CALIFORNIA DEPARTMENT OF WATER RESOURCES

California's Groundwater Conditions: Semi-Annual Update



OCTOBER 2024

FALL BULLETIN 118 INFORMATION UPDATE

CALIFORNIA DEPARTMENT OF WATER RESOURCES

California's Groundwater Conditions Semi-Annual Update: October 2024

Message from DWR Deputy Director of Sustainable Water Management

Ten Years of the Sustainable Groundwater Management Act



Paul Gosselin, DWR Director of Sustainable Water Management

Last month marked the 10-year anniversary of the Sustainable Groundwater Management Act (SGMA), a major milestone for groundwater management in California. In this edition of DWR's Semi-Annual Groundwater Conditions Update, we recognize this important milestone and the accomplishments over the last decade.

One important result of SGMA has been the significant innovations in groundwater data and tools that have substantially enhanced our understanding and management of groundwater resources. In total, over 350 basin-specific groundwater sustainability agencies (GSAs) have been formed in 142 basins, preparing and implementing plans and building local capacity for groundwater planning and management. By April 1, 2022, all GSAs were submitting annual reports to DWR, a requirement under SGMA. These reports are an important new data source, providing insights into groundwater conditions and the progress being made toward sustainable management across California's groundwater basins.

As part of DWR's technical assistance, in coordination with GSAs, DWR has installed 208 new groundwater monitoring wells at 81 sites across California. These wells track groundwater levels and water quality, providing valuable data and helping GSAs track conditions so they can better plan, prepare and respond to local needs.

Another notable advancement in data resources is the collection of 16,000 miles of Airborne Electromagnetic (AEM) Geophysical Data across 95 basins throughout California, completed by DWR between 2019-2022. This data has provided a much clearer picture of the underground geology, allowing for more informed decision-making and management strategies, including identifying the best locations for groundwater recharge projects.

DWR makes all groundwater related data publicly available through various resources including CNRA Open Data platform, the SGMA Portal, California's Groundwater Live, and

through the California's Groundwater Bulletin 118 suite of reports, including Semi-Annual Groundwater Conditions Updates. This transparency ensures that all interested parties have access to the latest groundwater data and information.

SGMA was signed into law during California's historic 2012-2016 drought, highlighting the need to address diminishing groundwater supplies and the adverse effects of over extraction. Since then, local agencies, with state support, have met every ambitious milestone required by SGMA. Over 98 percent of groundwater pumping in California is now subject to a locally adopted, enforceable groundwater sustainability plan (GSP), Alternative to a GSP, or Adjudication.

Under SGMA, GSAs and other local entities are implementing creative solutions in more than 130 groundwater basins. Innovative local recharge efforts, supported by state initiatives, resulted in a massive managed aquifer recharge of 4.1 million acre-feet in 2023. In some basins, decisions have been made to manage groundwater demand and develop projects and management actions to reduce groundwater pumping and associated overdraft. While these decisions are challenging, GSAs that are developing new demand management and groundwater allocation programs are leading the way in achieving groundwater conditions that support both agriculture and access to water for all beneficial uses and users of groundwater.

Under SGMA, new collaborations and partnerships are forming, including between counties and GSAs, to minimize or avoid impacts on drinking water wells and disadvantaged communities. This collaborative approach between state and local entities is necessary for a sustainable future, as we work together to balance the needs of various interests and ensure the long-term viability of groundwater resources and equitable access to it.

Significant progress has been made since the initial submission of GSPs in 2020 and 2022 under SGMA, but there is still more work to be done. These plans have been updated based on evaluations and recommended corrective actions from DWR, addressing critical issues such as drinking water wells and land subsidence. Plans will continue to be updated and improved over time, ensuring they remain effective and responsive to emerging challenges, and the latest data and science.

Entering the next decade of SGMA, the focus shifts from planning and organizing to implementing projects and management decisions. These efforts aim to bring all groundwater basins subject to SGMA into a sustainable condition by the early 2040s. DWR remains committed to working closely with local GSAs to achieve their basin sustainability goals.

Weather extremes, particularly drought, pose significant challenges for SGMA compliance. GSAs will need to prepare in advance and develop strategies to address ongoing drought cycles and the associated increased reliance on groundwater. This includes creating incentives and streamlined processes for groundwater recharge and reducing groundwater

demand and use. Funding these projects will require a concerted effort and commitment from GSAs, cities, counties, and state and federal partners to support all beneficial uses and users in their basins. The plans adopted and submitted in 2020 are now undergoing their first periodic updates to explain progress, update plans as necessary, and continue filling data gaps to inform projects and management strategies. DWR is confident that local GSAs will reach their sustainability goals under SGMA, ensuring sustainable agriculture, drinking water supply, and healthy ecosystems.

I am pleased to share this latest edition of DWR's Semi-Annual Groundwater Conditions Update, which provides an overview of groundwater conditions in Water Year 2024 and recognizes the accomplishment of ten years of groundwater management under SGMA.



Deputy Director, Sustainable Water Management, California Department of Water Resources

Executive Summary

The Sustainable Groundwater Management Act (SGMA), enacted in 2014, has fundamentally transformed California's groundwater management approach. Over the past decade, SGMA has improved groundwater planning and data collection, raised public awareness, enhanced recharge activities, and fostered local collaboration, positioning the state on a path toward sustainable water management, despite ongoing challenges such as extreme climate fluctuations.

Currently, most of California's high- and medium-priority basins and adjudicated areas, which account for 98% of the state's total groundwater supply, are managed under a Groundwater Sustainability Plan (GSP), alternative plans, or through adjudication. Many low-priority basins have voluntarily adopted SGMA guidelines, demonstrating broad participation in sustainable practices. SGMA has played a crucial role in increasing public awareness of groundwater's importance and fostering local collaboration. With support from Groundwater Sustainability Agencies (GSAs) and the state's financial, technical, and regulatory backing, innovative strategies such as groundwater recharge projects and demand reduction have emerged, strengthening California's water resilience.

Although rainfall increased in 2023 and precipitation was average in 2024, California continues to face a cumulative precipitation deficit from 2000 to 2024, exacerbating groundwater depletion. This underscores the need for sustainable water management strategies that prioritize recharge and conservation. While recent wet years have helped stabilize groundwater levels, California's future will likely see continued fluctuations between wet and dry periods, making adaptive management practices essential.

One of SGMA's major achievements in its first decade has been significantly improving groundwater monitoring, with nearly 9,000 wells monitored in Water Year (WY) 2024, including the addition of nearly 2,400 new wells since the program's inception. Advanced technologies, such as 156 telemetered wells, provide near real-time data, with 28% of groundwater measurements reported within 30 days in WY 2024.

Despite recent wetter conditions leading to some recovery in groundwater levels, long-term trends show persistent concerns, particularly in the San Joaquin and Tulare Lake hydrologic regions, where more than 50% of wells reported below-normal levels in WY 2024. In contrast, the Coastal regions have seen improvements, with only 24% of wells below normal. Long-term data reveals that more than half of California's groundwater wells have experienced declining trends over the last 20 years, underscoring the effects of over-extraction and drought.

Land subsidence, a consequence of excessive groundwater extraction, has been somewhat mitigated by recent wetter conditions, but it remains a significant concern in areas like the Central Valley, where it has damaged roads, levees, wells, water conveyance and other infrastructure. Advanced monitoring techniques, such as satellite data and continuous GPS stations, have improved subsidence monitoring and support active management, but reducing groundwater pumping remains essential to prevent further damage.

SGMA's first decade has laid a solid foundation for sustainable groundwater management in California, though challenges remain. As the state faces unpredictable climate extremes, SGMA offers a vital framework for ensuring long-term groundwater sustainability. Moving forward, local agencies must accelerate recharge efforts, enhance monitoring technologies, and promote water conservation. Collaboration among the state, GSAs, local agencies, and the public will be crucial in achieving SGMA's goals and protecting California's water future.

Groundwater supplies almost 60% of California's water in dry years, with over 80% of Californians depending on it for some portion of their supply. It serves as a critical drought buffer and a key element of the state's climate adaptation strategy. However, without sustainable groundwater management, issues such as overdraft, dry wells, land subsidence, stream depletion, and water quality degradation can occur, as has been seen historically. Governor Newsom's drought emergency proclamations have strengthened the state's drought response by accelerating data collection, improving dry well reporting, enhancing drinking water assistance, and fast-tracking groundwater recharge projects under certain conditions to mitigate drought impacts.

In conclusion, while the progress made during SGMA's first decade is commendable, the path ahead requires sustained commitment and innovation. Addressing groundwater depletion, particularly in key regions, will demand increased recharge efforts, reduced demand, and expanded monitoring. With continued investment and collaboration, California can overcome its challenges and secure a sustainable water future by 2040.

This semi-annual report is the latest in a series of Semi-annual Groundwater Conditions Updates, last published in May 2024. These semi-annual reports are part of the informational resources associated with DWR's California's Groundwater (Bulletin 118). This update uses groundwater data received electronically by DWR as of August 31, 2024 and partially reflects the impacts of climatic conditions and natural and managed aquifer recharge. However, it should be noted that groundwater response is a slow process and takes months to years to fully respond to changes in surface water conditions. The most recent groundwater data is available on the California's Groundwater Live website, which is updated daily as data is received by DWR. Additional data and information are available in the CNRA Open Data and Water Data Library websites.

Key Findings

10 years of Sustainable Groundwater Management Act

- The implementation of SGMA has changed statewide water management and through efforts of local groundwater sustainability agencies, and state support, California is on track for a sustainable groundwater future.
- SGMA has set an ambitious goal for GSAs to reach sustainable groundwater conditions by 2040/2042 with first GSPs having been adopted in 2020/2022 and Alternatives adopted in 2017.
- As a result of SGMA and the efforts over the last 10 years, we have greatly improved groundwater data collection providing a better understanding of California's groundwater conditions.
- SGMA has profoundly improved public awareness about groundwater and the importance of protecting this valuable resource and has fostered proactive and collaborative groundwater management that is addressing long term challenges of our changing climate and water supply reliability.

Precipitation and Groundwater

- California has seen some recovery in groundwater levels thanks in part to increased rainfall following the WY 2020 to WY 2022 drought. Despite the wet WY 2023 and average WY 2024 hydrologic conditions, some areas in the state continue to have groundwater level declines.
- Despite record precipitation in some parts of the state in WY 2023 followed by average precipitation in WY 2024 the cumulative departure from the average annual statewide precipitation (**Figure 4**) for the 2000-2024 period shows that there is an accumulated precipitation deficit. Groundwater level and storage data similarly reflect decreasing long-term trends.

Groundwater Levels

- In WY 2023, groundwater levels began to rebound from the prior drought years, but only partially. WY 2024 helped continue to stabilize groundwater levels. It will likely require several more wet years, along with focused efforts to increase recharge and reduce pumping, to recover from the most recent and past droughts and the cumulative depletion of groundwater aquifers that has occurred over decades.
- The one-year and ten-year change data (**Figure 6 and 8**) show more wells with higher groundwater elevations than those in past years. However, over the last 20 years (**Figure 9**) more than 50% of monitoring wells in the state had a decreasing trend in groundwater elevations.

- In the Tulare Lake and San Joaquin River Hydrologic Regions, over 50% of groundwater elevations were below normal in monitoring wells in WY 2024 (**Figure 7)**. In contrast, over 50% of groundwater elevations were above normal in monitoring wells throughout the Coastal Hydrologic Regions. Overall Statewide, only 24% of groundwater elevations were below normal with over 40% above normal.

Land Subsidence

- Between July 2023 and July 2024, a time of abundant surface water supplies and reduced groundwater pumping, an area of approximately 500 square miles experienced an uplift of greater than 0.1 feet, while an area of about 3,000 square miles subsided by greater than 0.1 feet. There are no areas that subsided by more than 0.6 feet (**Figure 10**).
- Active land subsidence is observed in the Sacramento River, San Joaquin River, and Tulare Lake Hydrologic Regions (**Figure 11**).

Well Infrastructure and Groundwater Monitoring Enhancements

- Fewer domestic and irrigation wells were installed in 2024 than any year in the past 10 years since the Sustainable Groundwater Management Act was passed (**Table 7**).
- Fewer dry wells were reported in WY 2024 compared to 2021, 2022, and 2023 (**Table 7**).
- GSAs are now submitting data from almost 6,000 groundwater monitoring wells, over 2,300 of those were not previously included in DWR's database. Additionally, DWR, in coordination with GSAs, has installed 221 monitoring wells at 85 sites, helping fill data gaps in monitoring California's groundwater conditions (**Figure 15**).
- Of the nearly 9,000 active groundwater monitoring wells in WY 2024, approximately 30% groundwater measurements were submitted within 30 days of data collection and two percent were telemetered, providing near-real time continuous data. (**Figure 16**).
- DWR has installed and operates 157 groundwater level monitoring sites equipped with telemetry for real-time data collection. Telemetered data provides accurate and timely information essential for informed decision-making, monitoring the effectiveness of water management practices, and identifying areas needing improvement.

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Introduction

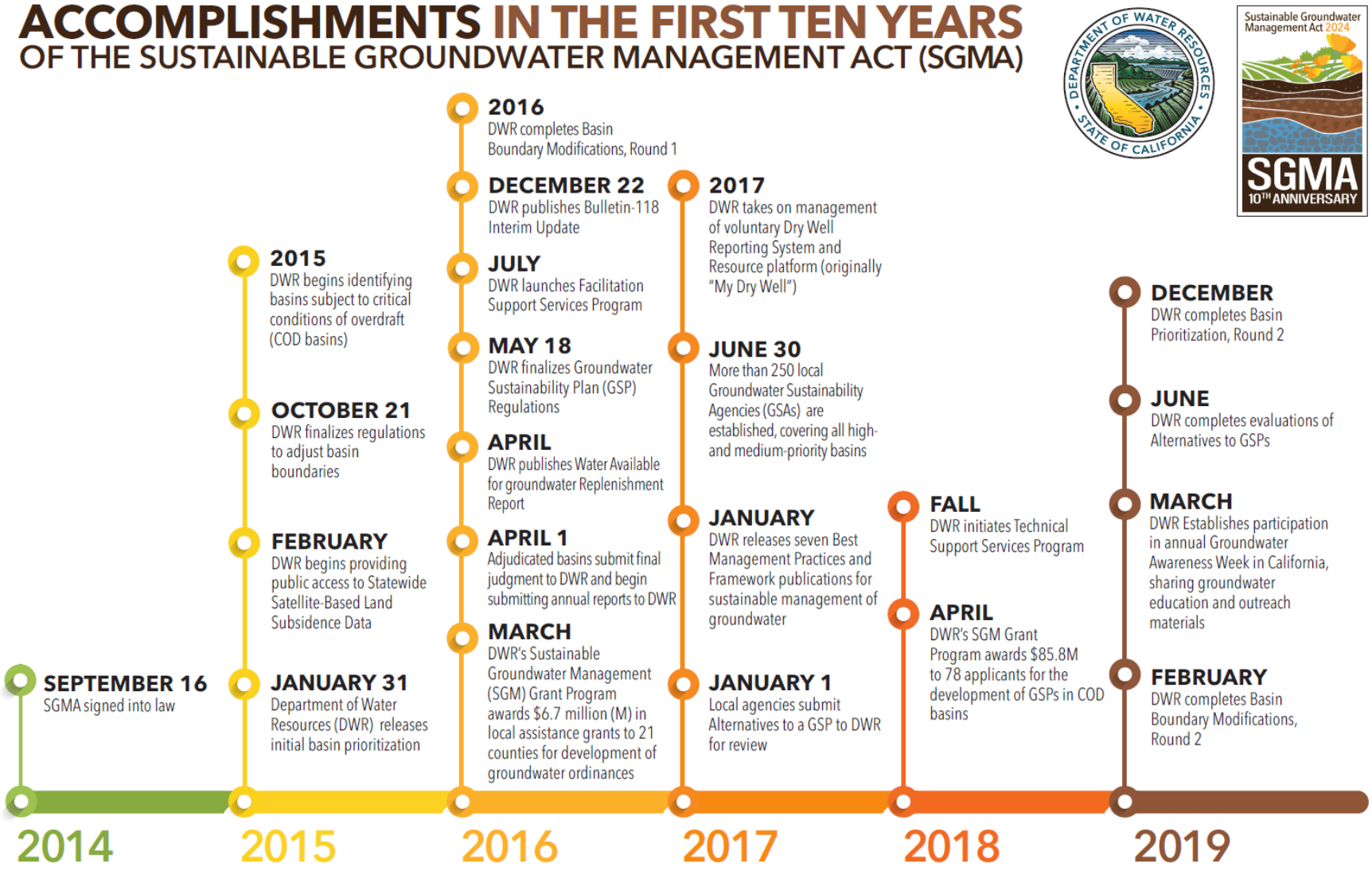
Over the past two years, California has seen some recovery in groundwater elevations thanks in part to increased rainfall following the Water Year (WY) 2020 to WY 2022 drought. Despite the recent wetter hydrologic conditions, some areas in the state continue to have groundwater level declines. Reflecting on the past 50 years of data, it is evident that California's climate swings between extremes, shifting from severe drought to heavy rain and large snowpacks. These unpredictable swings highlight the need for better water management. In the face of this challenge, the Sustainable Groundwater Management Act (SGMA) plays a crucial role in safeguarding California's groundwater by empowering local agencies to take control of their water resources and plan for long-term sustainability. Thanks to the management actions and commitment of local agencies and significant support from the state, California is making steady progress toward a more reliable and sustainable water future.

Local agencies and the state are also making great strides in gathering, sharing, and using groundwater data to improve the management of this vital resource under SGMA. Basins with Groundwater Sustainability Plans (GSPs) and alternative GSPs, along with adjudicated areas, provide 98% of the total groundwater supply in the state. DWR is actively working to make periodic groundwater monitoring data, annual groundwater use data and change in groundwater storage data—reported by Groundwater Sustainability Agencies (GSAs) and Watermasters – publicly accessible. In addition, DWR maintains the California's Groundwater Live and SGMA Data Viewer web applications and offers datasets for download on the CNRA Open Data website, ensuring access to the latest groundwater information.

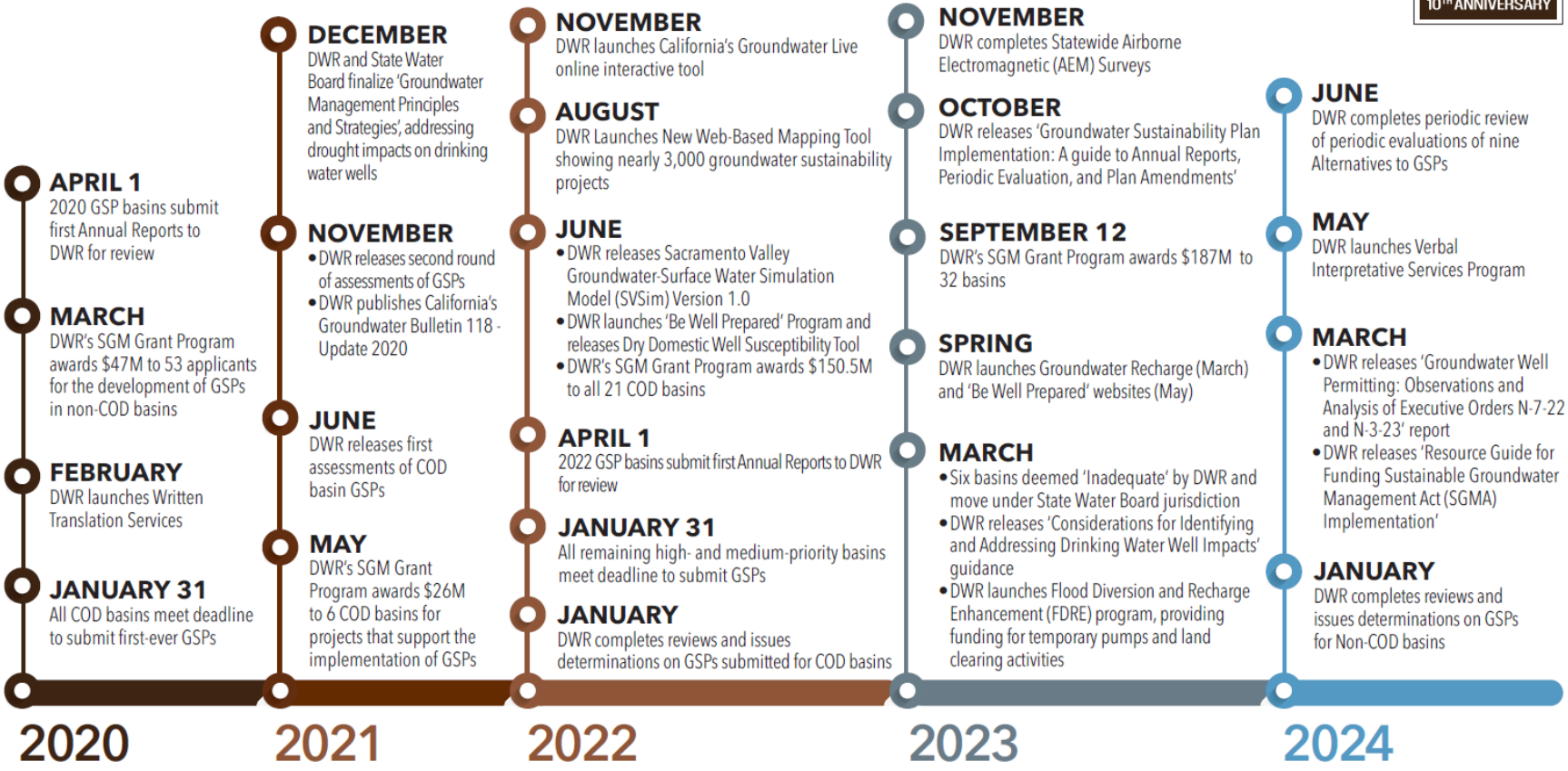
10 years of the Sustainable Groundwater Management Act (SGMA)

September 16, 2024, marked the 10-year anniversary of the signing of the Sustainable Groundwater Management Act (SGMA), California's landmark groundwater legislation. **Figure 1** shows the timeline of accomplishments in the first ten years of SGMA. SGMA established a statewide framework to protect groundwater resources and empowered local agencies to manage their groundwater basins, at the local level, for long-term sustainability. Beyond coordinating basin wide governance and planning for sustainable groundwater basins, SGMA has played a crucial role in protecting wells, which has led to significant improvements in drinking water reliability. The legislation has also driven infrastructure enhancements, such as the development of groundwater recharge basins, and has helped reduce the rate and the potential for land subsidence in some areas. Additionally, SGMA has played a crucial role in climate adaptation efforts, helping to ensure that California's various water management strategies are resilient in the face of changing climate conditions.

Figure 1: Timeline of accomplishments in the first ten years of SGMA.



ACCOMPLISHMENTS IN THE FIRST TEN YEARS
OF THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA)



Over the past decade, the implementation of SGMA has transformed water management across the state and has mandated additional coordination and consultation between California's water supply or management agencies and California's land use approval agencies. Thanks to the efforts of local agencies and GSAs, as well as state support, California is making steady progress toward a sustainable groundwater future.

The adoption of GSPs and Alternative GSPs has led to significant advancements in groundwater management in the state. The formation of a GSA and the preparation of a GSP, or an Alternative GSP, is only required in 93 of California's 94 high and medium priority basins, but many low and very-low priority basins have voluntarily chosen to follow SGMA's groundwater management structure. Of the State's 515 basins and subbasins, a plan has been prepared and adopted in 102 of those areas, as outlined in **Table 1** and **Figure 2**.

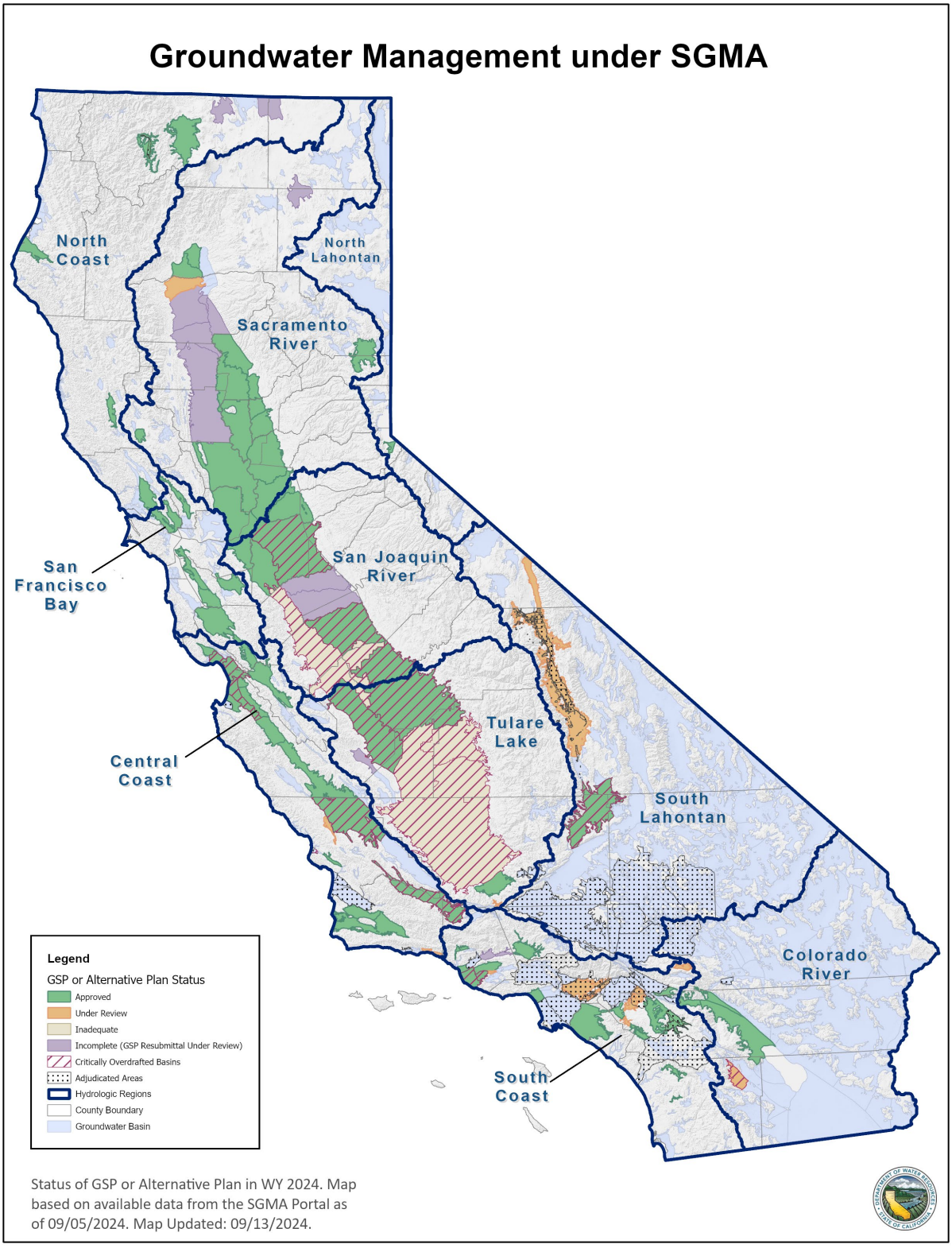
Enhanced data collection has deepened our understanding of California's groundwater conditions, facilitating greater collaboration among stakeholders. This has led to efforts to address critical issues such as land subsidence and dry wells, while innovative strategies like groundwater recharge and demand management are being implemented to safeguard water resources.

During the last decade, public awareness about the importance of groundwater has grown, fostering proactive and collaborative management efforts. Through SGMA implementation, local agencies are planning for sustainable management of key groundwater basins and working to ensure water availability during future droughts to support communities, agriculture, and ecosystems.

Table 1: Summary of GSP and Alternative approval status of groundwater subbasins as of July 2024.

Type of Plan and Approval Status	Number of Basins or Subbasins	Basin Priority
GSP – Approved	62	62 High and Medium
GSP – Inadequate	6	6 High
GSP – Incomplete (Under Review)	13	13 High and Medium
GSP – Under Review	11	2 High and Medium 9 Low and Very Low
Alternative GSP – Approved	9	9 High and Medium
Alternative GSP – Under Review	1	1 High
Not required to submit a GSP or Alternative	413	1 Medium 412 Low and Very Low

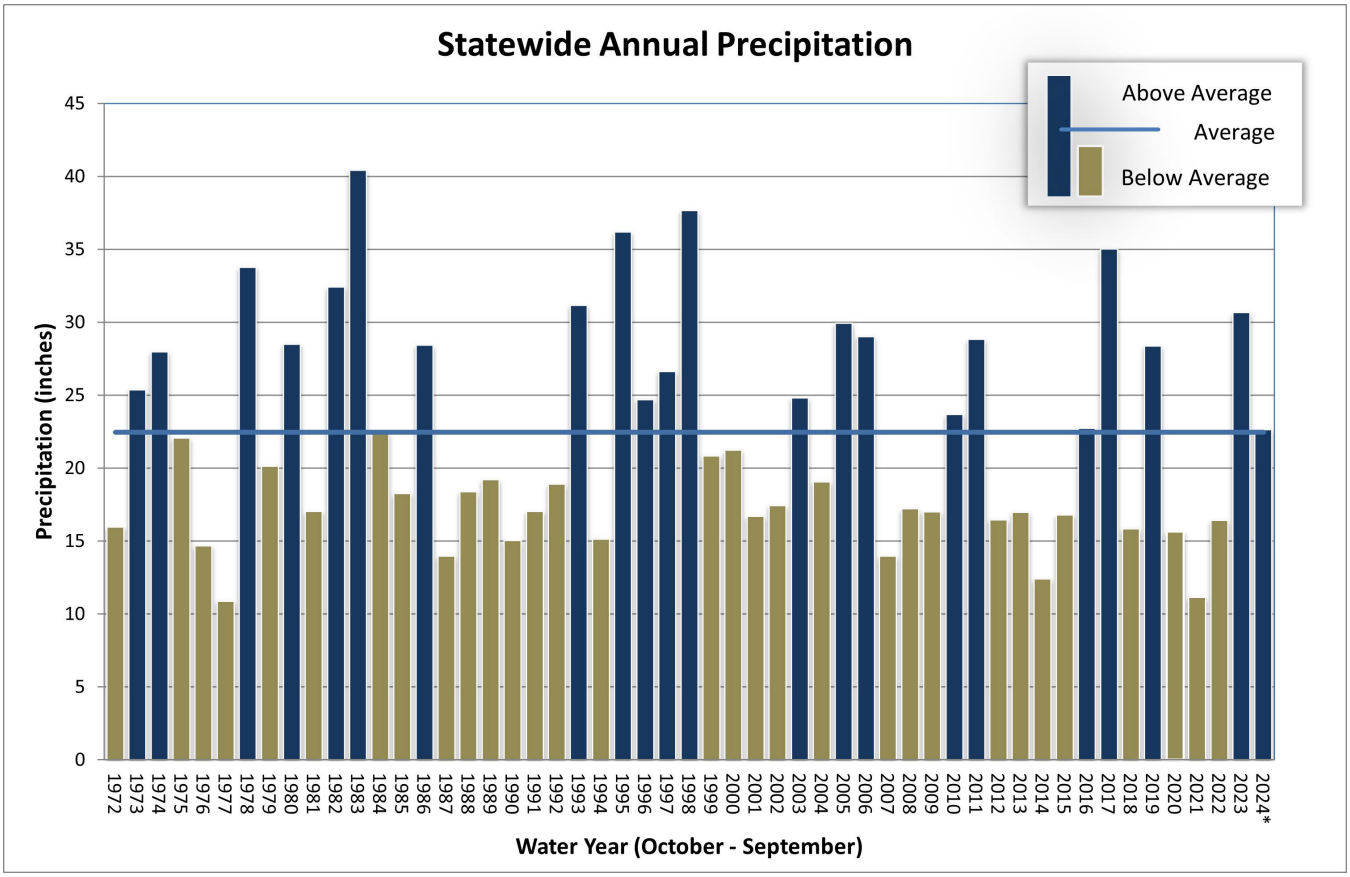
Figure 2: Groundwater Management under SGMA: The status of GSP or Alternative Plan in WY 2024. Data available from the SGMA Portal as of 09/05/2024.



Precipitation and Groundwater in California

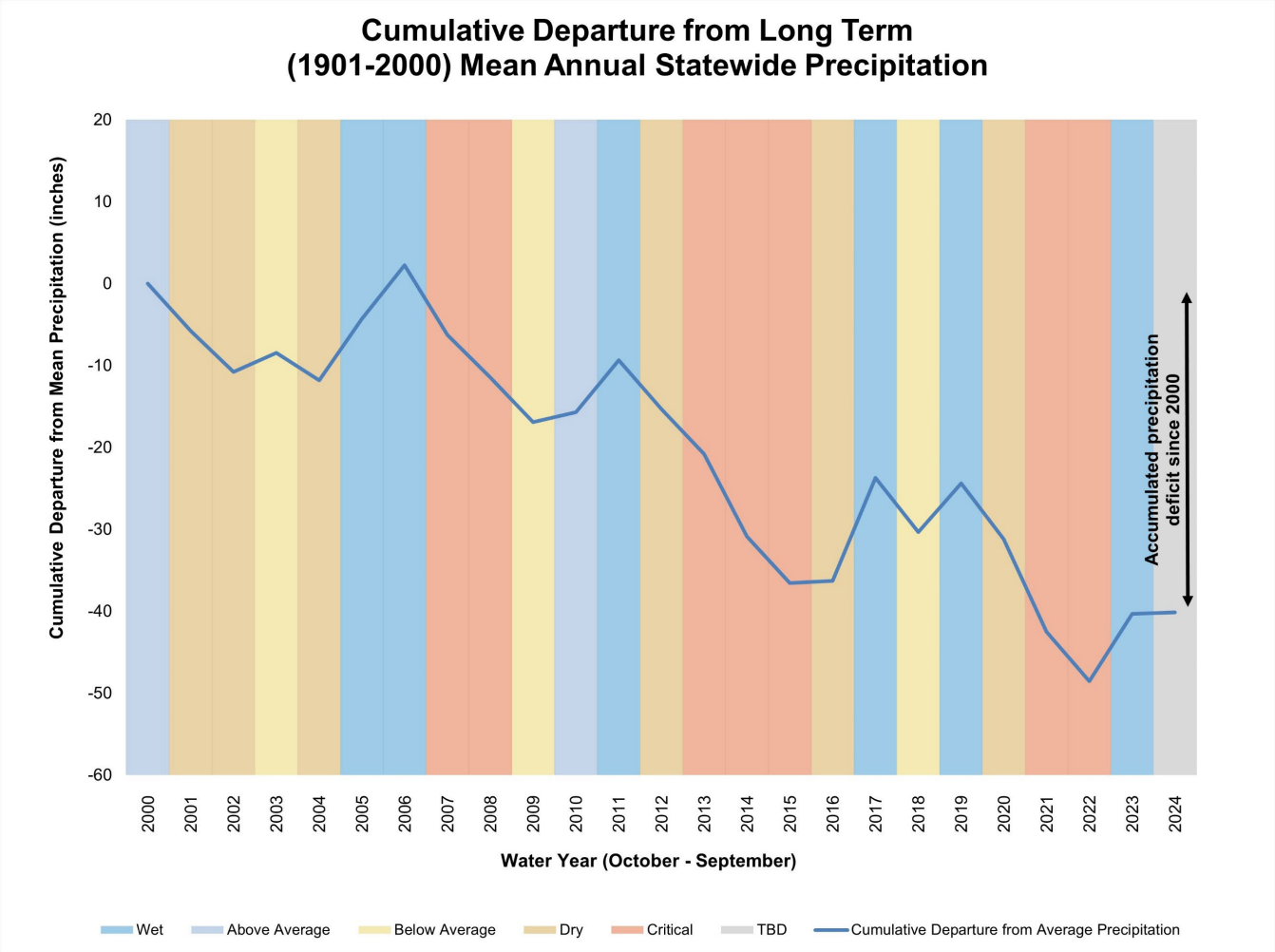
California received an average amount of precipitation in WY 2024. The state has experienced 22.79 inches of precipitation, slightly higher than the long-term average of 22.45 inches. Despite a very wet 2023 followed by 2024 with average precipitation, California has been in an extended dry period, punctuated by periodic average to wet years. Historical data shows that 15 of the 24 years during the 2000-2024 period had less than average annual statewide precipitation (**Figure 3**). The cumulative departure from the average annual statewide precipitation (**Figure 4**) for the 2000-2024 period shows the accumulated statewide precipitation deficit during this period.

Figure 3: Statewide Annual Precipitation, NOAA National Centers for Environmental Information, (Climate at a Glance: U.S. Time Series, Precipitation).



Average years, such as WY 2024, help to maintain existing conditions and can refill reservoirs and restore natural surface water systems but do little to restore groundwater basins depleted by decades of imbalance from pumping that exceeds recharge. As California faces a shift toward a warmer and drier climate, the risk of continued groundwater depletion becomes increasingly apparent, highlighting the critical need for sustainable groundwater management practices. This transition underscores the importance of adopting water conservation measures as a permanent part of resource management, regardless of climatic conditions.

Figure 4: Cumulative Departure from Average Annual Statewide Precipitation based on data from NOAA National Centers for Environmental Information, (Climate at a Glance: U.S. Time Series, Precipitation).



Historic Precipitation and Snowpack

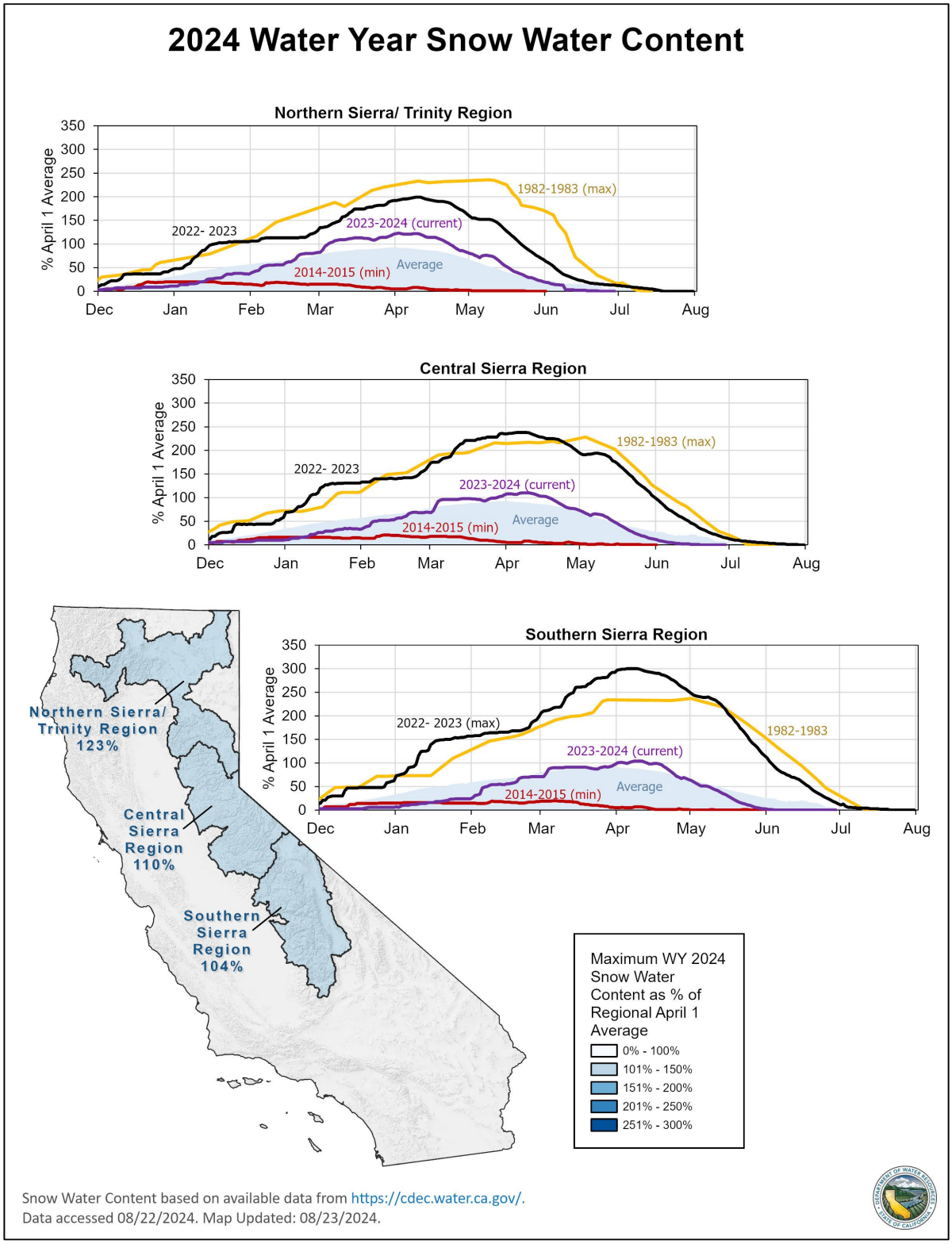
As of April 1, 2024 the California Cooperative Snow Surveys reported statewide snowpack at 111% of normal for the date, marking a significant improvement over the dry start to the year. On January 1st, the statewide Sierra snowpack was only at 28% of normal for the date; however, multiple atmospheric rivers brought substantial precipitation in February and March, helping to mitigate early concerns about a potential snow drought. The geographic distribution of snow water content in Northern, Central, and Southern Sierra is shown in **Figure 5** as percentage of the historical average.

Snowpack is crucial for California as it acts as a natural reservoir, gradually releasing water during the warmer months to replenish rivers, reservoirs, and groundwater. The Sierra Nevada snowpack alone typically accounts for about 30% of the state's water supply. The late winter and spring precipitation in WY 2024 had an important effect on surface water supplies, including the State Water Project (SWP), leading to increased water allocations

and storage in key reservoirs. Even with a slow start to the water year, by April 2024, the SWP water allocation was 40%.

Precipitation, snowpack, and runoff for WY 2024 appears to have preserved some of the gains achieved during the record-breaking WY 2023. While groundwater recharge efforts from WY 2023 continue, opportunities for recharge have been more limited in WY 2024, and the effects of previous drought years persist. These issues highlight the importance of continued water conservation and adaptive management strategies to make the most from the available water resources.

Figure 5: WY 2024 Snow Water Content, CDEC (Snowpack Conditions Snow Water Content).



Status of California's Groundwater Conditions

Average precipitation in WY 2024, following the wet conditions of WY 2023, has led to an improvement in groundwater levels compared to the previous dry and drought years. In areas with available data, spring 2024 groundwater levels were generally higher than in recent years, with some regions showing significant improvement when compared to historical averages. However, long-term comparisons reveal that groundwater levels have not fully recovered from the effects of past droughts and extended periods of overdraft.

Short-Term Groundwater Conditions

The one-year change in groundwater levels between spring 2023 and spring 2024, presented in **Table 2** and **Figure 6**, shows more increases than declines in groundwater elevations in wells across the state. From spring 2023 to spring 2024, 34% of measured wells showed groundwater level increases of more than five feet, whereas only five percent showed declines greater than five feet, 61% showed no significant changes (less than +/- 5 feet). This is similar to the results from a dry 2022 to a wet 2023 one-year comparison of spring water levels. The hydrologic regions with the greatest percentage of wells with increases in water levels from spring 2023 to spring 2024 (**Figure 6**) were Tulare Lake (65%), South Coast (48%), and San Francisco Bay (31%).

Table 2: Summary of Groundwater Level (GWL) Changes Compared to spring 2023 to 2024 and spring 2014 to 2024 (shown in **Figure 6**). Water Year Type as defined by the Sacramento River 8-Station Index, Department of Water Resources, California Data Exchange Center, WSIhist (ca.gov).

Period **(Water Year Types)**	**Total Well Count**	**Decrease > 25 ft**	**Decrease 5 to 25 ft**	**No Significant Change** **(Less than +/- 5 ft)**	**Increase 5 to 25 ft**	**Increase >25 ft**
1-Year GWL Change (Average): Spring 2023 compared to Spring 2024	6,316	1%	4%	61%	25%	9%

Figure 7 shows how data collected in spring 2024 (March, April, May) compared to other spring data collected in wells with at least 10 years of spring data. The spring 2024 measurement is classified into one of five percentile categories, or statistical bins, based on all spring measurements for that well. These categories are: lowest on record and less than10% (Much Below Normal), 10-25% (Below Normal), 25-75% (Normal), 75-90% (Above Normal), and Greater than 90% and highest on record (Much Above Normal). A more

detailed description of percentile class analysis is provided in the Semi-Annual Groundwater Conditions Update: October 2023 report.

When comparing spring 2024 groundwater levels to average conditions statewide, 24% of wells are still below normal, 42% are above normal, and 36% are normal (**Table 3**). More than 50% of measured spring groundwater levels are still below normal in San Joaquin River, and Tulare Lake hydrologic regions (**Figure 7**). The South Coast and San Francisco Bay hydrologic regions show the highest percentage of wells with spring 2024 groundwater levels that are above normal.

Table 3: Statistical Summary of percentile classes for March, April, May 2024 (as shown in **Figure 8**).

Percentile Class	Total Well Count	Lowest on Record	Less than 10%	10-25%	25-75% (Normal)	75-90%	Greater than 90%	Highest on Record
Statewide Percentile Class for March, April, May 2024	4,866	4%	9%	11%	36%	17%	14%	11%

Figure 6: Statewide and hydrologic region groundwater level percentile map for Groundwater wells in March, April, and May. See **Table 2** for specific groundwater level statistics. Map and chart are based on data from the DWR Water Data Library as of 08/31/2023.

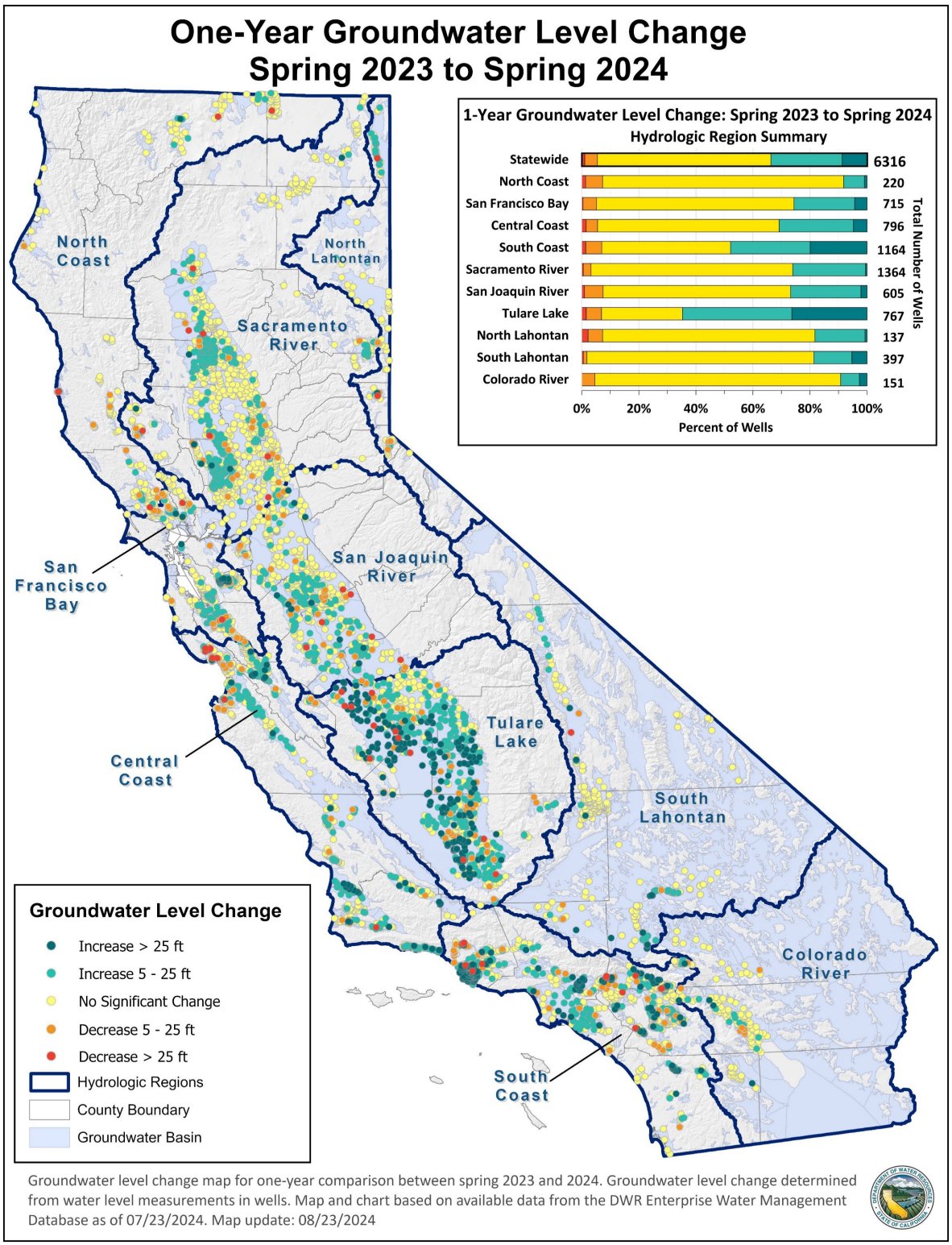
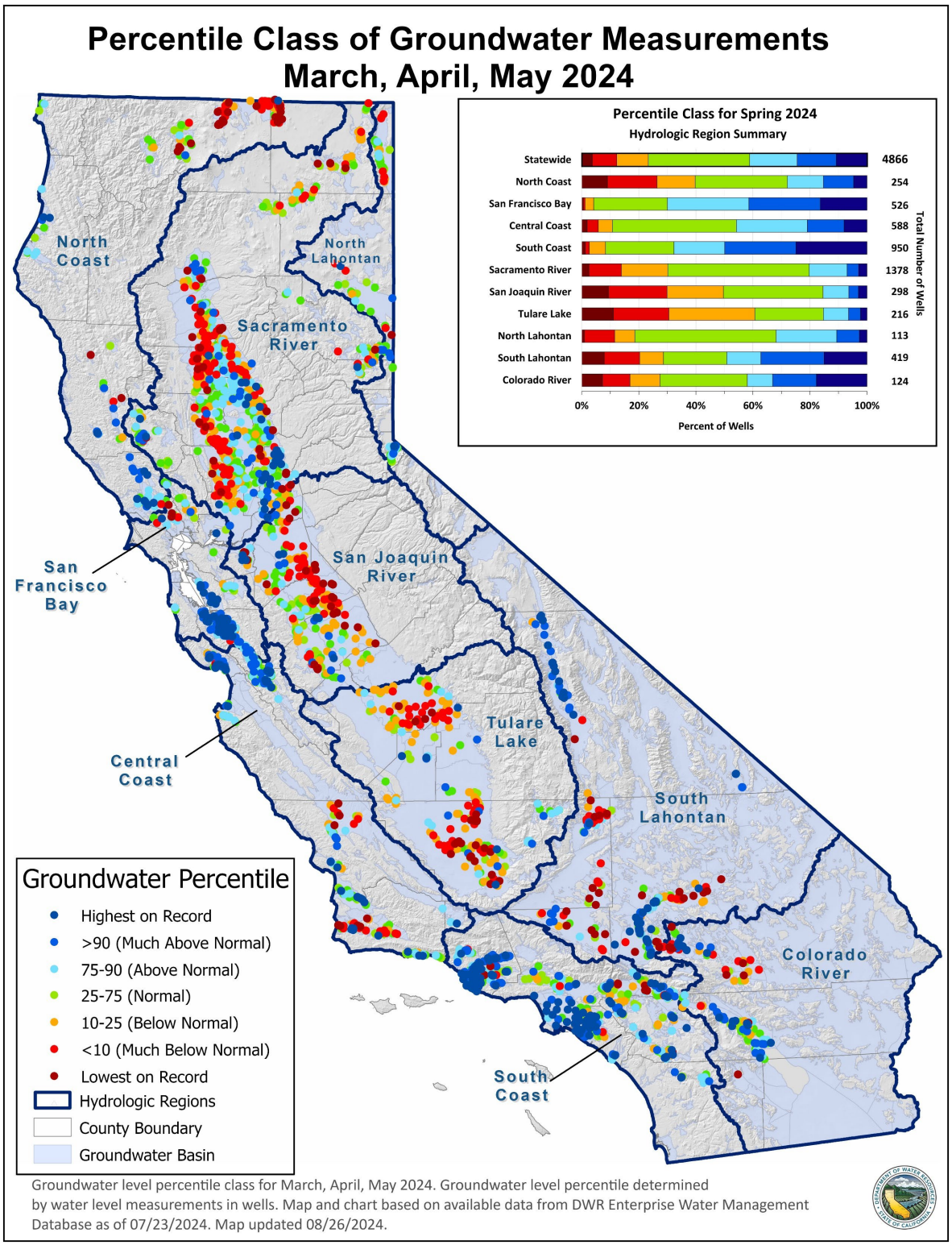


Figure 7: Statewide and hydrologic region groundwater level percentile map for groundwater wells in March, April, May. See **Table 3** for specific groundwater level statistics. Map and chart are based on data from the DWR Water Data Library as of 07/23/2024.



Groundwater level percentile class for March, April, May 2024. Groundwater level percentile determined by water level measurements in wells. Map and chart based on available data from DWR Enterprise Water Management Database as of 07/23/2024. Map updated 08/26/2024.

Long-Term Groundwater Conditions

While short-term trends provide insight into the immediate fluctuations in groundwater elevations and allow for more timely responses to water supply needs, long term trends offer a broader perspective on the sustainable use of the resource over many years. Statewide comparisons of spring 2024 groundwater levels to those from 2014 (**Table 4** and **Figure 8**), taken during the middle of the 2012 to 2016 drought show that 34% of groundwater levels are 5 feet or more higher, while only five percent are more than 5 feet lower. Spring 2024 groundwater levels in 61% of wells are similar to 2014 levels. This is an improvement over previous 10-year comparisons and is the first time the spring 10-year change comparison has shown more increases than decreases in water levels.

The 10-year comparison of water levels within the Tulare Lake and San Joaquin River hydrologic regions show decreases of more than 5 feet in 35 and 51% of wells, respectively. Over 60% of measured wells in the San Francisco Bay and Central Coast hydrologic regions had groundwater levels increases of five feet or more.

Table 4: Summary of Groundwater Level (GWL) Changes Compared to spring 2014 to 2024 (shown in **Figure 8**). Water Year Type as defined by the Sacramento River 8-Station Index, Department of Water Resources, California Data Exchange Center, WSIhist (ca.gov).

Period **(Water Year Types)**	**Total Well Count**	**Decrease > 25 ft**	**Decrease 5 to 25 ft**	**No Significant Change** **(Less than +/- 5 ft)**	**Increase 5 to 25 ft**	**Increase >25 ft**
10-Year GWL Change (Post-last Drought): Spring 2024 compared to Spring 2014	4,505	7%	13%	39%	29%	12%

Figure 9 shows the 20-year trend of groundwater level change over time by depicting the magnitude of decreasing or increasing groundwater level trends in wells from WY 2004 to WY 2024. This period includes droughts from 2007 to 2009, 2012 to 2016, and the most current drought (2020 to present). During this 20-year period of stressed water resources and increased groundwater use, more than 51% of statewide wells had a decreasing trend in groundwater levels while just over 10% of wells demonstrate an increasing trend. The percent changes observed from WY 2004 to WY 2024 are summarized in **Table 5**.

Figure 9 also shows 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

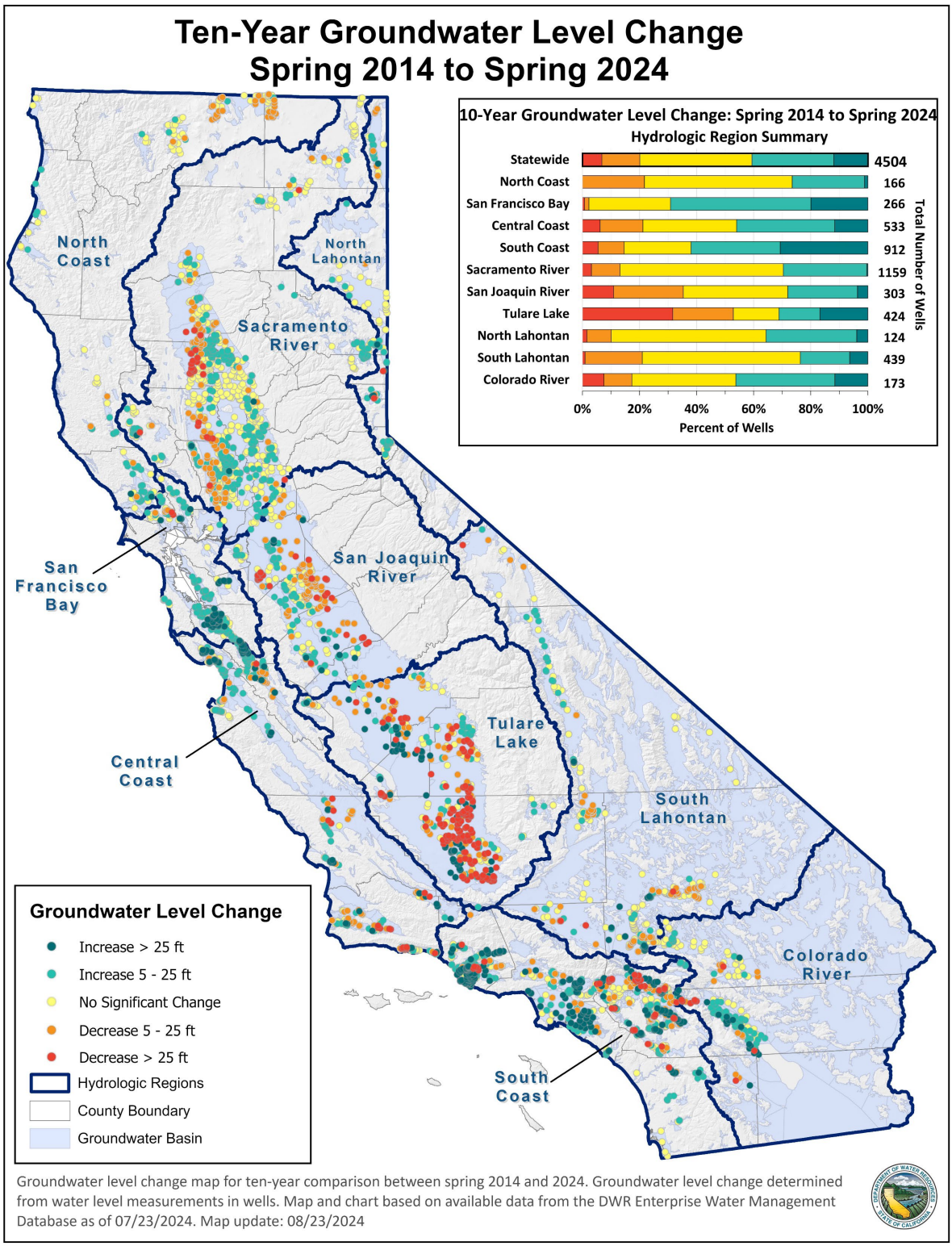
southern Central Valley, although the north end of the valley shows a continued decrease of groundwater levels of up to 2.5 feet per year. Areas of steep groundwater decline occur in the Sacramento Valley in the Sacramento River Hydrologic Region, the southeastern part of the San Joaquin Valley in the San Joaquin River Hydrologic Region, and most groundwater basins within the Tulare Lake Hydrologic Region. Moderate groundwater level declines occur 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 Colorado River Hydrologic Region.

Analysis of the spring 2024 trend data show that groundwater levels have not fully recovered from recent drought years, despite a wet 2019 and 2023. Additional wet years are needed to refill groundwater aquifers. This highlights a longer-term pattern where several years of drought followed by one or two wet years doesn't allow the groundwater systems to fully recover. The cumulative effect of this pattern of wet years followed by longer dry periods ultimately results in a decrease in groundwater storage and highlights the need for continued effort to sustainably manage groundwater basins.

Table 5: Statistical Summary of Groundwater Level Trend Map (**Figure 9**).

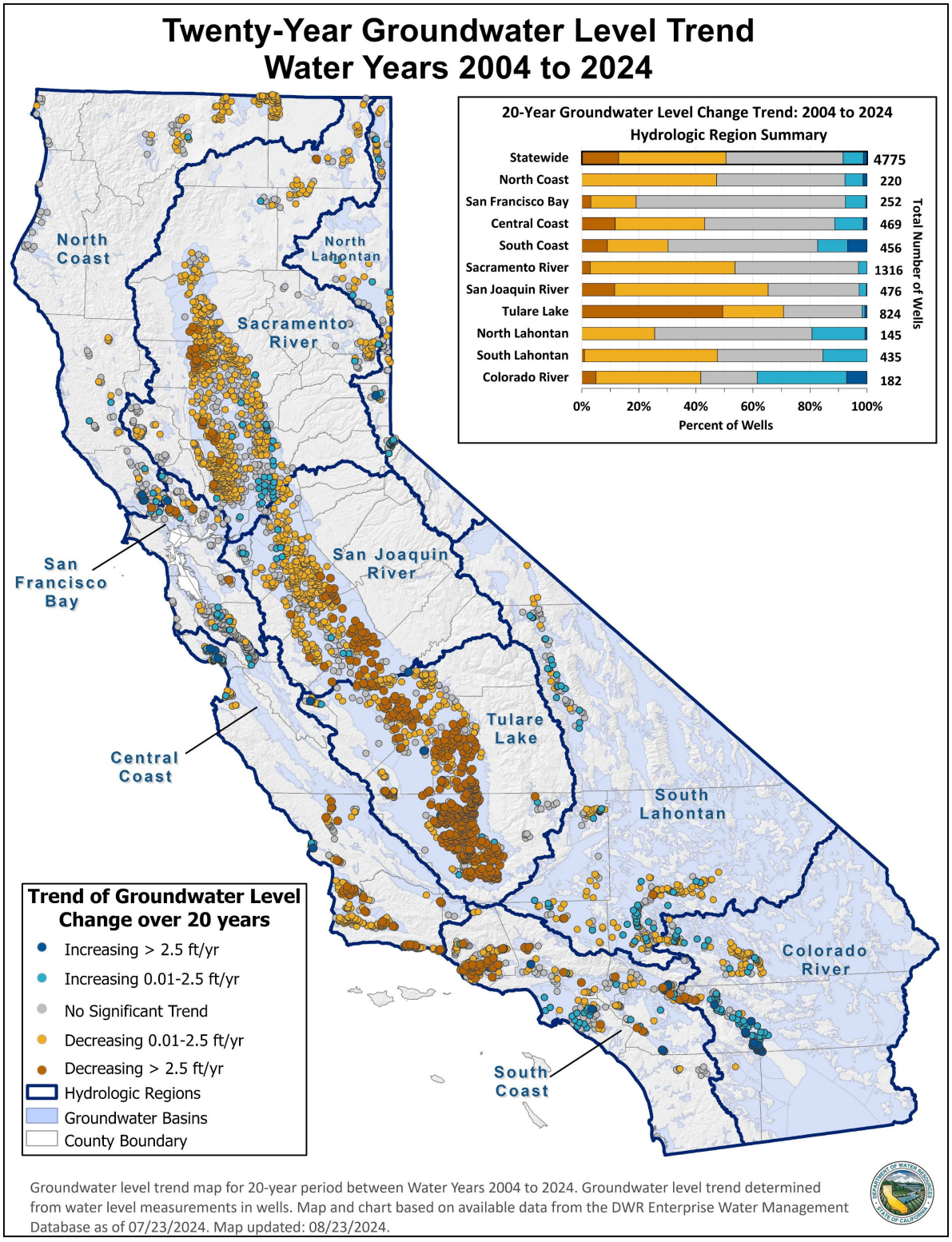
Period	Total Well Count	Decrease > 2.5 ft	Decrease 0.01 - 2.5 ft	No Significant Trend	Increase 0.01 - 2.5 ft	Increase > 2.5 ft
20-Year Trend: 2004 to 2024	4,783	13%	38%	41%	7%	1%

Figure 8: Statewide and hydrologic region groundwater level change map for ten-year period between spring 2014 and 2024. See **Table 4** for specific groundwater level statistics. Map and charts based on data from the DWR Water Data Library as of 07/23/2024.



Groundwater level change map for ten-year comparison between spring 2014 and 2024. Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Enterprise Water Management Database as of 07/23/2024. Map update: 08/23/2024

Figure 9: Statewide and hydrologic region groundwater level trend analysis map for WYs 2004-2024. See **Table 5** for specific groundwater level statistics. Map and charts based on data from the DWR Water Data Library as of 07/23/2024.



Land Subsidence

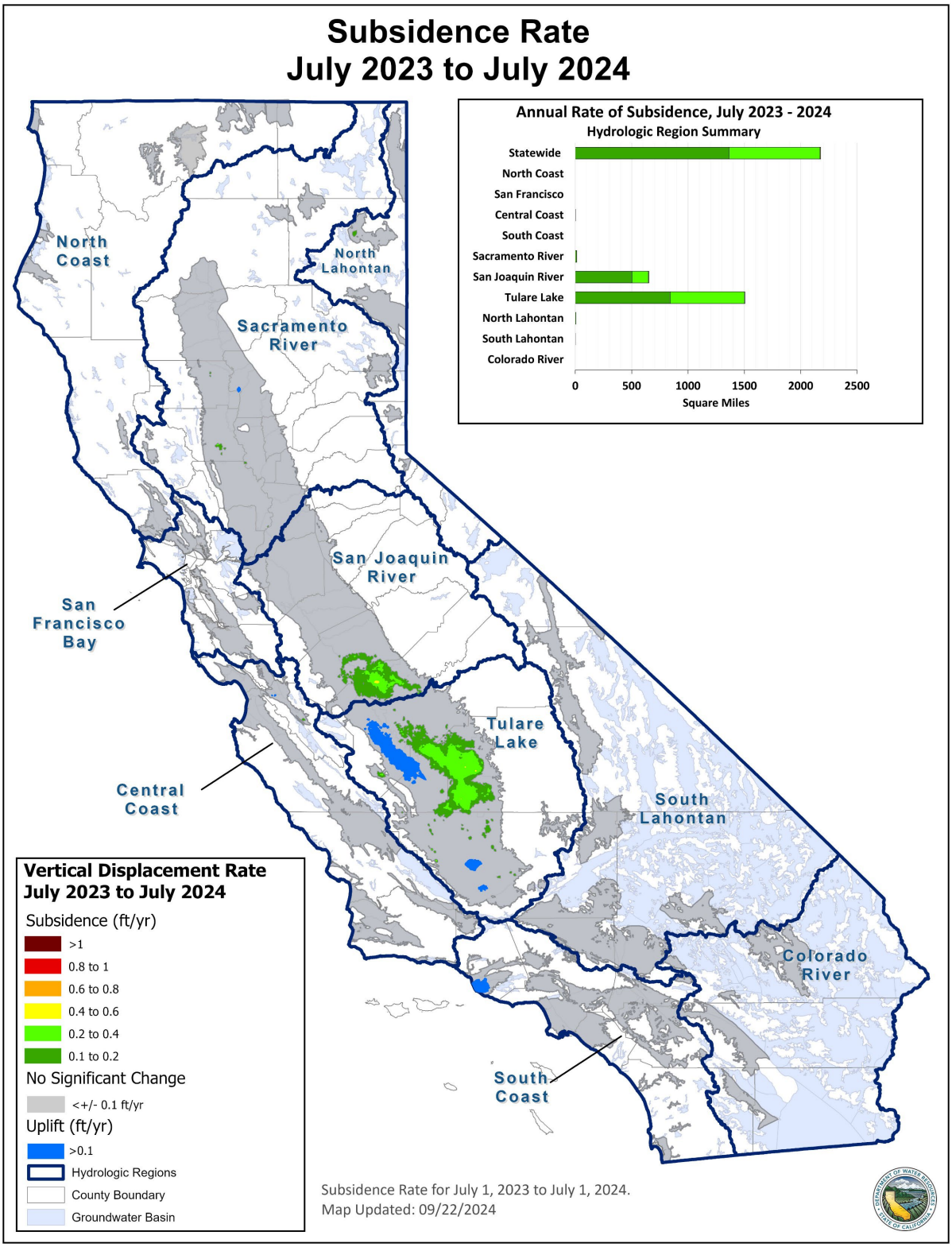
Land subsidence has been documented throughout the last century in many areas of the state, with over 30 feet of vertical displacement or "sinking" of the land surface in some areas. Subsidence has damaged and reduced capacity to water conveyance infrastructure, reduced groundwater storage availability for future use, and caused damage to other critical infrastructure. Since 2015, there have been significant improvements to the state's subsidence monitoring network, most notably the processing and reporting of satellite-based Interferometric Synthetic Aperture Radar (InSAR) data, which provides monthly subsidence data for more than 150 groundwater basins with a geographical coverage of about 40,000 square miles. In 2022, DWR increased the reporting frequency of InSAR data from annually to quarterly to provide more up-to-date information. In 2023, DWR has also started installing Continuous GPS stations in groundwater basins to further improve the statewide subsidence monitoring network with daily subsidence measurements at these sites. **Figure 10** shows annual land subsidence rates from July 1, 2023 through July 1, 2024, and Figure 11 shows for comparison the average annual rates over the most recent five years between July 1, 2019 through July 1, 2024. **Table 6** provides a summary of vertical displacement rates observed in the InSAR dataset between July 1, 2023, and July 1, 2024, and for the period from July 1, 2019 through July 1, 2024.

Table 6: Total Area (in square miles) of Subsidence (Subs.) and Uplift Corresponding to Displacement Rate (ft/yr) for one- year (**Figure 10**) and five-year (**Figure 11**).

	Uplift >0.1 ft/yr	**Subs. >0.1 ft/yr**	**Subs. >0.2 ft/yr**	**Subs. >0.4 ft/yr**	**Subs. >0.6 ft/yr**	**Subs. >0.8 ft/yr**	**Subs. >1 ft/yr**
One Year **July 2023 – July 2024**	517	2,177	813	6	0	0	0
Five Year **July 2019 – July 2024**	24	4,048	2,181	801	118	0	0

Figure 11 shows the annual rate of vertical displacement in feet per year from July 2023 to July 2024, and Figure 12 shows the annual rate of vertical displacement from July 2019 to July 2024. Annual displacement rates shown in these figures are divided into seven categories: subsidence of 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, greater than 1 foot/year, and uplift of greater than 0.1 feet/year.

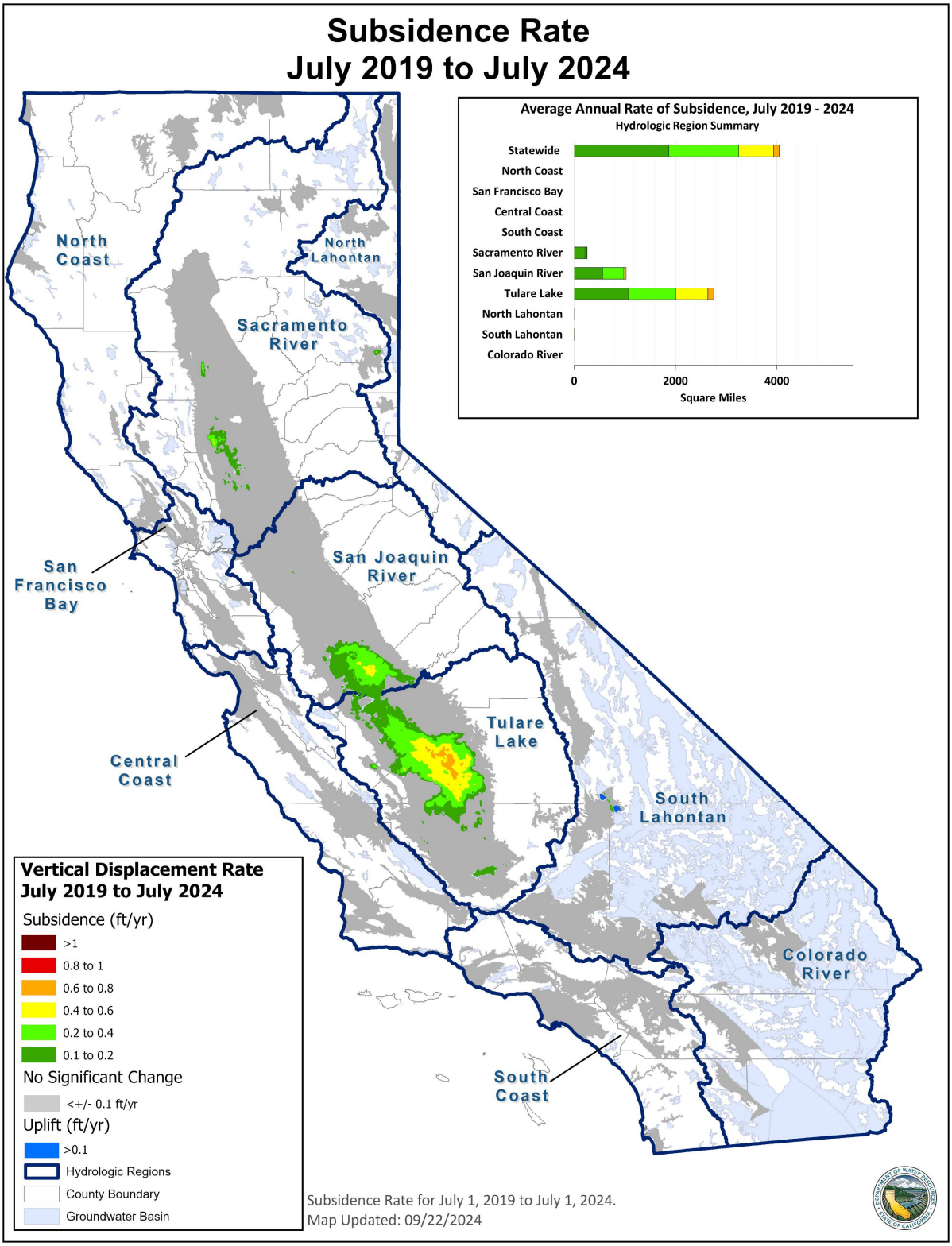
Figure 10: Statewide annual subsidence map for July 2023 to July 2024. See **Table 6** for specific subsidence level statistics. Map and charts based on data from CNRA Open Data as of 9/19/2024.



Similar to what was observed during the 2012–2016 drought, increased groundwater extraction during the most recent drought (2020-2022) resulted in accelerated land subsidence in parts of the Central Valley. The wet spring in 2023 has decreased land subsidence rates for now. For the period from July 1, 2023 through July 1, 2024, statewide data show an area of approximately 2,200 square miles with recorded subsidence of greater than 0.1 feet and about 6 square miles with subsidence greater than 0.4 feet, and no areas of subsidence exceeding 0.6 feet. In contrast, statewide data for WY 2022 showed a total area of about 5,400 square miles with recorded subsidence greater than 0.1 feet and about 80 square miles with subsidence greater than 1 foot (California Groundwater Conditions, Semi-Annual Update: March 2023).

Land subsidence can be elastic, where, under some conditions, the ground surface can rebound and show uplift. During the July 2023 to July 2024 period, the Tulare Lake Hydrologic Region had the most areas of uplift, with about 450 square miles experiencing an uplift of greater than 0.1 feet. Coincidentally, this region also had the most areas of subsidence, with about 1,500 square miles of area experiencing more than 0.1 feet of subsidence. Like previous dry-wet-dry climate cycles, land subsidence rates are likely to increase again during future dry periods unless long term groundwater extraction is reduced as part of ongoing sustainable groundwater management.

Figure 11: Statewide average annual subsidence map for July 2019 to July 2024. See **Table 6** for specific subsidence level statistics. Map and charts based on data from CNRA Open Data as of 9/19/2024.



Well Infrastructure

Many factors influence the type and number of groundwater extraction wells (well infrastructure) drilled in California, such as climate conditions, surface water supplies, groundwater level changes, legislative actions, age of the well and other local conditions. Well completion reports (WCR) are submitted to DWR through the Online System for Well Completion Reports (OSWCR) when a well is installed, replaced, or destroyed. California Water Code Section 13751 requires that WCRs be submitted to DWR within 60 days of the completion of the work. As such, there is up to a 2-month delay in the reporting of well construction information. This report includes a summary of data submitted to OSWCR over the last ten water years (2015 – 2024) for groundwater extraction wells classified as domestic or irrigation wells. Data for WY 2024 reported here includes data available through OSWCR on August 31, 2024.

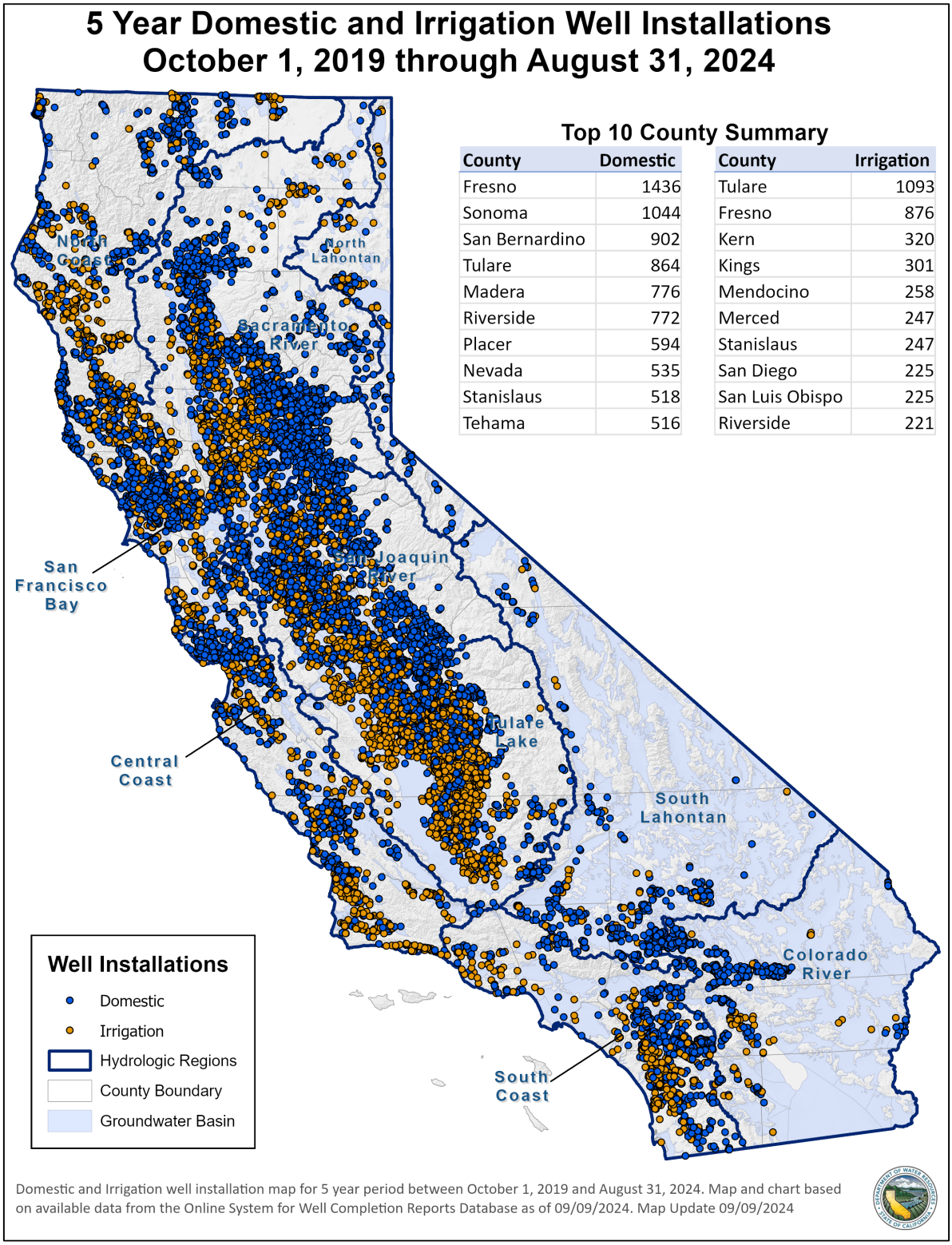
This report also provides a ten-year summary of dry water wells reported by members of the public to DWR's Dry Well Reporting System. Reporting to the Dry Well Reporting System began in 2013, with the specification of "approximate issue state date" becoming mandatory in 2017. Reporting is voluntary, so the actual numbers of dry wells and/or the number of resolved dry wells may be higher than what is reported in the database.

The year-to-year statistics of domestic, irrigation, and dry wells are provided in 7. The data go back to WY 2015, which captures the end of the previous drought (2012 – 2016). The total number of domestic and irrigation wells installed since 1977 are also provided for context. The water year type designations shown here are based on the San Joaquin Valley Water Year Hydrologic Classification Index, because no statewide water-year type index currently exists. **Figure 12** shows the domestic and irrigation wells installed during the past 5 water years (2020 – 2024).

Table 7: Statewide Summary of Newly Installed Domestic and Irrigation Wells and Number of Dry Well Reporting. *Dry Wells prior to WY 2017 are based on "Reporting Date", dry wells for WY 2017 onwards are based on the reported "Approximate Issue Start Date". **Dry Well Reporting started in 2013, whereas the database of WCRs for domestic and irrigation wells are considered complete since 1977.

Water Year	Water Year Type	Number of New Domestic Wells	Number of New Irrigation Wells	Dry Wells Reported*
WY 2015	Critical	3,530	3,050	1,442
WY 2016	Dry	4,414	2,871	546
WY 2017	Wet	3,137	1,488	75
WY 2018	Below Average	2,646	1,122	95
WY 2019	Wet	2,749	1,345	56
WY 2020	Dry	3,026	1,350	136
WY 2021	Critical	3,665	1,840	1,068
WY 2022	Critical	4,013	1,711	1,403
WY 2023	Wet	3,277	1,235	370
WY 2024 through August	TBD	1,959	596	122
5 Year Total	-	15,940	6,732	3,099
10 Year Total	-	32,416	16,608	5,313
Total since 1977**	-	283,735	62,876	5,939

Figure 12: Statewide newly installed domestic and irrigation wells map for 5-year period from WY 2020 through 2024. See **Table 7** for specific well data. Map and charts based on data from the CNRA Open Data as of 08/31/2024.



County	Domestic
Fresno	1436
Sonoma	1044
San Bernardino	902
Tulare	864
Madera	776
Riverside	772
Placer	594
Nevada	535
Stanislaus	518
Tehama	516

County	Irrigation
Tulare	1093
Fresno	876
Kern	320
Kings	301
Mendocino	258
Merced	247
Stanislaus	247
San Diego	225
San Luis Obispo	225
Riverside	221

Domestic Wells

Domestic (household) wells provide water to millions of people throughout California. During the WY 2024 through August, a total of 1,959 new domestic wells were reported to be installed in the state (**Table 7**). During the last ten water years (since October 2014), a total of 32,416 domestic wells have been installed, accounting for approximately 11% of the total 283,735 domestic wells installed since 1977. The 1,959 new domestic wells installed in WY 2024 through August is the lowest in the ten water years. The highest number of domestic wells (4,414) were installed in WY 2016.

The location of new domestic and irrigation wells installed in California over the past five years (WY 2020 through WY 2024) is shown in **Figure 12**. The counties with the highest number of new domestic wells were Fresno (1,436), Sonoma (1,044), and San Bernadino (902). The geographic distribution shows numerous domestic wells being installed outside of the 515 groundwater basins, in volcanic and fractured rock aquifers across the state, highlighting the dependence on groundwater in those areas.

Irrigation Wells

Irrigation wells typically have higher capacity and pump more groundwater than domestic wells and provide water to farms that feed millions of people throughout California and the world. During WY 2024 through August, a total of 596 new irrigation wells were reported to be installed in the state (**Table 7**). The 596 irrigation wells installed during WY 2024 through August is the lowest in the last nine full water years. Over the last ten water years since October 2014, a total of 16,608 irrigation wells have been installed across the state, accounting for approximately 26% of the 62,876 irrigation wells installed statewide since 1977. The year-to-year number of new irrigation wells has fluctuated from a low of 596 in WY 2024 to date to a high of 3,050 in WY 2015.

The location of new domestic and irrigation wells installed over the past five years (WY 2020 through WY 2024 through August) is shown in **Figure 12**. Irrigation wells are much less geographically spread throughout the state when compared with the geographic spread of domestic wells. Over the past five water years, Tulare County had more new irrigation wells (1,093) installed than any other county in the state, accounting for approximately one out of every six new irrigation wells (16%). Neighboring Fresno County (876) and Kern County (320) ranked 2nd and 3rd respectively for most new irrigation well installations.

Dry Well Reporting

DWR manages the Dry Well Reporting System where Californians experiencing problems with their private, self-managed wells that are not served by a public water system can voluntarily report dry wells and be connected with entities providing local drought assistance. DWR's Dry Well Reporting System was originally developed during the 2012-

2016 drought. Based on feedback from counties, the system has been updated to directly and immediately notify local agencies, including county officials, water agencies, and GSAs, when household water supply well outages are reported in their region. The system helps centralize and disseminate information statewide when well outages are reported. This centralized reporting system helps ensure that local and State agencies are quickly notified and can respond to provide available resources such as interim water supplies or appropriate funding sources to help address the issues. The Dry Well Reporting database is designed to receive reports when a domestic well goes dry, or when a dry well problem is resolved. DWR provides a statewide statistical summary of locally reported dry wells on the Dry Well Reporting System website. The summary includes a cumulative report of dry wells by county, a map showing the statewide distribution of dry wells, and an accounting of dry wells reported to the state by quarter from 2013 to present.

Dry Well Reporting is an important tool to track areas where changes in local groundwater conditions may be impacting beneficial uses and users of groundwater in California for household water uses. It is also a key indicator of areas where drought assistance is most needed. As California continues to experience climate-driven severe drought conditions, leading to less available precipitation and snowmelt, and extreme heat, Californians rely heavily on groundwater to meet their water supply needs. Reports of dry wells naturally increase during extended dry periods as groundwater use increases and groundwater levels decline.

The submission of dry well reports is voluntary so the data may not represent the total number of dry wells occurring across the state, only those submitted to the Dry Well Reporting System. Community outreach by DWR over the years since the development of the dry well reporting system has resulted in more awareness and greater usage of the system over time, and more dry well reports are likely being submitted to the Dry Well Reporting database than were submitted in the past. In 2017, the Dry Well Reporting System started requiring "*Approximate Issue Start Date*" as a required field when reporting dry wells. The report submission date historically has been used to assess the rate at which wells go dry across the state. However, it does not account for reporting delays or reporting of past dry wells and is not necessarily reflective of the number of dry wells for a given year. Prior to 2017, the "*Approximate Issue Start Date*" was optional and is not always included in the reported data. Of the 5,939 reports submitted in the system, there are 1,580 reports without an issue start date and 1,637 reports with an issue start date before 2013. Data after 2017 reflects the effects of reporting delays.

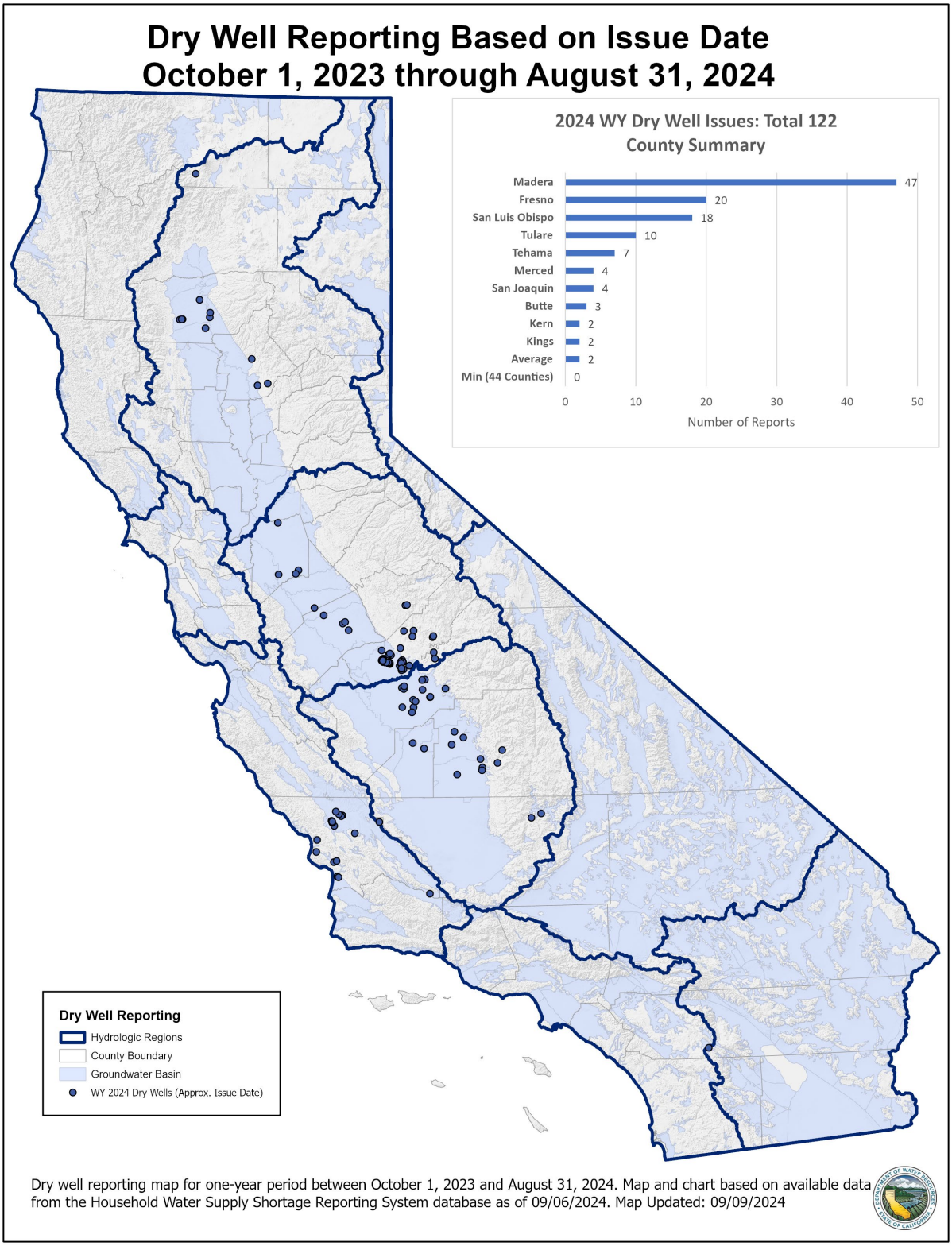
This report includes a summary of data submitted to the Dry Well Reporting System over the last nine water years (2015 – 2024) based on both Reporting Date and Approximate Issue Start Date. The count of dry wells prior to 2017 is based on Reporting Date while counts for 2017 onwards are based on Issue Start Date. Moving forward, counts will be based on the

Approximate Issue Start Date to account for reporting delays and best reflect reporting delays. Dry well reporting for WY 2024 includes issues reported through August 31, 2024.

In WY 2024 (up to August 31, 2024), a total of 122 new dry well issues were reported have occurred compared to 370 in WY 2023 and 1,403 in WY 2022. A wet 2023 followed by an average 2024 has helped reduce the strain on groundwater created by the prior drought years. However, the 122 new dry wells exceeded the number of issues reported to have occurred in any year between wet period of 2017 through 2019.

A total of 3,099 new dry well issues were reported to have occurred over the last five water years (2020-2024 through August), and a total of 5,939 dry well reports have been received since 2013. The year-to-year number of dry wells since 2017 has fluctuated from a low of just 56 in WY 2019 to a high of 1,403 in WY 2022 (**Table 7**). The locations of dry wells in WY 2024 are shown in **Figure 13**.

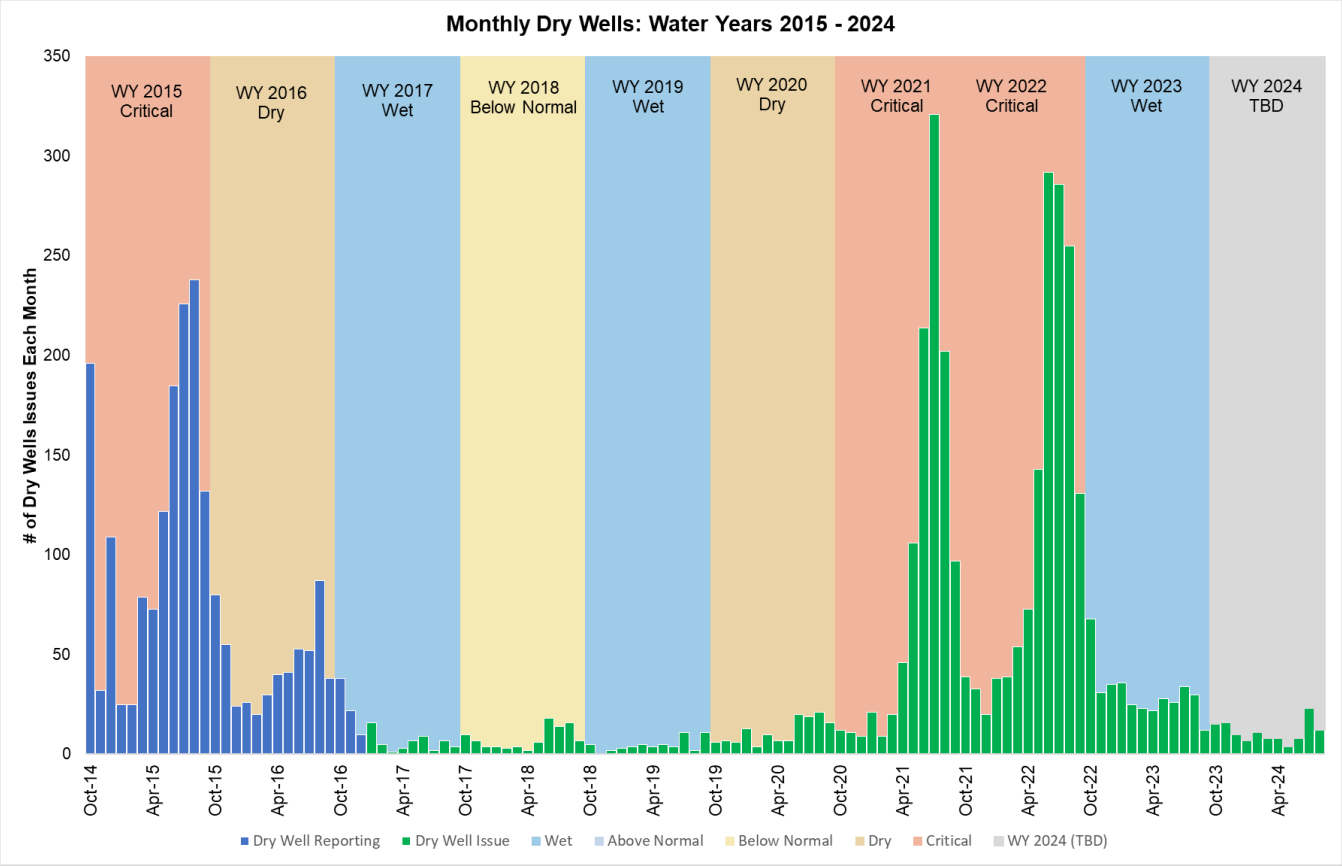
Figure 13: Statewide one-year reported dry wells issues map for WY 2024 through August 31. See **Table 7** for specific well data. Map and charts based on data from the CNRA Open Data as of 09/06/2024.



In WY 2024 up to August 31, 2024, the highest number of dry well reports were received in Madera County (47), Fresno County (20), and San Luis Obispo County (10). These three counties account for 70% of the dry well reports received statewide in WY 2024 to date. Seven counties reported between 1 and 10 dry wells and 44 counties reported zero dry wells issues.

The statewide trend for dry well reporting over the past ten water years (2015-2024) shows a correlation between extended dry periods and the number of dry well reports. More dry well issues were reported to have occurred during the 2021 and 2022 critical years than any other period. The wet winter of 2022-2023 resulted in a decline in dry wells issues reported for WY 2023. The average year in 2024 contributed to continued declines in dry well issues. **Figure 14** shows a monthly time series of dry well reports from October 2014 to August 2024. The number of dry wells prior to 2017 are based on report date while wells 2017 and after are based on reported issue date.

Figure 14: Monthly Dry Well Reporting (October 2014 through August 2024).



Groundwater Reporting Summary

Groundwater level data provides valuable information for assessing seasonal and long-term groundwater changes, trends in groundwater storage, susceptibility to land subsidence and dry wells. Groundwater level data are collected by DWR and also collected and reported to

DWR by hundreds of local Groundwater Sustainability Agencies implementing SGMA, by entities participating in the California Statewide Groundwater Elevation Monitoring (CASGEM) Program, and other parties. Groundwater level measurements are collected and submitted to DWR on various schedules, depending on the data collector and monitoring program. Since 2020, as part of SGMA implementation, DWR receives GSP and Alternative to GSP Plan Annual Report Datasets from GSAs and Alternative Agencies every year in April for the previous water year.

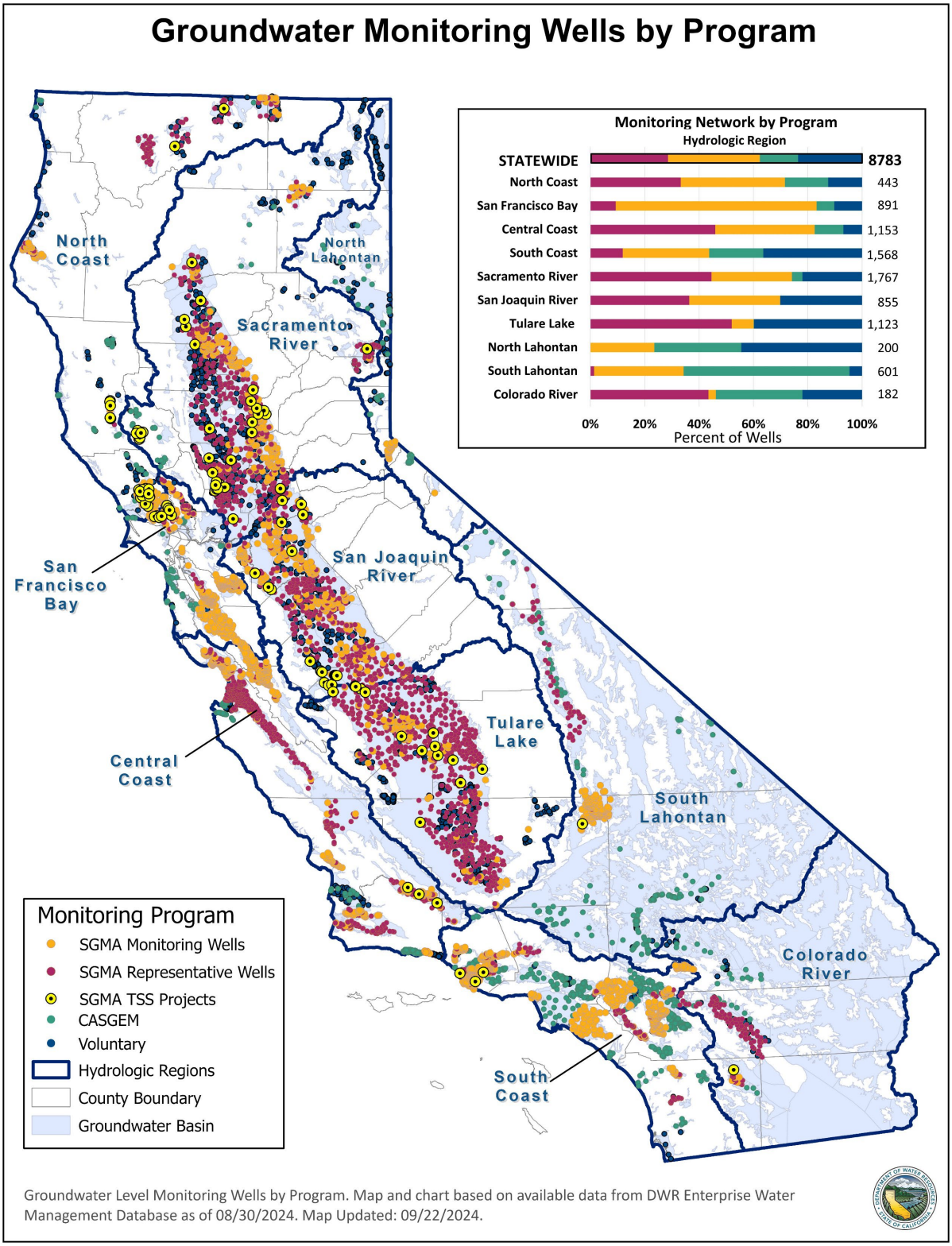
Groundwater level measurements collected by DWR, GSAs, and other agencies and monitoring entities are aggregated in DWR's centralized statewide data systems through the CASGEM Online System and SGMA Portal. **Figure 15** shows the statewide distribution of groundwater level monitoring wells organized by the SGMA and CASGEM program wells, voluntary wells, and wells install through the SGMA Technical Support Services program, as of 2024. SGMA monitoring wells are an integral part of GSPs and include Representative monitoring wells that track Sustainable Management Criteria information such as Minimum Thresholds and Measurable Objectives. DWR's Technical Support Services (TSS) program provided services to GSAs to drill new monitoring wells to help fill data gaps in a GSP. As of WY 2024, SGMA wells make up 64% of the state's monitoring wells, CASGEM wells account for 13 precent, and voluntary wells represent 22% of groundwater level monitoring wells.

The implementation of SGMA resulted in an expansion in the monitoring networks used to report data to DWR. Many of the CASGEM network wells were transferred to a SGMA GSP network. Additionally, GSP's and Alternative Plans added new wells that had not previously been submitted to DWR's database filling in data gaps in monitoring California's groundwater conditions. **Table 8** shows the Groundwater Monitoring Sites that were added to the SGMA Monitoring Networks by either transferring from the CASGEM program or adding new sites.

Table 8: CASGEM migration and new monitoring wells in the SGMA Program that were added to GSP monitoring networks. Based on available data from the SGMA MNM Portal 3/1/2024.

	CASGEM Migration of Monitoring Wells to SGMA	New Monitoring Wells added through SGMA	Total SGMA Monitoring Wells
GSPs Received By 01/31/2020	1,185	890	2,075
GSPs Received After 01/31/2020	1,709	1,276	2,985
Alternatives	720	200	920
Total	3,614	2,366	5,980

Figure 15: Comparison of groundwater monitoring sites by program. Map and charts based on data from the CNRA Open Data as of 8/30/2024.

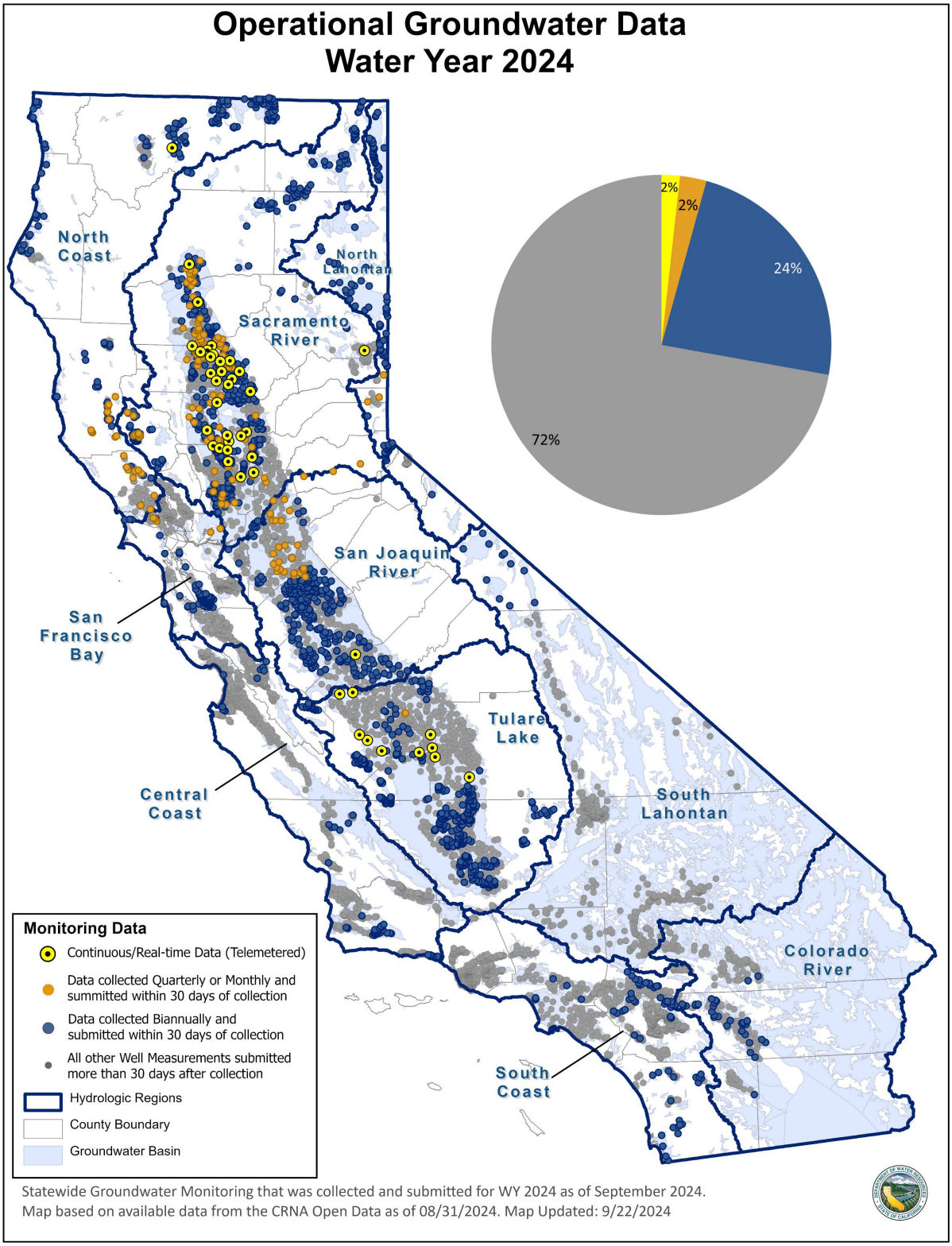


Groundwater level data aggregated in DWRs data systems is collected and submitted on different schedules, depending on the program and collecting entity. Operational Data refers to data that is collected monthly or more and submitted shortly after collection. This may be useful for groundwater management helping water managers understand real-time groundwater conditions. Data collected quarterly or more frequently provides groundwater level information as water levels change throughout the year. In most cases, wells across the state are monitored twice a year, typically capturing seasonal highs (spring) and lows (fall). While this frequency is sufficient for tracking long-term trends, more frequent monitoring is needed to understand how groundwater levels fluctuate within a season.

Figure 16 summarizes monitoring well data submittal timing and the data collection frequency for wells reporting groundwater level measurements collected during WY 2024. Data was submitted for 8,959 wells in WY 2024. Of these measurements, 2,507 measurements (28%) were submitted within 30 days of collecting the well data. There are 2,120 wells (24%) for which groundwater level measurements were collected at least twice a year and reported within 30 days. Operational Data is reflected in 226 wells (two percent) was collected at least ten times a year and submitted within 30 days and 157 wells (two percent) were equipped to collect continuous real-time telemetered data.

DWR, in coordination with the USGS, operates these 157 sites equipped with telemetry for real-time data collection. Telemetered data is considered the gold standard for effective groundwater management, as it provides accurate and timely information essential for informed decision-making, monitoring the effectiveness of water management practices, and identifying areas needing improvement. This represents a growth from one percent of wells being telemetered in WY 2023. As part of the 2021 Water and Drought Resilience Package and in support of the State's Human Right to Water statute, funding was allocated to the Department's four Region Offices to install dataloggers, preferably equipped with telemetry, in existing groundwater wells. This initiative aims to expand groundwater level monitoring in low and very low priority SGMA groundwater basins and in non-basin areas with a high-density of domestic wells that may be at risk of drying up during drought conditions. Expanding the use of telemetry in DWR's statewide groundwater monitoring network enhances data-driven water management decision-making at both local and regional scales across California, enabling communities to plan for and address the increasing demands on water resources.

Figure 16: Statewide groundwater level data reported for data collected WY 2024. Map based on data from the CNRA Open Data as of 8/30/2024.



Closing Thoughts

As California navigates the complexities of an increasingly volatile climate, the outstanding progress made in groundwater management in the first ten years of the Sustainable Groundwater Management Act (SGMA) provides a glimpse into the promise as well as the opportunity to build a more resilient future. However, the road ahead is fraught with challenges. Groundwater levels, though improving in many regions, remain below pre-drought levels in several areas, highlighting the long-term impacts of over-extraction, drought, and climate change.

The urgency to embrace adaptive, data-driven water management has never been clearer. Groundwater is not only the state's lifeline in dry years, providing critical support for agriculture, ecosystems, and millions of Californians, but also a potential underground reservoir with enormous capacity, if managed well. But without sustainable practices, we risk depleting this vital resource beyond repair. The variability in climate—swinging from drought to floods and back—demands a shift in thinking: groundwater management must become proactive, not reactive.

The importance of infrastructure to manage and capture floodwaters is crucial in this evolving climate. However, to fully capitalize on such opportunities, California must continue to invest in infrastructure improvements that facilitate both the capture and storage of excess water during wet years. California's investment in advanced monitoring, regulatory streamlining, and collaborative efforts between local agencies has laid the groundwork for long-term resilience. However, achieving true sustainability will require continued innovation, increased data transparency, and unwavering commitment to conservation. Furthermore, as land subsidence continues to affect large areas, particularly in the Central Valley, the integration of new technologies, such as satellite-based Interferometric Synthetic Aperture Radar (InSAR), offers a way to monitor and mitigate the risks associated with over-extraction. These innovations, along with the increase in telemetered groundwater monitoring wells, are strengthening California's ability to manage its water resources with real-time data, enabling more informed decision-making and timely interventions.

In the face of these challenges, SGMA's success hinges not only on managing groundwater demand but also on fostering partnerships between the state, local agencies, and communities. As these stakeholders continue to work together toward long-term sustainability, the lessons learned from recent extreme climate events will guide California in building a water future that is resilient, equitable, and capable of withstanding the pressures of a changing climate. The future of California's water security depends on our collective ability to adapt, innovate, and prioritize sustainable practices, ensuring the long-term health of our groundwater resources and the communities that depend on them.