California
WATER COMMISSION

A State Role in Supporting Groundwater Trading with Safeguards for Vulnerable Users: Findings and Next Steps

January 19, 2022

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Executive Summary

In those parts of California where groundwater pumping has long exceeded replenishment, people are striving to bring groundwater basins into sustainable conditions within 20 years, between 2040 and 2042, as state law requires. In some areas, groundwater sustainability agencies – the local agencies tasked with sustainable groundwater management – are beginning to work with other entities and stakeholders to discuss and experiment with the idea of giving groundwater pumpers allocations – entitlements to remove a certain amount of water from a groundwater basin – and allowing them to either use their allocation individually or trade allocations between specified parties. Ideally, groundwater trading could ease the economic disruption of cutting back the overall amount of water pumped from a groundwater basin; growers who have less need for pumping could sell their allocation to others willing to pay for it. But the concept of groundwater trading raises many questions: How would wetlands, streams, and other ecosystems fed by aquifers be treated in a groundwater trading program? Would operators of farms who lack the resources of larger neighbors be able to benefit from trading? How might trading affect people who depend upon a household well or communities that need reliable groundwater supplies for homes and businesses? Who develops, implements, and oversees trading rules and for what purposes? There is a State interest behind all of these questions – and a clear need for a focused discussion about groundwater trading.

The Water Resilience Portfolio, finalized in July 2020 by the Newsom Administration, acknowledges that need, and in March 2021, State water leaders asked the California Water Commission (Commission) to utilize its public forum to gather expert and public input and investigate what role California agencies should take to support in-basin groundwater trading that protects natural resources, disadvantaged communities, and small- and medium-size farms as local agencies turn to groundwater trading as a flexible tool to help them bring basins into sustainable conditions.

Through extensive outreach and input that involved learning from the experience of others around the country and world, the Commission has framed the basic elements of well-functioning, protective groundwater trading systems. Those elements start with trust, access to accurate data, and a sound, well-implemented groundwater sustainability plan. Groundwater trading will only help achieve sustainable groundwater management in areas that have capped groundwater use; that have a system for tracking and accounting for groundwater levels, quality, and use; and that have allocated how much groundwater can be used by individual pumpers to reach a sustainable groundwater condition while avoiding undesirable results. Groundwater trading will not always be the best way to advance sustainable groundwater management, but where local agencies do attempt it, there will need to be robust involvement by all interested parties in a basin, clearly defined rules, and fair enforcement for the program to be long-standing and successful. Without good governance in place and a careful, thoughtful approach to groundwater trading, trading programs run the risk of not meeting their goals and creating negative, third-party impacts.

To protect the environment, farmers, and communities, groundwater trading programs should incorporate specific, locally relevant mechanisms, including allocations that grant these groundwater users sufficient access to groundwater to be viable, and trading rules, such as buffer zones or special management areas, that direct how and when trading occurs. These mechanisms must be informed through inclusive stakeholder engagement, selected and evaluated through a transparent process, modified as needed, and strongly enforced. No trading system will be instantly perfect – it will take time and vigilance for decision-makers to develop a program that meets local needs and complies with state

policies. The endeavor initially may be uncomfortable for many stakeholders. By starting with small-scale trading programs, groundwater sustainability agencies (GSAs) can more easily adapt their efforts, modifying programs to ensure that they are functioning efficiently without causing harm.

State agencies' authority to develop rules or oversee trading is limited by current law, but the Commission suggests that State agencies can play an important role in promoting groundwater trading with appropriate safeguards for natural resources, small-and medium-sized farms, and disadvantaged communities. A State role could include disseminating information about where groundwater trading is being considered or used in California, developing best management practices, providing technical and financial assistance, hosting forums to further understanding, and engaging stakeholders to better recognize their concerns and fill information gaps. State agencies should also stand ready to administer additional authorities if the State Legislature finds stronger oversight is needed.

It is the Commission's hope this white paper will provide Californians a broad overview of the potential promises and pitfalls of groundwater trading and chart possible next steps for State agencies. By moving forward carefully and deliberately, the State can help foster groundwater trading that builds water resilience for all stakeholders.

Introduction

In 2014, halfway through California's 2012 to 2016 drought cycle, the California Legislature passed the Sustainable Groundwater Management Act (SGMA), laying out a means of stewarding the state's groundwater resources in perpetuity. SGMA gives local GSAs the authority and responsibility to manage and allocate groundwater resources. SGMA requires that GSAs develop, submit to the Department of Water Resources (DWR), and follow groundwater sustainability plans (GSPs) that describe the groundwater basin setting, determine a groundwater budget, create management criteria for monitoring and evaluating sustainability, and outline projects and management actions that will bring the basin into sustainability. Groundwater trading is one voluntary tool that a GSA could decide to employ to aid in the management of groundwater and there is potential for groundwater trading to be used broadly across GSAs. Of the 46 GSPs submitted by the 2020 SGMA deadline, approximately 19 note that the submitting GSAs will be or are considering setting up a groundwater trading program. To date, several GSAs are already developing trading programs and the current drought may be hastening their timelines. Sixty-three of the non-critically overdrafted high and medium priority groundwater basins will be submitting GSPs to DWR in January of 2022; some number of these basins could also include in their GSPs the intent to use groundwater trading.

Localized, within-basin groundwater trading occurs when one entity sells its groundwater allocation to another. Water is not typically being moved: participants in groundwater trading programs are trading their ability to pump, moving the place where pumping is occurring, but not necessarily conveying water through a pipe or trucking water from one area to another. Groundwater allocations, or the permission to pump a specific amount of groundwater, are the basis of groundwater trading. GSAs have the latitude to determine groundwater allocations and should consider many factors when setting or changing allocations, including basin hydrology, water rights generally, and the goals of SGMA. Groundwater allocations by a GSA are not a final determination or modification of groundwater rights, but allocations, along with trading rules and other policies, may specify how much water may be pumped, when it can be pumped, and from where it may be pumped, as well as who can own an allocation, how many allocations one may own, where those allocations can be used, and more. In this way, groundwater management is similar to land use: while land ownership entitles the landowner to a bundle of rights, the ability to utilize those rights is restricted by zoning, building codes, and other regulations put in place to manage land responsibly. The creation and modification of allocations is complicated and will likely be fraught, occurring in the shadow of potential lawsuits that could lead to adjudications or intervention into groundwater management by the State Water Resources Control Board (Water Board). The creation and modification of allocations, although related to groundwater trading, is not the primary focus of this paper, which looks instead at major public policy issues that can arise when allocations are traded.

Groundwater trading is intended to reduce the economic hardships caused by water scarcity by giving water users flexible, voluntary mechanisms to shift available water to where it is needed most: to the crops that cannot be fallowed or for the livestock that need reliable water to survive. Groundwater trading programs may create opportunities for water users in groundwater-constrained areas to purchase groundwater allocations to keep their operations functional, or to be compensated for foregoing pumping when selling their allocations. It is in the State's interest that such programs ensure that third parties are safeguarded and that diverse types of water users have the opportunity to benefit from trading.

In its optimal form, groundwater trading will complement other sustainable groundwater management tools, reducing the burden of implementing SGMA and helping preserve the long-term viability of California, where, statewide, groundwater provides for 40 to 60 percent of the water used each year. The State's interest in supporting groundwater trading is shaped by SGMA's clear intent to have all beneficial uses and users of groundwater considered in sustainable groundwater management and the state policy that domestic water use is the highest use of water (California Water Code section 106). The State interest includes advancing the Human Right to Water, codified in section 106.3 of the California Water Code, which specifies that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes," and protecting and preserving the statewide benefits of intact ecosystems.

Developing a groundwater trading program is a voluntary, locally driven action. Not all GSAs should or will develop groundwater trading programs; GSPs without a trading component are not deficient and are just as likely to result in sustainable groundwater management. Where trading is being considered, GSAs and existing water rights holders will be responsible for designing and implementing trading programs, building on established groundwater accounting systems and groundwater allocations. The State lacks the regulatory authority to direct a GSA to develop or not develop a groundwater trading program, nor can the State dictate how a GSA structures an in-basin trading program.[1] Neither can the State implement a statewide groundwater trading program on an inter-basin (between basins) scale, moving water from water-rich areas to water-poor areas. However, the State can use its resources to support well-managed groundwater trading, helping local water managers and users attain good outcomes. For groundwater trading programs to be successful, they must be thoughtfully designed and governed, with inclusive and robust stakeholder input, to achieve multi-benefit outcomes and prevent harm to vulnerable users such as disadvantaged communities, small- and medium-sized farm operators, and groundwater-dependent ecosystems, as well as to avoid other negative consequences.

With SGMA as a catalyst, groundwater trading in California is entering a period of rapid expansion and experimentation. California's groundwater basins will provide a laboratory for testing and refining the practice of trading groundwater to promote sustainability. The actions taken by early adopters will generate lessons to be heeded by others; California may serve as an example for other parts of the country and the world.

Box 1: Glossary of Terms

Groundwater sustainability agency: SGMA authorizes people to form groundwater sustainability agencies (GSAs) to develop, implement, and enforce a basin's groundwater sustainability plan.

Groundwater sustainability plan: A groundwater sustainability plan (GSP) is a plan developed by a Groundwater Sustainability Agency for the sustainable use of groundwater within a groundwater basin.

Undesirable results: Sustainable groundwater management under SGMA singles out six "undesirable results" to be avoided: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, land subsidence, water quality degradation, and depletions of interconnected surface water.

[1] Except to the extent that a trading program is so poorly structured that it results in the GSP as a whole being inadequate under SGMA

Groundwater rights: Groundwater rights are rules applied to the extraction and use of groundwater and are held by groundwater users. Unlike surface water, California does not have a permit process for acquiring groundwater rights. Most of the law governing groundwater rights is established through case law. In several basins, groundwater rights have been determined by court decrees adjudicating the groundwater rights within the basins. Case law precedent can be used to estimate and take into account users' groundwater rights, but a legally binding determination of groundwater rights can only be achieved though judicial decree.

Beneficial users: As defined by California Water Code section 10723.2, beneficial users of groundwater that must be considered by GSAs includes agricultural users and domestic well owners who hold overlying groundwater rights, environmental users, Tribes, and disadvantaged communities, among others.

Disadvantaged community: Disadvantaged communities refers to the areas throughout California which most suffer from a combination of economic, health, and environmental burdens; these communities, among other groundwater users, are to be considered in groundwater sustainability planning under SGMA.

Small- and medium-sized farms: USDA defines small farms as having gross cash farm income (GCFI) of less than $350,000. Mid-sized farms are defined as operations having GCFI of $350,000 - $999,999. California recognizes that the USDA definitions do not appropriately take into account the wide diversity of crops grown in California that are not grown in other states and the array of farm sizes and inputs. The California Department of Food and Agriculture is working with stakeholders and academic institutions to develop a more relevant description of small- and medium-sized farms.

De minimis users: SGMA defines a de minimis groundwater user as "a person who extracts, for domestic purposes, two acre-feet or less (of groundwater) per year." De minimis users may be defined otherwise in other circumstances, but generally are considered to be users with individually negligible impacts on overall water use due to the small amount of water they each consume.

Market power: Market power refers to an individual's or entity's relative ability to manipulate the price of an item in the marketplace by manipulating the level of supply, demand, or both.

Regulatory capture: Regulatory capture is an economic theory that regulatory agencies may come to be dominated by the interests they regulate and not by the public interest.

Box 2: Status of Groundwater Trading Programs in California under SGMA

Currently, California is home to several nascent groundwater trading programs linked to SGMA. The most established is the Fox Canyon groundwater market, located in the Oxnard Basin in Ventura County. Fox Canyon began trading in 2020 and was the first groundwater trading program to begin trading under SGMA. Agricultural producers in the Oxnard basin are largely groundwater dependent and groundwater itself is in short supply: The basin is critically-overdrafted and growers face pumping cuts of at least 40 percent to bring their basin into sustainable conditions under SGMA. Growers in the basin called for the development of the program and were integral to developing groundwater allocations and market rules during the design phase. The Fox Canyon groundwater market is an anonymous market that features algorithmic matching and a third-party exchange administrator, a design intended to thwart market power concerns by protecting participants' identities. The program features special management areas

with directional trading rules (meaning allocations can be traded out of the area but not into the area) put in place to limit increased pumping in areas at risk of seawater intrusion and over pumping. Initially, the program limited trading to agricultural water users, but the GSA will soon consider allowing municipal users to participate as well. All program participants are required to have meters on their wells with telemetric monitoring. The market is reviewed yearly by the GSA, allowing for the regular evaluation of its functionality and impacts, and allowing for changes to its design.

The Eastern Tule GSA, located in the Tule subbasin in Tulare County, established groundwater allocations in 2021 and allows landowners to transfer their allocations so long as they are in good standing with the GSA. Eastern Tule is home to many agricultural and domestic users who are not supplied by a water district and do not have access to surface water; many landowners are not irrigating and are presumed by the GSA to have dormant groundwater rights. These landowners receive a groundwater allocation from the GSA and may participate in the Eastern Tule trading program. Pumpers must arrange for trades themselves. Once a trade is negotiated, the pumpers submit a form to the GSA and the GSA then reviews the trade for approval. Eastern Tule measures groundwater pumping using remote sensing and evapotranspiration calculations and allows for a carry-over period of five years (meaning unused groundwater allocations created in one year can be stored and used or traded for up to five years). Eastern Tule GSA is monitoring the impacts of its program on subsidence levels around the Friant-Kern Canal and on groundwater wells in nearby disadvantaged communities and will impose rules to restrict pumping in these areas should additional impacts occur.

The Lower Tule and Pixley GSAs, also located in the Tule subbasin in Tulare County, have implemented a trading program similar to the Eastern Tule program and expect that trades will occur across GSAs within the Tule subbasin. Use of the same groundwater accounting platform as the Eastern Tule GSA's trading program will make this easier.

In Madera County, the county GSA, which represents those landowners not covered by another GSA, worked with other GSAs in the county to solicit stakeholder input to create a water trading program framework and then, in 2021, to run a simulation of the program. Approximately 60 people registered with 30 participating regularly. The simulation did not yield many trades. The biggest challenge to the process came from landowners who had not recently pumped groundwater and felt entitled to a groundwater allocation in order to sell it but were not given one. Instead, groundwater allocations were divided equally among existing beneficial groundwater users. Another consideration centered around the ability to move allocations between parcels with the same owner or manager. As a tool for flexibility, Madera County GSA included multi-parcel farm units that allow owners and managers within the same hydrogeologic zone to move an allocation among parcels that they own or manage.

The Kaweah subbasin, in Tulare County, is currently conducting a stakeholder-informed process that is projected to produce a water marketing strategy framework by 2022. Beneficial users in the basin have a representative seat at the table for discussions and decisions. Meetings are held regularly to share information and solicit public input. The Kaweah subbasin has discussed ideas like confining trading to those who own land in the Kaweah subbasin and imposing restrictions on trading around disadvantaged communities to protect shallow drinking water wells.

The McMullin Area GSA, located in the Kings subbasin in Fresno County, is dominated by agriculture, 75 percent of which is permanent crops. The McMullin Area GSA is considering developing a groundwater trading program based on per-acre groundwater allocations where pumping is tracked using meters and

telemetric monitoring. The GSA is working to install meters. Allocations will be voluntary at first and will be monitored to see if pumping reductions are being successfully implemented. It may take 10 years to get to a firm allocation. Landowners may test a trading program while allocations are still voluntary. The GSA is considering starting with the ability to carry over water for one year with pumpers arranging for trades themselves, although there is potential to move to using a platform that matches sellers and buyers. The McMullin Area GSA anticipates forming a stakeholder advisory group in the near future. The group will advise on the development of local groundwater trading rules, regulations, and methodologies.

The Commission's Role and Approach

The Water Resilience Portfolio (Portfolio) was guided by Governor Newsom's Executive Order N-10-19, which called for a "set of actions to meet California's water needs through the 21st century." Within the Portfolio, Action 3.6 relates to the topic of groundwater trading, calling on the Department of Water Resources, the State Water Resources Control Board, the California Department of Fish and Wildlife (CDFW), and the California Department of Food and Agriculture (CDFA) (together, the implementing agencies) to create flexibility for groundwater sustainability agencies to trade water within basins by enabling and incentivizing transactional approaches, including groundwater markets, with rules that safeguard natural resources, small- and medium-size farms, and water supply and quality for disadvantaged communities.

In March 2021, the Commission received a letter[2] from the Secretaries of Natural Resources, Environmental Protection, and Food and Agriculture asking the Commission to use its public forum to better understand the concerns and opportunities around groundwater trading and to explore how the State can help support well-managed, locally designed, and locally led trading programs that protect water users who might be impacted by groundwater trading. The language of Action 3.6 outlines the topics of focus for the Commission:

- **Natural resources, small- and medium-sized farms, and disadvantaged communities.** These three specific interests are the focus of this effort.
- **Scale.** The basin or subbasin scale is the spatial extent. Transboundary transactions are not under consideration.
- **State Role.** The dialogue is about what role the State could play in groundwater trading and to what extent the State could act to provide safeguards for natural resources, small- and medium-sized farm operators, and disadvantaged communities.

Additionally, the scope of the Commission's discussions covers percolating groundwater, but not surface water stored underground, which is subject to Water Board permitting authority.

The Commission has led a thorough and inclusive public dialog, described below, to frame State considerations around how to shape well-managed groundwater trading programs. The Commission acknowledges the complexity of groundwater trading: developing and implementing trading programs that advance sustainable groundwater management, avoid undesirable results, and do not create negative impacts requires building trust, collecting information, utilizing accurate groundwater data, and evaluating alternatives and trade-offs, all of which take time and resources. Considering how

[2] Letter from the Secretaries for Natural Resources, Environmental Protection, and Food and Agriculture

groundwater trading programs will interact with surface water use and trading, groundwater banking, and groundwater recharge, and how they will affect land use increases the complexity of this topic. For this endeavor, the Commission has focused its discussions on groundwater trading using the topics noted in the bulleted list above.

Step 1: Frame the Issue. To better understand the issues at play, Commission staff conducted interviews with small groups of stakeholders, spoke with out-of-state representatives about their groundwater trading efforts, and invited expert panels to address the Commission at its standing meetings. Staff organized 13 small group discussions with academics, agriculture representatives, associations, community-based organizations and community leaders, federal government representatives and wetland managers, environmental non-governmental organizations, northern GSAs, San Joaquin Valley GSAs and representatives, Central Coast GSAs, Tribal members, and economists. These discussions explored the status of groundwater trading; the bookends that should be placed on groundwater trading to protect communities, the environment, and small- to medium-sized farm operators; and perspectives about the State's role in groundwater trading to safeguard vulnerable water users. To gain an understanding of lessons learned about groundwater management and trading strategies outside of California, staff met with 22 people from Arizona, Colorado, Florida, Nebraska, Texas, and Australia. These discussions were brought to the public at the following Commission meetings:

- Groundwater Trading: Small Group Discussion Synthesis - September 2021, Item 12
- Groundwater Trading: Overview of Out-of-State Discussions and Emerging Themes - October 2021, Item 11

The Commission hosted the following expert panels and presentations at its monthly meetings:

- Water Trading: Panel Discussion on Markets and Groundwater Trading - June 2021, Item 13
- Groundwater Trading: Presentation on Groundwater Rights Law - July 2021, Item 10
- Groundwater Trading: Panel Discussion on Exploring Groundwater Trading - August 2021, Item 12
- Groundwater Trading: Panel Discussion on the Future of Groundwater Trading - September 2021, Item 13

Step 2: Hold Public Discussions. To further explore the information gathered in Step 1, Commission staff conducted localized outreach by attending stakeholder meetings, hosted public workshops, and collected information via an online survey. By holding these public discussions, the Commission sought to collect feedback from diverse participants about how groundwater trading could impact or benefit them and to gather information and test assumptions around opportunities and concerns; potential impacts to ecosystems, farms, and communities; and a State role in enabling groundwater trading with safeguards for water users. Commission staff made 14 presentations to stakeholder groups, including GSAs, habitat managers, farmers, county representatives, environmental and community nonprofit organizations, and community members. The Commission hosted two online public workshops, presented via Zoom. A total of 229 participants attended the workshops. The workbook used for the workshops is posted on the Commission's website: https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2021/GWTrading_Workbook_FINAL.pdf. Recordings for all workshops are posted to the Commission's website: https://www.water-ca.com/ground-water-trading-workshops.html. Results of the Commission's survey are discussed in the box below.

Box 3: Stakeholder Survey

To explore and validate themes identified during Step 1 conversations, the Commission conducted an online stakeholder survey, distributed through Commission communication lists and social media, stakeholder advisory group members' associated networks, and the DWR Sustainable Groundwater Management Office e-mail distribution list. The survey asked respondents to rank the importance of including various characteristics of well-managed groundwater trading in future policy recommendations and of possible State roles in supporting groundwater trading. It also asked respondents to share thoughts on how best to guide groundwater trading with safeguards for vulnerable water users. Over the course of four weeks, 135 people responded to the survey. Of the 135 responses, 35 percent indicated they were affiliated with or represented a GSA. Respondents were from across the state and included farm operators, county and regional representatives, environmental groups, state and federal agencies, private utilities, consultants, and Tribal members. Although the results are not statistically robust because respondents were not equally representative of the entire stakeholder population, responses indicate support for the themes identified by the Commission and offer areas for further exploration.

- **Characteristics of well-managed trading programs.** Respondents indicated that clear trading rules, measurement of water use, and water accounting and allocations are important characteristics of well-managed groundwater trading that should be incorporated into future policy recommendations. Responses show that stakeholder engagement has the least support for inclusion in future policy recommendations. This may be an area where some additional inquiry would be useful.
- **State role in supporting a well-managed groundwater trading program.** Respondents indicated that they would like to see the State provide guidance and minimum standards around how to establish well-managed groundwater trading programs and ensure that programs have metrics and monitoring. Responses show that a State role in enforcing protections for vulnerable users and ensuring the human right to water have the least support from the totality of respondents. Given the State's interest in having safeguards for vulnerable users, it may be useful to learn more about perceived concerns about these State roles
- **Guidance on how to establish a groundwater trading program with safeguards for vulnerable users.** Respondents indicated a preference for the State issuing best management practices and/or establishing standards that would need to be met to qualify for State funding or other assistance.

Throughout this process, Commission staff worked closely with a stakeholder advisory group to inform its approach and guide its discussions (see Appendix 1: Groundwater Trading Stakeholder Advisory Group Members). Commission staff also met regularly with representatives from the implementing agencies to share information and to keep them apprised of the status of the Commission's work.

Drawing on its public discussions, the Commission developed this white paper to guide the continued work on Action 3.6 by DWR, the Water Board, CDFW, and CDFA. The white paper includes a set of findings around how to shape well-managed groundwater trading programs with appropriate

safeguards for natural resources, small- and medium-sized farms, and disadvantaged communities, and addresses what role the State could play in advancing well-managed groundwater trading.

Current State Engagement

Under SGMA, sustainable management of groundwater starts with local GSAs, but the State plays a critical role in overseeing local progress. Defining how the implementing agencies are already engaged in SGMA and other groundwater-related efforts provides context for understanding possible State engagement on groundwater trading, specifically.

Department of Water Resources (DWR). The Department of Water Resources has two primary roles in SGMA: provider of assistance and regulator. DWR offers technical, planning, and financial assistance programs for local groundwater agencies. The technical assistance program provides various groundwater-related technical data, modeling, and tools to support development and implementation of GSPs for the purpose of supporting GSAs in addressing the undesirable results identified in SGMA. DWR's major regulatory oversight role is to assess GSP compliance and require modifications. GSAs must prepare and submit GSPs for review and assessment by DWR at least every five years beginning in 2020 for critically overdrafted basins and 2022 for all other high- or medium-priority basins. GSPs deemed unacceptable by DWR will result in Water Board intervention until the GSA resolves the GSP noncompliance issues. SGMA requires GSAs to achieve their sustainability goals, operating to a sustainable yield while avoiding undesirable results, within 20 years (by 2040 or 2042). DWR provides assistance throughout the implementation period to support and guide GSAs toward reaching their sustainability goals. In addition, DWR is required to maintain a clearinghouse of the GSPs created by GSAs.

Through SGMA, DWR has some limited regulatory authority over GSAs to ensure that sustainable groundwater management within a basin adequately takes into consideration all groundwater uses and users. This oversight authority, exercised during DWR's review of GSPs and GSP updates, may assure that trading programs address undesirable results for groundwater users and uses.

State Water Resources Control Board (Water Board). The State Water Resources Control Board serves as a SGMA backstop and enforcement agency. If DWR determines that GSAs are not sustainably managing their basin, the Water Board can step in to manage the basin in a process called "State intervention." Lack of plans, lack of coordination, inadequate plans, or inadequate implementation can trigger the State intervention process. After a triggering condition, the Water Board may designate a basin probationary after providing notice and holding a public hearing. Once a basin has been designated probationary, the Water Board may require groundwater extractors to install meters, measure and report all groundwater extractions, and pay fees to cover the cost of Water Board activities. The Water Board may also conduct investigations and gather data necessary for sustainable groundwater management. The Water Board may develop and implement an interim plan for a probationary basin if the Water Board determines that a local agency has not fixed the deficiencies that resulted in the probationary designation. An interim plan is intended to be a temporary measure to protect groundwater until effective local management is in place. An interim plan would likely focus on reducing groundwater use in the basin to sustainable levels as soon as practical.

To date, the Water Board has not initiated State intervention in any basins. The Water Board's focus has been on working with local agencies and interested parties to respond to questions and concerns about

SGMA implementation. Additionally, Water Board staff commented on several plans submitted to DWR. Comments drew from the Water Board's expertise and regulatory experience in certain topic areas, including water quality, drinking water, and water rights. The goal of plan review was to highlight concerns now, so that issues can be fixed and plan implementation is successful going forward.

California Department of Fish and Wildlife (CDFW). As trustee for the State's fish and wildlife resources, the California Department of Fish and Wildlife has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & Game Code §§ 711.7 and 1802). CDFW values and supports groundwater planning that carefully considers and protects groundwater-dependent ecosystems. In response to SGMA, CDFW developed a Groundwater Program to ensure fish and wildlife resources reliant on groundwater are addressed in GSPs and to support compliance with regulatory requirements on CDFW-owned lands and facilities in groundwater basins subject to SGMA.

California Department of Food and Agriculture (CDFA). The California Department of Food and Agriculture supports the ongoing vitality of the state's agricultural industry. In relation to SGMA, CDFA provides informational resources to support farmers and ranchers in accessing technical assistance and federal/state funding related to water-use efficiency and soil health.

While the implementing agencies of Water Resilience Portfolio Action 3.6 are already active in supporting SGMA implementation, SGMA legislation only describes a specific oversight role for DWR and specific triggers for the Water Board's enforcement actions. Per California Water Code § 10720.1(h), one of the primary goals of SGMA is to "manage groundwater basins through the actions of local government agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner." Aligned with the intent of SGMA, groundwater trading, as noted above, is a local, voluntary action selected, designed, and implemented by GSAs and other water rights holders. Currently, the State must act within the confines of its existing authorities when enabling well-managed groundwater trading and supporting protections for vulnerable water users.

Box 4: Related State Actions

Groundwater Management and Drinking Water Well Principles and Strategies. Called for in Governor Newsom's Executive Drought Proclamation in April 2021, the Groundwater Management and Drinking Water Well Principles and Strategies (Principles and Strategies) are intended to help ensure that potential drought impacts on communities that rely on groundwater for drinking water are anticipated and proactively addressed. DWR and the Water Board have developed these Principles and Strategies to monitor, analyze, and minimize the impacts of groundwater management on drinking water wells. The information contained in the Principles and Strategies document provides a complementary framework for considering how to protect some of the vulnerable water users considered in this white paper. The Principles and Strategies serve as a shared drought framework of State actions to benefit drinking water well users and for DWR and the Water Board to continue pursuing in drought and non-drought years.

Voluntary Open-source Groundwater Accounting Platform. DWR, the Water Board, the California Water Data Consortium (Consortium), and Environmental Defense Fund (EDF) are collaborating to enhance and scale a voluntary open-source groundwater accounting platform that will be freely available to help GSAs manage the transition to sustainable supplies. The open-source platform enables

water managers and landowners to securely track water supplies and use, create water budgets, model scenarios, and trade allocations of water within a district or basin. DWR and the Water Board are working with EDF and the Consortium to ensure that the platform is compatible with the online electronic portals that local agencies use to submit public data required by the State, such as DWR's SGMA Portal and the Water Board's Groundwater Extraction Annual Reporting System (GEARS). Groundwater trading is one of many tools that local agencies are considering for managing groundwater sustainably, and an accounting system is the first step for such programs.

Cross-Cutting Themes: Context for Groundwater Trading Discussions

From the Commission's conversations on groundwater trading, generally agreed-upon, high-level concepts emerged that provide context for consideration of the opportunities and challenges surrounding groundwater trading in California. The cross-cutting themes identified below touch on and impact groundwater trading, but also extend beyond the specific focus of Action 3.6, offering some understanding of the ways in which groundwater trading is connected to other aspects of groundwater management.

Trust is critical. Groundwater management involves community members coming together to collaboratively manage a shared resource with the intention of counteracting a history of institutions and individuals acting in their own interest, in some cases at the expense of others or of the greater good. To subvert a tragedy of the commons, to successfully manage groundwater – and, more specifically, to trade groundwater – starts and ends with building trust. In some instances, trust is lacking due to long-standing historical issues related to control over resources. To move toward well-managed groundwater trading will require building trust in institutions as well as person-to-person trust. This is not a short endeavor. It requires engaging stakeholders and ensuring that all groundwater users or their chosen representatives are included in conversations about groundwater management and, ideally, that stakeholder groups are represented in management decisions. It involves educating stakeholders so that they can understand the hydrogeology of the basin and how decisions made may impact them, which will help establish trust that GSAs are being forthright about how trading programs are accounting for specific users. GSAs – which are governed by a collection of local individuals – must endeavor to uphold good governance structures that are transparent and accessible and responsive to stakeholders; with groundwater trading, they must create clear rules and enforce them consistently. These are the pillars of building trust in the institutions that manage groundwater and groundwater trading. Without trust in institutions and their ability to govern effectively and enforce rules, those participating in groundwater trading programs may not feel that they or others need to abide by rules and vulnerable stakeholders may not believe that they are being properly protected. Because of the localized nature of trading, trust in individuals is also important, and this can be pursued through respectful interactions and inclusivity, as modeled by GSAs. Without trust between individuals, skepticism and fear that others might "game the system" could undermine the buy-in and participation necessary for a successful trading program. The Final Groundwater Management Principles and Strategies to Monitor, Analyze, and Minimize Impacts to Drinking Water Wells document referenced in Box 4 above outlines six actions for building trusted relationships, many of which are applicable to groundwater trading and should be pursued by GSAs. The document notes that building trust will "create opportunities for effective coordination, communication, and decision-making."

Implementing sustainable groundwater management takes time and information. Correcting decades of unsustainable groundwater management will not happen overnight, and neither will developing and implementing a robust, well-managed groundwater trading program. It is imperative that GSAs and local communities understand their basin context, both in terms of hydrology – the way water moves into, out of, and through the aquifer – and the consumptive context – how much groundwater is used, where, and at what time. It is also important that they know where vulnerable water users are located and how they might be impacted by groundwater management actions. The process of building trust, alone, may take years. Educating and engaging stakeholders, establishing governance systems, developing a trading program that is responsive to the local context and does not have negative consequences, gradually reducing groundwater use, and waiting for management actions to result in basin-wide changes will likely take decades. In its conversations with representatives from other states that have been managing groundwater for much longer than California, the Commission learned of examples of groundwater management that have taken 40 or more years to fully implement.

Groundwater trading is built upon accurate data and a sound GSP. Well-managed groundwater trading requires a sound GSP that appropriately considers agricultural, environmental, and community water use and that contains an accurate water budget that reflects best available data. GSPs should include a water budget that identifies adequate water for the environment and for human consumption. A sound GSP will provide some safeguards for groundwater declines in specific areas with shallower wells and for depletions of interconnected surface water by establishing groundwater level thresholds that protect groundwater users. With adequate groundwater monitoring, GSAs will know if groundwater use in the basin is bringing down groundwater levels near shallow wells or interconnected surface waters and can then act to avoid threshold exceedances by revising groundwater trading program rules or through other means. If a GSP contains impactful data gaps or if it has not been informed by thorough and inclusive stakeholder engagement, then it is missing the foundational information needed to develop a well-managed groundwater trading program. Participants in the Commission's workshops stressed the need to take time to verify newly developed GSPs and to close knowledge gaps before thoughtfully designing groundwater trading programs. Good data is imperative for understanding the likely impacts of trading and for ensuring that a trading program is meeting its goals.

Groundwater trading is just one tool in the sustainable management toolbox and may not be appropriate in all instances. Groundwater trading is not a silver bullet that will "solve" over-pumping, it is an optional part of a larger groundwater management effort that will involve a diverse suite of management actions to bring basins into sustainability. Trading programs are only applicable to address groundwater demands within a basin. Inter-basin water trading has not been contemplated and would in most instances run counter to the goals of respective GSPs, to water rights, and to community

interests. Trading programs may not be successful in areas that do not have limitations on groundwater use and established groundwater allocations. Trading programs are not appropriate if they create too many unavoidable third-party impacts, or if the risks associated with those third-party impacts are high or cannot be mitigated. To be a useful tool, groundwater trading needs sufficient interest and activity from trading parties. Trading may not be appropriate if there are few entities interested in trading or if allocations are concentrated in the hands of a few. Further, groundwater trading program development and oversight are costly endeavors and require specialized expertise. A cost-benefit analysis may indicate that trading is too costly. Finally, groundwater trading is not necessary to achieve sustainable groundwater management: many GSAs will work toward sustainability without developing a trading program.

The State has a role to play. Although groundwater management will be governed by local agencies, the State has a role to play in ensuring that groundwater management broadly, and groundwater trading more specifically, complies with the intent of SGMA and protects and enhances the public trust resources for which the State is responsible.

Box 5: Points of Divergence

During its conversations with small groups, the Commission identified three areas where there was not general agreement about how to approach groundwater trading programs.

1. Local control vs. state oversight
2. Customization vs. standardization
3. Transparency vs. confidentiality

These points of divergence represent a continuum of options for which there is not an inherently right or wrong approach. Instead, the choices are dynamic and highly contextual. Navigating conflicting viewpoints must be nuanced and adaptive and may consist of and/both rather than either/or options. The Commission explored these continuums at its public workshops, as described below.

Local Control vs. State Oversight. Overall, those providing feedback to the Commission had an interest in the State providing some form of support or oversight for groundwater trading. Many indicated a potential benefit in having the State articulate best practices and provide safeguards against trading systems that could create disproportionate impacts to some segments of the community. Participants proposed that the State could serve as a final arbiter of disputes associated with trading systems. Conversely, others felt it would be impossible for the State to provide more than high-level support, given the wide diversity of hydrologic, economic, and demographic conditions in individual groundwater basins. These individuals explained that the issuance of best practices could be adverse to the innovation and adaptation that will be necessary as people managing groundwater basins work to find trading options most suitable for their situation. Further, some questioned the State's authority to even exercise oversight.

Customization vs. Standardization. As a group, those providing feedback on this subject generally believed there would be a need for customization of groundwater trading approaches in different areas. They suggested that groundwater trading programs need to be tailored to address local conditions and that new accounting platforms should be designed with input from local groundwater users. Many of the same group also saw benefits to standardization for activities like data monitoring and tracking.

They believed the use of standardized tools across basins would facilitate better information sharing and potentially reduce costs as development costs and innovations could be shared across subbasins. Even so, participants recognized that standardized software or other tools may still need some customization to accommodate local conditions. Some also noted that standardized practices would better facilitate evaluation of a trading program's performance.

Transparency vs. Confidentiality. Feedback on this topic tended to support transparency. Those arguing for transparency in groundwater trading programs cited the need for accountability. They believed that access to trading information would increase fairness by highlighting both the beneficiaries of the trading program and the degree to which impacts may occur to program participants and non-participants. Data transparency would also allow the community to help police the trading process. Conversely, several stakeholders suggested that confidentiality would be necessary to maintain privacy, security, and proprietary information. They also argued that blind trades were inherently fairer as they precluded groundwater trading program participants from only selling to friends or otherwise discriminating against buyers.

Box 6: Synthesis of Out-of-State Conversations

Commission staff talked to 22 people total from the states of Arizona, Colorado, Florida, Nebraska, and Texas, and from Australia about the role of their states in trading programs, about their experience with considering vulnerable water users – namely, disadvantaged communities, the environment, and smaller farm operators – and about any salient issues and considerations they could share with the Commission. Out-of-state representatives discussed groundwater management generally as well as groundwater trading, including information about trading rules and governance and enforcement of trading programs. The information they shared complements what staff heard from its small group participants. Representatives stressed that sustainable groundwater management takes time – decades or more – and that local control is important, but that the State can serve as a catalyst for sustainable management and as removed but important oversight. The need to engage stakeholders and the community came up repeatedly, with representatives stressing the need for groundwater managers to embed in the community, to understand it, to educate pumpers, and to take the time to build trust.

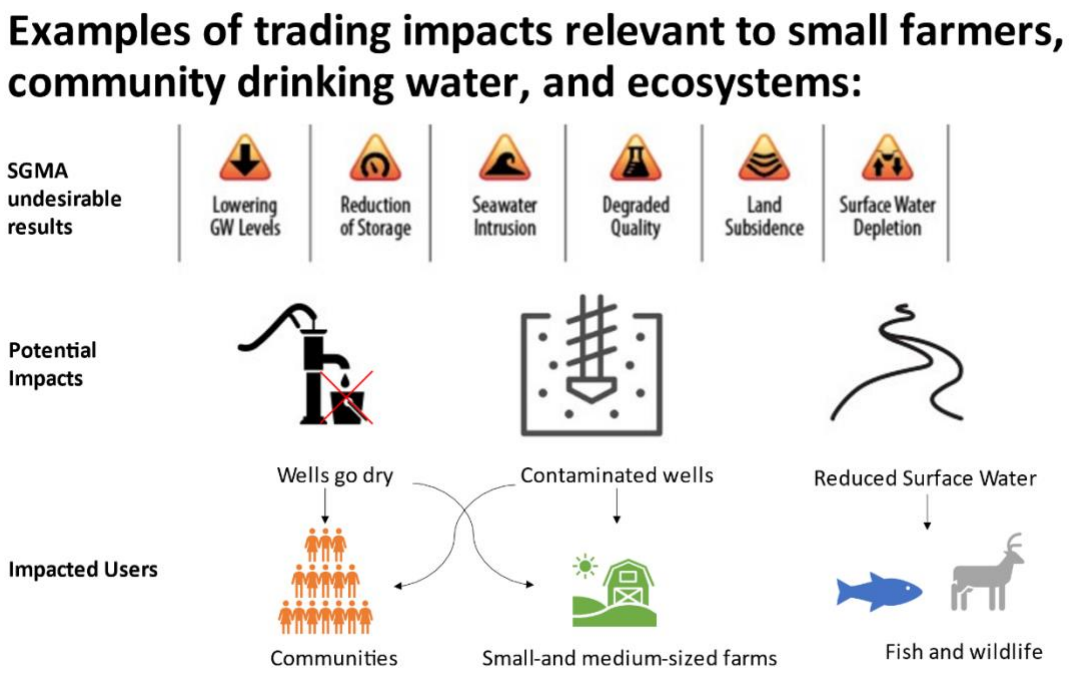
Through its conversations, the Commission learned of many ways of allocating groundwater: by permitting acres with unlimited pumping, which works best in areas with the same cropping patterns; by well and by year; by acre – based either on desired future conditions or historic use; and with restricted usage, with a certain portion specified for agricultural use and the rest unrestricted. In many cases, household wells and de minimis users are exempted from the allocation process. Some representatives explained that allowing for multiple-year allocations helps combat a "use it or lose it" mentality, leading to increased conservation and lower overall groundwater use. **Groundwater managers stressed the overarching importance of enforcing allocation limits and the need for compliance with groundwater management rules. In general, locals are bought into rules and want to see them enforced consistently; they do not see the rules as an imposition or a burden, but as a necessity for fairness.**

Representatives noted that groundwater trading is complicated and generally comes along later in the process of managing groundwater. Where trading is occurring at the state level, such as in Australia and Arizona, there is not a huge volume of trades nor a specific interest in safeguarding disadvantaged communities or small- and medium-sized farm operators. Two local groundwater trading programs – the

Edwards Aquifer in Texas and the Twin Platte in Nebraska – instituted groundwater management to protect surface water resources (streams, springs, and species) due to endangered species triggers or depletion of interstate surface water triggers. The Edwards Aquifer Authority uses directional trading to restrict trading near surface waters. The Twin Platte Natural Resources District uses a stream depletion factor (SDF) to calculate proportional trading, where the SDF determines the number of acres that can be irrigated based on the possible impact to the stream. As irrigated acres are moving closer to the stream, the SDF may indicate that fewer acres can be irrigated.

Considerations for Safeguarding Vulnerable Users: Concerns and Risks

As groundwater allocations are traded to the places of highest demand or the highest cost of reducing water use, it is possible that a groundwater trading program will lead to or exacerbate concentrations of pumping in certain areas. If groundwater trading programs are not thoughtfully designed and well-managed, they could negatively impact natural resources, small- and medium-sized farms, and disadvantaged communities. Concentrated pumping could draw down groundwater levels, creating cones of depression that cause shallower wells to go dry or that deplete interconnected surface water. Concentrated pumping could also lead to contaminant or seawater migration, degrading water quality, and to land subsidence, which could decrease groundwater storage capacity. In addition to physical risks, vulnerable users are also at risk of being overlooked during the design and roll-out of trading programs. In its consideration of groundwater trading, the Commission has looked closely at the concerns of and risks posed to vulnerable water users.



Natural Resources. The groundwater-dependent ecosystems (GDEs) of California are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface (California Code of Regulations, Title 23, section 351(m)). Examples include rivers, streams, and wetlands, all of which have been greatly diminished in size, extent, and/or quality due to land use changes and degradation over the last century. A small fraction of California's

once-immense aquatic habitat remains and, as a result, the state has lost biodiversity and valuable ecosystem services like filtration of water and attenuation of peak flood flows.

Stakeholders who seek to protect, enhance, and restore groundwater-dependent ecosystems include environmental non-governmental organizations (NGOs) and environmental advocacy groups, land trusts, habitat managers, natural resource agencies at the federal, state, and local level, resource conservation districts, philanthropic foundations, and Tribes. These stakeholders expressed concerns about the need for groundwater trading programs to be developed from GSPs and water budgets that reflect the needs of GDEs and for trading programs to consider and operate within the constraints of myriad regulations governing species and habitat protection. Stakeholders also expressed frustration that wetlands could face a disproportionate impact from SGMA implementation and from trading programs given their negligible contribution to the problem.

Groundwater trading programs pose the following risks to natural resources:

- Concentrated pumping in portions of the basin could deplete groundwater, leaving GDEs without enough water to remain viable.
- Concentrated pumping in portions of the basin could deplete interconnected surface water, leaving surface water streams without enough water to remain viable.
- Pumping patterns could shift the water quality (such as temperature, salinity, or pH), timing, and/or reliability of groundwater, threatening GDEs and interconnected surface water.
- For managed wetlands that depend upon pumped groundwater and need more water than they are allocated to keep wetlands viable, wetland managers may not have sufficient financial resources to buy additional allocations to keep wetlands viable.

Small- and Medium-Sized Farm Operators. California is home to a diverse agricultural community, with farms ranging in size from fractions of an acre to many thousands of acres. Small- and medium-sized farms represent approximately 90 percent of farm operations in California – a majority of which operate with sales of less than $100,000 annually. Farmers with smaller land holdings have less flexibility to aggregate their own allocations or shift their cropping practices and less operational capacity to participate in trading programs.

Stakeholders representing small- and medium-sized farm operators include farmers themselves, farm advocates and advocacy groups, agricultural land trusts and NGOs, the University of California Cooperative Extension, county Farm Bureaus, resource conservation districts, county governments, and Tribes. These stakeholders expressed concerns that groundwater trading programs could drive small- and medium-sized farms and lower-value crops out of production, reducing the economic diversity of the area. Stakeholders also expressed frustration that SGMA contains no protections for smaller-sized farm operators, such as a requirement to ensure that they are represented on a GSA board.

Groundwater trading programs pose the following risks to small- and medium-sized farm operators:

- Farmers may not have the capacity to engage in or stay informed about the process of developing and participating in a trading program, which may lead to trading programs that do not serve them or that they do not understand well enough to participate in in ways that serve their interests
- Farmers who need more water than they have been allocated to make a profit may not have sufficient resources to buy additional allocations to remain viable.

- Small- and medium-sized farm operators may not wield sufficient market power, allowing more powerful entities to dominate the trading program and control how allocations are used.
- Tenant farmers may not be able to lease parcels of land if the value of water is higher than the value of leasing land.
- Concentrated pumping in adjacent areas could create cones of depression, causing shallower wells to go dry.
- Concentrated pumping could create contaminant plume migration or seawater intrusion, degrading water quality.

Disadvantaged Communities. Throughout California, and particularly in the San Joaquin Valley, falling groundwater levels are causing drinking water wells to go dry, disproportionately impacting low-income communities and communities of color that rely on groundwater for domestic purposes. Drought exacerbates this problem, creating a water crisis for many vulnerable communities and well owners.

Stakeholders representing disadvantaged communities include community members themselves, community-based organizations, county governments, community services districts, small water system operators, and Tribes. These stakeholders expressed concerns that GSAs setting up trading programs or individuals participating in groundwater trading programs may not consider the needs of communities or protect their drinking water resources and may not respond swiftly to any negative consequences of trading. Stakeholders fear that decision-makers lack information about where shallow wells and other vulnerable resources are located, making it difficult to carefully design a trading program. Stakeholders also expressed frustration with the rapidity of well-deepening occurring around communities and with declining water quality on the cusp of exceeding water quality standards.

Groundwater trading programs pose the following risks to disadvantaged communities:

- Communities and community members may not have the capacity to engage in or stay informed about the process of developing and participating in a trading program, which may lead to trading programs that do not serve them or that they do not understand well enough to participate in in ways that serve their interests.
- Concentrated pumping in adjacent areas could create cones of depression, causing shallower wells to go dry.
- Concentrated pumping could create contaminant plume migration or seawater intrusion, degrading water quality.
- Communities may not have sufficient allocations nor sufficient resources to buy additional allocations to meet basic human health and safety needs.
- If not given allocations, communities and community members will not be able to choose to sell their allocations.

Findings

1. **Safeguards for vulnerable users.** The Commission finds that ensuring safeguards for vulnerable water users, namely natural resources, small- and medium-sized farms, and disadvantaged communities, is a critical component of well-managed groundwater trading programs. GSAs and local stakeholders will have the best understanding of the potential vulnerabilities at the local level. GSAs and local trading entities should strive to design programs that do not harm vulnerable users and to monitor implementation of programs to prevent and mitigate any unintended negative

consequences. Where harm to vulnerable users is likely or unavoidable, groundwater trading programs are not an appropriate tool for sustainably managing groundwater resources.

2. **Characteristics of well-managed local groundwater trading.** The Commission finds that well-managed groundwater trading, as described by the characteristics enumerated below, provides a basis for establishing safeguards for natural resources, small- and medium-size farms, and water supply and quality for disadvantaged communities.

   Precursors that need to be in place prior to designing a well-managed groundwater trading include:

   1) Clearly defined sustainable groundwater management conditions and a limit on the amount of groundwater that can be pumped to achieve sustainable conditions.
   2) A sound GSP, without data gaps, that accounts for water needs for human health and safety and the environment.
   3) A means of monitoring how much water is coming into and going out of the system.
   4) A means of measuring water use that provides verifiable, accurate data.
   5) A groundwater accounting system that tracks how much water is being used and by whom.
   6) Groundwater allocations that limit the amount of groundwater that an individual pumper can use and provide a consistent unit of trade (e.g., amount of water, number of acres, crop type).
   7) The flexibility to design a locally relevant program with rules that respond to the local context and that accommodate local needs.
   8) A sound governance system with transparent and robust decision-making mechanisms and leadership, and with program oversight and enforcement experience.

Box 7: Measuring Water Use

Measuring water use is a foundational part of groundwater trading. Without reliable water usage measurements, trading programs could exacerbate over pumping and erode trust. Some GSAs have or are pursuing mandatory metering on all wells because meters give the most accurate readings of the amount of water being pumped. In some instances, GSAs are using or would like to use telemetric monitoring that feeds pumping data into an online accounting system. These systems are expensive, but provide high accuracy and, if functioning properly, reliable reporting of groundwater usage amounts. However, some people shared examples of meters being tampered with and expressed concerns about the ability of bad actors gaming the system through meter interference. Other GSAs are measuring evapotranspiration through satellite imagery to determine the net water removed from irrigation practices in lieu of using groundwater meters or other methods of estimating groundwater pumping. While this data is less accurate, they are verifiable using satellite data and simple visual inspections and may be the best option for GSAs with remote, rural areas or GSAs that are struggling with well registration.

The designing of a well-managed groundwater trading program involves:

   9) An articulated program goal that is aligned with achieving sustainable conditions and avoiding undesirable results.
   10) Fully engaged stakeholders that represent all beneficial users.
   11) A transparent and accessible process for designing the program.

12) An understanding of vulnerable resources and users and how they might be impacted by a trading program.
13) Clear trading rules that have broad support from stakeholders and are designed to prevent impacts to vulnerable resources, vulnerable users, and other third parties.
14) A process for assessing and refining the program to ensure that safeguards are working properly, that there are not any unintended consequences, and that adaptive management can occur.

The implementation of a well-managed groundwater trading program involves:

15) Accessible processes for eligible participants to participate in the trading program.
16) Sufficient participation for the program to meet its goals.
17) Sufficient funding, capacity, and expertise to run the program efficiently.
18) Transparent data used to monitor the success and impact of the program.
19) A transparent process for monitoring and reporting on the progress and impacts of the program.
20) Clearly identified triggers for stopping or changing the program before it leads to harmful impacts.
21) A mitigation plan in place for addressing unintended negative consequences swiftly and fully.
22) Consistent enforcement with clear consequences for breaking the rules.

3. **Stakeholder engagement.** The Commission finds that stakeholder engagement is a critical component of developing and implementing a groundwater trading program, and that GSAs and local entities bear the responsibility for engaging all beneficial users or for considering all beneficial users should those users be unable to engage in their processes. GSAs and local entities should provide sufficient information to stakeholders for them to understand the potential risks and benefits of a trading program, providing information in layperson terms, providing information in the languages commonly spoken in the area, providing adequate notice via a variety of distribution methods for public meetings, holding public meetings at times and venues when stakeholders are able to attend, and convening a stakeholder advisory group with diverse representation to guide and inform decision-making. When engaged, stakeholders can contribute to design decisions, enhance understanding of where vulnerable resources are located, and share views on how vulnerable users may be impacted by a trading program. Stakeholder engagement builds trust in GSAs and between individuals and facilitates coming to agreement on the rules governing the trading program. A trading program should not function without stakeholder support for the rules.

4. **Accurate, reliable data.** The Commission finds that, to design a well-managed groundwater trading program, local entities need accurate, reliable data to understand how water may or may not move when traded, where wells might go dry, where interconnected surface water or groundwater dependent ecosystems might suffer, and where subsidence or sea water intrusion might occur if pumping increases in certain locations. Accurate and reliable data is also necessary for monitoring a groundwater trading program and tracking its impacts on groundwater users and resources.

5. **Mechanisms for safeguarding vulnerable users.** The Commission finds that incorporating the following mechanisms, as applicable, into the design of a well-managed groundwater trading program may improve safeguards for vulnerable water users. The list below is not comprehensive; it

is based on examples provided and discussed during the Commission's public conversations. The mechanisms described below would need to be selected and implemented based on local need and ramifications, agreed upon by groundwater users and other stakeholders, and combined with other tools for managing groundwater sustainably. In selecting safeguarding mechanisms, GSAs will need to ensure that the mechanism itself is not creating undue impacts to other users.

5.1. Allocations. Allocations can be designed to protect vulnerable water users.

- GSAs can create exceptions for disadvantaged communities, small- and medium-sized farms, and the environment, allowing these users to pump the full amount they need to be viable.
- GSAs can create a progressive allocation system that permits less pumping on larger landholdings (e.g., one acre-foot per acre on the first 10 acres and then a gradually reduced allocation for every 10 or more acres thereafter);
- GSAs can create a two-tier system that specifies that a certain portion of an allocation can only be used for agricultural purposes or another beneficial use while the rest of the allocated amount does not have any restrictions on how it is used; or
- GSAs can create carry-over rules allowing groundwater users to hold onto unused allocations for more than a single year, promoting conservation and flexibility.

5.2. Trading Rules. Trading rules can be used to restrict how and when groundwater trading occurs.

- Directional trading occurs when groundwater users can sell groundwater allocations but not buy them, limiting pumping in the areas where buying is restricted.
- Proportional trading occurs when groundwater users can trade a portion of their allocation but not all of it. The proportion that may be traded may fluctuate across a variant based on the distance of the trade site from a vulnerable resource.
- Spatial concentration limits or well-spacing requires a certain amount of space between operational wells.
- Pumping schedules limit the time when groundwater may be pumped or the amount that can be pumped in a certain timeframe.
- Notice requirements occur when trading parties or the governing body must notify the public of proposed trades.

5.3. Special Management Areas. Special Management Areas can create special rules, such as directional trading, within designated sensitive areas, such as areas prone to seawater intrusion, areas along streams and rivers, areas near important infrastructure that are at risk of damage due to subsidence, areas near shallow wells, and areas near communities.

5.4. Buffer Zones. Buffer zones create an area around vulnerable users or resources, such as areas with shallow wells, where trading out is not allowed.

5.5. Mitigation Plans. Mitigation and compensation requirements occur when trading parties or the governing body must mitigate potential impacts, such as by paying to deepen shallow wells or by providing water to habitat areas that could be impacted, or to compensate third parties for any damages caused by the program, such as providing potable water should wells go dry or be contaminated.

5.6. Program Operation.

- Anonymous, algorithmic trading occurs when parties submit their willingness to sell allocations or desire to buy allocations to a system that anonymously matches sellers and buyers, factoring in any applicable trading rules before approving the trade. Instead of a party-to-party negotiation of the amount and price of the allocation to be traded, trading parties do not know with whom they are trading, which helps ensure equal access to the trading program for vulnerable users, especially small- and medium-sized farm operators. Algorithmic matching helps ensure that trading rules are followed.
- Confined trading programs that limit trading to entities of the same size (e.g., bifurcating a program to keep trading between small farm operators or between large farm operators) may allow those entities to better access the trading program while guarding against power differentials that disadvantage certain participants.

5.7. Careful Well Aggregation. Well aggregation rules allow pumps that are owned or operated by the same entity the ability to move allocations among their parcels of land. Generally, users must apply for well aggregation and be approved by the trading program's governing body. Well aggregation rules can allow powerful entities the ability to aggregate huge numbers of wells, outside of the intention of the rule, allowing for "trading" to occur outside of the formal program, without oversight or application of trading rules. Careful well aggregation limits how wells can be aggregated and enforces aggregation rules, closing loopholes if they are exploited.

5.8. Annual Program Renewal. Annual renewal of a groundwater trading program allows for the regular evaluation of the program and its impacts, creating an opportunity to improve the design of the trading program.

6. **Applying safeguards to protect vulnerable users.** The Commission finds that the safeguarding mechanisms noted above may be applied to protect vulnerable users as follows.

6.1. Natural Resources. Groundwater dependent ecosystems, interconnected surface water, wetlands, and other natural resources may be protected through exemptions from the allocation process, allowing them to receive the full amount of water they need to be viable; through the creation of a two-tier allocation system that specifies that a certain portion of an allocation can only be used for environmental purposes; through the creation of special management areas and/or the use of directional trading, proportional trading, spatial concentration limits, pumping schedules, and buffer zones; through the use of protective mitigation plans that halt pumping when water levels drop or other habitat impacts are noted; and through annual program renewal. Natural resources may also benefit from financial support to help acquire water for species and habitat or a no net loss of wetlands policy.

6.2. Small- and Medium-Sized Farms. Small- and medium-sized farms may be protected through exemptions from the allocation process, allowing them to receive the full amount of water they need to be viable, or from a progressive allocation system that permits more pumping on smaller landholdings. Small- and medium-sized farm operators may be protected through creating a two-tier allocation system that specifies that a certain portion of an allocation can only be used for agricultural purposes; through creating carry-over rules allowing groundwater users to hold onto unused allocations for more than a single year; through notice requirements to alert them of proposed trades; through anonymous, algorithmic trading; through confined trading programs; through careful well aggregation; and through annual program renewal.

Small- and medium-sized farm operators may also benefit from cooperative programs designed to aggregate smaller trade amounts among farmers, allowing them to have the ability to sell their allocations more easily.

6.3. Disadvantaged Communities. Communities may be protected through exemptions from the allocation process, allowing them to receive the full amount of water they need to be viable; through the creation of a two-tier allocation system that specifies that a certain portion of an allocation can only be used for human health and safety purposes; through the creation of special management areas and/or the use of directional trading, proportional trading, spatial concentration limits, pumping schedules, and buffer zones; through the use of protective mitigation plans that halt pumping when water levels drop or water quality impacts are noted; through careful well aggregation; and through annual program renewal.

7. **Market power.** The Commission finds that issues related to market power can show up during the design of the trading program, such as with rules that restrict access to the program, and during implementation of the trading program, such as when powerful entities coerce others to trade or refrain from trading. Market power also may manifest outside of trading, operating as a work-around designed to thwart the rules of the program. For example, well aggregation could happen outside of a trading program, allowing certain parties to control and trade groundwater outside of the formal groundwater trading program. The implications of out-of-program trades may warrant additional conversation. Many people across sectors expressed concern to the Commission about trading program participants using their market power to escalate prices or to create user blocs that dictate where water goes. Further, many members of the public shared observations that outside interests are buying land in their area for above market value simply to get water out of it, leading to concerns that trading programs may be subject to the actions of distant landowners that are not committed to sustainable management of the basin. Unbalanced market power could impact many of the other important factors involved in trading programs, such as trust, engagement, access, and compliance, posing a risk to groundwater trading programs and to SGMA implementation overall.

8. **Oversight and enforcement.** The Commission finds that consistent, active enforcement is a critical function of the GSA, that it is essential to running a well-managed groundwater trading program, that most of those participating in trading programs should agree to enforcement mechanisms, and that penalties must be sufficient to deter non-compliance. The Commission heard concerns about intentional non-compliance with program rules, such as intentionally misreporting water use or manipulating monitoring equipment, and about regulatory capture. In other states, local groundwater management entities enforce rules by levying fines, revoking pumping allocations, and pursuing criminal penalties. In these instances, local participants were eager to see rules enforced: they voted on the rules and report those not following rules, understanding that lax compliance works against those who are following rules. Enforcing pumping limits and trading program rules demonstrates to stakeholders and participants that parties are being treated equally and fairly, which builds trust in the institutions overseeing trading and ensures that the trading program meets its intent. Enforcement requires an on-the-ground presence to develop relationships with groundwater users and other stakeholders and to verify that rules are being followed. Enforcement is built on good governance, stakeholder engagement, and clear trading rules and necessitates proper capacity and resources for the enforcing entity.

9. **Start small.** The Commission finds that starting with a small, geographically and temporally confined program will allow local entities to test and refine their programs to minimize negative impacts and maximize the chances of success. Trading programs may be conscribed to small geographic areas and short-term, temporary trades at the outset. Small programs may be the easiest means of securing stakeholder support and managing adverse trading impacts.
10. **Scaling up.** The Commission finds that, as groundwater trading programs grow within basins, they will require additional oversight to ensure that trades will not have negative consequences and that compatible systems that provide efficiency are developed. The implementation or consideration of the previous nine findings will advance viable groundwater trading programs that minimize unintended consequences.

Potential Next Steps for State Engagement

At this time, groundwater trading programs in California are under consideration or development or in the early stages of implementation. This is a period of learning, experimentation, and the amassing of information through observation and experience. GSAs and local entities are in the process of building trust and navigating a pioneering effort that may, at times, be uncomfortable in its unfamiliarity and unpredictability. The State, too, must position itself to navigate these early stages of groundwater trading by continuing to engage with GSAs and stakeholders to build trust. State agencies will need to fulfill their fundamental roles, described in the Current State Engagement section above, and meet their obligations under SGMA to ensure that GSPs are sound and being followed. Over time, if groundwater trading becomes more established, the State role may need to change, adapting as programs develop.

Because groundwater trading programs associated with SGMA are starting to be developed now, because they are forming in response to State policies, and because there may be many of them, the State has an opportunity to act now to help prevent some foreseeable harms to disadvantaged communities, the environment, and other state interests. Doing so will be complex and will require proper resourcing, but timeliness is of the essence.

The Commission proposes that the State take an iterative, multi-pronged approach to enabling and incentivizing well-managed groundwater trading, where appropriate. Specific actions are listed in the sections below. To successfully build trust in State institutions, DWR, the Water Board, CDFW, and CDFA will need to work together in a complementary and collaborative fashion. For each action listed below, the Action 3.6 implementing agencies will need to identify an appropriate lead and team for moving forward. The Commission encourages the implementing agencies to engage other departments and agencies to ensure that State priorities are being implemented consistently, especially as applied to permitting and existing financial assistance and incentive programs. The implementing agencies may also look to work with federal agencies to better incorporate federal priorities and leverage federal funds.

Group 1 Actions. The Commission suggests that the State operate within its existing authorities to target immediate needs by engaging in the following actions. These actions may require additional resources for implementing agencies.

1. **Conduct SGMA related oversight.** Ensure that GSPs adequately address all groundwater uses and users when designing and implementing groundwater trading programs, if identified as a management action in their GSP.

2. **Convene stakeholders to share information.** Bring together GSAs, stakeholders, and experts on a regular basis to share ideas, resources, and lessons learned.
3. **Identify and assess GSA needs**. Engage GSAs in areas where trading programs may be developed in ongoing dialog about their needs and identify how implementing agencies can use technical and financial assistance to meet these needs while making sure that relevant data and information are made widely available to the public. Some of the places where State resources could be deployed include:
    - Providing an open-source water accounting platform with a component that helps guide trading.
    - Providing statewide data sets to inform decision-making linked to designing trading programs.
    - Incentivizing the installation of meters and telemetric monitoring on wells that will help track water use needed to run a trading program.
    - Incentivizing and providing direct technical support for installing monitoring wells that will track impacts of trading programs.
    - Providing guidance or best management practices for data collection and measurement so that trading programs can be easily tracked and compared.
    - Supporting stakeholder engagement in trading programs.
    - Offering facilitation services as needed to establish trading programs.
4. **Engage and support vulnerable users** Engage community stakeholders, environmental stakeholders, small- and medium-size farm operators, the agricultural community, and GSAs in areas where trading programs may be developed to discuss how GSAs can identify stakeholders and how stakeholders can engage with GSAs on the topic of groundwater trading, and to develop processes at the State level for accepting, cataloging, and sharing feedback from stakeholders about conflict resolution and their groundwater trading concerns.

    4.1. For community stakeholders, directly support community-based organizations and communities to promote their engagement in the development of groundwater trading programs and ensure drinking water is a priority consideration, and work cross-programmatically to apply departmental Human Right to Water policies and programs to groundwater trading outreach efforts.

    4.2. For environmental stakeholders, consider working with environmental NGOs and other stakeholders to clarify the potential impacts and benefits to wetlands and interconnected surface water from trading programs.

    4.3. For agricultural stakeholders, provide informational services to the agricultural community and GSAs about available technical assistance and State and federal programs related to SGMA, drought, water-use efficiency, and soil health and, in coordination with the U.S. Department of Agriculture National Agricultural Statistics Service, County Agricultural Commissions and Sealers, and UC Agriculture and Natural Resources, make available to GSAs the most recent U.S. Census of Agriculture data that provides information related to the number of farms by size and by value of sales for each county so that GSAs may consider farm size when developing groundwater trading programs.

5. **Create digital resources and catalog available trading information**. Establish, populate, and promote the use of a website for sharing groundwater trading information that includes a repository of GSA- and stakeholder-identified resources and information available in GSPs and annual reports about SGMA-related groundwater trading programs. Consider creating a digital map to display where programs are being developed and the status of development using designations that could include pre-development, design phase, testing phase, and implementation phase.

6. **Provide allocation guidance.** Engage GSAs, stakeholders, and experts to discuss issues related to water rights and to groundwater allocations for communities, farms, and the environment, sharing information about which allocations methods are being pursued and under which situation a particular allocation method may be a good practice. Consider creating guidance around allocation of sufficient water for human health and consumption and protecting and enhancing drinking water quality, groundwater-dependent ecosystems and interconnected surface water, and small- and medium-size farms.

7. **Develop Best Management Practices.** Using the list of characteristics of well-managed groundwater trading programs (Finding 2), develop a best management practices guidance document for GSAs to use when establishing groundwater trading programs that stresses the importance of enforcing allocation limits and the need for compliance with groundwater management rules, and that includes data transparency guidance and guidance on common trading program attributes that will make it easier to trade across GSA and/or political boundaries, where such trades are appropriate and without triggering negative impacts.

Group 2 Actions. The Commission suggests that the State monitor, evaluate, and report on groundwater trading efforts to identify additional ways in which the State can enable well-managed groundwater trading with protections for vulnerable water users. The actions suggested below will need to be reviewed and refined as trading programs are developed; however, it behooves the State not to delay until the issues these actions seek to remedy have grown large in size. The suggested actions stem from the public dialog hosted by the Commission. The Commission received significant public feedback stressing the need to formally incorporate equity issues into groundwater management in order to enforce outreach and engagement efforts or representative governance structures, and to hold entities accountable for the impacts of overpumping. The actions below may extend beyond the State's current authorities and implementation of these actions may require the State to be given new authorities by the Legislature.

8. **Examine existing authorities**. Examine existing State authorities to determine where the State may need new authorities to assist with the oversight of groundwater trading programs, including whether authority is needed for setting up an oversight mechanism to ensure programs are run openly and fairly, and that rules are enforced.

9. **Create standard principles and rules**. Create a framework for standardized principles or rules to be applied across trading programs related to the treatment of natural resources, small- and medium-sized farms, and disadvantaged communities. Consider using standardized principles and rules as criteria for reviewing GSP updates, as a requirement for securing financial and technical assistance from the State, and/or as the basis of a groundwater trading program certification process, akin to land trust accreditation.

10. **Create oversight mechanisms.** Develop a committee with stakeholder representation to advise the State on its review and oversight of local groundwater trading programs, request additional information about trading programs in annual reports and/or GSP updates sufficient to conduct an annual review of trading efforts to ensure that they are advancing the goal of sustainability and avoiding undesirable results, and establish a State process for reviewing programs that repeatedly violate standard principles or rules.
11. **Evaluate incentives for wetlands**. Explore how to incentivize sufficient water for wetlands in areas where wetlands require groundwater much greater than their allocation.
12. **Support groundwater technical assistance programs for farmers.** Work with UC Cooperative Extension, NGOs, and resource conservation districts to expand technical assistance programs to help small- and medium-sized farm operators access groundwater trading programs.

Appendix 1: Groundwater Trading Stakeholder Advisory Group Members

	Agency	Member (Name, Title)	Alternate (Name, Title)
1	Environmental Defense Fund	**Dr. Christina Babbitt**, Senior Manager of the California Groundwater Program	**Ann Hayden**, Senior Director of Western Water and Resilient Landscapes
2	The Nature Conservancy	**Sarah Heard**, Director of Conservation Economics & Finance	
3	Mid-Kaweah Subbasin GSA	**Aaron Fukuda**, interim General Manager	
4	Madera County	**Stephanie Anagnoson**, Director of Water and Natural Resources	
5	Self-Help Enterprises	**Eddie Ocampo**, Director of Community Sustainability	**Angela Islas**, Community Development Specialist
6	Leadership Counsel for Justice and Accountability	**Nataly Escobedo Garcia**, Policy Coordinator	
7	University of California Cooperative Extension	**Dr. Ruth Dahlquist-Willard**, Small Farms and Specialty Crops Farm Advisor	
8	Community Alliance with Family Farmers	**David Runsten**, Policy Director	