Nested Institutions and California's Polycentric Groundwater Management

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I. Introduction

Until 2017, groundwater management in California has depended primarily on efforts and institutions initiated at the local level. In some cases this has involved the use of litigation to establish basin-scale rules for governing pumping and replenishment of groundwater. In others it has involved requests by local political actors to have the state legislature create a special governmental unit to tax and/or regulate groundwater use for a specific basin. In other cases it has entailed action by general-purpose local governments such as cities or counties to protect groundwater supplies or groundwater quality within their jurisdictions.

A new California state law – the Sustainable Groundwater Management Act (SGMA) – mandates the establishment of groundwater sustainability agencies (GSAs) in 127 basins across the state beginning in 2017. SGMA further requires those GSAs to fashion approved

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Portions of this paper draw substantially on previous papers, proposals, and reports on which we have collaborated in various combinations during 2016 and 2017.

groundwater sustainability plans (GSPs) by 2020 or 2022 depending on the basin. This paper reviews some empirical research efforts that are underway on how this new statewide mandate for local groundwater basin planning and management is being implemented, and how the new statewide requirements compare with existing locally-created basin management arrangements.

II. Background on State-Level Groundwater Management Efforts Prior to SGMA

Although California has been a U.S. state since 1850 and is the largest user of groundwater among the 50 states, the 2014 Sustainable Groundwater Management Act is its first state-level groundwater management mandate. When California became a state in 1850, the state legislature approved an act adopting English Common Law as the rule of decision in all areas not covered by the U.S. Constitution, the California Constitution, or state statutes. Since there was at that time no state legislation regulating groundwater, it therefore fell under common-law doctrine and was viewed as a resource appurtenant to land ownership. The owner of land overlying groundwater could extract and use the water without restraint.

Following a severe drought, in 1903 the California Supreme Court decided a dispute over groundwater use in a case named *Katz v. Walkinshaw,* 141 Cal. 116, 74 P. 766 (1903). In its decision, the state supreme court recognized that landowners drawing from the same body of groundwater could have negative impacts on one another's use. The court defined the landowners' rights as "correlative" rather than unlimited, meaning the landowners had to share the available groundwater. That decision also recognized that rights to use groundwater could be acquired by prescription.

In 1913, the passage of the California Water Commission Act created a permit system for appropriative water rights in California—rights to withdraw and use water on non-overlying and non-riparian land. Permits would be issued and administered by the Water Commission, which has since been reorganized and renamed the State Water Resources Control Board. The 1913 act did not distinguish between groundwater and surface water, so appropriative uses of either would have been subject to a state-level permitting system. However, the act was soon amended to restrict the Water Commission's permit authority to surface water, and groundwater remained unregulated by the state.

Local action to protect and maintain groundwater resources developed instead. Non-governmental "basin protective associations" were formed in some locations, largely to provide a forum for groundwater pumpers to meet occasionally and share information and to serve as a basin-scale monitor to watch out for any appropriative pumping that might remove water from the basin area and/or ripen over time into a prescriptive right. In the 1930s, the first groundwater basin adjudication in California occurred, in the Raymond Basin in Los Angeles County. The judgment in that case, Pasadena v. Alhambra, withstood appeals and was affirmed by the California Supreme Court in 1949, recognizing the validity of using the courts to define and limit pumping once a groundwater basin was becoming depleted. Other basin adjudications followed, mostly in Southern California (Blomquist 1992). Basin adjudication became one of the primary means of local groundwater management in the state. Figure 1 is a map showing adjudicated groundwater basins in California as of 2016.

Figure 1. Adjudicated groundwater basins in California

The other primary means of local groundwater management in California has been through the establishment of special district governments in certain basins that are authorized to monitor groundwater pumping and impose fees to finance basin replenishment and other water resource management activities. These special districts have been initiated locally even though their legal recognition as governmental bodies has to be approved in state legislation; local leaders have drafted bills approving the establishment of a basin management district and lobbied the legislature for their approval. Figure 2 is a map of the 15 special groundwater management districts in California that have been created in this way as of 2016.

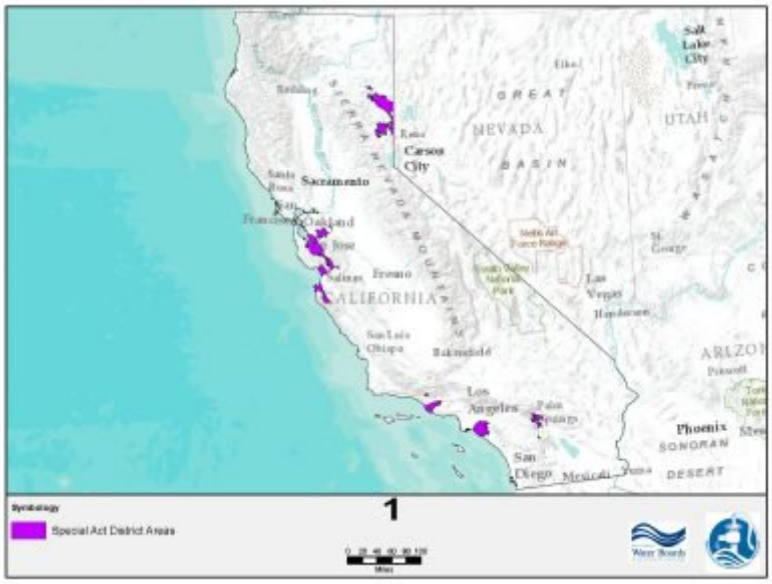


Figure 2. Groundwater management special districts

In the aftermath of another severe drought in 1976-77, state government officials made another attempt to assert some policy-making authority over groundwater. California Governor Jerry Brown established a commission to review California water rights law. The Commission recommended a state law to require groundwater basin management at the local level, with authority for the State Water Resources Control Board to step in if local officials failed, but that idea was not enacted.

Thereafter, state officials followed a different strategy of trying to encourage voluntary local efforts to manage groundwater. In 1992, the state government passed a law known as Assembly Bill 3030 (AB 3030) which allowed local governments overlying groundwater basins to undertake groundwater management plans. So-called "AB 3030 plans" were developed in some basins, but they lacked the power to alter individuals' groundwater rights and therefore had little effect on pumping even in overused basins. In 2002, a follow-up law tried to add stronger incentives for local groundwater management. Senate Bill 1938 (SB 1938) enacted more specific requirements to local groundwater management

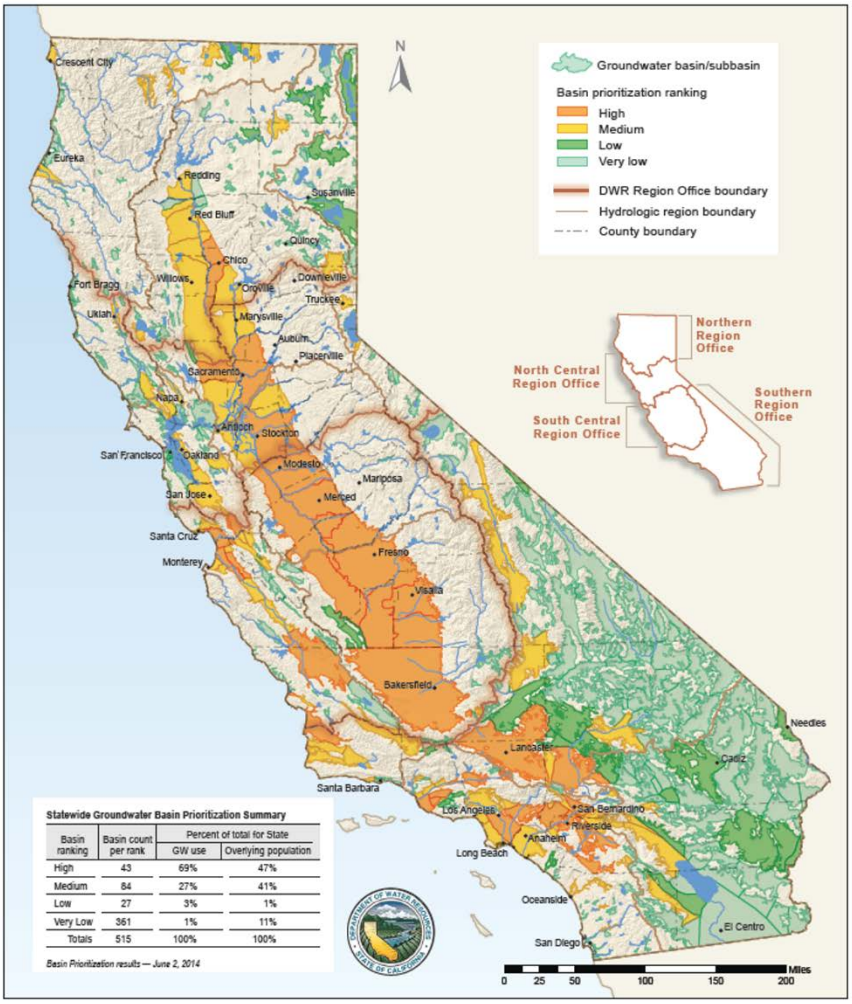
plans, and tied eligibility for any state funding for water projects to having a local groundwater management plan that met SB 1938 standards. Local management remained voluntary, but after SB 1938 there was a potential cost associated with failure to act.

A next step in state groundwater policy came in 2009, after another drought. The legislature passed five bills addressing water resources that year, one of which required regular and systematic local measurement of groundwater basin elevation, with reporting of groundwater levels to the state's Department of Water Resources. The resulting California Statewide Groundwater Elevation Monitoring Program (CASGEM) became an important information source and focal point of state action during the severe and extended drought which began in 2012 and persisted until 2017. In the midst of that drought, state officials finally enacted a statewide requirement for groundwater planning and management at the basin level for all basins that were identified in CASGEM as "high priority or medium priority."[1] Figure 3 is a CASGEM map of California highlighting the high-priority and medium-priority groundwater basins in orange and yellow. The reader can compare Figure 3 with Figures 1 and 2 and see that pre-SGMA local groundwater management arrangements cover a comparatively small number of those basins.

[1] The priority designation depends on more than just basin conditions; it also takes into account how dependent the location is on groundwater as part of its water supply, plus the population and economic activity in that location. Some currently managed basins are nevertheless identified as medium or high priority in the CASGEM priority classification scheme.

Figure 3.

CASGEM Groundwater Basin Prioritization



III. The Sustainable Groundwater Management Act of 2014 (SGMA)

A declaration by Governor Brown in 2013 provided the impetus for the legislation that passed in 2014. The governor directed that the State Water Resources Control Board should initiate groundwater planning and management in any groundwater basin where local management did not yet exist. The governor's proposed state budget in January 2014 even included funding for the State Board to do so.

The fear of state pre-emption of local groundwater management spurred a number of legislators and several interest groups into action (Leahy 2015). They crafted a package of three bills that together were named the Sustainable Groundwater Management Act (SGMA). The SGMA legislation passed the legislature and was signed by the governor in September 2014.

SGMA does not create a state groundwater management agency or require statewide implementation of specific groundwater management practices; it retains California's traditional commitment to local control. California is a large state that is diverse in almost every imaginable way, including the presence, characteristics, and use of groundwater resources. For instance, reliance upon groundwater use across hydrologic regions within the state varies between 9 and 86 percent of total water supply. The legislation retained primary authority to manage groundwater at the local level and gave local policymakers a little more time to act, but mandated them to do so, set deadlines for action, and retained the default position that if local entities did not create groundwater agencies and develop and implement groundwater management plans the State Board would intervene.

Rather than attempt to manage groundwater use centrally for the entire state, SGMA mandates that local governments establish groundwater sustainability agencies (GSAs) and that those agencies develop and implement groundwater sustainability plans (GSPs), with some important exceptions to be discussed later. The law requires a) that GSAs be created by June 30, 2017 in all medium- and high-priority groundwater basins in the state, b) that groundwater sustainability plans (GSPs) be completed by either January 31, 2020 or January 31, 2022, depending on the groundwater basin, and c) that implementation of those GSPs result in attainment of sustainable management within 20 years.

Fundamentally, SGMA requires local agencies to form GSAs that will be responsible for the development and implementation of GSPs.

Furthermore, SGMA established a statewide requirement that groundwater management in each basin achieve "sustainability" and provided a definition of it. SGMA requires first that a "sustainability goal" be defined and measured at the scale of each groundwater basin to avoid or reverse the negative impacts of groundwater overdraft. Second, it provides for the creation of Groundwater Sustainability Agencies (GSAs). These new public agencies are responsible for defining sustainability goals and indicators, and for developing and implementing plans to achieve those goals. Yet, prior to SGMA, very few water management agencies have existed at the groundwater basin scale.

The development of GSPs will require agencies to determine a basin's "sustainability goal" and then manage toward its achievement (Moran and Wendell 2015). This involves defining "sustainable yield," which SGMA defines as the "maximum quantity of water … that can be withdrawn annually from a groundwater supply without causing an undesirable result." The undesirable results to be avoided are defined to be any one or more of these conditions:

1. Chronic lowering of groundwater levels resulting in a significant and unreasonable depletion of supply;
2. Significant and unreasonable reduction of groundwater storage;
3. Significant and unreasonable seawater intrusion;
4. Significant and unreasonable degraded water quality;
5. Significant and unreasonable land subsidence;
6. Depletion of interconnected surface waters that have significant and unreasonable adverse impacts.

The Act requires local GSAs to develop and implement GSPs that will end or prevent these "undesirable results" of chronic groundwater overuse.

GSAs' obligations to achieving sustainable yield and avoid or eliminate undesirable results come with a range of groundwater management options that are authorized in the Act. Among other things, GSAs will have the authority to investigate water conditions, inspect facilities, acquire water for replenishment and storage, regulate well spacing and operation to prevent interference among pumpers, and treat water to improve water quality.

State agencies play important roles in SGMA implementation, particularly the Department of Water Resources and the State Water Resources Control Board. The department is responsible for receiving and reviewing the notices from agencies seeking to become GSAs, establishing the regulations that determine the standards that GSPs will have to satisfy, [2] maintaining and sharing data, and providing facilitation support to GSAs as they proceed through the GSP development and implementation stages. Meeting those requirements for GSPs will be a formidable challenge for the GSAs in many basins, as the regulations specify extensive basin monitoring requirements to demonstrate that sustainability goals are being met and undesirable outcomes are being avoided.

The State Water Resources Control Board stands in reserve to intervene in any basin where SGMA requirements are not being met. For example, if a basin is not covered by one or more GSAs after the June 2017 deadline, the State Water Resources Control Board can intervene to manage the basin itself. The State Water Board also has the authority to

[2] http://water.ca.gov/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf.

intervene and take over the management of a groundwater basin if the groundwater sustainability agencies don't adopt a groundwater sustainability plan by either 2020 for the most seriously overdrafted basins or by 2022, or if the groundwater sustainability plans that are adopted are deemed by the state to be legally inadequate.

One more aspect should be mentioned of how SGMA has reshaped the nested institutional arrangements for groundwater management in California. A follow-up bill enacted in 2015—Senate Bill 226 (SB 226)—requires that any future groundwater basin adjudications in California need to be consistent with SGMA. Basin users who would prefer to govern and manage their groundwater basins in a different fashion will not be able to get around SGMA's sustainability requirements by pursuing an adjudication instead; adjudications are allowed and are expected to occur in at least some basins, but they will have to result in groundwater management that is consistent with SGMA.

There are a few exceptions and qualifications that should be noted before moving on to the research on SGMA implementation. First, not every groundwater basin in California is covered by SGMA. The Department of Water Resources has identified 515 basins in the state, of which 43 are classified as high-priority and 84 as medium-priority. These are the 127 groundwater basins covered by SGMA. Although that may seem to be a small percentage, those 127 basins account for approximately 88% of the population and 96% of groundwater use in California (DWR 2014). Remaining basins are classified as low or very low priority. Although the state requires these basins to report groundwater extractions and encourages them to develop GSAs and GSPs voluntarily, GSA and GSP development is not required under SGMA. Also, the possibility remains that unconstrained groundwater pumping or other changes in groundwater conditions in these low and very low priority

basins in the future could lead to adverse impacts and possible changes in priority in the future. DWR plans a reprioritization this year, so some basins priority classifications may shift.

Additionally, of the 127 medium- and high-priority basins, SGMA exempts 27 adjudicated basins[3] (see Figure 1) plus three others where adjudications are pending. In these exempted basins, the respective groundwater management bodies are not required to file GSPs, but must submit annual reports to the state Department of Water Resources. Special acknowledgement is also made in SGMA of those special act districts with specific groundwater management responsibilities (see Figure 2). Under SGMA, these entities must form GSAs and prepare GSPs, but they hold the exclusive right to form GSAs within their service areas unless they opt out of doing so.

Perhaps most important from a broader perspective of water resource policy, SGMA does not make any changes to California's complex array of legally recognized groundwater rights. SGMA implementation will require local agencies, groundwater users, and other stakeholders in many parts of the state to make difficult decisions and take potentially contentious actions in order to meet the act's requirements and goals. The difficulties attending those decisions are likely to be exacerbated and vulnerable to litigation if actions such as groundwater pumping reductions are viewed as interfering with property rights. Groundwater users in the basins covered by SGMA, and their lawyers, are on guard.

[3] The Owens Valley is not formally an adjudication, but it is shown in Figure 1 and is treated as an adjudicated basin in SGMA because it is subject to a long-term settlement agreement between Inyo County and the Los Angeles Department of Water and Power.

While SGMA does not attempt to create a statewide groundwater management program for all of California or change California water rights law, and it makes exceptions for some basins, it is nevertheless a landmark water policy enactment for the state. For the first time, local governments in many currently unmanaged groundwater basins throughout the state are going to have to create governance mechanisms and institute management activities to address and halt or reverse the overdrafting that has occurred for decades. Those governance and management arrangements will have to obtain state approval by meeting requirements of the Act and its accompanying regulations, and the local agencies who satisfy those requirements will gain an array of regulatory tools for doing so. Groundwater users in many basins will find themselves newly subject to reporting and monitoring protocols, usage fees, and the prospect of fines and penalties for overuse. State intervention looms in the background for basins where their actions fail to meet state approval. Implementation and compliance will be daunting, and groundwater policy and practice in California will be dramatically changed as a result. Those who are engaged in SGMA planning and management activities in each basin will have to resolve a host of governance and technical issues, and make what can be extremely contentious decisions.

IV. An Examination of GSA Formation Processes: Overview and Case Studies

Several scholars are undertaking studies of the development of GSAs and GSPs (e.g., Christian-Smith and Abhold 2015, Christian-Smith and Alvord 2016, Kincaid and Stager 2015, Kiparsky et al. 2016, Moran and Wendell 2015, Water Education Foundation 2015). This section of the paper draws upon Conrad et al. (2016) and Conrad et al. (under review). Since January 2015, thousands of local agencies and other stakeholders involved in

managing water and land use have been working to form GSAs by the statutory deadline of June 30, 2017. As Kiparsky et al. (2016, p. 9) describe it, the GSA formation process is a "grand experiment in the design of institutions for groundwater governance."

The establishment of GSAs for groundwater basins is clearly a critical step in implementing SGMA. The procedure itself appears relatively straightforward. A local agency that wishes to become the GSA for a particular groundwater basin must first publish a notice pursuant to Section 6066 of the Government Code. After publishing the notice, the local agency (or agencies—see below) must hold a public hearing in the county or counties overlying the basin. The governing board(s) of the agency/agencies must vote to request GSA designation. Then within 30 days, the GSA must inform the California Department of Water Resources of its intention to undertake groundwater management responsibilities within its area, and the department, after reviewing for completeness, will post the GSA's notice on its website. If no other entity requests GSA designation over that area within 90 days, the petitioning GSA is presumed to be the exclusive GSA for that area.

Although the GSA designation procedure appears straightforward, the formation of GSAs has presented some challenges. There are 127 groundwater basins in the state that are covered by SGMA at this point. There are approximately 2,300 local agencies across California currently involved in some aspect of groundwater management (Nelson 2012), and any local agency with any groundwater management responsibilities in those 127 basins may apply to be a GSA for that basin or for a portion of that basin. One possible outcome therefore is the establishment of multiple GSAs within the same basin. On the other hand, another possible outcome is that no agency within a basin applies to be the GSA. Failure to obtain GSA designation in any of the 127 basins may trigger state

intervention, although SGMA states that county governments are presumed to be the GSAs for unmanaged areas in the basins within their boundaries, placing counties in the position of being the local "backstop" before state intervention would occur. Counties assuming GSA status are still required to provide notice of their intention to do so.

Under SGMA, local public agencies with water management, water supply or land use responsibilities are eligible to become GSAs. GSAs may be public water agencies/districts, counties, or municipalities. Local agencies overlying various portions of a groundwater basin may come together to create a single GSA (e.g., through the establishment of a joint-powers agency or similar structure) to manage the basin in a coordinated manner. Furthermore, SGMA allows a single or multiple GSAs to manage a groundwater basin, either through a single GSP or separate but coordinated GSPs in the same basin.

A further potential complication is that local water and land use agencies retain their existing authorities and responsibilities regardless of whether they become GSAs. County and municipal agencies are specifically granted primacy over land use and well permitting, construction and abandonment responsibilities. The challenge for water and land use agencies will be to bring their existing authorities, expertise and resources to the table to meet the expectations of SGMA. Also, regardless of how and which GSAs are formed in a basin, land use agencies are required to take into consideration the information in the GSP during a revision or update to their general land use plans. This is clearly intended to advance the integration of land use and water resource management, although it is likely to entail coordination costs and raise problems if coordination is perceived to be lacking.

GSAs also need to incorporate representation of certain interests into their decision making structures or through participation processes. The interests so designated by SGMA

include "all beneficial uses and users of groundwater" -- i.e., overlying property owners, public water systems and other appropriators, and environmental users -- plus surface water users, the federal government, Native American tribes in California, disadvantaged communities, and listed monitoring entities.

A crucial choice that local agencies are confronted with relates to the scale at which to form GSAs, i.e., whether to form a basinwide GSA or to form multiple GSAs within a basin. Conrad et al. (2016) refers to these as "consolidated" (single GSA) and "coordinated" (multiple GSA) approaches, respectively. That publication provided an overview of GSA formation statewide, and reviewed seven case studies of GSA formation. The selection of those cases and the summary descriptions of their GSA formation experiences appear at the end of this paper as Appendix A and Appendix B. Later in this section of the paper, we focus on three cases in greater detail. The analysis of GSA formation processes presented here cannot be comprehensive, but does highlight some trends that were observed as the June 2017 deadline approached.

In many basins, the GSA formation process has involved extensive discussions involving GSA-eligible agencies, private pumpers and other interested parties, as well as the general public. In many cases, meetings occurred over a period of two years. The Department of Water Resources provided funding for facilitation services in over 20 basins at the request of local agencies. Observations and experiences of the facilitators have contributed substantially to scholars' understanding of the GSA formation processes. In addition, staff in DWR's four regional offices have been available to provide technical assistance to local agencies, answer questions regarding the GSA formation process, and help groups to apply

for facilitation support services. State Water Resources Control Board staff fielded and responded to inquiries about GSA formation as well.

Conrad et al. (2016) reported the results of a review of all GSA notifications submitted to DWR prior to September 30, 2016, and Conrad et al. (under review) updated that information through April 30, 2017. The analysis of GSA formation notices indicates that while some groundwater basins subject to SGMA will be governed by a single GSA covering an entire basin, in most basins there will be multiple GSAs, which will then need to coordinate with one another to create either a single shared GSP or multiple but coordinated GSPs. As of April 30, at least one GSA had been declared in 80 high or medium priority basins. Of these, 25 basins were completely covered by a single GSA. The remaining 55 basins had between 2 and 17 GSAs each, and in many, coverage was still incomplete (see Figure 4).

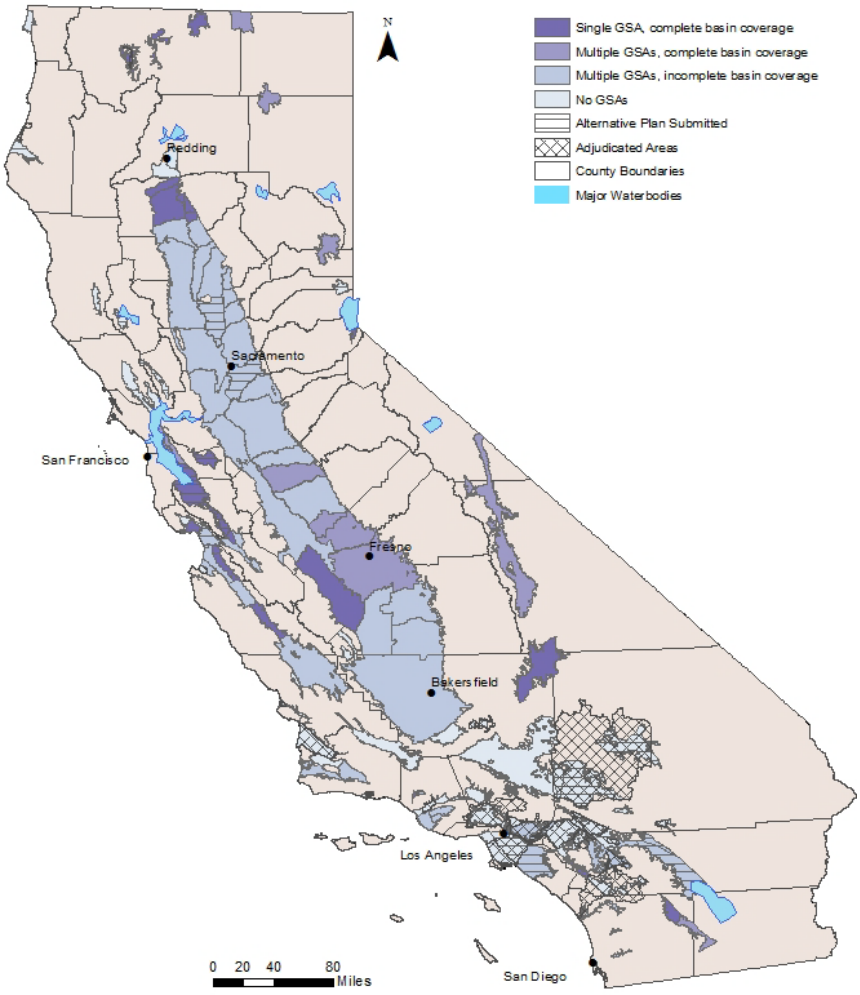


Figure 4. GSA notices as of April 30, 2017

For deeper analysis of factors that affected the GSA formation process, we focused further on three basins with multiple GSAs. They are the Colusa and Yolo subbasins of the Sacramento Valley groundwater basin, and the Eastern San Joaquin subbasin of the San Joaquin Valley basin (see Figure 5).[4] All three basins cover portions of multiple counties. Table 1 provides some additional descriptive statistics about each basin.

[4] Although identified as "subbasins" in the Department of Water Resources' inventory of California groundwater basins, DWR Bulletin 118, they are basins for purposes of SGMA compliance.

Figure 5. GSA case study locations

Table 1. Case study basins

	Yolo	Colusa	Eastern San Joaquin
Land area (sq. mi)	788	1,099	1,202
Population, 2010*	194,158	48,369	582,662
No. of counties with land area in basin	1	2	3
Value of agricultural production (2015)**	$510 million	$752 million	$2.26 billion
Groundwater basin priority (DWR, 2014)*	High	Medium	High, critically overdrafted
Percent of water use accounted for by groundwater*	25%	10%	43%
No. of GSAs ***	1	2	17
No. of GSA-eligible entities	33	TBD	TBD
Length of GSA formation process	19 months	Colusa County: 16 months Glenn County: 13 months	20 months

Data: DWR 2016 boundaries shapefile; CASGEM 2014 prioritization data; California Agricultural Statistics Review 2015-16; GSA formation meeting notes

* Estimates based on 2003 groundwater basin boundaries

** Estimates based on county-level data and percent of county area falling within each basin.

*** In Yolo and Colusa, existing GSA notices are being withdrawn and replaced with one and two multi-agency GSAs.

In all three basins, discussions about a collaborative approach to GSA formation began early and extended over more than a year. The current status of discussion in these basins suggests that they will likely have anywhere from 6 to 15 GSAs, some of which had not yet filed notices with DWR as of April 30th while discussions were still underway. In Kings and Eastern San Joaquin subbasins, there appears to be agreement among prospective GSAs to work together to create a single GSP. Discussions in East Butte as of October 2016 indicate the possibility of two GSPs, but this may change over time.

In each case, a convening entity played a key role in the GSA formation process and sought to include all relevant stakeholders in a group decision-making process at basin scale. In the Colusa and Eastern San Joaquin basins, county governments convened these meetings; in the Yolo basin, a non-profit water association and the Yolo County Farm Bureau led the process. Beneficial users were represented during the GSA formation process through a mix of public and private entities. Irrigation, reclamation and water districts, and some mutual water companies, represent landowners who have access to surface water but also rely in part upon groundwater. Private pumpers are landowners who are not part of a district, and usually rely solely upon groundwater for irrigation, domestic use, or both. Municipalities deliver water for domestic use, but many residents of these cities have ties to agriculture. Finally, agricultural interests were also represented through non-profit associations, particularly by the Farm Bureau in each county.

Review of the topics discussed at GSA formation meetings and in interviews with participants indicate that a) the desire for local control and b) issues concerning how private interests would be represented influenced GSA formation decisions in these three basins. These two issues overlapped and intersected in GSA formation choices.

GSA formation represents a significant change for most agricultural users, who in most of California have historically faced few constraints in exercising their overlying rights. Although SGMA explicitly states that it does not alter property rights, it grants authority to GSAs to manage groundwater, including to establish fees, limit extractions, and require metering in some instances. In our case studies, stakeholders far preferred to form GSAs than to allow the state to intervene. However, most participants in GSA formation were concerned about the prospect of larger-scale public agencies such as counties assuming these roles, with potentially limited familiarity with the needs of local agencies and private pumpers.

Concern for local control sometimes led to initial filings of notices to become GSAs that were reconsidered later. Numerous water districts in our case study basins initially decided to form their own GSAs in order to retain control over surface and groundwater management activities within their jurisdictions. However, as discussions progressed in Yolo and Colusa, many decided to withdraw their notices and join with other agencies to form multi-agency GSAs.[5] In Eastern San Joaquin, a few multi-agency GSAs have formed but most local agencies have remained single-agency GSAs, resulting in numerous GSAs within the basin.

Most irrigation, water and reclamation districts have access to surface water, which provides an alternative water source and is critical for groundwater recharge. Those districts wanted to retain control of surface water deliveries and receive credit for groundwater recharge in the basinwide water budget. On the other hand, private pumpers

[5] What we are calling a multi-agency GSA can be formed through a joint-powers agreement (JPA) or memorandum of understanding (MOU) among two or more agencies within a basin.

are often entirely reliant upon groundwater for irrigation and domestic purposes, and have often invested significant personal funds in their well systems. Areas where farmers rely solely upon their own wells are often where the most significant management efforts will be needed. For example, in the Yolo basin, the most significant overdraft and land subsidence is in the Yolo Zamora area where there is no access to surface water. These landowners have a strong interest in being represented by the GSA; otherwise, their area would be declared as "unmanaged" and they would be subject to state intervention and management fees. However, they are also concerned about the potential fees and pumping restrictions that could be imposed by whatever entity serves as the GSA.

Local districts and private pumpers also differ in the options available to them in the GSA formation process. As local agencies with water management responsibilities, SGMA grants districts the right to form their own GSAs, and initially many did so in all three cases. In the Colusa basin, as many as 15 GSA notices were submitted to DWR. Once Glenn and Colusa counties began to convene discussions aimed toward collaboration to form multi-agency GSAs, districts met to develop a set of "Districts' Principles" to convey their common interests.

As individuals, private pumpers cannot themselves serve as GSAs. In areas not covered by other local agencies, SGMA presumes that the county will serve as the GSA. However, many private pumpers did not believe that their county would adequately represent their interests. In an effort to address their concerns, Colusa and Glenn counties in the Colusa basin each established a Private Pumper Advisory Committee composed of private pumper representatives. Many private pumpers, as well as landowners within districts, also looked to their county Farm Bureau as a voice for their interests. Although the Farm Bureau

cannot serve as a GSA either, Farm Bureau representatives participated in GSA formation meetings in all three cases and played a particularly significant role in Yolo and Eastern San Joaquin. In Yolo, the Farm Bureau conducted outreach that resulted in the participation of hundreds of private pumpers in GSA formation meetings.

The three cases reviewed here suggest indicate that basin-scale collaboration is under way in at least some basins with multiple GSAs. In the Yolo and Colusa basins, collaborative, multi-agency GSAs have been created, reducing the number of GSAs per basin to one and two, respectively. In Eastern San Joaquin, there are 17 separate GSAs, but they have developed a relatively strong collaborative governance structure at the basin scale. In all three basins, multi-level governance arrangements have emerged that take into account the need for local agencies to retain some autonomy, and for private pumpers and other interests to have a voice in decision-making. In addition to being reflected in academic literature (Newig and French 2009), this multi-level approach has been articulated in practical terms as the "Local Implementing Agency" (LIA) model for GSA formation (Ceppos 2016).

In all three cases, basin-scale decision-making is limited to the coordination of GSP development, including activities such as securing grant funds, hiring consultants, data management, and monitoring. These basinwide structures emerged in large part to share costs and to ensure compliance with SGMA's requirements for common assumptions and data underlying GSPs.

In Yolo, the basin-level governance body formally holds all the powers of a GSA, including to impose fees and restrict pumping. However, during the GSA formation process participants developed a mutual understanding that, in general, these powers would not be

exercised at this scale. The JPA establishing the Yolo Subbasin Groundwater Authority states that "the Agency will serve a coordinating and administrative role" without limiting a member's "rights or authority over its own water supply matters," although the GSA retains the right to intervene if sustainability criteria are not being met (Section 8.1, p. 13). Similarly, in Eastern San Joaquin the basinwide JPA holds jointly the powers of its members – all of whom are GSAs – but is restricted from undertaking activities within the service areas of Members without their consent (Section 3.6, p. 5).

Private pumpers are involved in basin-scale governance in Yolo and Eastern San Joaquin basins, but in different ways. In Yolo, the Farm Bureau serves as one of five "Affiliated Parties" holding voting seats on the GSA board (others include an environmental representative, two mutual water companies and a university). In Eastern San Joaquin, the Farm Bureau does not have a voting seat, but will serve in an advisory capacity to the basinwide JPA, which is structured such that membership is restricted to GSAs. However, in this basin the Farm Bureau has a long history of working with most of the local agencies involved, and served in a non-voting, advisory role to a previous JPA responsible for groundwater management, increasing their confidence that their voice would be heard.

In our three cases, below the level of the GSA, multiple agencies will work together to identify and agree upon management actions in specific areas of the basin. In Yolo, five "Management Areas" (MAs) have been defined, roughly according to groundwater conditions and usage patterns. The specifics of how Members and Affiliated Parties will work together within each MA have not yet been spelled out, but advisory committees plus opportunities for public involvement are anticipated. In the Colusa basin, the primary

governance structure is at the multi-agency scale, defined in terms of a single GSA for each of the two counties, formed as JPAs. These two county-level GSAs also anticipate forming MAs, adding a fourth governance level. Finally, in Eastern San Joaquin, the multi-agency scale consists of several multi-agency GSAs that have formed in certain parts of the basin.

Private pumpers are involved at the multi-agency level in Colusa, through their inclusion in the governance of the two county-level GSAs. In Colusa County, there are two voting seats for private pumpers on the GSA board, both of whom will be representatives from the county's pre-existing Groundwater Commission. In Glenn County, private pumpers will advise the county – which is a member of the GSA – through an established Private Pumpers Advisory Committee. Private pumpers will also likely play a role in the MAs established in Yolo basin.

In all three cases, individual agencies represent a third level of more localized decision-making and action, focused on GSP implementation. The delegation of this authority – particularly as related to groundwater use restrictions and fees – to local agencies was critical to reaching agreement to create larger-scale GSAs. The JPAs establishing the GSAs in Yolo and Colusa basins contain clauses specifying that fee-setting and implementation will primarily be undertaken by member agencies rather than by the GSA as a whole. In Eastern San Joaquin, most individual agencies have declared themselves as GSAs (unless they are participating in a multi-agency GSA), and therefore have all of the authorities SGMA grants to GSAs.

Formally, the counties in each basin are currently serving as the local agencies representing the interests of private pumpers, although in Yolo private pumpers are taking

steps to be annexed to a water district. However, as described earlier, in all three basins private pumpers have avenues to voice their concerns at the multi-agency or basin scales.

Each basin's specific governance arrangements will be shaped by its distinct institutional setting, past experiences with collaboration, and even by particular individuals who play significant roles in the process. Three cases are far from capturing the full range of California's groundwater basins, and further research will be needed to understand the factors shaping whether and how collaborative approaches are undertaken, and to assess effectiveness in managing groundwater basins sustainably.

V. Comparing SGMA Requirements and Pre-SGMA Managed Basins

Another research initiative concerning SGMA and groundwater management in California focuses on the fact that local groundwater management arrangements were developed in some basins prior to SGMA's adoption. The principal research question is how the goals, governance structures, and opportunities for stakeholder participation in pre-SGMA arrangements compare with the requirements laid out for GSAs under SGMA. With that overall question in mind, more specific questions for this research on the pre-SGMA managed basins include the following.

- What goals did these pre-SGMA arrangements seek to achieve?
- How do their definitions of "safe" or "sustainable" yield compare to how sustainability is defined in SGMA (i.e., which "undesirable results" were targeted)?
- To what extent do local management bodies in these pre-SGMA cases possess and use the authorities that SGMA outlines for GSAs?
- Which stakeholders have participated in the governance structure established in each case, and how closely does this match SGMA's list of interests that GSAs are required to engage? Do any stakeholders or stakeholder groups have representation on basin decision-making bodies and, if so, which ones?

Pursuing this research entails coding the institutional rules and organizational structures of the governance and management arrangements of pre-SGMA managed basins. The researchers engaged in this research program have developed a coding scheme that is based on the requirements and powers delineated in SGMA. The coding form itself appears in Appendix C1, with the SGMA information in the third and fourth columns.

We have selected 17 institutionally diverse California groundwater basins with pre-SGMA management arrangements. We reviewed the documents establishing those management arrangements (e.g., court judgments in the adjudicated basins, enabling legislation establishing special districts, etc.) and coded the institutional rules for those managed basins using the same coding form that was constructed based on SGMA.

The study focuses on 17 cases:

- nine basins that have been adjudicated since 1990 – Antelope Valley, Beaumont, Los Osos, Mojave, San Jacinto, Santa Maria, Santa Paula, Seaside, and Six Basins;
- five special act districts that were selected using a matching approach, where districts in similar locations were eliminated – Zone 7 Water Agency, Desert Water Agency, Fox Canyon Groundwater Management Agency, Pajaro Valley Water Management Agency, and Santa Clara Valley Water District;
- Sonoma County and Sacramento Groundwater Authority, two negotiated agreements commonly cited as successful examples of planning under AB3030; and
- Glenn County, the first example in CA of using general police powers to manage groundwater.

The coding of the 17 cases has been completed. The completed coding form for the Antelope Valley case appears as Appendix C2. Comparative analysis of these coded data allows for a determination of which existing groundwater management arrangements among these pre-SGMA cases come closest to matching the specifications of SGMA that newly managed basins must now achieve and the authorities they may use in doing so.

These research results will be shared with individuals and local governments as they attempt to construct governance and management arrangements in currently unmanaged basins in the state.

VI. Looking Ahead

The statutory deadline for GSA formation has now passed, and the newly formed agencies must begin developing their Groundwater Sustainability Plans (GSPs). The GSAs must be effective if sustainable groundwater management is to be achieved, and plenty of challenges remain (Kiparsky et al. 2016).

- GSAs will need to develop and maintain institutional capacity—especially expertise, personnel, and funding—through the processes of GSP development and implementation. This will be more difficult for some GSAs than others.
- GSAs will need to determine how the authority will be organized and exercised to make and enforce potentially unpopular decisions such as the imposition of pumping fees or restrictions on wells. Coupled with this challenge is how GSAs and the other agencies participating in basin management will be responsive and accountable in the exercise of that authority.
- Information should be collected about the GSAs and disseminated among the GSAs in order to help them see what alternative structures have been established across the state. The DWR's database of GSA notices will serve this purpose initially and will need to be transitioned into an ongoing database about the GSAs as they change over time. This information will be beneficial to GSAs for identifying similarly structured GSAs around the state who might become partners in sharing experiences during the GSP development and implementation processes. It will also be beneficial to GSAs in considering what other organizational arrangements a GSA might consider adopting, since they are allowed to change over time.
- Both state and local officials need to prepare for legal challenges to SGMA as the difficulties of GSA coordination in multi-GSA basins and of GSP development and implementation are experienced.
- Perhaps the largest challenge that lies ahead is one that is likely to be triggered by SGMA but not limited to SGMA. That will be the adjustments that will be needed across the many elements of California water resource management—laws, regulations, state-level agency jurisdictions and responsibilities, and local

government jurisdictions and responsibilities. SGMA's requirement that groundwater use not cause unreasonable depletion of interconnected surface water will eventually draw groundwater management, surface water management, and ecosystem protections together and will therefore almost certainly spawn a great deal of policy revision and institutional reforms.

As SGMA implementation proceeds, there will be many needs and opportunities for further research. How the challenges above are addressed, the ongoing roles and performance of the state agencies and the GSAs, the processes by which GSPs are developed, their content, and their effects once adopted and implemented, all represent important and interesting research questions for the future. The fruits of that research should contribute not only to the understanding of water resource management in California but of polycentric governance systems for natural resource management more broadly.

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Appendix A: Methods for GSA Formation Analysis in Conrad et al. (2016) and Conrad et al. (under review)

Upon receiving a GSA notice, DWR reviews it for completeness and posts it on its SGMA Portal (http://sgma.water.ca.gov/portal/#gsa). Once a GSA notice is posted, there is a 90-day waiting period before that GSA is deemed an "exclusive" GSA for that area. This gives other entities within that geographic area the opportunity to submit their own notice. If another, overlapping notice is submitted, then no GSA within that area becomes "exclusive" until overlaps are resolved.

To understand how consolidated and coordinated basin governance approaches look in practice and to identify factors that influence decisions about the scale of GSAs, information was gathered about the GSA formation experiences in seven case studies for Conrad et al. (2016). Potential case studies were identified through conversations with facilitators who are working to support the GSA formation process in specific basins. The cases were selected based upon whether the GSA process that was advanced enough to be able to discuss their evolving approach, and to achieve a balance across different areas of the state and basins with varying groundwater conditions. The cases included four examples of consolidated (single GSA) and three of coordinated (multiple GSA) basin governance, and six out of the seven received facilitation support during their GSA formation processes.

For each case, in addition to reviewing available documents, on-the-ground perspectives were obtained through phone interviews with facilitators and key stakeholders, attending GSA formation meetings, or both. Because our cases were not randomly selected, they are not representative of all basins in the state or of the basins in which GSA notices have been filed so far. Instead, these basins represent early actors that may serve to illustrate factors that have affected consolidated versus coordinated GSA formation should be instructive.

The analysis of GSA notices for Conrad et al. (under review) was based on all GSA notices posted on the SGMA portal as of April 30, 2017, including notices for which the 90-day waiting period had not yet elapsed. Analysis of the *number and type of GSAs, consideration of the interests of beneficial users, and the role of agricultural interests in GSA governance* was conducted based on all GSAs, including those in low and very low priority basins. The analysis of the *number of GSAs per basin* was conducted only for high and medium priority basins, where GSA formation is required by June 30, 2017.

- *Number and type of GSAs.* GSA notices were reviewed to count the number of separate entities declaring as GSAs. This is different from the number of notices, since some agencies have submitted multiple GSA notices. Next, GSAs were classified as single-agency or multi-agency. A GSA was designated as multi-agency if its governing body was composed of multiple agencies, pursuant to a Joint Powers Agreement (JPA), Memorandum of Agreement (MOA) or another legal instrument. If a GSA notice was submitted by single agency and the GSA would be governed by its existing board of directors, this GSA was classified as single agency. If a single agency signed an MOA with other entities regarding coordination of GSA activities, but the GSA is still governed by the board of one agency, this GSA was classified as single agency. Single agencies were further categorized according to whether they

were involved in managing water for agricultural or urban use, or both. When available, agency websites were consulted to determine this.

- *Consideration of the interests of beneficial groundwater users in GSA formation.* SGMA requires Groundwater Sustainability Agencies (GSAs) to "consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans," and provides a list of ten specific types of beneficial users that must be included, as well as entities responsible for groundwater monitoring (§10723.2). All GSA notices submitted to DWR must include a "list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan," (§10723.8).

Table A1. Beneficial users of groundwater listed in GSA notices.

	GSAs indicating that these beneficial users are:			
Beneficial Users in GSA Notices	Present	Not present	Not mentioned or not yet identified	**Percent with this interest present**
Overlying rights for agricultural use	159	15	7	**88%**
Overlying rights for domestic/other use	166	10	5	**92%**
Municipal well operators	127	49	5	**70%**
Public water systems	135	35	11	**75%**
Land use planning agencies	172	0	9	**95%**
Environmental uses of groundwater	75	63	43	**41%**
Surface water uses connected with groundwater	79	74	28	**44%**
Federal government	91	69	21	**50%**
Tribes	46	116	19	**25%**
Disadvantaged communities	94	65	22	**52%**

Table A2. Number of beneficial users present in GSAs.

No. of beneficial users	GSAs with this number present
10	9
9	15
8	33
7	27
6	32
5	26
4	20
3	9
2	3
1	0
0	7

We reviewed the list of interested parties provided in each GSA notice. Most notices described interested parties according to the ten categories in §10723.2,

which are listed in Table A1. Notices provided varying degrees of detail about interested parties, with some naming specific entities under each category and others simply listing the categories present. For each notice, we tracked whether each interest was described as present, not present, or were not yet identified or not mentioned. Notices also listed entities responsible for monitoring and reporting groundwater elevations, but since these are not groundwater users they were not included in the analysis. Data in Table A1 is by GSA, not by notice. When GSAs submitted multiple notices, data from these notices were combined to reflect all interested parties within the whole area covered by a given GSA. To assess the degree of diversity of stakeholders that GSAs plan to engage, we counted how many of the ten beneficial users were listed as present by each GSA; results are presented in Table A2.

- *Role of agricultural interests in GSA governance*. For Conrad et al. (under review), additional analysis was performed to assess how agricultural interests were represented in each GSA's governance structure. For single-agency GSAs, all irrigation districts and reclamation districts – whose boards are typically elected by participating landowners – were included as having agricultural representation. For water districts and other types of single-agency GSAs, agency websites were consulted (if available) to confirm whether the agency's board of directors includes representatives of the agricultural water users or landowners. For multi-agency GSAs, the JPA or MOA included in the GSA notice was reviewed to determine whether agricultural interests are represented by a specific entity on the governing body or on an advisory committee. A GSA was counted if its JPA or MOA included an irrigation district as a voting member, or designated a specific seat for representatives of agriculture and/or private pumpers on its board or advisory committee.

- *Number of GSAs per basin.* This analysis was conducted only for high or medium priority basins where GSA formation is required. Since DWR has not yet completed its prioritization using the 2016 basin boundaries, for the purposes of this analysis we considered a basin as high or medium priority if any part of it had been ranked as a high or medium priority basin as of 2014. This resulted in 134 high and medium priority basins. The GSA map viewer in the SGMA portal was used to assess whether a basin was: 1) completely covered by a single GSA; 2) completely covered by multiple GSAs; 3) partially covered by multiple GSAs; or 4) no GSAs had yet been submitted. We also recorded the number of GSAs formed in multi-GSA basins.

Appendix B: GSA Formation Case Study Summaries (from Conrad et al. 2016)

The following case study summaries reflected the status of these GSA formation processes in these seven basins as of October 2016.

Examples of consolidated (single-GSA) basin governance

Mid-County Santa Cruz Basin. The newly formed Mid-County Santa Cruz Basin is composed of portions of four previous groundwater basins or subbasins underlying portions of Santa Cruz County. This area has been managed jointly by the Soquel Creek Water District and the Central Water District, which entered into a JPA and developed their first AB3030 Groundwater Management Plan in 1995. The city and County of Santa Cruz, as well as representatives of private pumpers who account for as much as 30% of groundwater use, were involved in an advisory capacity. With the advent of SGMA, Soquel Creek Water District, which is the largest district and depends solely upon groundwater, took the lead to establish and convene the Soquel-Aptos Groundwater Committee, which included representatives of the four entities as well as private pumpers.

This group, which received support from SWRCB for facilitation services, ultimately decided to form a JPA that would serve as a GSA, covering roughly the same area as the existing AB3030 plan. The board of the newly-created Mid-County Santa Cruz Groundwater Management Agency is composed of two representatives each of the four partner agencies, and three appointed representatives of private pumpers, resulting in an 11-member board with each member holding one vote. The group also proposed a basin boundary modification, which DWR accepted, so that the basin boundaries now match those of the GSA.

A key factor that enabled the creation of this consolidated governance arrangement at the basin scale appears to have been the high level of familiarity among partner agencies, developed through long experience in working with one another. In addition, the fact that the basin is relatively small, as is the number of partner agencies, may have made it easier to reach agreement. Finally, partner agencies have been very proactive in conducting workshops and public meetings to engage the community throughout the process.

Yolo. The Yolo subbasin was modified through the Basin Boundary Modification process to consolidate portions of several neighboring subbasins into one high-priority basin covering 790 square miles within Yolo County. While the County depends heavily upon groundwater for both agricultural and domestic purposes, conjunctive management efforts have resulted in reasonably stable groundwater conditions to date. However, there are some areas of the county that currently lack access to surface water supplies and have experienced declining groundwater levels. Additionally, tree crop acreage has been increasing rapidly in recent years, and is likely to draw heavily upon groundwater and create a hardened demand in the future.

Cities and water districts have worked together in Yolo County for more than 20 years through the Water Resources Association of Yolo County (WRA), which has undertaken critical groundwater and subsidence monitoring activities over the years. Its role in undertaking these so-called “foundational actions” emerged through the WRA’s

preparation of an initial IRWM plan in 2007.[6] The WRA, in partnership with the Yolo County Farm Bureau and with support from DWR for facilitation services, has been playing a lead role to convene a series of public meetings as well as smaller discussions among GSA-eligible agencies. Even prior to SGMA's enactment, leadership within the WRA – in particular, the Yolo County Flood Control and Water Conservation District – has conducted outreach to local entities across the county through individual meetings and presentations at board meetings.

Although several local agencies submitted early GSA notifications, these entities have been participating (along with GSA-eligible agencies) in discussions, and the discussions aim to create a single GSA for the basin. The GSA structure being explored in Yolo County attempts to balance the need for local control with the benefits of coordination at a larger scale. Because the WRA already plays a convening role and conducts well-established monitoring activities, it is currently anticipated that the WRA would be re-formed as a JPA so that it could assume the role of a GSA (currently, the WRA does not meet SGMA's requirement that GSAs be a public agency with water or land use management responsibilities). However, in order to ensure that local agencies are able to retain as much control as possible over how they manage groundwater use, five "management areas" would be created, generally reflecting areas with distinct groundwater uses and conditions. The concept currently being discussed involves granting management areas a significant role in determining fees and other requirements that would directly affect groundwater users. The larger GSA, whose governance would be composed of representatives from each of the five management areas, would take on monitoring, reporting and other tasks benefitting from economies of scale. Yolo County's approach draws upon the Local Implementing Agency (LIA) model, recently described in a white paper produced by the CCP (CCP, 2016).

Upper Ventura. Located within the Ojai Valley in Ventura County, this small, medium-priority subbasin is a critical source of water for agricultural, municipal, and environmental uses in the Ventura River watershed. This area is entirely supported by local water sources, and groundwater represents about half of all water use. Pumping from private wells for agricultural and domestic use accounts for a significant amount of groundwater use. The interconnection between groundwater and surface and subsurface water in the Ventura River is an important consideration in managing this subbasin, particularly to preserve steelhead habitat in the Ventura River.

Beginning in the fall of 2014, the Ventura River Water District took the lead to create a GSA Formation Committee, which included the three other water purveyors in the area – Meiners Oaks Water District, the City of Ventura, and Casitas Municipal Water District, along with the County of Ventura. Representatives of agricultural groundwater pumpers as well as environmental non-profit organizations participated in numerous stakeholder meetings held throughout the GSA formation process. While each of the public agencies and stakeholders involved have strong and sometimes competing interests with regard to the management of this region's limited water resources, they have considerable experience in working with one another, particularly through the Ventura River Watershed Council

[6] The WRA now represents Yolo County in the larger Westside Sacramento IRWM region, but continues to update and utilize its own IRWM plan at the Yolo County scale.

(VRWC). Formed in 2006, the VRWC is one of three watershed committees that make up the Watersheds Coalition of Ventura County, which serves as the IRWM region for Ventura County.

The five-member GSA Formation Committee includes all of the public agencies with an interest in being actively involved managing this small subbasin. They decided relatively early on to work toward forming a JPA that would serve as a single GSA for the subbasin, and signed an MOU to that effect in May 2015. The Committee took a number of steps to ensure that the process was as inclusive as possible, including seeking facilitation support from DWR, provided through the Center for Collaborative Policy (CCP), and hiring an attorney to work on behalf of the group. The Committee also submitted a successful Basin Boundary Modification request that updated the subbasin's boundaries to match the latest scientific knowledge. This provided landowners with greater certainty about whether they would be inside or outside of the subbasin as the GSP process was being launched.

One significant question the Committee faced was how to include representatives of agricultural and environmental interests in the governance structure. The committee decided that their inclusion was important to the ultimate success of the GSP process, and the draft JPA, which is currently under discussion, includes two "Stakeholder Directors," appointed by the public agency members. The agricultural stakeholder director would be appointed based on nominations by the Farm Bureau of Ventura County, while environmental non-profit organizations in the area would submit nominations for an environmental stakeholder director. The voting rights of these directors would be largely the same as others, except for actions such as the addition of new members of the JPA that can only be taken by public agency members.

Basins within Tehama County. Tehama County covers almost 3,000 square miles, including all or portions of ten subbasins of the Sacramento Valley groundwater basin. Of these, seven are medium or high priority and are subject to SGMA. Tehama County Flood Control and Water Conservation District (TCFCWCD), for which the Tehama County Board of Supervisors serves as the governing body, has long played a role in groundwater management. It prepared its first countywide groundwater management plan in 1996; a Technical Advisory Committee (TAC) composed of representatives of local agencies and private pumpers was also established at that time. The plan was most recently updated in 2012, and the TAC continues to meet on a quarterly basis.

Given this history, the TCFCWCD announced its intent to serve as a county-wide GSA. During public meetings, representatives of cities and water districts expressed an interest to participate in the governance of the GSA. TCFCWCD held further meetings with other GSA-eligible entities, and developed the concept of a Water Commission that would play an important role in decision-making. Based upon the County's existing Planning Commission, the Water Commission will be composed of six representatives of major cities and water districts, as well as one appointed representative from each of the County's five supervisorial districts to represent surface water agencies, private pumpers, and one "at-large" representative. This consolidated approach was accepted in part because small cities and water districts, which otherwise would not have had the capacity to serve as GSAs themselves, now have a voice in decision-making.

TCFCWCD is in the process of accepting applications for the appointed representatives, and anticipates that the existing TAC for the AB3030 plan will continue to provide technical

inputs to the process. Like Butte and Sutter counties, Tehama County participates in the North Sacramento Valley IRWM process, which has promoted dialogue and collaboration among County staff working on SGMA implementation. For example, several of the counties worked together to advocate that DWR provide funding for a new land subsidence survey that will inform GSP development.

Examples of Coordinated (Multi-GSA) Basin Governance

Eastern San Joaquin Basin. Encompassing approximately 1,100 square miles, this subbasin covers portions of San Joaquin, Stanislaus and Calaveras counties, and is designated as both high priority and in critical overdraft. Since 2001, the Eastern San Joaquin Groundwater Basin Authority (GBA), a 13-member JPA, has undertaken management activities in the portion of the Eastern San Joaquin basin located within San Joaquin County, pursuant to a Groundwater Management Plan adopted in 2004. Since 2007, the GBA has also served as the regional water management group responsible for IRWM planning. The GSA formation process has built upon this foundation. In 2015, the GBA created the SGMA Workgroup, which includes GBA members as well as at least ten other GSA-eligible agencies, and is charged with developing an approach to complying with SGMA in the subbasin. San Joaquin County, which has been providing staff support to the GBA, convenes the Workgroup and has invested significantly in supporting the GSA formation process overall. The Workgroup has been meeting on a monthly basis for over a year, and DWR has provided funding for facilitation services to support this process.

While a strong history of collaboration and investment in groundwater management exists within this basin, many agencies have decided to form separate GSAs. At present, this basin is expected to have 10-15 GSAs, most of which will be individual cities, water districts and irrigation districts, but a few will be formed through MOUs involving multiple agencies. San Joaquin County will serve as a GSA for unmanaged areas, and is working on agreements with certain small water districts which do not want to establish their own GSAs due to their limited capacity. Interest in establishing separate GSAs appears to be driven a desire to ensure adequate representation of agency and/or landowner interests in the development of a GSP, distinctions between rural and urban interests, and a desire to maintain existing working relationships and management efforts.

Although the large number of GSAs suggests a fragmented approach, the monthly SGMA Workgroup meetings and considerable resources invested by the County to promote dialogue appear to be yielding a strong foundation for coordination among GSAs. The County has hired an attorney to support the effort, who has been working with the attorneys of GSA-eligible agencies as part of an "attorney workgroup" that reports back to the SGMA Workgroup. The County has also appointed an "ombudsperson," who is tasked with understanding each agency's interests and serving as a neutral sounding board.

Participants in the SGMA Workgroup have all agreed to work toward developing a single GSP for the basin, and have been exploring the possibility of creating a JPA including all GSAs in the subbasin as the mechanism to coordinate the development of a single GSP. A draft has been prepared for a JPA composed of the GSAs declared in the subbasin. This JPA would explicitly not be formed as a separate entity, and would have the specific purpose of coordinating the development of a single GSP for the basin. The draft JPA language is under review by the SGMA Workgroup. However, some have expressed concern that the JPA

would create potential liabilities and additional bureaucracy, and that it would be more difficult to include non-GSA eligible entities, such as the Farm Bureau and private water companies, in the development of the GSP. Another issue is the potential overlap in roles of this new JPA with the existing GBA. These issues are currently under consideration by the SGMA workshop. Many of the agencies involved are waiting to make a final decision about their GSA formation until the mechanism for basin-wide coordination has been more clearly determined.

Kings Subbasin. This basin encompasses approximately 1,500 square miles, and covers portions of Fresno, Kings, and Tulare counties. Kings Basin has experienced significant groundwater level declines for decades, and is designated as high priority and in critical overdraft. Numerous agencies in this basin have worked together through the Kings Basin IRWM process since it was initiated here in 2004. The Kings River Conservation District (KRCD), a multi-purpose agency that has actively worked with surface and groundwater users as well as environmental interests for decades, served as a convening entity in the IRWM process. KRCD has played a similar role in the GSA formation process. Key agencies signed an MOU in May 2015 to work together to engage in dialogue about how best to organize GSA formation for the whole basin, and have participated in frequent coordinating meetings hosted by KRCD.

Although the boundaries of the Kings Basin IRWM region match those of the groundwater basin and the IRWM process helped establish working relationships among many key players, participants in the discussions hosted by KRCD decided not to form a single GSA at the scale of the basin. Instead, there will likely be six GSAs, one representing a single irrigation district and five that involve multiple agencies. The multi-agency GSAs will take diverse forms; several will operate under either an MOU or JPA, and two have created new special act districts, pursuant to legislation approved by Governor Brown in September 2016.[7] One reason why some local agencies decided to create special act districts was that in the face of contention – a likely scenario in such a severely overdrafted basin – a special act district would not be subject to severability in the same manner as a JPA. Another was that a special act district accommodates the creation of positions on the board of directors for representatives of non-public entities such as landowners and unincorporated communities. While a JPA can be structured to allow for such representation through public agencies appointing board members, participants in the Kings River East process felt these arrangements were more subject to challenge, as compared to a legislated arrangement.

The boundaries of some of these GSAs are similar to those of existing AB3030/SB1938 Groundwater Management Plans. For example, the North Kings GSA and the Kings River East GSAs cover a similar area and involve many of the same partners as previous AB3030 plans. The Consolidated Irrigation District, which is serving as its own GSA, had also had its own groundwater management plan, as did James Irrigation District. The GSA boundaries also reflect some long-standing relationships, particularly among certain member agencies ("units") of the Kings River Water Association, who have coordinated surface water deliveries along the Kings River for many years. Their ability to coordinate access to

[7] SB 37 (Vidak) created the Kings River East Groundwater Sustainability Agency and SB 564 (Cannella) created the North Fork Kings Groundwater Sustainability Agency.

surface water – a critical resource for undertaking groundwater recharge – was one reason why these GSA groupings made sense. Another factor that agencies considered was their collective ability to raise funds to implement the management activities needed to reach sustainability, recognizing that introducing or raising rates for groundwater use may trigger requirements to gain voter or property owner approval under Propositions 218 and 26. Some local entities felt that their chances of success in raising rates would be improved by working in collaboration with particular agencies, or by creating new governance structures, such as a special act district with a board representing key interests.

Moving forward, KRCD will continue to play a coordinating role as these GSAs are finalized and declared through notices to DWR. KRCD has submitted a request for facilitation services to support continued dialogue among representatives of the eight GSAs. A new MOU to guide basin-wide coordination is being developed, involving financial contributions from each GSA.

East Butte. This medium priority subbasin of the Sacramento Valley groundwater basin covers 415 square miles, falling largely within Butte County but also including the northern portion of Sutter County. Several water districts in Butte County have their own AB 3030 or SB 1938 groundwater management plans, and the County has its own plan for the areas outside of these districts. These water districts, cities, and Butte County have been working together on groundwater issues, particularly since as the County has undertaken significant groundwater modeling and monitoring activities in cooperation with local agencies. In addition, the County's Water Commission, which includes private pumpers as members, has provided an important forum for discussion.

The County began early, even prior to SGMA's passage, to conduct public meetings regarding the law's potential implications, and has encouraged local agencies to consider their options and file a GSA notice if they wished to do so (Kearns & West/Hydrometrics, 2016). As of September 2016, eleven entities within Butte County had filed GSA notices within the East Butte basin, including four cities, five water and irrigation districts, a local college, and the County. Another three have filed within Sutter County, for a total of 14 declared GSAs in the basin. Within Butte County, all GSAs currently have overlaps to resolve. County staff anticipates that many of the declared GSAs will ultimately decide to retain their GSA status as the June 2017 GSA formation deadline approaches. Although parties are aware they will have to work together at a basin scale, local agencies have pursued separate GSAs primarily in order to retain some degree of autonomy over their management actions.

The County, with facilitation support from DWR, has posted regular meetings to discuss how GSAs will work together at a basin scale. Following a model that emerged in neighboring Colusa County, Butte County has developed a committee including private pumpers and an environmental representative to advise on the county's GSA activities. Initially, all participants in the GSA formation process had indicated a willingness to work with one another on a single GSP for the basin, with the County government taking the lead on modeling, monitoring, and community engagement activities across the basin. This coordination would likely occur in the context of an MOU, which participants seem to prefer over signing a JPA. However, as of October 2016 the water districts, which had their own groundwater management plans prior to SGMA, have expressed their interest in developing their own GSP. If two separate GSPs are developed, agreement will need to be

reached on common data and methodologies, a coordination agreement will be needed. These discussions are still underway, and it is not yet clear whether this multiple GSP approach will ultimately be agreed upon.

Appendix C1: Coding Form Showing SGMA Requirements and Powers

Final Coding - SGMA
March 7, 2017

Bold text indicates "shall"; Regular text indicates "may"

Coding Scheme		SGMA	
Category	**Element**	**Coding**	**Reference**
Management goal	Overall objectives	**Achieve "sustainability" in medium and high-priority basins by 2040/2042**	10721 (u) , (v)
	Definition of sustainable or safe yield	**Sustainable Yield: "The maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result."**	10721 (v)
Types of impacts to be avoided	Overdraft	**Yes**	10721 (w)
	Reduction in groundwater storage	**Yes**	
	Seawater intrusion	**Yes**	
	Degraded water quality	**Yes**	
	Land subsidence	**Yes**	
	Depletions of interconnected surface water	**Yes**	
Interests represented	Overlying agricultural users	**Yes**	10723.2
	Overlying domestic well owners	**Yes**	
	Muncipal well operators	**Yes**	
	Public water systems	**Yes**	
	Local land use planning agencies	**Yes**	
	Environmental users of groundwater	**Yes**	
	Surface water users (if hydrologic connection exists)	**Yes**	
	Federal government	**Yes**	
	California Native American tribes	**Yes**	
	Disadvantaged communities (incl. those served by private domestic wells/small CSDs	**Yes**	
	Entities involved in monitoring groundwater elevations	**Yes**	
	Other	**Yes**	
Process for stakeholder involvement	Stakeholder outreach/communication	**Yes. GSAs are required to: Maintain a list of all interested persons; provide a written statement of how they can participate in GSP development; and "encourage active involvement of diverse social, cultural and economic elements of the population"**	10723.4
	Advisory committee (general)	Yes. GSAs may appoint and consult with an advisory committee in developing and implementing a GSP	10727.8
	Advisory committee (for special interests)		
Authorities	Conduct investigations (to assess water resource conditions)	Yes	10725.4 (a) and (b)
	Conduct inspections (of facilities, to confirm water use)	Yes	10725.4 (a) and (b)
	Acquire, sell and manage property	Yes	10726.2 (a)
	Import water (i.e., acquire water that originates outside of the basin)	Yes	10726.2 (b)
	Undertake water storage or groundwater replenishment programs	Yes **(but shall not alter existing conjunctive use or storage program except if it interferes with GSP)**	10726.2 (b)
	Buy, sell, or exchange water	Yes	10726.2 (c)
	Buy, sell, or exchange water rights	Yes	10726.2 (c)
	Distribute or deliver water	Yes **(but shall not deliver retail supplies within service area of public water system without that system's consent)**	10726.2 (d)
	Treat water to improve water quality	Yes - may transport, reclaim, purify, desalinate, treat or otherwise manage polluted water, wastewater, or other water	10726.2 (e)
	Impose well spacing requirements and/or operating regulations to minimize interference	Yes	10726.4 (a)(1)
	Limit extractions	Yes	10726.4 (a)(2)
	Limit construction, expansion or re-activitation of wells	Yes	10726.4 (a)(2)
	Establish groundwater allocations	Yes	10726.4 (a)(2)
	Authorize temporary or permanent water transfers	Yes	10726.4(a)(3)
	Establish rules for carryovers	Yes	10726.4(a)(4)
	Issue well permits	**No (except as authorized by county that holds this authority)**	10726.4(b)
	Well registration	Yes	10725.6
	Determine water rights	**No**	10726.8(b)
	Coordinate with land use plans	**Yes (shall ensure consistency with general plans)**	10726.9
	Promote water conservation	Not mentioned	
	Promote voluntary fallowing of agricultural lands	Yes	10726.2 (c)
	Exemptions for de minimus extractors	De minimus (< 2AFY) may be exempted from reporting requirements	10725.8 (e)
	Allocate groundwater storage space	Not mentioned	
	Right to engage in legal proceedings regarding groundwater	Not mentioned	
	Other		

Appendix C2. Completed Coding Form for Antelope Valley Basin

Final Coding - Antelope Valley	March 6, 2017		
Bold text indicates "shall"; Regular text indicates "may"			
Coding Scheme		**Antelope Valley**	
Category	**Element**	**Coding**	**Reference**
Management goal	Overall objectives	The Physical Solution is "intended to ensure that the Basin can continue to support existing and future reasonable and beneficial uses."	Judgment, II. 3.4, p. 7
	Definition of sustainable or safe yield	Safe yield: "The amount of annual extractions of water from the Basin over time equalt ot the amount of water needed to recharge the aquifer and maintain it in equilibrium, plus any temporary surplus." Native Safe Yield: naturally occurring groundwater recharge to the basin, including "return flows" from pumping naturally occurring recharge, on an average annual basis. Imported water return flows are not included in the Native Safe Yield. NSY = 82,300 AFY.	Judgment, p. 13, p. 10 and p. 15
Types of impacts to be avoided	Overdraft	Yes	Definition of "material injury" on p. 10 of the judgment; also, Statement of Decision 2015, Sec. IV.B.
	Reduction in groundwater storage	Yes	
	Seawater intrusion		
	Degraded water quality	Yes	Definition of "material injury" on p. 10 of the judgment
	Land subsidence	Yes	Definition of "material injury" on p. 10 of the judgment, see also Statement of Decision 2015, Sec. IV.B.
	Depletions of interconnected surface water		
Interests represented	Overlying agricultural users	Yes (not specified as ag or domestic)	Judgment 2015, Sec. 18.1.1, p. 44
	Overlying domestic well owners	Yes (not specified as ag or domestic)	Judgment 2015, Sec. 18.1.1, p. 44
	Muncipal well operators	Yes	Judgment 2015, Sec. 18.1.1, p. 44
	Public water systems	**Yes**	Judgment 2015, Sec. 18.1.1, p. 44
	Local land use planning agencies		
	Environmental users of groundwater		
	Surface water users (if hydrologic connection exists)		
	Federal government	Yes (non-voting)	Judgment 2015, Sec. 18.1.1, p. 44
	California Native American tribes		
	Disadvantaged communities (incl. those served by private domestic wells/small CSDs		
	Entities involved in monitoring groundwater elevations		
	Other		
Process for stakeholder involvement	Stakeholder outreach/communication		
	Advisory committee (general)	**Yes (producers, as part of Advisory Committee and Subarea Advisory Management Committees) - "authorized and directed"**	Judgment 2015, Sec. 19, p. 56 - 57
	Advisory committee (for special interests)		
Authorities	Conduct investigations (to assess water resource conditions)	**Yes. Watermaster Engineer is required to operate and maintain monitoring wells and other equipment needed to determine basin conditions.**	Judgment 2015, Sec. 18.5.6, p. 49
	Conduct inspections (of facilities, to confirm water use)		
	Acquire, sell and manage property		
	Import water (i.e., acquire water that originates outside of the basin)	Yes	Judgment 2015, 18.5.7, p. 49
	Undertake water storage or groundwater replenishment programs	Watermaster can enter into Storage Agreements with parties; parties cannot store water or extract stored water without a Storage Agrement.	Judgment 2015, Sec. 6.3 and Sec. 18.5.14
	Buy, sell, or exchange water	Yes	Judgment 2015, Sec. 18.5.7, p. 49
	Buy, sell, or exchange water rights		
	Distribute or deliver water	Yes (may deliver imported water)	Judgment, p. 49
	Treat water to improve water quality		
	Impose well spacing requirements and/or operating regulations to minimize interference	Yes, partly - may change point of extraction unless causes material injury.	Judgment, p. 43
	Limit extractions	Yes (ensure reductions to achieve rampdown to NSY); and Watermaster Engineer may curtail any party's production (except the U.S.) if necessary to avoid material injury to the basin, provided the Watermaster supplies the	