Dry well reporting is an important tool to track where local groundwater conditions may be impacting beneficial uses and users of groundwater in California. As previously discussed, dry well reports submitted to the Dry Well Reporting database can document a newly dry well or a resolution to a reported dry well. The submission of these dry well reports is voluntary so it may not represent the actual number of dry wells occurring across the state. Also, new systems to track dry well reporting have been put in place recently so more dry wells reports are likely being submitted to the Dry Well Reporting database now than in the past.

In WY 2021, 953 new dry well reports were received by DWR across California compared to 1,253 new dry well reports over the last 5-years and 3,887 total reports submitted to the system since 2013. The year-to-year number of dry well reports has fluctuated from a low of just 51 in WY 2019 to a high of 953 in WY 2021. For full year-to-year statistics of dry well reporting over the last five-years see **Table 9**. Two maps showing the location of dry well reports are included in this report: Dry Well Reporting WY 2021 **(Figure 15)** and Dry Well Reporting WYs 2017-2021 **(Figure 16)**.

Table 9: Statewide Summary of Newly Installed Domestic and Irrigation Wells and Number of Dry Well Reporting Over Last 5-Years, Dry Wells Emphasized

	Statewide	5 Year Total	WY 2021	WY 2020	WY 2019	WY 2018	WY 2017
Domestic Wells	272,447	14,399	3,467	3,046	2,824	2,245	2,817
Irrigation Wells	58,895	6,757	1,626	1,322	1,354	1,033	1,422
Dry Well Reports	***3,778***	***1,283***	***953***	***84***	***51***	***72***	***123***

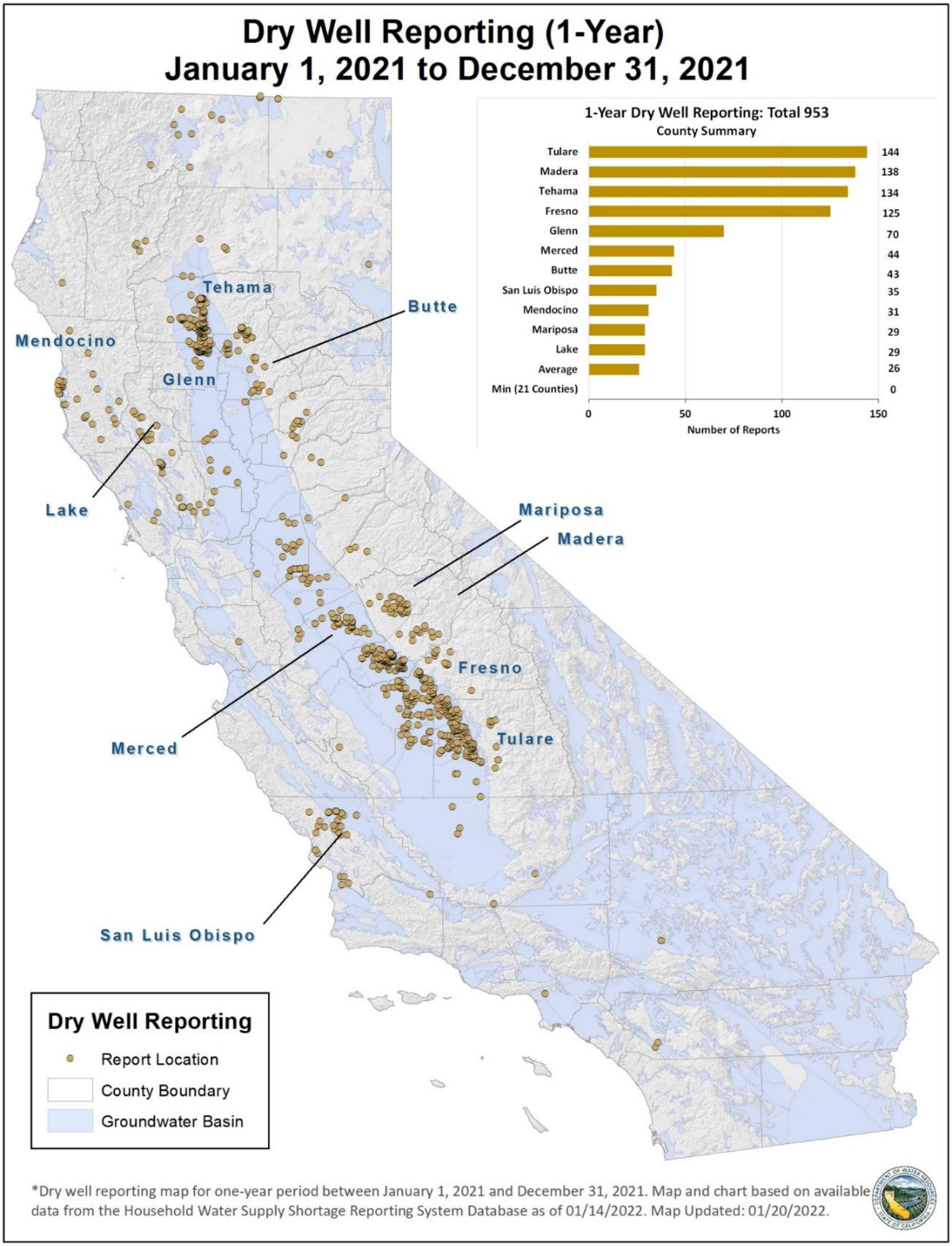


Figure 15: Statewide one-year dry well report wells map for Water Year 2021. See **Table 9** for specific newly installed domestic statistics. Map and charts based on records received since 2013 submitted to the Dry Well Reporting database as of 01/14/2022.

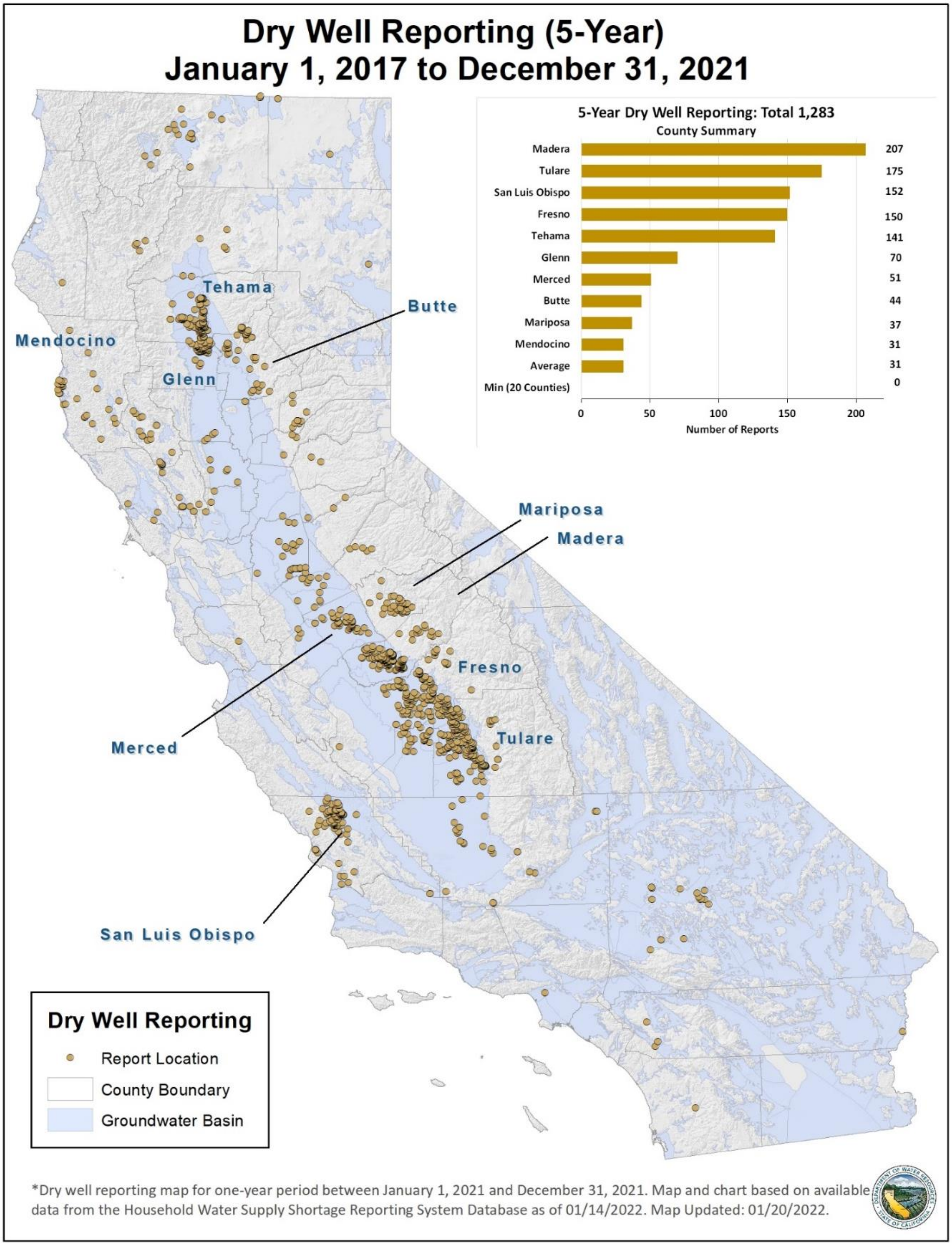


Figure 16: Statewide five-year dry well report wells map for Water Years 2017 - 2021. See **Table 9** for specific newly installed domestic statistics. Map and charts based on records received since 2013 submitted to the Dry Well Reporting database as of 01/14/2022.

Reports of dry wells naturally increase during extended dry periods and declared droughts as groundwater use increases and groundwater levels decline. Within the last water year, the highest number of dry well reports were received in Tulare (144), Madera (138), Tehama (134), Fresno (125) and Glenn (70) Counites. These five counties account for approximately two out of every three dry well reports (64 percent) received statewide in WY 2021. 75 precent of counties received fewer than 10 reports with 21 counties receiving zero reports.

The statewide trend for dry well reporting over the past five water years shows a correlation between extended dry periods or declared droughts and the number of dry well reports. More than 75 percent of the total dry well reports were received in just one water year (2021), the only year during the five-year period in which the Governor declared a statewide drought. While the majority of the reports were received in water year 2021, there were some areas of the state that experienced localized clusters of dry well reports over the previous four-years such as San Luis Obispo County where 117 of the 152 total dry well reports received in the county were submitted prior to water year 2021.

Closing thoughts

Groundwater conditions in California are reflecting the increased use of groundwater, even during normal and wet years. During the past and current drought, nearly two thirds of the state's monitoring wells were below their historical average groundwater level and one in five wells were measured at their historic low in fall of 2021 (**Figure 8**). Areas in the southern San Joaquin Valley continue to experience land subsidence at rates up to one foot per year and new areas on the western side of the Sacramento Valley have begun experiencing land subsidence at rates up to 0.7 feet per year as groundwater levels decline (**Figure 9**). Nearly 1,000 dry well reports were received this water year as the drought ensued, a large increase from the previous water year. In addition to drought impacts, more domestic and irrigation wells were installed during this water year than any of the previous five water years (**Figures 12 and 14**) adding to the pressure on the resource.

Historic rainfall totals in December 2021 were welcomed and added to surface water supplies in several of the state's reservoirs, but for the majority of the groundwater system, there is considerable lag time between precipitation and recharging of groundwater basins. Groundwater levels in many regions of California have not fully recovered to conditions preceding the 2012-2016 drought as shown in the 10-year change map and 20-year trend map (**Figures 6 and 7**). Much more precipitation is needed to restore California's depleted groundwater supplies.

California's groundwater supply depends on the complex interaction of water recharge and management, including precipitation, the use of surface and recycled water supplies (in place of groundwater supplies), and groundwater pumping. At present, even during the above normal and wet years of 2016, 2018 and 2019, the data show that groundwater levels in many areas continued to decline. This trend continued during WY 2021 as most groundwater levels across the state were below normal (63 percent) with one in five wells being at measured at its all-time low groundwater level (**Figure 8**).

Water Year 2021 was challenging across the state especially for newly established groundwater sustainability agencies (GSAs) working to draft and implement groundwater sustainability plans (GSPs) under the Sustainable Groundwater Water Management Act (SGMA). Heading into what is shaping up to be another dry year, GSAs are faced with tough management decisions as they begin implementing their GSPs to achieve sustainable groundwater management.

Balancing the State's water supply and demands in the midst of a changing climate is imperative to the State's water resiliency. A necessary component of this is a balanced groundwater system and is the goal of SGMA. Continued commitment and investment in sustainable groundwater management will improve the ability of state and local GSAs to effectively manage droughts when a lack of precipitation and shortage of available surface water supplies result in a greater reliance on groundwater. To assist water managers and the public with accessing and visualizing up-to-date groundwater information, DWR has developed several web-based tools, the most recent of which is California's Groundwater Live website, an interactive application that allows users to explore, analyze, and visualize the latest groundwater data and information for California.

Groundwater conditions throughout the state are highly variable and can respond differently to precipitation at both the regional and local levels. Understanding what is happening at the local level is critical to successfully managing water resources. A foundational tenet of SGMA is the local management of groundwater resources which enables a powerful and collaborative framework for interested parties to be involved with groundwater management within their region. DWR encourages locals to reach out to their area's GSA, attend public GSA meetings, and provide input on the sustainable management of the local groundwater resource.

Additional groundwater level data and information about current conditions can be found on DWR's Data and Tools Site, California Drought, and SGMA Program webpages.