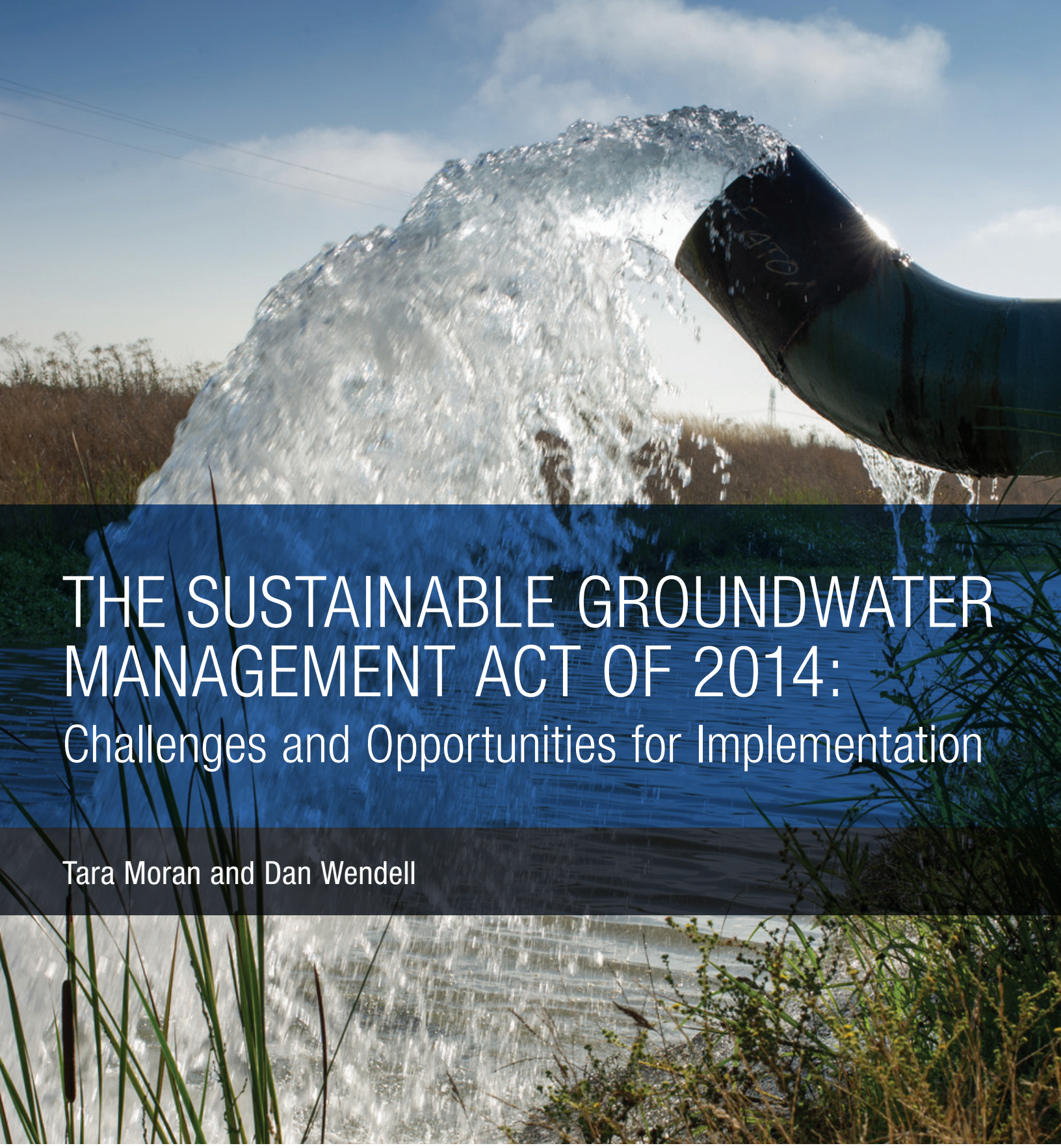

THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT OF 2014:

Challenges and Opportunities for Implementation

Tara Moran and Dan Wendell

WATER IN THE WEST

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About Water in the West

Water in the West is a partnership of the faculty, staff and students of the Stanford Woods Institute for the Environment and the Bill Lane Center for the American West. The mission of Water in the West is to design, articulate, and advance sustainable water management for the people and environment of the American West. Linking ideas to action, we accomplish our mission through cutting-edge research, creative problem solving, collaboration with decision-makers and opinion leaders, effective public communications and hands-on education of students. To learn more visit waterinthewest.stanford.edu.

About The Nature Conservancy

The Nature Conservancy is a global, non-profit organization dedicated to the conservation of the lands and waters upon which all life depends. Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives. We achieve our mission and vision by working collaboratively to develop field-leading science, demonstrate solutions at place and advocate for policies that enable conservation at scale.

About the Authors

Tara Moran

As Program Lead for Water in the West's Sustainable Groundwater program, Tara combines her passion for science with strong communication skills and a strong desire for practical groundwater management solutions. She identifies research opportunities for improved groundwater management and connects groundwater managers throughout California and the western U.S. with groundwater researchers at Stanford University. She also works with policy makers and other entities to advance policy for sustainable groundwater management.

Dan Wendell

As a Senior Scientist for groundwater and water resources with The Nature Conservancy of California, Dan focused on the environmental aspects of groundwater development, including impacts to ecosystems and river flows. In 2015, he became an independent water consultant with Groundwater Dynamics, Inc., and is profiling successful groundwater management agencies to identify common characteristics, especially as they relate to the implementation of the new groundwater law.

1. EXECUTIVE SUMMARY

In 2014, after three years of severe drought, the California legislature passed the Sustainable Groundwater Management Act (SGMA), creating a statewide framework for groundwater regulation in California. Prior to passage of SGMA, groundwater use in California was largely unregulated.[1] The unconstrained use of this resource has led to widespread lowering of water tables, drying of domestic wells, land subsidence and corresponding damage to infrastructure, increased energy costs from pumping from greater depth, the reduction or elimination of baseflow to streams and rivers, diminished water quality, and the loss of groundwater-dependent ecosystems.

SGMA presents a significant opportunity to address these impacts and ensure that groundwater resources are available to meet the state's long-term water needs. Developing solutions to support the successful implementation of SGMA will require a breadth of expertise. Local, state and federal governments and agencies will need to work closely with research institutions, policy centers, non-governmental organizations, trade associations, facilitators, groundwater users, and the public to develop robust and timely solutions that address all interests. Failure to do so may result in legal battles and continued degradation of groundwater resources.

Stanford University's Water in the West program, in partnership with The Nature Conservancy of California, hosted an Uncommon Dialogue[2] with groundwater managers, state officials, special interest groups, legal and policy experts, technical experts, land use planners, facilitators, and researchers to discuss the changing landscape of groundwater management in California. Held in January 2015, just four months after passage of SGMA, the dialogue identified challenges that local agencies are likely to face during SGMA implementation, plus potential short-term solutions to address these challenges.

This report is informed by discussion from the Uncommon Dialogue. A list of Dialogue participants and accompanying research agenda are included in Appendices A and B, respectively.

Uncommon Dialogue participants identified these eight key findings that could be undertaken in the next two to three years to streamline implementation of SGMA:

1. **Avoid fragmentation** — The state should work with local agencies to ensure that groundwater sustainability agencies (GSAs) are geographically expansive and able to develop coordinated groundwater sustainability plans (GSPs) that prioritize sustainable groundwater management across an entire groundwater basin.
2. **Early successes** — The state should identify local agencies throughout California that are making significant, early progress toward successful SGMA implementation and provide financial, technical and other resources to support these efforts.
3. **Case studies** — Research institutions, state agencies, and public policy centers should develop case studies from California, other states and other countries that can serve as examples of sustainable groundwater practices. An analysis of groundwater adjudications and special act districts could provide lessons on successful groundwater management relevant to SGMA.
4. **Conjunctive management** — Research institutions, state agencies, and public policy centers should identify basins where conjunctive management programs including groundwater storage, recharge and water markets are currently being used, and study the conditions necessary for their success.
5. **State intervention** — The Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB)

1 With exception to special act districts and adjudicated groundwater basins.

2 The term Uncommon Dialogue refers to moderated conversations, hosted by the Woods Institute for the Environment, its affiliated Centers or Programs, among researchers and government, non-governmental organizations and business leaders as well as experts from Stanford and other academic institutions to develop practical solutions to pressing environmental challenges, guide leaders in making informed decisions for a sustainable future and inform environmental research.

need to develop clear criteria for how the state will intervene and enforce regulations in groundwater basins not meeting SGMA mandates.

6. **Collaborative processes** — DWR and SWRCB should support the use of professional facilitators during SGMA implementation to ensure representative governance. They should work jointly with professional facilitators to develop best management practices for collaborative processes specific to SGMA and to create a collective learning repository and venue for sharing these lessons.
7. **Groundwater data** — DWR should work with federal, state, and local agencies, research institutions, and technical consultants during the development of regulations and best management practices (BMPs) for groundwater data collection, monitoring, and modeling. DWR and SWRCB should develop a database to support data collection, analysis and sharing.
8. **Funding and other resources** — The state should provide immediate, consistent, long-term funding to support implementation of SGMA. It should also provide local agencies with other tools and resources to develop their own long-term operating capacity.

SGMA presents local water agencies with significant opportunities and challenges. It is important that state and federal agencies, research institutions, policy centers, non-governmental organizations and other parties work collaboratively to understand these challenges and develop timely, relevant, and practical solutions that ensure the longevity of this important resource for all present and future groundwater users.

2. INTRODUCTION

This report is informed by the insights, lessons and key findings from an Uncommon Dialogue[3] co-hosted by the Water in the West and The Nature Conservancy of California, called "Identifying Challenges and Barriers in Implementation of the Sustainable Groundwater Management Act," held at Stanford University on January 27th and 28th, 2015. This document contains the authors' analysis of workshop findings and does not reflect the individual views of any particular participant. A complete list of Dialogue participants can be found in Appendix A.

3 The term Uncommon Dialogue refers to moderated conversations, hosted by the Woods Institute for the Environment, its affiliated Centers or Programs, among researchers and government, non-governmental organizations and business leaders as well as experts from Stanford and other academic institutions to develop practical solutions to pressing environmental challenges, guide leaders in making informed decisions for a sustainable future and inform environmental research.

3. DROUGHT AS A CATALYST FOR CHANGE

Summary

- Groundwater is an important part of California's water supply system supplying between 30 to 60 percent of the state's water supply depending on climatic conditions.
- Groundwater is commonly used in dry years to supplement reductions in surface water flows. However, our over reliance on the resource in the last several decades has led to long-term declines in groundwater levels in many parts of the state.
- Chronic declines in groundwater levels have been exacerbated by four years of severe drought.
- The severity of groundwater overdraft in many groundwater basins in California prompted the passage of the Sustainable Groundwater Management Act of 2014.

In an average year, water in California comes from three main sources: streamflow from mountain snowpack (~30 percent), water stored in reservoirs (~30 percent) and groundwater (~40 percent). As California endures its fourth consecutive year of severe drought (Diffenbaugh 2015) the availability of, and stress on, all three of these water sources are changing fundamentally.

Box 1. The Importance of Groundwater in California

- California receives an average of 200 million acre-feet (an acre-foot of water is enough to supply two to four families with enough water for a year) of precipitation each year (DWR 2013).
- Just over 70 million acre-feet of the precipitation flows to rivers and streams or infiltrates into groundwater aquifers where it can be used – the remainder is lost through evaporation and transpiration from plants.
- Between 2005 and 2010 groundwater supplied more than 16 million acre-feet per year or approximately 38 percent of the state's water supply (DWR 2013). This percentage increases to nearly 50 percent of the state's water supply during dry years and to nearly 60 percent in drought years (DWR 2013; DWR 2014a).
- There is broad regional variation in groundwater use across the state, which varies between 9 and 86 percent of the total water supply by hydrologic region.
- Agricultural, urban and managed wetlands account for approximately 76 percent, 21 percent, and 2 percent of all groundwater used in the state, respectively (DWR 2013).
- Many groundwater basins throughout the state manage groundwater conjunctively, drawing the aquifers down during dry years, when there are diminished surface water flows, and recharging aquifers during wet years (e.g., Santa Clara Valley Water District, Orange County Water District).
- Other areas of the state are experiencing chronic groundwater level declines. The California Department of Water Resources (2013) estimates that statewide overdraft of groundwater may be as high as 2 million acre-feet per year, with 1.4 million acre-feet year of that occurring from agricultural use in the Tulare Lake region and San Joaquin River region.

Springtime measurements of the Sierra Nevada snowpack in April 2015 reported an all-time historic low of 6 percent of average annual values. The previous low was 25 percent, which has been measured only twice—in 1977 and 2014—since 1940, when the state began taking these measurements. The lower-than-average precipitation and snowpack have lead to below average reservoir levels throughout the state and severe reductions in surface water deliveries to many water users throughout the state. In 2014, the Central Valley Project (CVP) delivered between zero and 40 percent of water allocations to its contractors. Despite less severe reductions in surface water deliveries in 2015, with CVP allocations between zero and 75 percent, 2015 will be the first time in the CVP's 75-year history that many agricultural water contractors will not receive CVP water in consecutive years.

A highly regulated surface water supply system combined with a largely unregulated groundwater system has increasingly led to over reliance on the state's groundwater supplies. During periods of drought, the state rations surface water deliveries. Because groundwater has been largely unregulated, water users commonly turn to groundwater to make up for this deficit. A study by Howitt et al. (2015) estimates that in 2015 growers will pump an additional 6.2 million acre-feet of groundwater to offset the 8.7 million acre-feet shortfall in surface water deliveries. Even with groundwater substitutions, the drought is expected to result in $2.7 billion in losses to the agricultural sector (Howitt et al. 2015). This cost estimate does not include long-term costs of groundwater overdraft.[4] Rather, the study focuses on the indirect and direct costs associated with the drought including: job losses (18,600 jobs in 2015), fallowed land (564,000 acres) and revenue loss from livestock and dairies ($350 million). These costs are expected to be significantly higher if the drought extends into 2016 and beyond (Howitt et al. 2015).

The length and severity of California's ongoing drought have indirectly contributed further to declines in groundwater levels observed throughout the state during the past several decades (DWR 2013). Unconstrained use of this resource has led to widespread lowering of water tables and the subsequent drying of domestic wells (DWR 2014a), land subsidence and the corresponding damage to infrastructure (Borchers et al. 2014), increased energy costs from pumping from greater depth (DWR 2013), the reduction or elimination of baseflow to streams and rivers (ELF v. SWRCB 2014), diminished water quality (Harter et al. 2012), and the loss of groundwater-dependent ecosystems (Nelson 2014).

The warm temperatures and lack of precipitation causing the present drought are expected to become increasingly common with climate change; in the coming decades, dry years are more likely to occur with warm temperatures (Diffenbaugh et al. 2015). The resulting uncertainties in surface water deliveries due to a diminishing snowpack and changing climatic conditions will likely exacerbate many of the challenges Californians are currently facing in achieving sustainable management of groundwater. In the fall of 2014, faced with historical low groundwater levels throughout the state and chronic groundwater overdraft in many groundwater basins, the California legislature passed the Sustainable Groundwater Management Act of 2014 (SGMA).

The authors would like to note that at the time of publication, clean up legislation (SB 13) amending portions of SGMA (SB 1168, AB 1739, and SB 1319) was being drafted. This legislation is expected to pass later in 2015.

4 Groundwater overdraft is the chronic lowering of groundwater levels over a period of years that never fully recover, even in wet years.

4. THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

Summary

- Passed in 2014, the Sustainable Groundwater Management Act requires all 127 high- and medium-priority groundwater basins in California to develop groundwater sustainability plans (GSPs) that achieve sustainability within 20 years of implementation.
- These 127 basins account for approximately 96 percent of the state's groundwater use and 88 percent of the population.
- GSPs must prevent "undesirable results" of chronic groundwater overdraft and consider the interests of "all beneficial uses and users of groundwater…."

SGMA creates a statewide framework for sustainable groundwater management, but leaves primary control in the hands of local entities. The Act mandates that local groundwater sustainability agencies (GSAs) develop groundwater sustainability plans (GSPs) to prevent "undesirable results" of chronic groundwater overdraft and other impacts, as well as to consider the interests of "all beneficial uses and users of groundwater … " These users include overlying property owners, municipal water purveyors (who typically have an appropriative, rather than overlying, water right), public water systems, local land use agencies, environmental users, surface water users, the federal government, Native American tribes in California, disadvantaged communities, and listed monitoring entities. We refer to these interests collectively throughout this report as stakeholders and/or interested parties.

"When properly managed, groundwater resources will help protect communities, farms and the environment against the impacts of prolonged dry periods and climate change."

All groundwater basins in the state must have formed a GSA or equivalent by June 30, 2017 or be subject to groundwater extraction reporting (Cal. Water Code § 5202-5204).[5] The legislation requires all high- and medium-priority groundwater basins (as defined by the California Statewide Groundwater Elevation Monitoring [CASGEM] Program) to develop and manage groundwater basins under a GSP by January 31, 2020, if subject to critical conditions of overdraft, or by January 31, 2022 (Cal. Water Code § 10720.7(a)).[6] GSAs have 20 years from the date of GSP implementation to achieve their sustainability goal.[7]

5 This report uses the term groundwater basin to refer to a groundwater sub-basin or basin as defined by DWR's Bulletin 118.

6 Low and very low-priority basins must develop a Groundwater Sustainability Agency (GSA) or report groundwater extractions annually, but are not required to develop and implement a Groundwater Sustainability Plan (GSP) (Cal. Water Code § 5202.2).

7 A sustainability goal under SGMA refers to the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the application basin is operating within its sustainable yield.

The Department of Water Resources (DWR) Bulletin 118 identifies 515 basins in the state, of which 43 are classified as high-priority, and 84 as medium-priority (DWR 2003). Taken together, these 127 basins encompass approximately 96 percent of groundwater use and 88 percent of population in the state. Remaining basins are classified as low- or very low-priority. Although the state encourages these basins to develop GSPs, their development is not required under SGMA. It is important to recognize that unconstrained pumping of groundwater in low and very low-priority basins in the future could lead to adverse impacts, something the current legislation does not address. Additionally, SGMA makes 29 "adjudicated areas" (basins) largely exempt from SGMA.[8] Legislative efforts to harmonize groundwater adjudications (SB 228 and AB 1390) with GSPs developed under SGMA are currently underway.

8 Adjudicated areas are required to submit annual water use reports, but are not required to develop a GSP.

5. DEFINING AND ACHIEVING SUSTAINABILITY

Summary

- SGMA requires all high- and medium-priority groundwater basins in the state to be managed to avoid "undesirable results" over the long-term.
- Defining "undesirable results" will require GSAs to work collaboratively with all groundwater users and representative stakeholders in a basin. Ensuring an appropriate, representative and inclusive GSA governance structure will be a crucial step in avoiding local litigation or state intervention.
- Deciding the management actions necessary to meet the sustainability goals of SGMA will require local agencies to make many difficult choices to decide, who will govern?, who will pump? and who will pay?

Fundamentally, SGMA requires local agencies[9] to form GSAs that will be responsible for the development and implementation of GSPs. The development of GSPs will require agencies to determine a basin's "sustainable yield" and then manage to achieve it. Doing this will require local agencies to make difficult decisions around three central questions: 1) who will govern?; 2) who will pump?; and 3) who will pay? Because SGMA does not make any changes to a landowner's water rights (Cal. Water Code § 10720.5(b), 10726.4(a)(2), 10726.8(b), 10735.8(h); see also § 5205, 5207, 10720.5(a), 10736.4) answering these questions will require local agencies within a basin to collectively develop science-based goals that consider the interests of all local agencies, stakeholders, groundwater users, and interested parties.

Local agencies in high- and medium-priority basins face the threat of state intervention if they are unable to form a GSA by the June 30, 2017 deadline or if they fail to make the difficult decisions required for GSP development and implementation by the required deadlines. The specter of such intervention may provide agencies with the motivation and long-term commitment necessary for SGMA implementation. In addition, this state backstop provides an incentive to move beyond stalemate in local conflicts. Local agencies can legitimately point out the politically unpalatable possibility of state intervention if local entities fail to act. Most will prefer to develop local solutions rather than accept state intervention and the possibility of worse outcomes.

9 A local public agency refers to any local agency that has water supply, water management, or land use responsibilities within a groundwater basin (DWR 2015).

Box 2. What is "Sustainable Yield"?

The term sustainable yield is central to SGMA and is defined as the "maximum quantity of water … that can be withdrawn annually from a groundwater supply without causing an undesirable result." Undesirable results are further defined as the one or more of the following effects caused by groundwater conditions throughout the basin:

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

This definition of sustainable yield allows for a range of management options that may not trigger adverse impacts. Determining where the threshold of acceptable impact lies will require GSAs to work collaboratively with local agencies, landowners, municipalities, groundwater users, interest groups and other interested parties to ensure all interests are taken into account. Failure to include stakeholders in groundwater management decisions could lead to impacts that are considered as "significant and unreasonable" by one or more groundwater users or interested parties. Failure to sufficiently address these impacts could result in local litigation or state intervention.

5.1 Who Will Govern?

The first major deadline for local agencies under SGMA is for the formation of GSAs, which are responsible for developing and implementing GSPs to meet sustainability goals. Meeting the deadline for GSA formation will require agencies to make a host of difficult decisions on various governance issues early in the process, including: identifying an existing local agency or agencies to serve as a GSA, or forming a new entity to fill that role; developing the governance structure between multiple GSAs that cover the same basin; defining the roles that each agency (or agencies) will play in developing, implementing and enforcing GSP development; evaluating the interaction between the physical boundaries of groundwater basins and GSA management areas; and engaging interested parties in the GSA formation process—which sets the groundwork and expectations for later engagement in developing the GSP. Most of these issues cross local political boundaries, and heighten the importance of jurisdictional cooperation.

SGMA allows a single or multiple GSAs to manage an entire groundwater basin, either through a single GSP or separate but coordinated GSPs. With approximately 2300 local agencies across the state currently involved in some aspect of groundwater management (Nelson 2012), it will be important that agencies work jointly to develop a governance structure that functions well on a basin level and is inclusive of all groundwater users and interested parties. SGMA, however, leaves open the possibility of fractured, poorly coordinated governance structures.

Local agencies may come together to create a single GSA and GSP to manage the basin in a coordinated manner. However, doing this may require some local agencies or districts to relinquish some aspects of water management over which they previously had control. In many cases local agencies will favor coordination agreements between agencies or with an entirely new agency. Doing so will require a great deal of up front effort and coordination. Agencies will need to work together to create processes that allow for coordinated GSP drafting and implementation, and that unite water users and other stakeholders in a basin around a single vision for groundwater management. Devoting the time and energy necessary to ensure that guiding processes, plans and charters

are transparent, clear and representative will help to achieve later success. If managed correctly, GSA formation can be used as an opportunity to develop trust between agencies and a common understanding of one another's underlying interests. These relationships formed during GSA formation will be important during GSP development and implementation and may help to ensure that the creation of multiple agencies does not lead to fractured governance.

Box 3. Ensuring a Representative Governance Structure

Ensuring appropriate representation of all groundwater users, stakeholders and interested parties in the decision-making process will be necessary for GSAs to avoid local litigation. As SGMA is currently written, GSAs may need to develop more flexible governance structures capable of providing additional flexibility in the decision-making process. Managed as a joint powers authority between four public agencies, the Sacramento Groundwater Authority (SGA) is an example of a creative governance structure enabling diverse representation. The SGA is comprised of four public agencies that collaboratively manage Sacramento region's North Area Groundwater Basin through a 16-member board comprised of representatives from 14 local water agencies, agriculture and self-supplied pumpers. The flexibility that this governance structure provides could enable GSAs to provide diverse representation of stakeholders in the decision-making process including agriculture, environmental groups, disadvantaged communities, investor-owned utilities and others.

SGMA recognizes the linkage between land use and groundwater management by limiting the eligibility of being a GSA to local public agencies with water management, water supply or land use responsibilities. This means that GSAs may be public water agencies/districts, counties and municipalities. Additionally, counties are presumed to be the GSA for unmanaged areas in a basin, placing counties in a position of being the local "backstop" before intervention by the State Water Resources Control Board (SWRCB). Water and land use agencies retain their existing authorities and responsibilities. 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. Regardless of how 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 plan. Doing so in a real and meaningful way will advance the integration of land use and water resource management.

5.2 Who Will Pump?

Under SGMA, GSAs have significant additional powers to manage local groundwater to achieve sustainability goals, including well registration, wellhead metering, monitoring, reporting, allocating groundwater production, assessing fees, and taking enforcement actions. In some basins, achieving sustainable management and avoiding undesirable results may be possible through enhanced groundwater recharge, conjunctive management, changes in land use, minor pumping reductions, or some combination of the above. Other basins, however, may require drastic reductions in groundwater extractions to achieve sustainability goals.

Groundwater adjudications and special act districts[10] in California have used a variety of supply- and demand-based solutions to bring their basins into safe yield (Blomquist 1992). While some groundwater adjudications have been costly and time consuming (Enion 2013), others have developed creative solutions that incorporated input from a breath of local stakeholder groups (e.g., Seaside groundwater basin, Six Basins groundwater basins). An analysis of past groundwater adjudications and special act districts to glean lessons pertaining to governance structures and groundwater extraction reduction strategies could be useful for developing GSAs and long-term sustainable groundwater management under SGMA.

Legislation (SB 228 and AB 1390) to coordinate groundwater adjudications and SGMA is currently in development. While these bills are in progress, the potential for adjudication could possibly delay SGMA implementation (Cal. Water Code § 10735.2 (d)). As a result, GSAs will need to work closely with groundwater pumpers within their basin when deciding how reductions in groundwater pumping will be met. Groundwater users that are required to reduce their pumping may believe the GSP violates their water rights and consider filing an adjudication to prevent the GSA from impairing their water rights.

Efforts to determine a basin's sustainable yield, which will ultimately serve as the basis for groundwater allocations and pumping levels, are complicated by the lack of data on groundwater inputs and extractions in most groundwater basins across the state. This topic will be discussed in the Adaptive Management and Numeric Models subsection (subsection 6.3) of the report. Inadequate groundwater extraction data will ultimately make it more difficult for GSAs to balance a groundwater basin's water budget. While SGMA authorizes GSAs to meter groundwater wells, many basins may be reluctant to use this power initially. As a result, the majority of GSPs developed under SGMA will need to answer the question of, "who is allowed to pump and how much?" in the absence of accurate groundwater pumping data. In many cases, this will requires GSPs to develop reasonable estimations for groundwater extractions. Ensuring that these determinations are defensible will be important to avoid litigation.

In some cases domestic pumpers,[11] who are largely exempt from metering and water use reporting under SGMA, may significantly contribute to a basin's groundwater withdrawals. Failure to adequately collect or estimate these withdrawals may hinder a GSA's estimation of supply availability. In these instances, basins may choose to develop an adaptive management[12] approach that enables them to modify a basin's sustainable yield as new information becomes available.

Box 4. The Role of Domestic or De Minimus Pumpers in SGMA

Domestic, or de minimus pumpers (extractors who pump 2 acre feet per year or less for domestic purposes) are largely exempt from the monitoring or pumping fee requirements of SGMA. In many basins throughout the state, however, domestic pumpers are likely to make up a significant portion of the overlying population. GSAs will need to develop creative methods for actively engaging this stakeholder group into the planning process of SGMA implementation. In many cases, this will be best achieved by utilizing advisory committees that include domestic groundwater users.

10 Special act districts are local agencies or districts, formed through special acts of the Legislature, with greater authority to manage groundwater.

11 The statute defines de minimus extractors as a person who extracts two acre-feet or less per year for domestic purposes.

12 Adaptive management refers to an inclusive, collaborative management approach that iteratively incorporates views, knowledge, and expertise from a variety of groups into management decisions (Pahl-Wostl 2007).

Given the lack of a formal representative body (other than a City Council or Board of Supervisors) overseeing or representing domestic groundwater users, GSAs may struggle to identify and engage domestic groundwater users in their basin. In some cases, Counties— through the elected Board of Supervisors—may be viewed as representing the broader constituency in a basin. Leveraging the experience and resources of County agencies could be valuable in engaging domestic pumpers, as many counties will have faced similar challenges during general plan and zoning amendment processes. Developing relationships with community leaders representing domestic pumpers early on in the SGMA process will be important in ensuring that these interests are represented in the groundwater planning process.

5.3 Who Will Pay?

Funding groundwater sustainability programs under SGMA will require a mix of state and local funds. SGMA provides GSAs with various tools that can be used to fund groundwater sustainability programs in their basins, including permit fees and groundwater pumping fees. Assessing new fees may be politically unpalatable for some agencies, and certain fees might be subject to litigation.

Groundwater pumping fees have been used to control extractions in a basin, and to fund aquifer recharge and other management activities by some agencies in California (e.g., Orange County Water District, Santa Clara Valley Water District). However, most of these agencies are urban with large population bases to fund management efforts. Many of the high- and medium-priority groundwater basins, particularly those in the Central Valley and on the Central Coast, are predominantly rural, with low population density and a lot of domestic groundwater use. These regions are likely to find it difficult to raise adequate funds to support long-term, sustainable groundwater management using pumping fees alone, and may require state financial, technical, or other assistance to meet sustainability goals.

Box 5. Funding Sustainable Groundwater Management in Agricultural Regions

The Pajaro Valley Water Management Agency (PVWMA) illustrates a number of challenges to funding management activities in an agricultural area. The area is almost completely dependent on groundwater and local growers are keenly interested in taxes and fees associated with groundwater management. Local special interests have defeated efforts to import water to the area and posed legal challenges to the district's fee structure that nearly bankrupted the agency.

In the PVWMA area, influential local stakeholders came forth to lead an effort to better listen and address local concerns. Results of these outreach efforts and collaborative problem solving allowed the agency to successfully increase fees through a Proposition 218 compliant effort and develop additional water resources. This time, the fees withstood legal challenges by local special interests.

The full effect of Proposition 218 on groundwater pumping fees is not settled. A recent decision by the Second Appellate District (City of San Buenaventura v. United Water Conservation District 2015) found that groundwater pumping fees are not property-related. As a result, these fees are not subject to the requirements of Proposition 218. These findings conflict with rulings made by the Sixth Appellate District's (Griffith v. Pajaro Valley Water Management Agency 2013; Great Oaks Water Company v. Santa Clara Valley Water District 2015). Decisions on how Proposition 218 applies to groundwater pumping will ultimately determine whether GSAs need to undertake the potentially lengthy public protest process. While the Second District specifically ruled that fees to fund "groundwater sustainability program[s]" under SGMA are not subject to the requirements of Proposition 218, this decision may change if the California Supreme Court chooses to address these conflicting rulings.

Box 6. What Is Proposition 218 and How Does it Apply to Water?

Passed in 1996, Proposition 218 amended Articles XIIIC and XIIID of the California Constitution to provide voters and taxpayers with control over taxes, assessments, and property-related fees or charges. Water rates are typically categorized as property-related fees and, as a result, subject to the "cost of service" requirements of Proposition 218. However, recent Appellate District decisions (City of San Buenaventura v. United Water Conservation District, 2015 and Griffith v. Pajaro Valley Water Management Agency, 2013) are at odds on this requirement and may prompt the California Supreme Court to resolve the issue.

6. UNDERSTANDING AND MANAGING GROUNDWATER BASINS

Summary

- Meeting the sustainable groundwater management goals mandated under SGMA will require GSAs to develop a comprehensive understanding of the basin's water budget and the many variables affecting it.
- Long-term groundwater monitoring networks will play a critical role in determining a basin's sustainable yield and evaluating their progress in attaining it.
- Numeric models will play an important role in long-term water planning. Ensuring model reliability, adaptability and a collaborative development process can help to improve understanding of the model for non-technical users and build trust around water planning processes.

SGMA states that, "[s]ustainable groundwater management is best achieved locally through the development, implementation, and updating of plans and programs based on the best available science." It requires the development of GSPs by January 31, 2020 or 2022. GSPs must include interim milestones and measurable objectives to achieve sustainable groundwater management within 20 years of GSP implementation.

Achieving these goals will require: (1) a comprehensive understanding of the groundwater basin, basin boundaries and flows across them, including spatial and temporal information on groundwater levels, groundwater quality, subsidence, groundwater-surface water interactions, water demands, and recharge areas; (2) a comprehensive groundwater monitoring network that is tied to quantifiable groundwater management objectives; and (3) a groundwater model that can be used to assess and adapt to changing land use, climate and hydrologic conditions.

In 2009, DWR implemented the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. This program categorizes each of California's 515 groundwater basins into one of four categories: high-, medium-, low- or very low-priority, based on eight criteria. Those criteria include overlying population, reliance on groundwater, the number of wells, and impacts on the groundwater system. CASGEM categorizes 127 basins as high- or medium-priority basins, which are required to develop GSPs under SGMA. Approximately 60 percent of all high- and medium-priority basins are fully monitored under the CASGEM Program. An additional 11 percent are partially monitored,[13] leaving nearly 30 percent of all high- and medium priority basins without adequate monitoring (DWR 2014b). If the 29 adjudicated actions listed in SGMA are removed from the basin prioritization list, nearly 40 percent of the basins requiring GSPs under the legislation lack adequate groundwater monitoring networks, as defined by the DWR CASGEM program.

13 Partially monitored: indicates a portion of a basin has a designated monitoring entity and is actively monitored in the CASGEM program, but the remainder of the basin is unmonitored.

Box 7. Managing for Sustainable Yield

It is useful to think of sustainable yield as existing along a sliding scale that varies from no groundwater pumping on one end to "safe yield" on the other. In the case of safe yield, water levels are typically maintained well below the bottom of streams, which maximizes basin recharge but also stream depletion. Under safe yield, no natural discharge remains to support groundwater-dependent ecosystems such as wetlands and perennial streams. This is the case in many adjudicated groundwater basins, where basins are operated at court-ordered safe yields and groundwater dependent ecosystems and perennial streams are rare or absent.

Implementation of sustainable management plans in basins that are not managed to the safe yield threshold presents unique challenges and opportunities. In these basins, agreement will need to be reached regarding how much natural discharge should be left for nature, and where this should occur. This represents the tradeoff between groundwater pumping and impacts to surface water and ecosystems and is important because the SGMA is specific in the need to prevent "significant depletions of interconnected surface waters."

The lack of data in these basins has serious implications for a GSA's ability to develop basin-wide GSPs and the required measurable management objectives. The lack of consistent, long-term groundwater monitoring data is also likely to impair the state's ability to effectively evaluate GSPs. The repercussions of the paucity of data in groundwater basins throughout the state are not isolated to the unmonitored or partially monitored groundwater basins. Many of these basins are hydraulically connected to neighboring basins, giving rise to concerns over basin boundaries, because unsustainable groundwater management practices in one basin could affect a neighboring basin.

6.1 Basin Boundaries

SGMA relies on using DWR's Bulletin 118 (DWR 2003) to define groundwater basins and sub-basins, although localities can apply to have those boundaries revised. DWR is in the process of developing the regulations for basin boundary revisions, which are to be adopted by January 1, 2016. It will be important that DWR carefully consider all applications for basin boundary revisions, to ensure that basins are not adjusted to jurisdictional/agency boundaries that could ultimately hinder sustainable groundwater management.

Box 8. Defining Basin Boundaries

The Santa Maria Groundwater Basin is an excellent example of the difficultly in determining groundwater basin boundaries. Over a year was spent during this groundwater adjudication defining the physical boundaries of the basin. In this case, even parties that did not want to be part of the process were included because the court held they were in the same hydrologic basin.

Bulletin 118 basin boundaries are not all coincident with the physical limits of groundwater flow. A key challenge under SGMA will be to deal with water budgets in connected groundwater basins, particularly in California's Central Valley. There, Bulletin 118 defines 45 groundwater sub-basins, each of which is part of fewer, larger basins. Ultimately, the majority of groundwater basins throughout the state will require some degree of coordination with neighboring basins to jointly monitor subsurface flows across those basins, especially where the physical extent of the main aquifer units does not coincide with the Bulletin 118 boundaries.

6.2 Groundwater Data, Monitoring and Advanced Technologies

Once basins are defined, GSAs will need adequate data to develop a baseline understanding of groundwater conditions throughout the basin, including: flows across basin boundaries, spatial and temporal information on groundwater levels, groundwater quality, subsidence, groundwater-surface water interactions, seawater intrusion, groundwater dependent ecosystems, water demands, and recharge areas. As discussed above, some of these data are being collected in high- and medium-priority basins throughout the state and protocols for their collection are well established. However, in many basins these data are lacking. It will be important that GSAs identify key groundwater management issues and develop groundwater monitoring networks that give priority to initial concerns, while continuing to reevaluate priorities and incorporate additional elements over time.

An integral component of GSPs is the development of measurable objectives and interim milestones that can be used to gauge an agency's progress toward meeting their sustainability goal(s) and avoiding "undesirable results"[14] (see Box 2). Given the inherent flexibility that the statute allows in the definition of undesirable results, agencies will need to work with all groundwater users and stakeholders within a basin to jointly develop measurable objectives and the accompanying thresholds and triggering management actions. Doing so will reduce vulnerability to legal challenges that may result if certain management actions are perceived as "significant and unreasonable." If data are not adequate to accurately define objectives and measure progress towards their sustainability goals, GSAs may face legal challenges.

SGMA requires that DWR develop regulations for evaluating and implementing GSPs by June 1, 2016 and best management practices (BMPs) for sustainable development of groundwater by January 1, 2017. It will be important that these regulations and BMPs find the balance between the amount and types of data necessary to make sound decisions for sustainable groundwater management, without creating unreasonable burdens on GSAs with respect to data collection, management and monitoring. Mining existing groundwater models and data sets, as well as the use of advanced technologies present a significant opportunity to (1) determine baseline data, (2) identify critical data gaps and prioritize areas for data collection, thereby saving both time and money, and (3) develop BMPs that maximize coordination between existing groundwater monitoring programs and models.

Large-scale geophysical methods are becoming an increasingly popular tool to gain information about subsurface conditions (Binley et al. 2015). These methods can be used for a breadth of groundwater management applications. They include, for example, the use of Interferometric Synthetic Aperture Radar (InSAR) to assess large-scale land subsidence patterns (For example in California: Sneed et al. 2013; Faunt 2009); measuring changes in hydraulic head (Reeves et al. 2011); estimating changes in groundwater storage from GRACE satellite data (Famiglietti et al. 2011; Famiglietti 2014); quantifying evapotranspiration from Landsat data using models like METRIC and SEBAL (Allen et al. 2007a; Allen et al. 2007b; Ahmad et al. 2006); tracing subsurface contaminant plumes (Gasperikova et al. 2012); and mapping freshwater and saltwater distributions in coastal aquifers (Pidlisecky et al. 2015).

In many instances geophysical methods can be used to complement existing groundwater monitoring networks (Kowalsky et al. 2011). Borehole and surface Nuclear Magnetic Resonance can provide models of subsurface hydraulic properties using existing wells, or non-invasively by laying cables on the earth's surface (Walsh et al. 2013; Dlubac et al. 2013; Knight et al. 2012). The continuous nature of the data that some geophysical methods provide can be useful in determining whether new monitoring wells are necessary. For example, electrical resistivity imaging was used to demonstrate the need for additional seawater intrusion monitoring wells in Orange County Water District. Such continuous data can optimize operations, or be used to site groundwater recharge ponds, as is currently being done in Pajaro Valley. Field trials with local agencies to test geophysical methods and determine the groundwater management decisions under SGMA that are most suited to their use will help ensure that limited funds are optimized.

14 SGMA defines an undesirable result as a "significant and unreasonable" depletion of groundwater supply, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence interfering with surface land uses, and the depletion of interconnected surface water impacting the beneficial use of surface water users.

6.3 Adaptive Management and Numeric Models

Changing environmental, social, technological and political conditions have made it increasingly difficult for natural resource managers to predict and plan for the future (Pahl-Wostl 2007). Transitioning from a "top-down" control-oriented management style to a more collaborative management structure capable of learning from and adapting to new information is a central component of adaptive management (Williams and Brown 2012).

Numeric models[15] provide a unique opportunity in the adaptive management process, allowing resource managers to "test" the impact of uncertainties in resource management behaviors and to guide investigations through basic research and learning-oriented management interventions (Williams and Brown 2012). The quality of these models, and their collaborative use in the water planning process will play an important role in the success of SGMA.

In order to understand the impacts of groundwater planning and management decisions over the 50-year time period that SGMA requires,[16] GSAs will need to develop numeric models that enable them to adapt management strategies in the face of uncertainty.[17] These models can be used at various phases of groundwater planning to meet different needs. In the early phases of plan development, models can be used to guide the development of alternate scenarios. Later, models can help evaluate alternatives and analyze how each performs under different conditions.

Coordinating modeling decisions among agencies will be essential to the development of long-term, consistent groundwater management goals. Decisions include the determination of numeric models and data projections, as well as the data collection, monitoring and sharing protocols on which they rely. Using a common numeric model for basin-wide water management decisions may help to alleviate issues of "dueling experts" as well as potential issues of data and model compatibility. Such coordination can promote a shared understanding of the numeric model and its data requirements and underlying assumptions and limitations. Using a common model may also encourage collective decision-making for long-term groundwater management. There are, however, barriers to this goal. Many agencies will have invested resources into the development of groundwater models for their jurisdiction, and may resist adopting different models. Also, numeric models can lack transparency. As a result, non-expert water users and other stakeholders may feel prone to distrust models, especially when the models support decisions that adversely affect their interests. Including non-technical users in the numeric modeling process can help to alleviate some of these concerns and build trust around water planning processes (Emerson et al. 2012). This topic will be discussed further in the Creating a Collaborative Planning Process section (Section 8) of the report.

The process by which numeric models are chosen, explained, and used is therefore critically important. Technical advisory committees (TACs) are likely to play a critical role in this cross-basin coordination process. More broadly, TACs are also likely to play an important leadership role in ensuring an adaptive management approach that allows stakeholders to learn iteratively, and to contribute as new data and information is integrated in the model over time. Similarly, TACs have a role to play in teaching non-technical stakeholders and the public to interpret numeric model outputs.

15 We use the term numeric groundwater models to refer to a computer model that solves groundwater flow equations. These models can be used to simulate different groundwater management decisions by changing the input data or model assumptions (Reilly and Harbaugh 2004).

16 The sustainability goals in SGMA define "undesirable results" as "significant and unreasonable" impacts resulting if continued over the planning and implementation horizon (a 50-year time period).

17 Williams and Brown define four main types of uncertainty in natural resource management. These are: 1) environmental variation – fluctuations in the physical environment; 2) unintended outcomes - the difference between the intended results of a management decision and the actual results; 3) partial observability - our inability to understand the resource system holistically and completely; and 4) structural uncertainty – an incomplete understanding of social structures.

Box 9. Management Strategies For the Future

An increasing population base and more extreme climatic events are likely to make the management of water resources increasingly challenging. Water managers will need to diversify their management portfolio as a means of increasing their system's resiliency to changing economic, climatic, technological and social futures. Some management strategies include:

Regional management of water supplies enabling joint investment in mutually beneficial projects, lower transaction costs for water trades between users, and increased system efficiency.

Conjunctive water management, which jointly manages surface and groundwater resources, enabling water managers to store excess surface water in the ground during wet years for use during dry years. Some agencies practicing conjunctive management in California are Orange County Water District, Santa Clara Valley Water District and Sonoma County Water Agency.

Adaptive management strategies are increasingly being used by water managers to make management decisions in the face of uncertainty (see above) (Williams and Brown 2012). Adaptive management strategies often require agencies to shift from a "top down" management approach to a more inclusive, collaborative management style that iteratively incorporates views, knowledge, and expertise from a variety of groups into management decisions (Pahl-Wostl 2007).

Decision Support Tools (DSTs) or collaborative models integrate technical computer models with process and facilitation skills to guide stakeholders through complex management decisions involving scientific data. During the collaborative modeling process, representative stakeholders, decision makers and scientific experts work jointly to develop and test a model that is representative of the system they are trying to manage and make collaborative decisions that maximize benefits for all parties.

Finally, basins should aim for an adaptive management approach, where initial forecasts and analyses based on numeric modeling during the planning stage are updated regularly as new information becomes available and gaps are filled. Such adaptive management is possible only with sufficient, coordinated baseline data and ongoing monitoring that iteratively informs decision-making (EPA and DWR 2011).

Basins may be required to make difficult choices between investing in ongoing monitoring versus an initial investment to improve baseline data. Frameworks for long-term, integrated groundwater monitoring networks have been developed as part of the National Groundwater Monitoring Network. These frameworks may help agencies balance their choices to best achieve their long-term objectives (ACWI 2013). Without continual monitoring, it will be difficult to evaluate the success of the GSPs. Therefore it will be important for both GSAs and the state to identify key groundwater management issues and develop groundwater monitoring networks that set priorities for initial concerns, while continuing to reevaluate priorities and incorporate additional elements over time.

7. BALANCING THE WATER BUDGET

Summary

- Maximizing recharge and conjunctive use will play an important role in basin management under SGMA.
- Addressing groundwater overdraft issues using "supply side" solutions will become increasingly difficult as abundant, relatively cheap supplies of imported water are no longer available, and competition increases for limited supplies of wastewater.
- Water markets and other economic tools may play an important role in establishing limits and ascribing value to groundwater resources.

Achieving sustainable groundwater management under SGMA will require local agencies to develop and implement sustainable, balanced water budgets within their groundwater basin. Maximizing recharge and basin yield through protection of natural recharge areas, the development of recharge facilities, and conjunctive use will play an important role in basin management moving forward. Moreover, such strategies help to minimize cutbacks in groundwater pumping levels.

Protecting natural recharge locations is one of the most cost effective means of achieving long-term groundwater recharge to groundwater basins. This will require broad regional coordination in many groundwater basins throughout the state because many groundwater basins are isolated from their main sources of recharge. This is particularly true in the Central Valley, where recharge to many of the groundwater basins occurs predominantly in the foothills of the Sierra Nevada Mountains, far from the where the water is withdrawn. A newly formed GSA may have no authority over the areas that provide recharge to its aquifer, or portions of its aquifer. Developing a more regional approach to groundwater management that identifies and prioritizes the protection of recharge zones should be a priority in the development of GSPs.

In order for conjunctive use to be sustainable, many groundwater basins will require a fundamental change in the way that water agencies manage water during both wet and dry years. Agencies will need to commit to "bank" or store water during wet years to replenish basins for use during dry years. Managing basins conjunctively is a much less expensive approach to increasing water storage than is the construction of surface water reservoirs (Perrone and Rohde 2014). Despite the cost savings associated with groundwater storage, raising adequate financial resources to fund groundwater recharge projects will take time and require long-term commitment and vision. GSAs that develop these basin management goals jointly with ratepayers will ensure they are transparent and equitable, and ultimately that they improve the system's resiliency.

Box 10. Funding Conjunctive Use

The Orange County Water District (OCWD) is an example of a successful groundwater management agency in an urban environment. OCWD has been conducting conjunctive use on a large scale since the early 1950s, and that has allowed OCWD to more than double the yield of the basin. Conservation and increased use of reclaimed wastewater have decreased OCWD's reliance on imported water, increased local control of water supplies, and increased overall supply reliability.

The majority of OCWD's $200 million annual operating budget is devoted primarily to groundwater recharge operations. The main source of revenue is a "Replenishment Assessment," commonly referred to as a "pump tax," levied on the amount of water pumped. In 2014 the Replenishment Assessment was $294 per acre-foot. Any pumping above the "Basin Production Percentage," set annually at approximately 75 percent of total extraction volume, is charged a "Basin Equity Assessment." This brings the cost of pumped groundwater in line with that of imported water, and effectively discourages overdependence.

Addressing groundwater overdraft issues using "supply side" solutions will become increasingly difficult as abundant, relatively cheap supplies of imported water are no longer available, and competition increases for limited supplies of wastewater. Many areas will need to make difficult decisions to reduce groundwater pumping and associated consumptive use in order to achieve hydrologic balance and meet mandated sustainability goals. Stakeholder involvement in these decisions will be crucial to finding a pumping reduction strategy that achieves the legislative requirements and enables local economies to adapt to reduced extractions, while avoiding litigation. Indeed, a key benefit of the long time horizon for implementation of GSPs, approximately 20 years, is the ability to phase in these changes so that economic and social disruption is minimized.

Conjunctive management programs have been critical to the sustainability of many basins in California. And advancing conjunctive management will be important for the success of SGMA. Thus, programs, policies and funding should be developed to assist GSAs in advancing groundwater storage and recharge.

Additionally, the expansion of existing water markets may provide a valuable groundwater management tool in some basins. For example, in areas where pumping cutbacks are needed to bring the basin back into hydrologic balance, the development of a "cap and trade" water market could provide an economic tool to help apportion groundwater pumping within the sustainable yield of a basin. Some may pay to pump beyond the cutback for their areas, while compensating those who volunteer to cut back on their pumping. However, in order for market-based solutions to be successful long-term, GSAs will need to provide groundwater users with a "defined unit of use" that can be transferred between parties.

8. CREATING A COLLABORATIVE PLANNING PROCESS

Summary

- Sustainable groundwater management is as much an exercise in social problem solving as it is about technical solutions.
- Approaches to resolving conflicts that arise during implementation of SGMA are likely to vary widely, from local negotiations and voluntary plans to classic court adjudications.
- Collaborative processes have been shown to result in creative, innovation arrangements with an improved capacity for adaptation. Investing in these processes early and with a genuine commitment to collective learning may help agencies to maintain local control of groundwater resources while avoiding the courtroom.

Given the fundamental importance of water to all aspects of life, there has been a growing recognition of the need for collaboration and stakeholder engagement in water resource planning (Bourget 2011). These values are reflected in SGMA through mandated coordination between GSAs where applicable, throughout an entire groundwater basin, and among cities and counties covered by GSPs, as well in the consideration of "all beneficial uses and users of groundwater." These limited mandates, however, will not be enough to ensure that all communities regulated under SGMA broadly support GSPs. Significant upfront investment of funds and time, as well as a firm commitment to relationship building will be required by all parties if collaborative processes are going succeed and result in meaningful changes to the groundwater planning process. Learning from and incorporating elements from other successful natural resource management processes, such as surface water management (OASIS, WEAP, Shared Vision Planning), and collaborative ocean planning (SeaSketch), may improve community support for GSPs developed under SGMA, particularly in areas that require significant groundwater pumping reductions to achieve sustainable yield.

Many agencies will benefit from the use of a third party professional mediator or facilitator[18] during SGMA implementation, particularly during GSA formation. Many decisions and negotiations that take place during this process are likely to be complex and time consuming, and they may take place between agencies who have little or no existing relationship, or even hostile relationships. Facilitators can assist with jointly developing communication strategies and timelines, as well as assign roles for all agencies involved in governance of a basin. Addressing these functions can alleviate concerns about the expectations of individuals and agencies as they move through the GSA formation processes and, ultimately, the groundwater planning and implementation process.

Additionally, given the required level of stakeholder engagement under SGMA, it will be important for agencies to begin the process of identifying, communicating with, and engaging stakeholders early and iteratively. Facilitators can help with GSA formation by performing a stakeholder assessment to help local agencies develop an outreach and engagement plan that is comprehensive, inclusive, and feasible. These actions may help to mitigate conflicts and legal challenges that may arise during development of GSPs (see Box 10).

18 Technically, a mediator is a neutral person who helps parties in a dispute reach agreement. A facilitator supports a group to work more effectively, for example by designing meetings or capturing "group memory." In environmental decision making process, the roles of mediators and facilitators can become blurred. We have not made a strict distinction in this report; however, we note the distinction here, as it may become important to individual agencies defining the kind of outside help they could best use.

Box 11. Ways Facilitators Could Help In SGMA Implementation

During GSA Formation

- **Governance Structure**— Help coordinating agencies develop a representative governance structure and determine best fit for their basin.
- **Convening Documents**— Develop convening documents, charters, a communication plan, and establish engagement and communication protocols.
- **Engage Interested Parties Effectively**— Perform a stakeholder/situation assessment to provide information on stakeholders, their values and interests, and basin history. This information can be used to anticipate and mitigate conflict, identify opportunities and common ground between stakeholders, and identify the most effective engagement, communication and information sharing forums.

During GSP Development

- **Develop Data Collection Goals and Protocols**— Develop data collection and modeling protocols jointly to ensure transparency and a common understanding among stakeholders.
- **Joint Fact Finding**— Work collaboratively with all agencies and stakeholders to define research questions and identify areas requiring additional data or research. Develop a common understanding and language to serve as basis for discussion water management issues.
- **Consensus-based Decisions**— Work with representative stakeholders to agree on process and negotiate GSP development.
- **Engage Interested Parties Effectively** — Support the GSA in its public engagement strategy. Ensure GSAs use the input and feedback received through public engagement to inform GSP development, implementation, and associated decision-making.

* Table from Moran and Cravens (2015)

Developing basin-wide collaborative processes will enable agencies to collectively identify groundwater management priorities and pool their resources to meet these goals, ultimately resulting in regional self-sufficiency and drought resilience. Advancing a shared vision of sustainability for an entire groundwater basin will require GSA to provide venues for stakeholders to listen, learn and provide input and feedback. These venues may take various forms including social media groups, public meetings, small group or personal interviews and advisory councils. Keeping stakeholders actively engaged throughout the GSP development process will require that GSA integrate feedback from stakeholders into groundwater planning decisions in a meaningful and transparent manner. The communication and engagement strategies developed during the GSA formation process will help to guide stakeholder engagement processes. However, these processes and protocols may need to be refined as GSAs transition to GSP development and implementation, which has a more active stakeholder participation component. Developing an effective stakeholder engagement process that includes all interests in some manner is essential. However, the exact approach will vary depending on the specific basin's circumstances.

Collective development of protocols for data collection, management, and analysis, as well as the coordination of data projections and numeric models between agencies, are likely to play an extremely important role in proactively managing the "dueling expert" dynamic. Conflict resolution practice presents well-accepted methods for doing this, using methods that are designed to produce information that all parties trust. These methods include, for example, joint fact-finding, where parties agree about the questions they need to have answered and together commission independent parties to conduct those studies (Ehrman and Stinson 1999).

Other options include the development of basin advisory councils, depending on an individual basin's goals and challenges. Collaborative processes take time, energy, and a long-term commitment to their development (Heikkila and Gerlak 2014). However, here in California and elsewhere they have been shown to result in creative, innovative arrangements with an improved capacity for adaptation (Blomquist 1992; Dietz et al. 2003; Blomquist 2006). Investing in collaborative processes early and with a genuine commitment to learning will be key for these processes to be successful under SGMA.

9. FUNDING AND RESOURCES

Summary

- Successful implementation of SGMA will require significant social and financial resources, as well as a breadth of expertise.
- Meeting the financial requirements of SGMA will require consistent funding opportunities from the state, as well as long-term strategies for GSAs to implement rate structures and pumping fees leading to self-sufficiency.
- Building capacity at all levels of management will be essential.

Successful implementation of SGMA requires local agencies to 1) facilitate GSA formation, including the development of a representative governance structure, guiding documents and charters, inter- and intra-agency coordination agreements, and the engagement of interested parties and other stakeholders; and 2) develop and implement a science-based GSP that is coordinated with land use agencies and municipalities, and that seeks the input of all groundwater users and interested parties. Accomplishing these tasks by the mandated deadlines will require local agencies to access a breadth of expertise and to deploy financial resources and considerable staff time.

Proposition 1, passed in 2014, includes $100 million in funds for the development and implementation of groundwater plans and projects. Meetings are currently underway to determine how these funds will be distributed. A portion is likely to be available for GSA formation. Money from Proposition 1 presents a significant opportunity for local agencies to acquire funding to help in GSA formation and GSP development and implementation. However, given that there are ~100 high- and medium- priority groundwater basins throughout the state that are required to develop GSPs, these funds will likely be inadequate. GSAs, and the local agencies behind them, will have to develop a short-term plan to fund aspects of GSP creation, and a long-term plan to fund groundwater management under the GSP. Adequate, consistent state funding, particularly during the initial SGMA implementation phase, will be crucial to ensuring its long-term success.

DWR will play an important role in ensuring the successful implementation of SGMA through technical and non-technical agency support. Technical support from DWR will be available in various forms, including the development of regulations and best management practices for sustainable groundwater management, the Groundwater Information Center, ongoing development of the CASGEM system, updates to Bulletin 118, groundwater basin assessments, and identification of alternative water supplies (DWR 2015).

In May 2015 DWR announced facilitation support services to connect and fund professional facilitation services for local agencies. The Facilitation Support Services program provides various services including: strategic planning; stakeholder identification assessments, outreach and mediation; meeting facilitation; governance assessment; and public outreach. Funds will prioritize groundwater basin-wide planning efforts with a particular emphasis on assisting local agencies seeking resolution of contentious GSA development or GSP development issues. These issues may include basin boundary changes and developing governance structures.

Tapping the experience of, and learning from agencies that have already gone through the GSA formation (or are further ahead in the process) may be another effective way of supporting agencies through the process. Agency mentoring and document sharing could facilitate collective learning from these processes. One method of facilitating information exchange could be to tie the DWR Facilitation Support Services to a commitment to mentor other agencies through the GSA formation process, by providing them with relevant documents, examples and insights. Also, DWR could develop a learning repository where document templates, guidebooks and case studies of successful processes developed by agencies may be accessed. Such resources could guide late-developing agencies through the process with minimal help from third-party facilitators.

Economic, practical, or other constraints may minimize access to professional, experienced facilitators and technical experts. In these cases, stakeholder engagement in SGMA implementation provides the potential to enlist a broad expert base from within the community, who may provide needed services through advisory councils or other guidance roles.

10. NEXT STEPS

Uncommon Dialogue participants identified these eight key findings that could be undertaken in the next two to three years to streamline implementation of SGMA:

1. **Avoid fragmentation** — The state should work with local agencies to ensure that groundwater sustainability agencies (GSAs) are geographically expansive and able to develop coordinated groundwater sustainability plans (GSPs) that prioritize sustainable groundwater management across an entire groundwater basin.
2. **Early successes** — The state should identify local agencies throughout California that are making significant, early progress toward successful SGMA implementation and provide financial, technical and other resources to support these efforts.
3. **Case studies** — Research institutions, state agencies, and public policy centers should develop case studies from California, other states and other countries that can serve as examples of sustainable groundwater practices. An analysis of groundwater adjudications and special act districts could provide lessons on successful groundwater management relevant to SGMA.
4. **Conjunctive management** — Research institutions, state agencies, and public policy centers should identify basins where conjunctive management programs including groundwater storage, recharge and water markets are currently being used, and study the conditions necessary for their success.
5. **State intervention** — The Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB) need to develop clear criteria for how the state will intervene and enforce regulations in groundwater basins not meeting SGMA mandates.
6. **Collaborative processes** — DWR and SWRCB should support the use of professional facilitators during SGMA implementation to ensure representative governance. They should work jointly with professional facilitators to develop best management practices for collaborative processes specific to SGMA and to create a collective learning repository and venue for sharing these lessons.
7. **Groundwater data** — DWR should work with federal, state, and local agencies, research institutions, and technical consultants during the development of regulations and best management practices (BMPs) for groundwater data collection, monitoring, and modeling. DWR and SWRCB should develop a database to support data collection, analysis and sharing.
8. **Funding and other resources** — The state should provide immediate, consistent, long-term funding to support implementation of SGMA. It should also provide local agencies with other tools and resources to develop their own long-term operating capacity.

SGMA presents local water agencies with significant opportunities and challenges. It is important that state and federal agencies, research institutions, policy centers, non-governmental organizations and other parties work collaboratively to understand these challenges and develop timely, relevant, and practical solutions that ensure the longevity of this important resource for all present and future groundwater users.

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APPENDIX A. PARTICIPANT LIST

Identifying Challenges and Barriers in Implementation of the Sustainable Groundwater Management Act

January 27 & 28, 2015 – Stanford University

PARTICIPANT LIST

Name	Organization Name
Melanie Askay	S. D. Bechtel, Jr. Foundation
Joya Banerjee	S. D. Bechtel, Jr. Foundation
Mary Bannister	Pajaro Valley Water Management Agency
Gary Bardini	DWR, Northern Region Office
Gina Bartlett	Consensus Building Institute
Dave Bolland	Association of California Water Agencies
Gordon Burns	Cal EPA
Bruce Cain	Stanford University, Bill Lane Center for the American West
Vanessa Casado-Perez	Stanford Law School
Dave Ceppos	Center for Collaboration Policy
Janny Choy	Stanford University, Water in the West
Jennifer Clary	Clean Water Action
Amanda Cravens	Stanford Law School
Erik Ekdahl	State Water Resources Control Board
Laurel Firestone	Community Water Center
Terry Foreman	Camrosa Water District
David Freyberg	Stanford University, Civil & Environmental Engineering
Paul Gosselin	Butte County Dept. of Water & Resource Conservation
Sargeant Green	California Water Institute, CA State University, Fresno
Maurice Hall	The Nature Conservancy of California
Ellen Hanak	Public Policy Institute of California
Rob Jackson	Stanford University, Environmental Earth Systems Science
Jay Jasperse	Sonoma County Water Agency
Ted Johnson	Water Replenishment District of Southern California

Name	Organization Name
Rosemary Knight	Stanford University, Earth Sciences
Jeff Loux	UC Davis Extension
Robert MacLean	California American Water
Felicia Marcus	State Water Resources Control Board
Janet Martinez	Gould Center for Dispute Resolution, Stanford Law School
Sandi Matsumoto	The Nature Conservancy of California
Russell McGlothlin	Brownstein Hyatt Farber Schreck
Dan McManus	DWR, Northern Region Office
Paige Miller	Stanford Woods Institute for the Environment
William Mills	Consulting Engineer
Rebecca Nelson	Stanford University, Water in the West
Tara Moran	Stanford University, Water in the West
Jonathan Parker	Kern Water Bank Authority
Tim Parker	Parker Groundwater Management
Debra Perrone	Stanford University, Water in the West
Jeff Pratt	Ventura County Public Works Agency
Jack Rice	California Farm Bureau
Lea Rosenbohm	Stanford Woods Institute for the Environment
Mary Scruggs	CA Department of Water Resources
Athena Serapio	Stanford University, Water in the West
Lester Snow	California Water Foundation
Brian Stranko	The Nature Conservancy of California
Leon Szeptycki	Stanford University, Water in the West
Buzz Thompson	Stanford Woods Institute for the Environment
Anna West	Kearns & West
Daniel Wendell	The Nature Conservancy of California
Mike Wehner	Orange County Water District
Clare Wildenborg	Stanford Woods Institute for the Environment
Kate Williams	California Water Foundation
Jay Ziegler	The Nature Conservancy of California

APPENDIX B. RESEARCH AGENDA

Below are potential research areas identified by participants at an Uncommon Dialogue on Challenges and Opportunities in Implementation of the Sustainable Groundwater Management Act of 2014. The Dialogue was co-hosted by Stanford University's Water in the West Program and The Nature Conservancy of California on January 27th and 28th, 2015.

For more information on the event please visit the Water in the West website at waterinthewest.stanford.edu. A list of acronyms is included on page 33.

Potential Research Areas for SGMA Implementation and Organizations Involved.

Top 5 Priorities – as identified by Dialogue participants

ITEM	ORGANIZATION INVOLVED AND/OR INTERESTED
1. Conduct a comprehensive analysis of groundwater recharge	
a. Recharge as a beneficial use	ACWA
b. Ownership of recharge water	ACWA
c. Recommendations for legal or policy changes to streamline or incentivize wastewater recharge	CWS
d. An assessment of urban stormwater for recharge and potential impacts on water rights and the environment	
2. Develop a guide to financing tools that could be useful for funding GSA and GSP development	
a. Analyze how different fee option, such as pumping fees, infrastructure fees, tiered-pricing, pump taxes, etc.	WitW
b. Determine Prop 218 compliance issues for fee options	
3. Perform a comprehensive analysis of solutions for groundwater conflicts	WitW
4. Overview of existing governance structures for forming GSAs	
a. Outline pros / cons of different governance structures	DWR, CLEE, OPR, CWF
b. Use Case Studies to show successes and failures	OPR, WASSRI
5. Track early successes and progress overtime	DWR, SWRCB

List of Acronyms

ACWA	Association of California Water Agencies
CBI	Consensus Building Institute
CCP	Center for Collaborative Policy, California State University Sacramento
CLEE	Center for Law, Energy & the Environment, University of California, Berkeley
CWA	Clean Water Action
CWC	Community Water Center
CWF	California Water Foundation
CWS	Center for Watershed Sciences, University of California, Davis
DWR	California Department of Water Resources
EDF	Environmental Defense Fund
GRAC	Groundwater Resources Association of California
OPR	The Governer's Office of Planning and Research
SC	Sustainable Conservation
SCWA	Sonoman County Water Agency
SWRCB	State Water Resources Control Board
UCS	Union of Concerned Scientists
WASSRI	Water Security and Sustainability Research Initiative, University of California
WitW	Water in the West, Standford University

Potential Research Areas for SGMA Implementation and Organizations Involved.

Top 5 Priorities – as identified by Dialogue participants

ITEM	ORGANIZATION INVOLVED AND/OR INTERESTED	NOTES
I. DEVELOP TOOLS TO SUPPORT GSA FORMATION		
1. Overview of existing governance structures for forming GSAs		
a. Outline pros/cons of different governance structures	DWR, CLEE, OPR, CWF	
b. Use case studies to shows successes and lessons	OPR, WASSRI	
2. Track early successes and progress overtime		
a. Highlight early success stories of GSA creation and SGMA implementation. Capture and share the reasons for the successes	DWR, SWRCB	State developing a data portal
b. Track the progress of GSA formation in different groundwater basins over time	DWR, SWRCB	
3. Develop a communications and engagement guide to identify, engage and educate stakeholders and interested parties		
a. Develop a stakeholder assessment survey to better understand groundwater user and interested parties	CBI, SCWA	
b. Identify tools or technologies that could be useful for promoting engagement and communication among a wide range of stakeholders	CWF funding CWA & UCS, CWC, GRAC, EDF, CWF	
c. Provide case studies from different sectors, particularly on engaging hard-to-reach stakeholders	CWF funding CWA & UCS, CWC, GRAC, EDF, CWF	
4. Develop a stakeholder assessment survey to better understand groundwater users and interested parties		
a. For use by individual basins		
b. For use throughout the state to develop a more comprehensive typography of different regions		
c. To determine what capacities are needed to effectively develop GSAs and GSPs, and strategies for developing those capacities		

ITEM	ORGANIZATION INVOLVED AND/OR INTERESTED	NOTES
II. DEVELOP TOOLS FOR GSPS		
1. Develop a technical guide for GSP planning and implementation		
a. Develop guidelines and/or BMPs for data collection and sharing, monitoring, and management	DWR, ACWA, WitW	
b. Develop criteria on minimum data requirements for the developing of sustainability goals	DWR, ACWA	
c. Develop guidelines for interim milestones and measurable objective, management triggers and corresponding actions	DWR, ACWA	
d. Develop guidelines and BMPs for groundwater models, adaptive management, and management tools used to achieve sustainability	DWR, ACWA, WitW	
2. Create best management practices (BMPs) for groundwater management		
a. Incorporate groundwater and surface water interactions in groundwater planning	DWR, ACWA	
b. Integrate land use planning and groundwater management in GSPs	DWR, ACWA	
c. Improve data collection, standardization, security and sharing	DWR, ACWA, WitW	
d. Determine how conflict resolution tools been used in pumping reduction scenarios	DWR, ACWA, WitW	
3. Develop a guide to groundwater models that helps agencies choose the most effective model for their management needs.	WitW	
4. Provide case studies of successes and failure in the development of groundwater management plans or sustainable groundwater levels		
a. These could be specific to California or from other states and countries	WASSRI	
5. Develop a guide for remote sensing and geophysical methods and their potential role for improved groundwater management and GSP develop and implementation	WitW	
6. Develop methods with existing data and technologies for tracking changes in groundwater storage on a weekly to monthly time scales for use in evaluating whether groundwater sustainability targets are met		

ITEM	ORGANIZATION INVOLVED AND/OR INTERESTED	NOTES
III. RESOLVING GROUNDWATER CONFLICTS		
1. Perform a comprehensive analysis of solutions for groundwater conflicts.		
a. Identify and explore the potential interplay between new adjudication and the SGMA	WitW	
b. Identify the causes of and solutions to conflicts in the adjudication process	WitW	
c. Study "friendly" adjudications and whether their key elements could be used be replicated in GSPs	WitW	
d. Examine different water master models and develop guidance on governance design	WitW	
e. Identify options for addressing the "dueling experts" dynamic in adjudications	WitW	
f. Identify ways to expand diverse representation in the adjudication process (i.e. environment, tribal, disadvantaged communities, etc.)	WitW	
g. Determine the need for a "streamlined" adjudication model		
h. Identify other options for addressing conflicts in allocation decisions	WitW	
2. Develop a "clearinghouse" for adjudications, GSP, research papers, etc.		
a. Allow these and other analyses to be searched, accessed, and used independently by water mangers, state agencies, lawyers, and others	WASSRI	
b. Analyze and disseminate the different tools that have been used to address specific management problems and disputes in past adjudications	WASSRI, WitW	
IV. ECONOMIC ANALYSES AND TOOLS		
1. Develop a guide to financing tools that could be useful for funding GSA and GSP development.		
a. Analyze how different fee options, such as pumping fees, infrastructure fees,, tiered-pricing, pump taxes, etc., could be used for different management outcomes	WitW	
b. Analyze Prop 218 compliance issues for these different options		

ITEM	ORGANIZATION INVOLVED AND/OR INTERESTED	NOTES
2. Develop a comprehensive guide to the resources1 that will be required to implement SGMA at the local and regional levels		
a. Conduct an assessment of funding sources for GSAs and GSPs, including available state funding and how to effectively transition from state grants to self-sufficiency		
3. Create a guide to groundwater markets	EDF	
a. Study the potential role that transferable groundwater allocation and other market tools could play in SGMA	EDF	
b. Recommend legal and policy changes necessary for successful water market loss	EDF	
c. Develop case studies and lessons learned from California, other state or countries, and other sectors	EDF	
4. Study the value of groundwater and how it varies geographically and over time	WitW	
V. SGMA IMPLEMENTATION AND OTHER POLICY AND LEGAL TOOLS		
1. Develop guides on collaborative processes for decision-making		For both GSA formation and GSP planning
2. Develop model local ordinances that support SGMA implementation.		This could include monitoring, metering, and property access
3. Highlight case studies from California and other states with strong integration of groundwater management and land use planning	WASSRI, WitW	
4. Conduct a comprehensive analysis of groundwater recharge		
a. Recharge as a beneficial use	ACWA	
b. Ownership of recharge water	ACWA	
c. Recommendation for legal or policy changes to streamline or incentivize wastewater recharge	CWS	As it relates to capturing winter flood flows and applying to activate farmland
d. An assessment of urban stormwater for recharge and potential impacts on water rights and the environment.		

For more information visit:
waterinthewest.stanford.edu

Water in the West
Stanford University
Jerry Yang & Akiko Yamazaki Environment
& Energy Building
473 Via Ortega, MC 4205
Stanford, CA 94305
waterinthewest@stanford.edu

WATER IN THE WEST

Stanford WOODS INSTITUTE for the ENVIRONMENT

STANFORD UNIVERSITY
THE BILL LANE CENTER FOR THE AMERICAN WEST