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Agriculture and Natural Resources
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In this issue:

This newsletter focuses on groundwater topics. Two articles provide an update on local efforts to organize Groundwater Sustainability Agencies. The third article summarizes recent groundwater levels at various locations across Tehama and Glenn Counties. The fourth article provides a snap shot of how regional groundwater levels have been affected by consecutive years of drought followed by the record setting wet year of 2016/17. The last article outlines five important questions to consider when evaluating the suitability of a water supply for nut crops.

Special thanks to Ryan Teubert of the Tehama County Flood Control and Water Conservation District, Lisa Hunter, Glenn County Water Resources, and Bill Ehorn, Mary Randall, and Michelle Dooley of the California Department of Water Resources – Northern Region for their contributions to this newsletter.

Full color articles and photos are available on our Website: cetehama@ucanr.edu

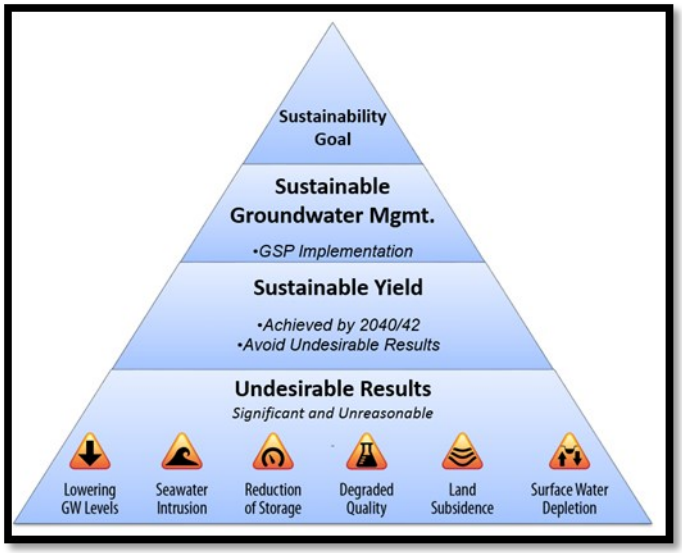
Tehama County Groundwater Sustainability Agency Formed

Ryan Teubert, Flood Control and Water Resources Manager, Tehama County Flood Control and Water Conservation District

The Tehama County Groundwater Sustainability Agency was formed in response to the Sustainable Groundwater Management Act (SGMA) of 2014. SGMA was approved by the State legislature to encourage sustainable management of groundwater resources throughout California. SGMA focuses on alluvial groundwater subbasins and requires that those identified by the Department of Water Resources' (DWR) Bullitin 118, as either high or medium priority, be managed by a Groundwater Sustainability Agency (GSA). Additionally, SGMA requires that each GSA have a Groundwater Sustainability Plan (GSP) in place by January 31, 2022 detailing how each GSA intends to sustainably manage the groundwater resources within its jurisdiction.

The main goals of SGMA are: to promote the sustainable management of groundwater basins; enhance local management of groundwater (or in the absence thereof the state to step in if necessary); improve data collection and understanding of groundwater resources and management; and avoid or minimize impacts for land subsidence. With these objectives in mind, DWR drafted GSP regulations requiring GSA's to define minimum thresholds for six specific Management Criteria. The six criteria include chronic lowering of groundwater levels, seawater intrusion (not an issue in Tehama County), reduction of groundwater storage, degraded water quality, land subsidence, and depletions of interconnected surface water. Additional information regarding SGMA, GSA formation, and GSP regulations, can be found on DWR's Sustainable Groundwater Management website:

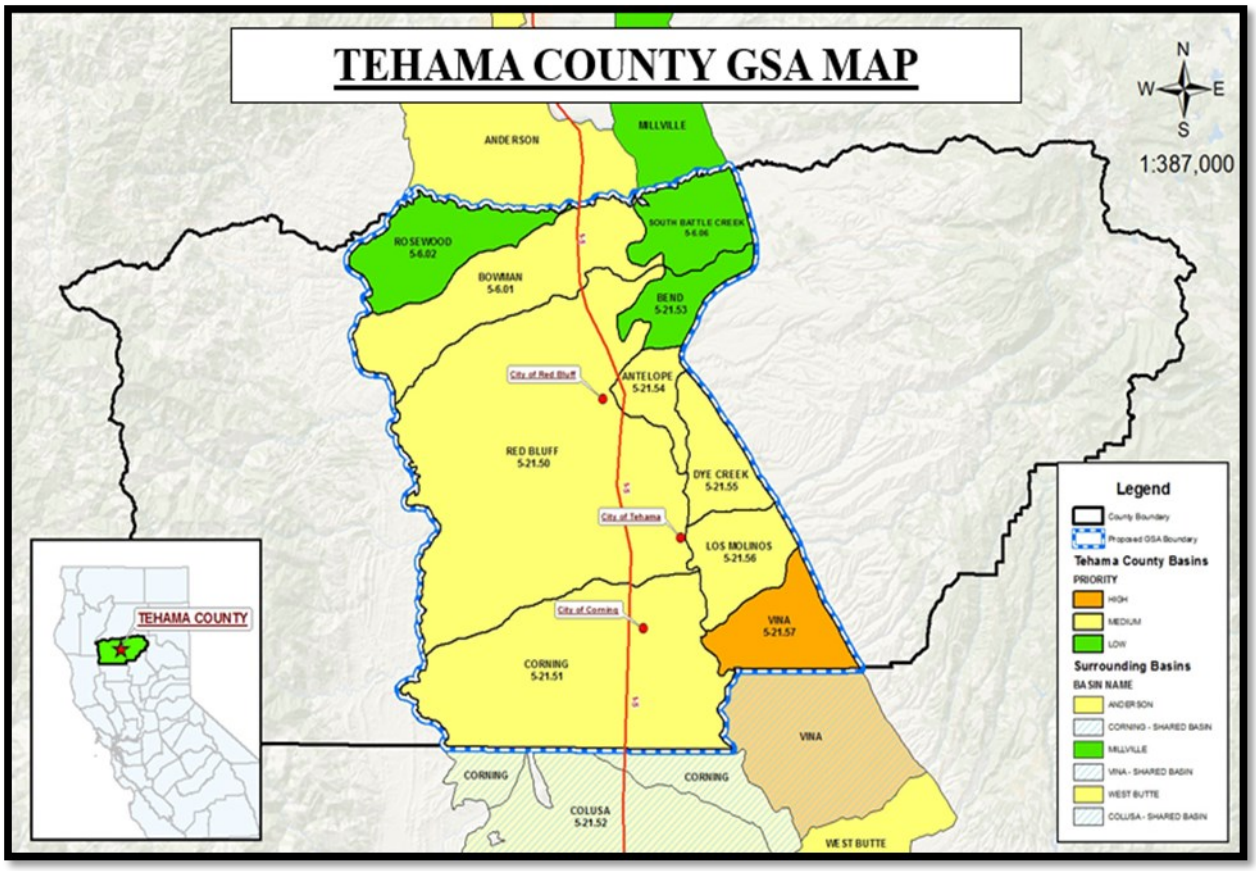
http://www.water.ca.gov/groundwater/sgm/index.cfm.



Once a GSA has developed sustainability goals based on local conditions, they will have 20 years to achieve these goals. DWR was required by the legislature to provide local support to GSAs, draft the GSP regulations, and to approve submitted GSPs. DWR will work with the GSAs to set, implement, and adjust interim milestones throughout the 20 year timeframe. The legislation does give the State Water Resources Control Board (SWRCB) the authority to take over for those GSAs that fail to implement their GSP or make progress towards achieving their short or long term sustainability goals. For any subbasin that the SWRCB takes authority over, groundwater users will be assessed a fee to cover the cost the SWRCB incurs managing the subbasin. Additional information regarding the SWRCB roles and responsibilities under SGMA can be found at:

http://www.waterboards.ca.gov/water_issues/programs/gmp/groundwatermanagement.shtml.

The Tehama County Flood Control & Water Conservation District (District) has taken the lead on monitoring and managing groundwater resources within Tehama County since the mid 90's. The District adopted the County's Coordinated AB3030 Groundwater Management Plan in 1996 with participation from numerous partner agencies throughout the County. When the SGMA legislation was passed in 2014, the District Board of Directors (comprised of the County Board of Supervisors) directed staff to explore the possibility of the District becoming the GSA for those portions of the ten groundwater subbasins located within Tehama County.



The District Board determined the District was the most appropriate agency to move forward as the GSA and submitted a Notice of Intent to become the GSA in November of 2015. The District was recognized by DWR as the Exclusive GSA in February of 2016. The GSA governance structure includes the Board of Directors as the governing body, a Groundwater Commission that will have both decision-making and advisory responsibilities, and a Technical Advisory Committee to provide technical expertise as needed.

The Groundwater Commission consists of eleven members made up of representatives from the cities, local water districts, and at large supervisor district members. The Commission is comprised of representatives from the cities of Corning, Red Bluff, and Tehama, El Camino Irrigation District, Rio Alto Water District, Los Molinos Community Services District, and one representative from each of the five Supervisorial Districts.

The six Commissioners representing the cities and districts have permanent seats on the Commission with each agency appointing their own representative. These agencies were selected to be on the Commission because of their involvement, interest, and participation in the governance structure of the GSA, and being representatives of some of the larger groundwater users within the County.

The Supervisorial District representatives have four year terms and should be a resident, property owner, or groundwater user within Tehama County. The desired makeup of the Commission is to include two members that represent the interests

of agencies or districts that supply surface water, two members that represent the interest of private groundwater pumpers, and ber that represents the interest of the general public. The process to fill these five positions is a responsibility of the seated Com for the review of submitted applications and to make recommendations to the Board, who will make the final confirmations.

The duties of the Commission include development of the GSP and all GSA ordinances, rules, and regulations, making final rec tions to the Board of Directors; conducting investigations to determine the need for groundwater management, monitor com enforcement, and propose fee increases; review all proposed grant applications; review and make determinations on permits or titlements; and make quasi-judicial decisions in GSA enforcement matters.

The first meeting of the GSA was held November 9, 2016. The current members of the Commission include:

City of Corning – Dawn Grine

City of Red Bluff – Clay Parker

City of Tehama – Bill Borror

El Camino Irrigation District – Kris Lamkin

Los Molinos Community Services District – Todd Hamer

Rio Alto Water District – Martha Slack

District 1 – Harley North, private pumper

District 2 – Gib Bonner, general public

District 3 – Bart Fleharty, surface water agency/district

District 4 – Hal Crain, surface water agency/district

District 5 – David Lester, private pumper

Upon formation of the Commission, initial tasks included developing bylaws and completing Brown Act training. Over the past six months, Commissioners received additional training on SGMA, GSP Regulations, and current groundwater conditions within the County. The District has also hired a consultant to develop a high-level SGMA risk assessment of the six undesirable results in relation to the GSP requirements and a work plan and budget for implementing the GSP.

Next steps for the Tehama County GSA include: submittal of a SGMA grant application to fund the development of the GSP, defining subbasin boundaries and management areas within the County, and starting work on the GSP. If funding is obtained through the SGMA Grant, the District intends to hire a consultant to facilitate the development of the GSP. Tasks would likely include developing a water budget and groundwater model for all of the subbasins within the county, development of a data management system, evaluation of the current monitoring network in relation to the GSP requirements, and drafting the GSP document.

For SGMA or GSA specific questions please contact Ryan Teubert, Flood Control and Water Resources Manager at rteubert@tcpw.ca.gov or 530-365-7332. Additional information on the Tehama County GSA can be found on the Districts website:

http://www.tehamacountypublicworks.ca.gov/flood/default.html

Sustainable Groundwater Management Act (SGMA) Implementation in Glenn County, September 2017 Update

Information provided by Glenn County Water Resources

SGMA Update: The Groundwater Sustainability Agency (GSA) formation deadline has passed (June 30, 2017) and eligible local agencies, as defined by SGMA have either currently formed or determined the status of formation throughout subbasins in California. GSAs will be working on the development of Groundwater Sustainability Plans (GSP) for the next several years. The status of GSA formation throughout the state can be viewed using the following link.

http://sgma.water.ca.gov/portal/#gsa

Glenn County SGMA Update: GSAs in Glenn County are committed to working cohesively together in order to achieve sustainability and comply with SGMA. Stakeholder involvement in the SGMA process is vital to avoid state intervention. There are three subbasins required to be managed under SGMA in Glenn County (refer to Figure 1 on next page). It shows the three subbasins in Glenn County and how they extend into neighboring counties which will require broader coordination.

1) Colusa Subbasin: The Colusa Subbasin shared with Colusa County has a Joint Powers Agreement creating the Glenn Groundwater Authority (GGA) made up of 9 member agencies which govern the Glenn County portion of the subbasin. Colusa County also has a multi-agency GSA covering its portion of the Colusa Subbasin. Ongoing coordination between both GSAs regarding GSP development and SGMA implementation will create efficiencies and consistency within this subbasin.

Glenn Groundwater Authority Member Agencies

City of Orland

City of Willows

County of Glenn

Glenn-Colusa Irrigation District

Glide Water District

Kanawha Water District

Orland Artois Water District

Princeton-Cordora-Glenn Irrigation District

Provident Irrigation District

2) West Butte Subbasin: The agencies forming GSAs in West Butte Subbasin have elected to maintain independent jurisdictional boundaries, with the commitment to develop strategies for successful basin management. Butte County applied for facilitation support services for the entire subbasin which have been approved by DWR. The following GSAs listed are within Glenn County. The West Butte Subbasin spans Butte, Glenn and Colusa Counties. Coordination with the counties and other GSAs is ongoing.

West Butte Subbasin GSAs

County of Glenn
Reclamation District 1004
Reclamation District 2106
Western Canal Water District

3) Corning Subbasin: In the Corning Subbasin a Memorandum of Agreement (MOA) created the Corning Sub-basin GSA made up of two member agencies which govern the Glenn County portion of the subbasin. The extent of the subbasin also goes into Tehama County, coordination between agencies will be ongoing.

<u>Corning Sub-basin GSA Member Agencies</u>

County of Glenn

Glenn-Colusa Irrigation District

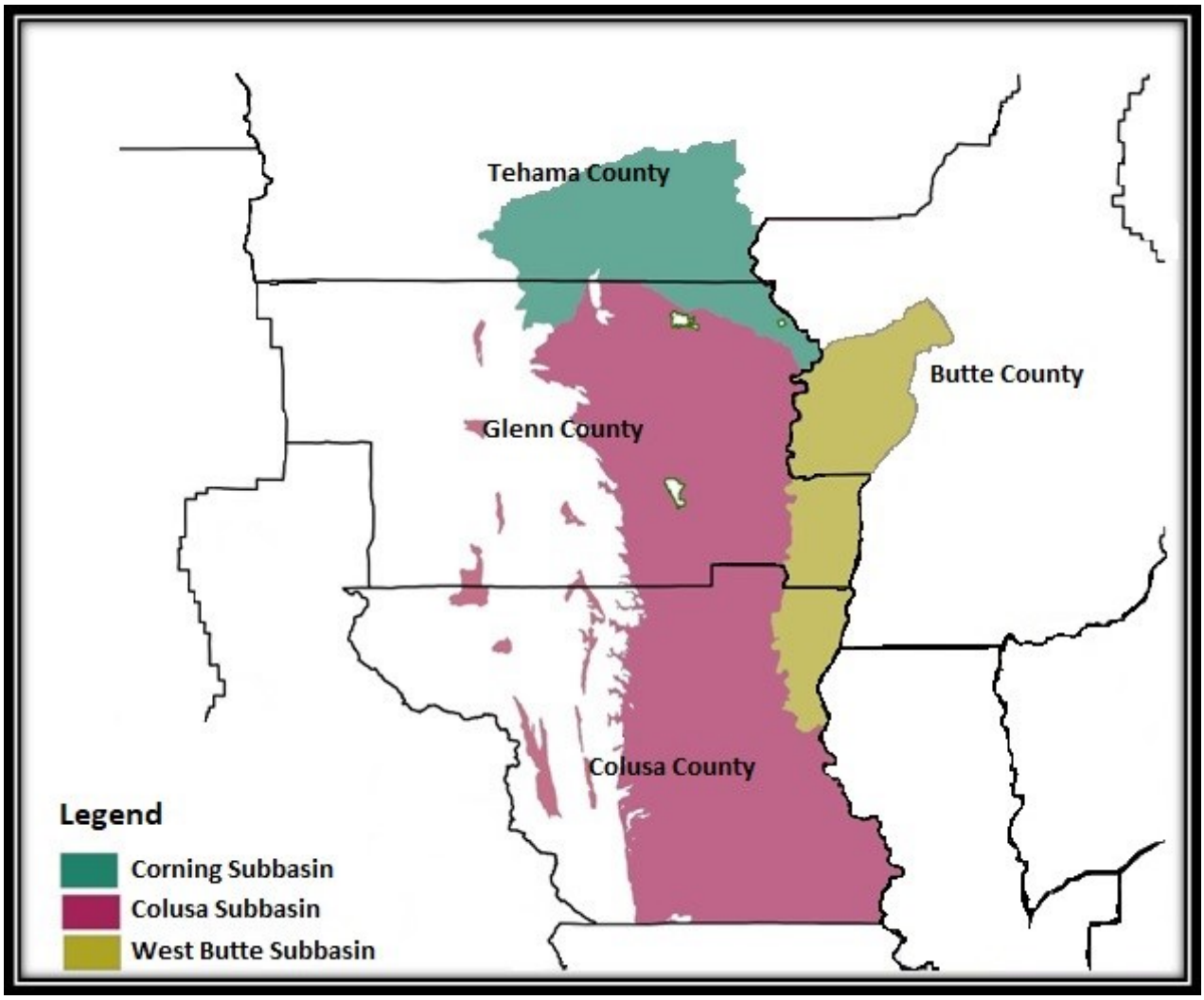


Figure 1. Colusa, West Butte, and Corning Subbasins in Glenn County and their reach into neighboring counties.

Upcoming Glenn County SGMA Related Public Meetings:

Glenn County Private Pumper Advisory Committee Meeting, September 25, 2017 from 1-4 pm at the Glenn County Farm Bureau, 831 5th Street, Orland CA 95963

Glenn County Groundwater Authority Meeting, October 9, 2017, 9:00 a.m. Glenn County Department of Agriculture, 720 N. Colusa Street, Willows, CA 95988

Northern Sacramento Valley Integrated Regional Water Management Technical Advisory Committee Meeting, October 18, 2017 at the Willows City Council Chambers, 201 North Lassen Street, Willows, CA 95988

Recent Groundwater Levels in Tehama and Glenn Counties

Allan Fulton, UC Irrigation and Water Resources Advisor

Groundwater levels in Tehama and Glenn Counties are summarized in Tables 1 and 2, respectively, from the spring of 2015 through the summer of 2017. These levels provide a short term perspective.

Spring groundwater levels are collected by the California Department of Water Resources, Northern Region in cooperation with local agencies in mid March. Summer levels are generally taken in early-August (exceptions are footnoted). Most measurements in these tables are from a larger public online database called the Water Data Library. It is maintained by the California Department of Water Resources. In some instances, groundwater level data was provided from local public agencies.

Static (non-pumping) groundwater levels are presented in Tables 1 and 2 as the depth to groundwater below ground surface and are measured in feet. Some of the measurements are taken in dedicated monitoring wells that are constructed specifically for monitoring and there is no pumping. When a dedicated monitoring well is not available for monitoring, irrigation or domestic wells are used as an alternative and efforts are made to take measurements when the wells are not pumping and have not been in operation for some time to attain static levels.

Groundwater levels are variable with season and among different areas within Tehama and Glenn Counties. Many variables influence the depth to groundwater. Topography or ground surface elevation is one. Foothill areas in eastern, western, or northern portions of the valley have higher land elevations than in the center of the valley. An example of this is seen in the Bowman subbasin of Tehama County where groundwater levels in the Hooker Creek Road area are deeper than 100 feet below ground surface. Areas in closer proximity to the river or streams will generally have shallower depths to groundwater. Similarly, areas that distribute more surface water for irrigation are likely to have shallower depths to groundwater. Examples of this are the LeClaire and Decker Avenue area adjacent to Antelope Creek in Tehama County and areas of Glenn County adjacent to the Sacramento River and in southern portions of the Glenn County between Highway 99W and the eastern boundary of Glenn County. The recent drought from 2012 through 2016 followed by the record setting wet year of 2016/17 and changes in land and water use are also variables affecting groundwater levels.

Static groundwater levels in the spring provide insight into groundwater recharge from the previous fall/winter season and we have particular interest in how much groundwater levels improved following the 2016/17 winter. Summer groundwater levels show the effects of regional pumping. They also provide limited insight about how deep water wells should be constructed and how deep pumps should be set to secure a reliable water supply. Working directly with a professional well driller will provide much more accurate information for specific circumstances.

On average spring groundwater levels improved 5.1 feet and 4.9 feet from the spring of 2015 to the spring of 2017 among the two monitoring networks in Tehama and Glenn Counties, respectively. Maximum recovery of groundwater levels was between 13 feet and slightly more than 15 feet for individual wells in these respective monitoring networks. Some wells showing the most recovery in spring levels were located in the Corning East and Red Bluff East subbasins of Tehama County. Some wells in Glenn County showing the most recovery in spring levels were in the vicinity of Road 20 & Road P, Road 24 & Road VV, and Road 35 & Road W.

As expected summer groundwater levels are deeper than in the spring and reflect regional pumping. Average summer groundwater levels were 3.0 and 6.4 feet higher in August 2017 (mid-summer) for the monitoring networks in Tehama and Glenn Counties, respectively than they were in August of 2015.

Theses short term improvements in groundwater levels are encouraging. A broader regional perspective and slightly longer view of groundwater level changes are summarized in the next article.

Table 1. Spring and summer groundwater levels measured in Tehama County in 2015, 2016, and 2017.

Well ID No.	General Location	Spring 2015	Summer 2015	Spring 2016	Summer 2016	Spring 2017	Summer 2017
ANTELOPE SUB-BASIN		------ (feet below ground surface) ------					
26N02W17E001M	LeClaire & Decker Ave	18.2	21.8	14.2	20.2	12.9	21.1
27N02W31C001M	Bray & Craig Ave	27.9	NA	26.6	38.4	27.4	37.1
27N03W16K003M	Roundup Ave	34.4	47.9	32.5	49.1	21.2	42.6
27N03W23D001M	Hogsback Rd & Hwy 99E	29.9	43.6	28.6	43.5	22.7	35.0
BOWMAN SUB-BASIN							
28N04W04P001M	Hooker Creek Rd & Hooker Rd	124.5	129.7	123.0	127.7	122.0	125.2
29N03W18M001M	Lake California Drive	25.3	NA	24.2	27.7	22.5	NA
29N04W15E002M	Draper Rd & Oak Lane	38.3	39.9	35.0	36.0	32.6	35.8
29N04W20A003M	Bowman Rd & Learning Way	41.6	48.0	40.4	45.8	39.8	43.1
29N04W28D001M	Hooker Creek & Jeffries Rd	102.4	106.6	101.5	104.5	99.3	102.4
29N04W35B001M	I-5 & Snively Rd	88.0	87.5	87.5	86.3	84.7	82.4
CORNING EAST SUB-BASIN							
23N02W16B001M	Near Cattle Drive	46.8	66.5	NA	62.6	NA	60.5
23N02W28N004M	5th & Moller Ave	49.7	70.5	46.4	81.4	35.3	75.0
23N03W05G001M	Liberal Ave & Cushman Lane	52.3	63.1	61.6	NA	NA	84.5
23N03W13C006M	Capay & Hall Rd	52.8	72.2	54.6	69.8	50.5	67.9
23N03W24A002M	Capay Rd & Sour Grass Creek	50.4	69.2	49.5	70.5	42.4	67.4
23N03W25M004M	Ingram Ave & TC Canal	71.9	89.4	72.2	91.1	66.3	87.5
24N02W29N003M	New York & Hall Rd	48.3	64.5	44.1	73.6	36.8	68.5
24N03W03R002M	Highway 99W & Finnell Ave	49.0	71.2	51.9	67.5	43.0	61.4
24N03W29Q001M	Chittenden Rd & Mt. Shasta Ave	89.1	109.8	92.2	110.4	89.0	105.9
24N04W14N002M	Corning Rd & Freeman School House Rd	98.6	127.6	101.1	124.7	99.5	123.5
DYE CREEK SUB-BASIN							
26N02W14G001M	Foothill Rd	81.3	86.1	82.9	82.0	80.4	81.3
26N02W15C001M	68th Ave & Hwy 99E	37.3	NA	37.7	NA	33.3	38.0
26N02W16C001M	68th Ave & Schafer Ave	18.7	21.5	16.7	22.3	13.5	21.0
26N02W21Q001M	9th Ave & Hwy 99E	20.9	26.1	17.3	25.1	15.4	22.6
26N02W29R001M	5th Ave	4.3	4.5	4.5	4.5	4.9	4.8
LOS MOLINOS SUB-BASIN							
25N01W32P001M	Leninger Rd & Deer Crk	81.3	83.5	81.1	83.4	80.5	83.1
25N02W09G001M	Buena Vista Ave	39.4	40.5	36.4	44.4	33.3	40.6
RED BLUFF EAST SUB-BASIN							
25N03W10L001M	Rodeo & Central Ave	55.2	97.7	48.5	100.7	41.0	99.9
25N03W11B001M	99W & Gerber Rd	35.8	67.9	26.0	69.2	20.4	68.2
25N03W19N001M	Gyle Rd	88.5	114.4	78.1	116.5	72.9	121.2
26N03W17B001M	Cody Drive	64.3	68.0	61.3	68.0	NA	NA
26N04W25J001M	Ottman Ave & Paskenta Rd	66.0	NA	64.0	66.2	59.9	NA
27N04W35E001M	Live Oak & Red Bank Rd	119.3	136.1	116.0	NA	114.4	NA
RED BLUFF WEST SUB-BASIN							
27N04W05G002M	Hwy 36	46.4	65.0	43.7	57.0	41.1	55.2
ROSEWOOD SUB-BASIN							
29N05W14L001M	Old Gold Rd	36.9	41.8	35.7	37.6	29.6	34.6
29N05W21H001M	Farquhar Rd	149.2	152.6	142.0	144.5	148.9	142.7
29N05W33A004M	Farquhar Rd	41.8	48.9	40.1	46.6	38.2	44.0
VINA SUB-BASIN							
24N01W05J003M	Reed Orchard Rd	NA	NA	92.3	94.8	91.9	95.0
24N01W05Q002M	Reed Orchard Rd	50.3	54.4	51.8	48.3	45.7	46.8
24N02W12P001M	Vina Rd	33.6	37.5	32.0	37.4	30.3	36.9
24N02W25G001M	South Ave & Stephens Rd	26.8	NA	27.6	NA	19.0	NA

[1] NA indicates groundwater level measurement was not available or the measurement was questionable.
[2] Currently groundwater levels are not monitored in South Battle Creek, Bend, and Corning West groundwater sub-basins.

Table 2. Spring and summer groundwater levels measured in Glenn County in 2015, 2016, and 2017.

Well ID Number	General Location	Spring 2015	Summer 2015	Spring 2016	Summer 2016	Spring 2017	Summer 2017
		----- (feet below ground surface) -----					
22N03W34A01M	Rd 20 & Rd M	24.2	38.8	22.2	32.0	11.3	19.1
22N03W30C01M	Between Rds 15 & 17 & Rd DD	124.8	131.4	131.0	135.6	130.7	135.6
22N03W21F02M	Rd 14 & Rd HH	24.2	29.5	23.4	28.4	17.2	25.8
22N03W17E01M	Rd 200 & Cedar Ave	14.5	16.1	14.0	15.9	NA	16.7
22N03W12Q03M	Rd 9 & Rd O	42.4	66.9	38.8	63.3	33.7	58.1
22N02W31C01M	Rd 20 & Rd P	32.3	60.5	32.2	50.8	17.0	40.3
22N02W21D01M	6th Ave & Hwy 32	NA[b]	49.0	26.7	NA	21.2	27.7
22N02W20Q01M	Rd 16 & Rd XX	17.4	23.0	15.7	18.4	10.8	18.7
22N02W11Q01M	Rd 9 & Between 1st & 2nd Aves	32.3	50.9	25.6	50.2	18.9	48.5
22N01W29K01M	Rd 206 & Hamilton City	19.5	27.2	15.3	24.6	8.1	21.3
21N04W24A03M	Rd 28 & Rd D	158.1	NA	168.0	NA	169.8	NA
21N03W31H01M	Rd 31 & Rd F	100.4	130.3	109.2	129.0	107.8	124.4
21N03W24P01M	Rd 30 & Rd P	NA	NA	65.7	NA	56.8	NA
21N03W12C02M	Rd 25 & Rd NN	42.0	71.6	46.0	54.9	33.2	34.7
21N02W31M01M	Rd 33 & Rd P	44.8	68.4	50.5	71.1	40.3	NA
21N02W23G01M	Rd 29 & Rd V	34.8	52.4[a]	35.9	NA	26.4	NA
21N02W09M02M	Rd 25 & Rd S	NA	66.3[a]	56.3	61.7[a]	42.5	NA
21N02W02B02M	Rd V V & Rd 24	34.4	55.9	30.5	49.1	20.8	39.1
21N01W04N01M	Rd 23 & Rodgers Ranch Road	21.0	28.0	18.0	25.0	12.3	20.4
20N04W12F02M	Rd 35 & Rd D	69.0	75.9	78.0	78.8	76.5	76.5
20N03W33J01M	Rd 45 & Rd J	16.1	NA	21.5	NA	10.0	NA
20N03W23G02M	Rd 39 & Rd P	29.9	NA	36.9	45.3	23.8	38.2
20N03W17P01M	Rd 39 & Rd H	29.4	74.4	39.8	56.8	26.6	57.3
20N03W12C01M	Rd 35 & Rd P	45.1	56.8[a]	48.8	57.1	42.7	53.8
20N02W29G01M	Rd 44 & Rd S	7.2	5.1	5.8	3.2	5.4	3.2
20N02W13G01M	Rd 37 & Rd WW	5.9	1.6	1.6	1.3	3.3	1.1
20N02W11A03M	Rd 35 & Rd W	26.1	31.8	17.5	29.7	12.5	28.6
20N02W11A02M	Rd 35 & Rd W	16.0	16.2	11.5	14.0	9.5	12.5
20N02W11A01M	Rd 35 & Rd W	11.2	3.2	3.6	2.8	4.8	4.1
20N02W02J01M	Rd 34 & Rd W	12.7	3.8	6.9	3.2	8.1	3.2
19N03W26P01M	Rd 60 & Hwy 99W	2.0	4.9	2.6	2.4	0.4	1.6
19N02W36H01M	Rd 61 & Between Hwy 45 & Rd WW	9.4	8.3	6.1	5.3	2.4	4.9
19N02W34F01M	Rd U & Rd 61	4.5	4.9	1.5	4.1	1.4	3.7
19N02W29Q01M	Rd 60 & Rd SS	4.4	4.3	1.2	4.6	1.8	3.9
19N02W13J01M	Rd 56 & Between Hwy 45 & Rd WW	11.4	16.5	9.5	15.6	3.3	13.4
19N01W27R01M	Hwy 162 & Rd Y	9.5	31.6	14.4	30.5	4.4	24.8
18N02W36B01M	Dodge Road & Hwy 45	11.8	12.2	9.1	11.0	3.0	10.5
18N02W18K01M	Norman Rd & Lambert Lane	10.5	38.5	6.4	NA	6.1	NA
18N01W22L01M	Rd 69 & Rd Y	NA	19.7[a]	7.3	6.0	NA	10.6
18N01W17G01M	Rd 67 & Levee Rd	17.9	28.9	16.0	21.9	5.0	NA
18N01E05D01M	Hwy 162 & Rd Z	6.7	21.6	NA	5.6	3.4	6.0
KWD-1	Rd 65 & D	26.0	43.0	27.0	25.0	20.0	26.0
KWD-2	Rd 60 & Rd B	19.0	27.0	26.0	26.0	18.0	17.0
KWD-3	Hwy 162 & Rd D	20.0	78.0[a]	16.0	26.0	13.0	76.0[a]
GWD-1	Rd 45 & Rd D	47.0	79.0	50.0	66.0[a]	39.0	60.0
GWD-2	Rd 45 & Rd D	38.0	44.0	77.0[a]	65.0[a]	49.0	67.0
GWD-3	Rd 43 & Rd D	37.0	120.0[a]	48.0	67.0	26.0	58.0
CALWater 002-01	Within the City of Willows	19.0	42.0	23.0	35.0	16.0[c]	26.0

[a] Measurement taken shortly after pumping had stopped so levels may not be static. In other instances levels were difficult to measure due to oil in the pumping column or were taken during a slightly different timeframe (example: summer levels are usually measured in August but may have been taken in June or July.

[b] NA indicates levels were not measured because well was not accessible.

[c] Denotes groundwater level was measured in April 2017 and not March 2017.

Regional Changes in Groundwater Levels: Multi-year Drought Followed by Record Setting Wet Year

Bill Ehorn, California Department of Water Resources, Northern Region
Allan Fulton, UC Irrigation and Water Resources Advisor

Trends in cumulative spring groundwater change by county are shown in Figures 1 and 2 below for a shallow well monitoring network and an intermediate well monitoring network across five northern Sacramento Valley counties. The period of interest includes the spring of 2011 which was a wet water year, 2012 through 2016 which were a series of dry or critically dry water years, followed by 2017 which has been a record-setting wet year. The trends indicate that groundwater levels have recovered to 2011 (pre-drought) conditions at both shallow and intermediate zones in the Redding Basin which includes Shasta and part of Tehama Counties. Groundwater levels are still recovering to pre-drought levels in both the shallow and intermediate zones in all counties within the Sacramento Valley Basin. While it is encouraging that groundwater levels are recovering, it appears that more than a single year of above average precipitation is needed for groundwater levels to recover to pre-drought conditions in many areas of the northern Sacramento Valley.

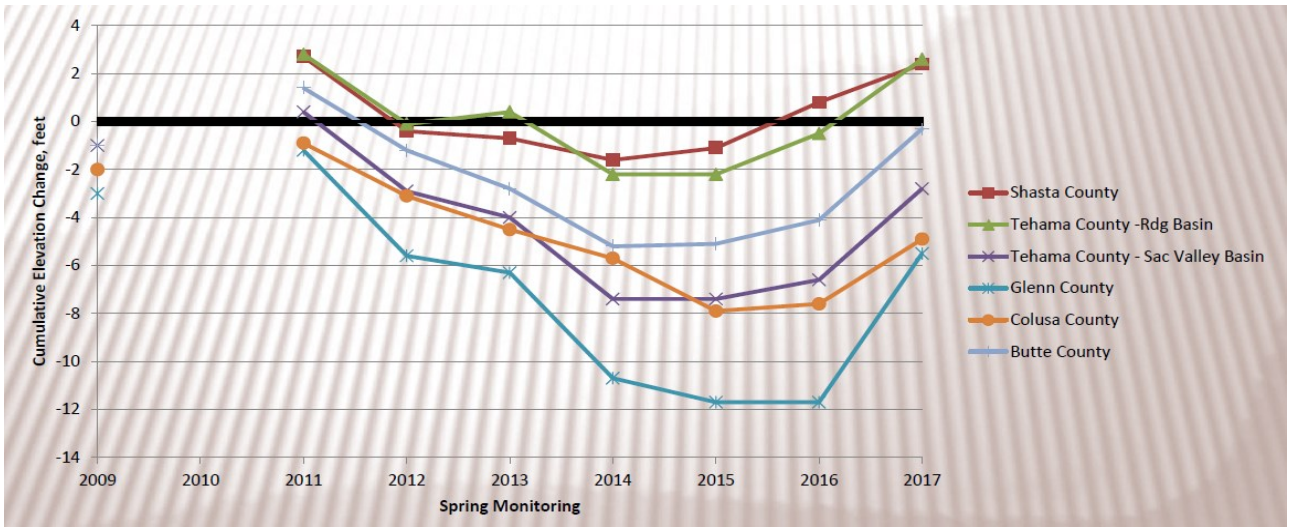


Figure 1. Cumulative average spring groundwater elevation change by county (about 180 wells in shallow well monitoring network, < 200 feet). Graphics prepared by Bill Ehorn and Mary Randall, DWR.

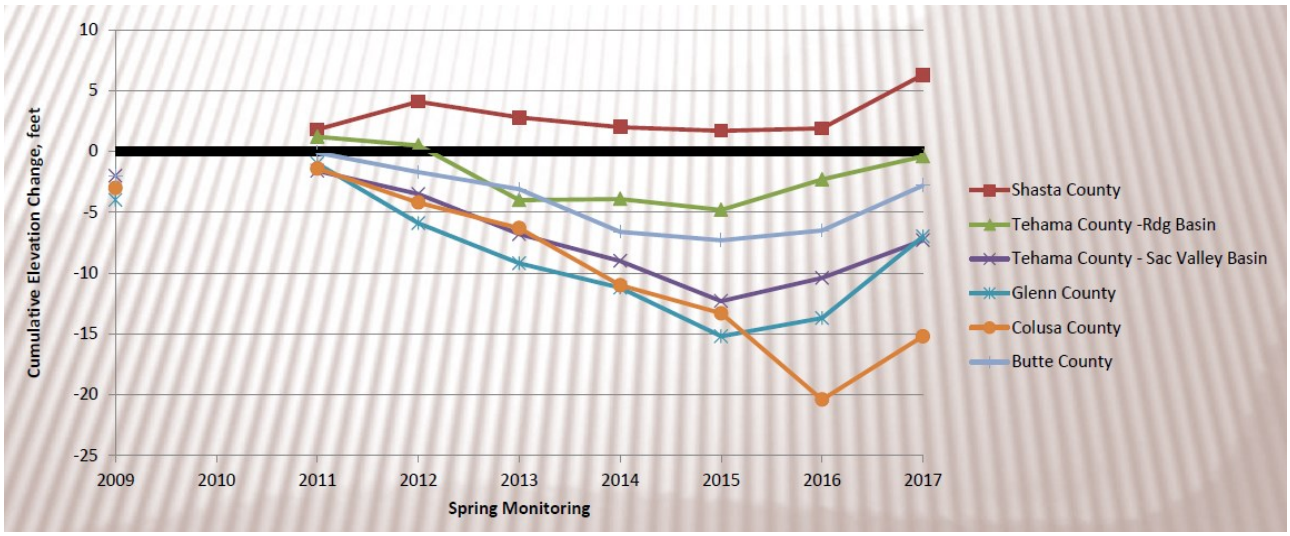


Figure 2. Cumulative average spring groundwater elevation change by county (about 150 wells in intermediate well monitoring network, 200 to 600 feet). Graphics prepared by Bill Ehorn and Mary Randall, DWR.

Top Five Questions: Evaluating a Water Supply for Suitability to Irrigate Nut Crops

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1. Does the salt concentration (ECw) pose a potential problem (osmotic effects)?

Crop	Unit	Degree of growth or yield reduction		
		None	Increasing	Severe
Almond, Walnut, Prune	dS/m	<1.1	1.1 -3.2	>3.2
Pistachio	dS/m	<4.0	4.0 - 8.0	>8.0

2. Are there specific elements (B, Cl, and Na) that could accumulate in the tree or soil to potentially toxic levels?

Element	Unit	Crop	Degree of growth or yield reduction		
			None	Increasing	Severe
B (boron)	mg/l (ppm)	Almond, Walnut, Prune	<0.5	0.5 - 3.0	>3.0
		Pistachio	<4.0	4.0 - 10	>10.0
Cl (chloride)	meq/l	Almond, Walnut, Prune	<4.0	4.0 - 10	>10.0
		Pistachio	<20.0	20 - 40	>40.0
Na (sodium)	SAR (none)	Almond, Walnut, Prune	<3.0	3.0 - 9.0	>9.0
		Pistachio	<5.0	5.0 - 10	>10.0
Na (sodium)	meq/l	Almond, Walnut, Prune	<4.0	4.0 - 7.0	>7.0
		Pistachio	<20.0	20 - 40	>40.0

3. Could the water chemistry reduce soil tilth, porosity, and cause slower water infiltration rates?

Lab Information	Unit	Potential of Water Infiltration Problems Developing		
		Unlikely	Increasing Likelihood	Likely
Ratio of SAR/EC_w	ratio	<5.0	5.0 - 10.0	>10
Ratio Ca/Mg	ratio	>2.0	2.0 - 1.0	<1.0

4. Could the water chemistry be prone to plugging drip emitters, microsprinklers, or filters and reduce irrigation distribution uniformity?

Lab Information	Unit	Potential for Plugging Problems Developing		
		Unlikely	Increasing Likelihood	Likely
EC_w	dS/m	<0.8	0.8 to 3.0	>3.0
HCO_3+CO_3	meq/l	<2.0	2.0 - 4.0	>4.0
Mn (manganese)	mg/l	<0.1	0.1 - 1.5	>1.5
Fe (iron)	mg/l	<0.2	0.1 - 1.5	>1.5

5. How much nitrate-nitrogen is in an irrigation water supply?

If lab reports NO_3-N *NO_3-N (mg/l, ppm) x 2.7 = lbs N per acre-foot of water*

If lab reports NO_3 *NO_3 (mg/l, ppm) x 0.6 = lbs N per acre-foot of water*

University of California
Agriculture and Natural Resources

Water & Land Resource Manager

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