Water Risk Trends in California

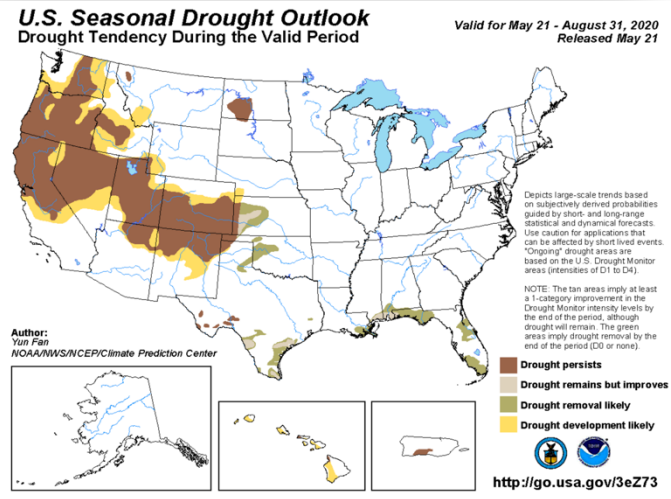
Trends are only useful if you can take action based on them. We will look at the macro trends of California and proceed to zoom all the way to the parcel to note current trends, but also how to put those trends into context. The future will present new challenges in climate variability and adaptation. Today we see new regulatory and management practices to comply with that require assessment of risks and a strategy to boost water security. The GSPs provide insight into risks associated with limits on groundwater pumping on some agricultural operations. However, there are also efforts to implement management practices and develop existing water supplies that may mitigate some of the risks.

Connecting data from these trends and putting it into context will provide positive returns and an efficient decision-making process. Let's look at some trends and what you can do with them.

Water Data's Value to Ag

You can't track what you don't measure. Many in the ag industry find themselves barely treading water when it comes to due diligence research that incorporates changes from both climate and regulation. Locating the right data to track changes in water risk is a key component to fulfilling modern due diligence research requirements and provides an opportunity to compare different regions. Without comparing the right trended datasets, due diligence becomes a dangerous guessing game.

SGMA and the Megadrought



Several scientific reports sent a warning to the western U.S. this past April: the mega-drought has begun.[1] Something that was often referenced as a potential future event has arrived and it is now a question of how do we adapt? But first, what is a "megadrought"?

Drought

No exact definition exists for megadrought, but a drought of this magnitude is one that lasts decades and had not occurred since the medieval ages.[2] An increase in megadrought

[1] https://blogs.ei.columbia.edu/2020/04/16/climate-driven-megadrought-emerging-western-u-s/

[2] https://www.scientificamerican.com/article/climate-change-has-helped-fuel-a-megadrought-in-the-southwest/

conditions will magnify the negative consequences observed in California's most recent critically dry years that will lead to increases in subsidence, curtailment of surface water, and an unsustainable reliance on groundwater. SGMA attempts to mitigate some of the worst impacts from the continued dry conditions over the next 20 years.

As climate change increases the average temperatures, the odds we will roll a severe drought are consistently getting worse for agricultural operations. One expert, using the analogy of tossing dice, likened the future scenario to chances of rolling a drought will continue to increase.[3]

With the enactment of the Sustainable Groundwater Management Act (SGMA), groundwater is no longer a reliable resource for the agricultural industry to count on without innovations in water management and data analysis.

SGMA and Curtailment

The State of California's response to unsustainable reliance on groundwater is manifested in the 2014 enaction of SGMA. As of 2020, we are at the very beginning of implementation. Groundwater Sustainability Agencies (GSAs) in critically overdrafted basins were required to submit Groundwater Sustainability Plans (GSPs) earlier this year.

The emphasis on groundwater is important but is not the only key component of water supply and conditions in California. For example, due to a pair of below normal to dry water years, Westlands Water District faces a reduced allocation of 20 percent from the Central Valley Project and predicts 160,000 acres of farmland fallowed[4] as of June 2020[5] . While there was a good amount of storage to cover most operations this year, another below normal or worse year could cause additional curtailments and surface water supply reductions. Curtailments are not unheard of but act as the proverbial canary in the coal mine for extended drought. Conditions that include curtailments and dry years are similar to the lead up to the major drought years of 2014 and 2015. SGMA's implementation may be just in time for drought conditions water management tactics.

Fires

In 2017 and 2018, California set records destruction related to fire spending over $1.5 billion on fire suppression. In part, the fires were related to the change in water year patterns that feature increased extremes and volatility. In 2017, there was a very wet year which increased vegetation growth only to be followed by a rather dry year in 2018 that reduced the moisture in the

[3] https://blogs.ei.columbia.edu/2020/04/16/climate-driven-megadrought-emerging-western-u-s/

[4] https://www.agalert.com/story/?id=14052

[5] Link to the curtailment order: https://mavensnotebook.com/2020/06/06/notice-of-immediate-curtailment-term-91-water-right/

vegetation turning it into fire fuel.[6] The threat of fire may impact agricultural economies near fire risk areas and divert dollars away from important downstream water infrastructure projects that would mitigate water supply risk.

Ag Economy

Adding to the competition for water and financial resources are a host of additional impacts from a drying and volatile climate in California. The following is part of a list created by the National Drought Mitigation Center that sums it up nicely:

- Farmers may lose money if a drought destroys their crops.
- If a farmer's water supply is too low, the farmer may have to spend more money on irrigation or to drill new wells.
- Ranchers may have to spend more money on feed and water for their animals.
- Businesses that depend on farming, like companies that make tractors and food, may lose business when drought damages crops or livestock.
- Water companies may have to spend money on new or additional water supplies.[7]

Additionally, the impacts of subsidence on water conveyance infrastructure is already a known problem with very expensive solutions.

As the severity of drought increases and the side-effects of climate change present risk of fire, flood, and economic loss, how does this relate to trends occurring on, and under, the ground in California?

Trends from Recently Released Groundwater Sustainability Plans

AQUAOSO has analyzed over 74 GSAs that recently released GSPs which are just one of many data sources needed for complete water risk due diligence, albiet one of the most complex sources. AQUAOSO put our analyses together to assess the various trends, water risks, and water security highlights in California's critically overdrafted basins. We took a sample size of 53 GSA analyses and here are the results:

Water Risk Trends

Assessing GSPs that applied to 53 GSAs in critically overdrafted basins we found:

- 33 out of the 38 distinct water budgets captured in our analysis demonstrate water budget deficits in at least one water year type (87%).
- The largest water budget deficit out of the plans analyzed is in the Kern Subbasin, where estimated overdraft was equal to -2,225,366 acre-feet in 2015.
- The most common risk identified by GSPs is continued overdraft due to water budget deficits.

[6] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EF001210

[7] https://drought.unl.edu/Education/DroughtforKids/DroughtEffects.aspx

Water Security Trends

From the same sample of GSAs, we found the following trends in improvements to water security:

- 50% of GSAs plan to conduct or participate in some form of groundwater recharge in order to reach sustainability.
- 48% of GSPs that specify projects and management actions include a mention of supply augmentation as a strategy to meet sustainability. Supply augmentation projects include: water reuse and recycling, purchased and imported water, stormwater capture, reservoir reapportions etc. and does not include demand reductions or increases in water use efficiency.
- Only 33% of GSPs with reported projects and management actions mention groundwater pumping restrictions or groundwater allocation as a method to reach sustainability. GSPs tend to focus more on strategies to augment supply as compared to reducing pumping.

Case Study: Water Risk in Madera County

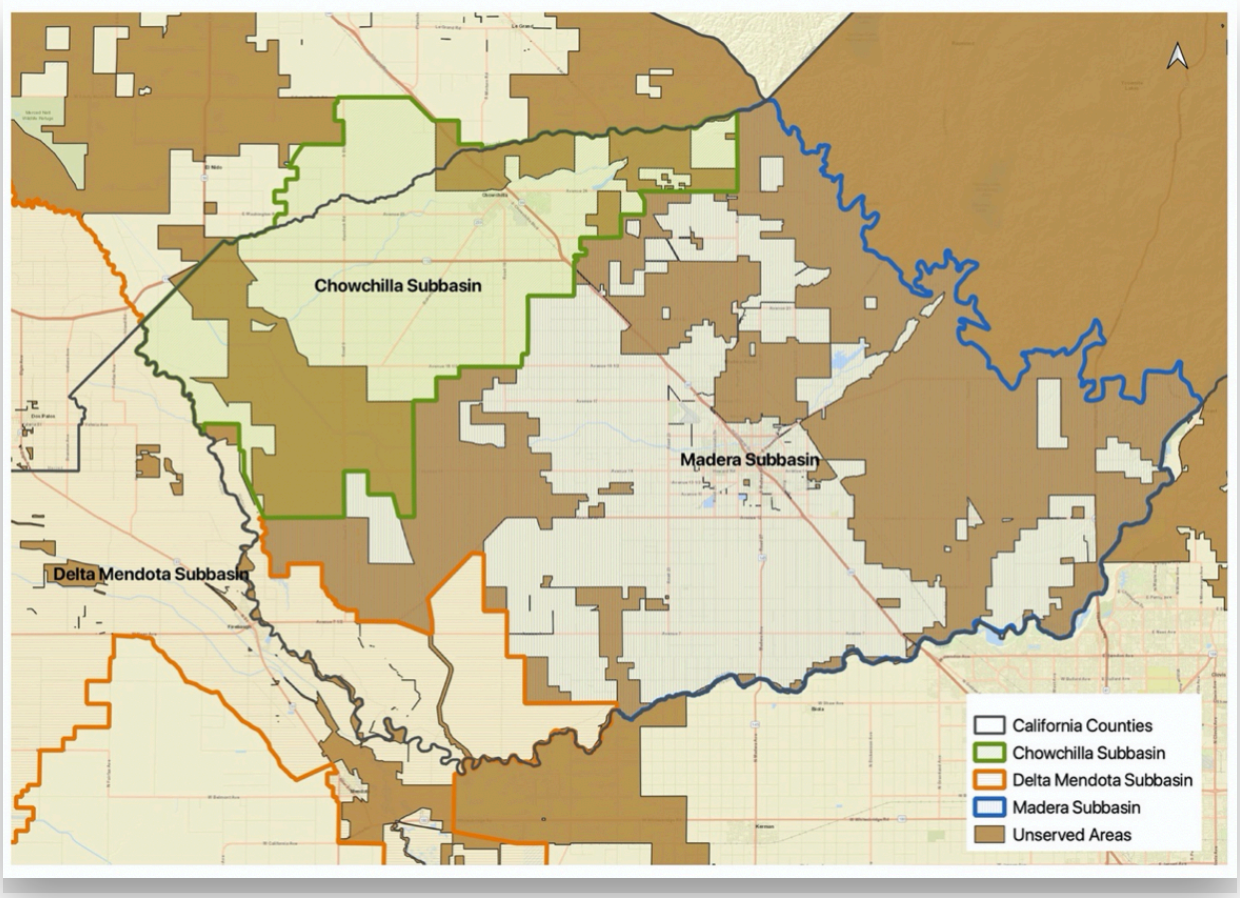
Madera county contains 12 water districts and 12 Groundwater Sustainability Agencies (GSAs). We analyzed each Water District and GSA, along with areas that are not served by a water district (unserved areas). All of the GSAs are in critically overdrafted subbasins, meaning groundwater extraction consistently exceeds replenishment. The estimated sustainable yield, related to future potential limits on groundwater pumping, range from 0.86 to 1.7 acre-feet per acre. What we discovered were pockets of higher risk in Madera County and pockets of higher water security depending on the grower location within certain water districts and GSAs.

The San Joaquin Valley basin is divided into small sub-units, or subbasins. The relevant subbasins for SGMA purposes are the San Joaquin Valley – Madera Subbasin, San Joaquin Valley – Chowchilla Subbasin, and the San Joaquin Valley – Delta-Mendota Subbasin which are all listed as “Critically Overdrafted.” The rest of the county does not have a priority under SGMA meaning groundwater extraction does not affect the health of the underlying basin or there is no groundwater basin because of the granitic or topographical conditions typical of foothills and mountain ranges.

Pockets of Risk

What we found were pockets of Risk in Madera County to the west of the County and some select areas to the south and southeast. Largely these areas were either unserved by a water district or lacked surface water supplies. For example, Aliso Water District’s primary water supply is from pumping groundwater since the District currently has no surface water supplies. Aliso Water District is also in a critically overdrafted subbasin that will have to reduce reliance on groundwater pumping by growers to comply with SGMA. Lack of surface supplies means the District is overly dependent on groundwater and is at a very high risk during dry conditions, such as the ones occurring this year and potentially into a megadrought.

The unserved area around Aliso Water District lacks water district coverage and is reliant on groundwater. An unserved area means a larger private investment may be required to develop surface water supplies or water management actions. The added expense may negate the economics of growing high profit crops and impact the value of the land.



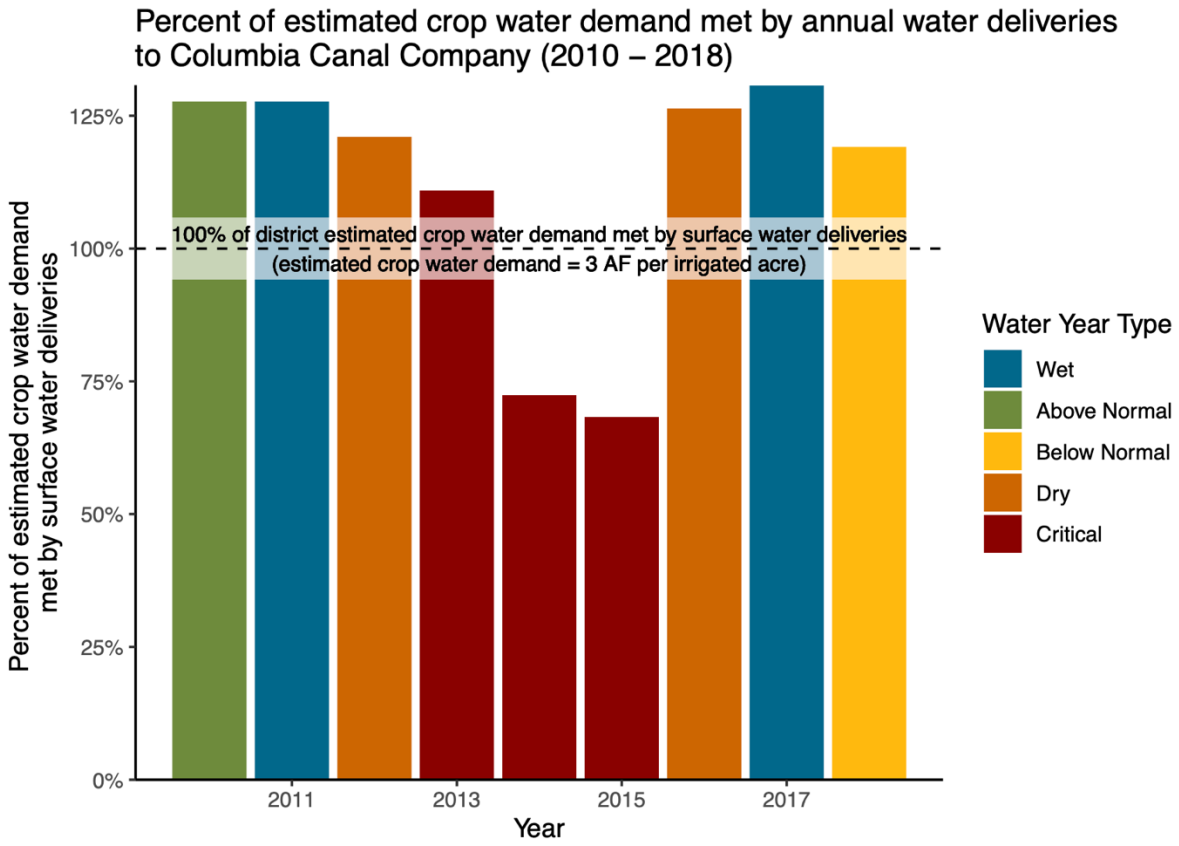
The map above shows the three subbasins in Madera County and the unserved areas. There are several new plantings with the last three years of orchard crops in the western unserved areas that typically have a water demand well over 3 acre-feet per acre. If, for example, a GSA cannot allow more than 1.7 acre-feet per acre to be pumped to meet SGMA sustainability requirements, where is the water going to come from?

Pockets of Water Security

We found that parts of Madera County where a water district had a federal contract for Central Valley Project (CVP) Class 1 water and a lower reliance on groundwater were in better shape than the rest of areas within the critically-overdrafted subbasins. The table below compares the federal contractor delivery data between last year and what is projected for this year. This gives a picture of the current water supply for these districts that have a CVP contract:

Water District	# of Contracts	Est. 2020 Total Delivery	Est. 2020 AcFt/Ac	2019 Total Delivery	2019 AcFt/ Ac	Change AcFt/Ac
Central California Irrigation District	1	336,367	2.37	448,490	3.36	(-0.99)
Chowchilla Water District	3	46,000	0.8	95,000	1.42	(-0.62)
Columbia Canal Company	1	44,004	2.86	58,067	3.81	(-0.95)
Gravelly Ford Water District	1	0	0	14,000	1.82	(-1.82)
Madera Irrigation District	3	70,750	0.71	127,600	1.58	(-0.87)

Based on this analysis and general forecasting from the United States Department of Agriculture for the region, there is a likelihood of a below normal water year that has a potential to become a dry year in 2020. Below normal and dryer water year types increase water supply risk across the County. However, some water districts fair better in dryer conditions and are less reliant on groundwater.



For example, the above chart shows a typical water surface water delivery profile for Columbia Canal Company. Even in a Critical water year like 2013, the water district is able to meet and exceed 3 acre-feet per acre in estimated average surface water delivery. This is a strong indication that water is more secure because there is less reliance on groundwater. By contrast, a less secure area would be completely reliant on groundwater and not have access to CVP contract water, which is the case for unserved areas in Madera County.

A Trend Towards Data Driven Groundwater Management Actions

There are two primary types of mitigation projects included for implementation in Madera County: recharge and conveyance. Recharge projects are designed to support sustainability by diverting floodwater or other available surface water for direct infiltration in constructed basins or spreading onto fields. Conveyance projects facilitate the delivery of additional water supplies to increase direct recharge or to use for irrigation, reducing groundwater pumping. Conveyance projects may include structural improvements, operational changes, or both. Some projects have a specific water source, but many of the recharge projects can draw from the same general sources.

The demand management action by the Madera County GSA provides groundwater users a flexible way to meet any future pumping restrictions. Madera Subbasin GSP projects and management actions are estimated to provide a gross average annual benefit of about 216,000 AF to subbasin recharge from all seven GSAs. Chowchilla Subbasin GSP projects are estimated to provide a gross average annual benefit of about 137,000 AF to subbasin recharge.

Over the next five years, it is likely that the GSAs within Madera County will phase in new regulations that could limit groundwater extractions. How much they limit extractions depends on the impacts of projects and management actions, climate, and state regulatory oversight.

How Do the Trends Impact Future Due Diligence?

The future is difficult to predict in these unprecedented times, but that does not mean data is unable to provide insight to mitigate risk. Important for researching water for due diligence is to understand the context of the data you are reviewing to make proper comparisons and assessments, and to connect that data back to the parcel or group of parcels you are researching.

Understanding Context

Data is plentiful in the 21st Century. The challenge is keying in on the data that is meaningful for the task at hand. Commonly referred to as noise, a large amount of irrelevant data can dilute the powerful insight hiding in all the bits and bytes. The signal, often used as a term to indicate the valuable data you seek within the noise, is more easily located when you understand the context of the data.

One example of the importance of context: determining if there is enough water in a specific part of a county that could support permanent crops over the next seven years. There are many variables and datasets that could be used to make a decision. A few of the datasets could be:

- Soil data
- Precipitation Forecasting
- U.S. Drought Monitor Data
- Mapping which water district(s) or GSA(s) have jurisdiction
- Surface water deliveries for current and past years
- Evapotranspiration for the permanent crops

The challenge is that many of the datasets have extra information that is not relevant to the amount of water needed for the crops you are interested in, and other datasets may be missing information that make it difficult to find value in them when looked at on its own.

Don’t look at data in isolation, the data must be connected to the other datasets and put in the context of location. If you are looking only at the average surface water delivery for an area you crucially miss the potential risks of the groundwater situation or that there is a new canal project that will serve part of the area you are researching. Below is a risk assessment on Madera County CVP contract water recipients from Spring 2020 that shows how decision making can benefit:

Water District Name	Supply Risk	Reliability Risk	Quality Risk	Land Risk	Overall
Central California Irrigation District	Medium	Medium	Low	Medium	Medium
Chowchilla Water District	Very High	Low	High	Medium	High
Columbia Canal Company	Medium	Low	Low	Low	Low
Gravelly Ford Water District	Very High	Low	Low	Medium	Medium
Madera Irrigation District	Very High	Low	Low	Medium	Medium

While the overall risk of some of the Federal Contractors, except Chowchilla Water District, is not of great concern, the water supply risk is higher than expected for water districts with federal contracts. A low risk to reliability and a medium to very-high risk of water supply indicates a heavy water demand, which may mean the water district will have a consistent issue in meeting crop water demand with surface water alone.

Placing the data in the context of location provides a foundation to make important connections between the data and arrive at better estimates.

Connecting Data to Parcels

Using location to put data into context is not new. GIS data has become a required component in properly executing the due diligence process. However, with the only constant being change, knowing how those changes impact a parcel of land is a necessary step in agriculture underwriting, appraisal, and investment.

We are seeing a trend in organizations wanting to connect their data together so they are able to boost the signal, reduce the noise, and improve decision-making at the parcel level. Utilizing best practices in data management and implementing GIS technology is an important step in understanding trends and more importantly, what they mean for your due diligence research goals.

Benefit from the Macro and Micro Views

We looked at the implications of the western US Megadrought and SGMA on California as the beginning of our macro view into what is going on in California. We then narrowed our focal point by zooming into GSAs and the trends for the GSPs from critically overdrafted subbasins in the Central Valley. Next, we looked at Madera county and the variations in risk present in an agricultural county. At this point our macro view transitioned to a more micro view with our discussion of context and connecting the Macro data to the Micro data on a parcel.

This is how you take action on the water trends. Look at both macro and micro views of water and land data to put that data into context, and then you can begin to draw conclusions and flag potential concerns.

To keep up on macro and micro trends happening in California and the western US visit our blog at https://aquaoso.com/blog/.