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EXECUTIVE SUMMARY

Trading Sustainably:

CRITICAL CONSIDERATIONS FOR LOCAL GROUNDWATER MARKETS UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

Nell Green Nylen, Michael Kiparsky, Kelly Archer, Kurt Schrier, and Holly Doremus

Wheeler Water Institute | Center for Law, Energy & the Environment | UC Berkeley School of Law

The Sustainable Groundwater Management Act (SGMA), passed in 2014, is changing the way California manages its groundwater resources. SGMA calls for the creation of local Groundwater Sustainability Agencies (GSAs) and tasks them with developing and implementing Groundwater Sustainability Plans (GSPs) to achieve sustainable groundwater management. SGMA offers GSAs a broad palette of tools to choose from and significant flexibility to tailor their management activities to local conditions and needs. Because it allows GSAs to assign groundwater extraction allocations to pumpers and to authorize transfers of these allocations under certain circumstances, SGMA potentially opens the door for the development of local groundwater markets. In such a market, a willing seller might trade a portion of their groundwater extraction allocation to a willing buyer, allowing the buyer to pump groundwater in the seller's stead.

In concept, markets can be used as tools to efficiently achieve specific management objectives. For example, in some areas, local groundwater markets could potentially further sustainable management under SGMA. However, this will not be the case in every groundwater basin. Used inappropriately, groundwater markets could have unintended consequences, including harmful social and environmental impacts. Where GSAs decide to employ local groundwater markets, careful design and implementation will be critical to ensuring their success.

The stakes involved in SGMA implementation are high. Groundwater is a common-pool resource: extractions by one user in one place affect the resource at large and, therefore, the ability of others to use the resource. Changing where or when groundwater is pumped or the place, method, timing, or purpose of its use can change the impacts experienced by people and ecosystems. Groundwater management decisions made today will affect everyone in a basin, now and well into the future. The full impacts of poor decisions may not be felt until long after they are made, and some impacts may be irreversible.

Therefore, this report outlines a set of considerations GSAs will need to examine when evaluating whether a local groundwater market might be a viable tool for furthering sustainable management in a particular groundwater basin, and, if so, how to effectively implement it.

SGMA requires local agencies to sustainably manage groundwater resources

SGMA requires the formation of GSAs in medium- and high-priority groundwater basins. It tasks them with developing and implementing GSPs to achieve sustainability within 20 years of plan implementation. Sustainable management avoids six undesirable results: significant and unreasonable (1) depletion of groundwater supply, indicated by chronic lowering of groundwater levels, (2) reduction of groundwater storage, (3) seawater intrusion, (4) degraded water quality, (5) land subsidence, and (6) adverse impacts on beneficial uses of interconnected surface water.

SGMA potentially opens the door for local groundwater markets based on within-GSA transfers of groundwater extraction allocations

SGMA offers GSAs a broad palette of tools for achieving sustainability. For example, GSAs can limit groundwater pumping by establishing groundwater extraction allocations for groundwater users within their jurisdictions. SGMA allows GSAs to then authorize transfers of these allocations when the total amount of groundwater pumped within the basin is consistent with the applicable GSP. Beyond these basics, SGMA does not provide guidance about the circumstances under which specific transfers, or a transfer program more generally, might be useful and appropriate additions to GSAs' sustainability programs. Although transfers of groundwater extraction allocations could be used in other ways, this report focuses on the possibility that they could be used as the basis for local groundwater markets that enable water users to voluntarily redistribute basin groundwater resources among themselves.

In some areas, carefully designed and implemented groundwater markets might further sustainable management

A central argument advanced by market proponents is that markets enable the reallocation of limited resources more efficiently than other mechanisms, including regulations

alone. GSAs in many groundwater basins, including those that are critically overdrafted, will need to limit pumping to address unsustainable groundwater use. Limits will affect individual and collective incentives for groundwater use, potentially making some past uses of groundwater less feasible and leading to changes in where and how groundwater is used. Groundwater markets would affect these incentives more explicitly.

Carefully designed and implemented local groundwater markets could potentially contribute to socially, environmentally, and economically desirable reallocation of groundwater resources in some basins, but success is not a foregone conclusion. Markets (like all management tools) can have externalities—unintended or incidental effects on third parties or the environment that result from market transactions. Transfers of groundwater extraction allocations change where groundwater is pumped and where and how it is used, potentially changing its social and environmental impacts. Unrestricted or poorly administered transfers could result in significant negative externalities, including the undesirable results SGMA requires GSAs to avoid.

Whether a local groundwater market might be a viable tool for furthering sustainability in a particular basin will depend on a host of factors. These include applicable laws and regulations, basin conditions (and the state of knowledge about basin conditions), market design, and market implementation. In some areas, groundwater markets may not be viable management options: for example, where the potential impacts of trading are not well understood, where trading rules cannot sufficiently address negative externalities, or where—relative to other management options—the expected benefits of a market do not outweigh the burdens and uncertainties associated with designing and implementing it. However, in other areas, local groundwater markets may have the potential to not only further sustainable groundwater management but to contribute significant sustainability benefits. Careful design and implementation will be needed to guard against harmful side effects.

Critical considerations for local groundwater markets that further sustainable management under SGMA

Information provides the foundation for good decision making. GSAs and the stakeholders they serve should analyze potential management options and compare their expected benefits and burdens. Factors like local climate, geology, hydrology, ecological resources and needs, legal requirements, social and economic conditions, and goals will affect these analyses. These factors may vary significantly from basin to basin and within a single basin.

This report outlines a set of considerations designed to help GSAs and others evaluate whether a local groundwater market based on transfers of groundwater extraction allocations might be a viable management tool (Table 1).

We organize these considerations into three groups:

- 1 Foundational considerations** — Because local groundwater markets under SGMA would be based on transfers of groundwater extraction allocations, GSAs need to analyze a set of foundational considerations shared in common with other programs that limit groundwater pumping. These considerations relate to measuring groundwater extractions, setting overall pumping limits for basins and basin management areas, and establishing individual groundwater extraction allocations.
- 2 Market-specific considerations** — A number of additional considerations are relevant for local groundwater markets based on transfers of groundwater extraction allocations. These considerations relate to market goals, groundwater rights questions, the potential impacts of trading, trading rules, and the trading system and transfer approval process. Carefully designed rules will be needed to ensure that trades support progress toward sustainability and sufficiently address negative impacts to third parties and the environment.
- 3 General considerations** — Some considerations are important for all groundwater sustainability programs. For example, GSAs will need to establish and maintain monitoring systems that help them understand how program activities affect basin conditions. They will need to exercise oversight and enforcement authority to ensure compliance with program requirements, evaluate program effectiveness, and address problems by making needed changes. Transparency and public engagement will be important throughout. Finally, developing and implementing sustainability programs will require sufficient resources, including human capacity, physical and technological infrastructure, and funding.

When discussing these considerations, the report points out legal ambiguities and other sources of uncertainty that may present challenges for those seeking clarity about market programs. GSAs should consider the relationship between groundwater extraction allocations and groundwater rights. They should ask whether and how differences in the characteristics of groundwater rights should be accounted for in the allocation process and whether and how these differences should affect transferability. Robust public engagement may help GSAs navigate these issues successfully, while failing to address them adequately could prompt an adjudication or lay the groundwork for water right takings claims.

Developing and implementing local groundwater markets that successfully further sustainable management under SGMA will require significant effort. We hope the considerations outlined in this report help GSAs and others evaluate whether such markets might be viable local management tools and, if so, how to effectively implement them.

TABLE 1. Critical considerations for local groundwater markets under SGMA.

1. Foundational considerations		
Measuring groundwater extractions	<ul style="list-style-type: none"> • What is known about historical groundwater extraction and use in the basin? • How well understood are current patterns and volumes of groundwater extraction and use? • How will groundwater extraction and use be measured going forward? 	
Setting overall pumping limits	<ul style="list-style-type: none"> • How will the total amount of groundwater that may be pumped from the basin (and, if appropriate, from different management areas) be determined? <ul style="list-style-type: none"> - What sustainability indicators, minimum thresholds, measurable objectives, and interim milestones will be used to gauge undesirable results and progress toward sustainability? - How will these be translated into sustainable yield for the basin and, if appropriate, to extraction limits for different management areas? 	
Establishing individual groundwater extraction allocations	<ul style="list-style-type: none"> • What is the relationship between groundwater extraction allocations and common-law groundwater rights? • How adversarial are basin stakeholders? How open to cooperative solutions are they? • What factors will be used to determine individual groundwater extraction allocations? • To what extent should differences in the characteristics of groundwater rights be accounted for in the allocation process? Under conditions of overdraft, will appropriate users still receive allocations? How will probable prescriptive uses be addressed? • How will the allocation system address the dormant overlying rights of landowners not currently making overlying use of groundwater? How will it address landowners that want to begin new overlying uses in the future? • What groups would benefit most, and least, from different allocation options? • How should return flows to surface water or percolation to groundwater from the use of imported and native surface water be addressed? • Will those issued allocations be able to carry over some or all of an unused portion for future use? If so, how much, for how long, and under what conditions? 	
2. Market-specific considerations		
Market goals	<ul style="list-style-type: none"> • What is the market intended to accomplish (or avoid)? • How will the market complement or reinforce other sustainability programs? • How will market success be measured? 	
Groundwater rights questions	<ul style="list-style-type: none"> • To what extent should the characteristics of groundwater rights affect the transferability of groundwater extraction allocations? • How might transfers of groundwater extraction allocations injure other water users? 	
Potential trading impacts	Spatial dimensions	<ul style="list-style-type: none"> • How might transfers of groundwater extraction allocations change the spatial impacts of pumping and using groundwater?
	Temporal dimensions	<ul style="list-style-type: none"> • How might transfers of groundwater extraction allocations change the near-term, long-term, and delayed temporal impacts of pumping and using groundwater? • How might transfers of carried over portions of groundwater extraction allocations affect temporal impacts?
	Method and purpose of use dimensions	<ul style="list-style-type: none"> • How might transfers that change the method and purpose of use potentially affect the amount of groundwater consumptively used, return flows, and recharge? How might they affect water quality?
	Social dimensions	<ul style="list-style-type: none"> • How might transfers of groundwater extraction allocations negatively affect people within the basin? Outside the basin? • What communities and segments of the population might be especially at risk of experiencing, or being negatively affected by, undesirable results?
	Environmental dimensions	<ul style="list-style-type: none"> • How might transfers of groundwater extraction allocations negatively affect environmental resources? • What ecosystems or species might be especially at risk of experiencing, or being negatively affected by, undesirable results?
Trading rules	<ul style="list-style-type: none"> • How will rules sufficiently address the various dimensions of potential trading impacts? • How might rules minimize the negative—and maximize the positive—impacts of trades? • How will rules address information gaps and uncertainty? 	

Trading system and transfer approval process	<ul style="list-style-type: none"> • How will potential buyers and sellers find one another? • What will the transfer approval process involve? <ul style="list-style-type: none"> - What environmental review will be needed for proposed transfers of groundwater extraction allocations? Will long-term or permanent transfers be allowed, and, if so, how will this affect environmental review requirements? - How will the approval process address potential impacts to other water rights? • How and when will the parties to a transfer demonstrate that they meet environmental review, and other, requirements? • How will trading rules be operationalized? If an electronic trading platform will be used, who will design, operate, and maintain it? • How will completed transfers be tracked and confirmed? • What trading-related information will be available to the public, when, and in what format? 	
3. General considerations		
Monitoring	<ul style="list-style-type: none"> • What is known about the physical and temporal relationships between groundwater extraction, groundwater use, and basin conditions? How do these relationships vary across the basin? • What is known about how other factors, such as changes in climate or land use, have affected basin conditions in the past and are likely to affect them in the future? • Going forward, how will changes in basin conditions be monitored? <ul style="list-style-type: none"> - How will the impacts of groundwater extraction and use in general, and the impacts of transfers of groundwater extraction allocations in particular, be monitored? - What new technical expertise will be needed to monitor basin conditions and understand the effects of transfers? 	
Oversight and enforcement	<ul style="list-style-type: none"> • How will compliance with limits on overall groundwater extractions be tracked and ensured? • How will compliance with groundwater extraction allocations, trading rules, and other program requirements be tracked and ensured? <ul style="list-style-type: none"> - How will voluntary compliance be encouraged? • How will fair and consistent enforcement of groundwater extraction allocations, trading rules, and other program requirements be achieved? 	
Evaluation	<ul style="list-style-type: none"> • When and how will program decisions and processes be evaluated? • How will the assumptions and models that underlie limits on overall groundwater extractions, groundwater extraction allocations, and trading rules be assessed? • How will the success of sustainability programs be evaluated? 	
Modification	<ul style="list-style-type: none"> • When and how will program elements and processes be updated? • What mechanisms will trigger or enable changes to sustainability programs that respond to lessons learned, new information, and increased understanding of basin conditions? 	
Transparency and public engagement	<ul style="list-style-type: none"> • How will information relevant to developing and implementing sustainability programs be communicated to the public? • How will broad and meaningful public engagement in program development, implementation, and evaluation be ensured? • What information about the actual operation of sustainability programs (e.g., about market transactions) will be available and in what contexts? • What information will be shared about program oversight, enforcement, evaluation, and modification activities? How and when will this information be shared? 	
Resources	Human capacity	<ul style="list-style-type: none"> • What skills and expertise will be needed to design and implement effective sustainability programs? • How will these capacities be developed or accessed?
	Physical and technological infrastructure	<ul style="list-style-type: none"> • What infrastructure will be needed to carry out sustainability programs? <ul style="list-style-type: none"> - What infrastructure will be needed to measure groundwater extraction and use? - What infrastructure will be needed to monitor basin conditions and understand the effects of transfers? - What computing hardware and software will be needed to organize and analyze data, develop models, etc.?
	Funding	<ul style="list-style-type: none"> • How will sustainability programs be funded?