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Improving California's Water Market

How Water Trading and Banking Can Support Groundwater Management

Technical Appendix A. Legal Issues Related to Water Trading and SGMA Implementation

Brian Gray

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Introduction

This appendix provides detailed background information to support the legal and institutional recommendations of the main report (Ayres et al. 2021a). It includes a review of the principal laws and policies that govern groundwater transfers—including the Sustainable Groundwater Management Act (SGMA)—and analysis of the effects of these laws on the creation and administration of groundwater markets. The appendix also considers a variety of laws and agency rules that affect inter-basin and inter-agency groundwater trading, as well as state and federal policies that govern the diversion, transport, and trading of surface water used for direct water supply and groundwater recharge. These rules are important in the context of groundwater trading, because integrated conjunctive management of groundwater and surface water across basins and jurisdictional boundaries can both facilitate compliance with SGMA's sustainability mandate and reduce the costs of SGMA implementation (Hanak et al. 2019; Ayres et al. 2021a).[1]

Overview

Although the laws and policies reviewed in the following pages are diverse, they may be divided into four categories: (1) common law and statutory rules that govern the intra-basin use and trading of groundwater; (2) county ordinances and local agency rules governing groundwater and surface water across jurisdictional boundaries; (3) state and federal rules that govern the use of water project facilities to transport water for trading and groundwater banking; and (4) state policies that authorize the diversion of high-water flows for underground storage and regulate exports of water from the Sacramento–San Joaquin River Delta. The delineation among these categories is not precise, but it is nonetheless a helpful way to organize the analysis of this complex set of laws and policies.

The appendix is therefore divided into four parts, with subsidiary sections that address the following specific topics:

1. **SGMA and groundwater rights law**
    - The effects of SGMA's quantification and allocation of groundwater pumping rights on water markets.
    - Lingering risks of water rights claims on SGMA's groundwater allocations and potential trading programs.
    - Statutory and common law protections of third-party water right holders and other parties that may be adversely affected by groundwater transfers.
2. **Local laws and regulations**
    - County ordinances that regulate transfers of groundwater—and, in some cases, surface water—to users in other counties.
    - Local water agency rules that may inhibit surface water and groundwater transfers within and beyond the agency's service area.

[1] Throughout this appendix, the term "sustainability mandate" is used as a shorthand for SGMA's requirement that all high- and medium-priority groundwater basins be managed pursuant to groundwater sustainability plans (GSPs) that will achieve sustainable groundwater management over a 20-year implementation period (Water Code §§ 10720(a) & 10727.2(b)(1)). The sustainability deadline is 2040 for critically overdrafted basins and 2042 for other high- and medium-priority basins, although the Department of Water Resources (DWR) has authority to grant two five-year extensions for good cause (Water Code § 10727.2(b)(3)). For a more detailed overview of SGMA's myriad requirements, see Littleworth and Garner (2019).

3. **State and federal water transfer, wheeling, and groundwater banking policies**
    - General Central Valley Project (CVP) and State Water Project (SWP) policies on water transfers.
    - Rules governing the "wheeling" of project and non-project water through CVP and SWP facilities.
    - Revised rules for long-term transfers and groundwater banking.
    - Project carriage water requirements for water transported through the Delta.
4. **Diversions of surface water for groundwater recharge and other uses**
    - State Water Resources Control Board guidelines on diversions of high-water flows for groundwater recharge and other beneficial uses.
    - The Delta Stewardship Council's policy limiting reliance on water exported from or transported through the Delta.[2]

The Legal and Policy Setting

Water transfers are an important component of California water policy and management. Local and regional trading of surface water—usually among users within a common watershed or water supply agency—is now routine. There also has been an increasing number of long-term transfer agreements, which represent a significant share of overall water trading by volume. In addition, California has experienced significant short-term trading—including both intra- and inter-basin transfers—during periods of drought (Hanak and Stryjewski 2012a; WestWater Research 2020; Hanak et al. 2021).

In contrast, inter-agency and inter-basin transfers of groundwater are both rare and controversial. About half of California's counties have enacted ordinances that restrict the transfer of groundwater beyond county boundaries. These laws apply both to the direct groundwater transfers and to "groundwater substitution transfers"—transactions in which the transferor sells or leases surface water and then increases its pumping of groundwater to replace the transferred surface water. Spurred by SGMA's sustainability mandate, however, more intra-basin groundwater trading programs are beginning to emerge (Babbitt et al. 2017; Green Nylen et al. 2017; Ayres et al. 2021a).

Over the past several decades, the California Legislature has enacted a series of statutes that encourage and facilitate surface water transfers. These statutes authorize (and regulate) short-term and long-term transfers, transfers of conserved and surplus water, transfers of water made available through recycling and participation in conjunctive use programs, and access to third-party agency facilities to transport water (Water Code §§ 1010-1018, 1020-1031, 1700-1745.11 & 1810-1815; DWR and SWRCB 2015).[3] In the Central Valley Project Improvement Act of 1992 (CVPIA), Congress also authorized transfers of

[2] Although there are other laws and policies that are relevant to inter-basin transfers, wheeling, and groundwater banking, a broader study of California water transfers is beyond the scope of this appendix. For more comprehensive analyses of California water transfer law and policy, with reform recommendations, see National Research Council 1992; Gray 1996; LAO 1999; Water Transfer Workgroup 2020; Hanak and Stryjewski 2012a; Gray et al. 2015; ACWA 2016; Sellers et al. 2016; and Watson 2016.

[3] Although many transfers must be approved by the State Water Board, the board's jurisdiction generally is limited to transfers of surface water that require a change in the point-of-diversion, place-of-use, or purpose-of-use set forth in the transferor's permit or license (Water Code §§ 1700-1706 & 1725-1737). This means that transfers of water held under riparian and pre-1914 appropriative rights are exempt from State Water Board review, as are transfers within water service areas covered by a single water right permit or license. Surface water therefore may be transferred between users and contracting agencies within large water projects such as the CVP and SWP without board review—even though the transfers may move water across water basins—because they do not require a change in the projects' authorized points-of-diversion, places-of-use, or purposes-of-use (Gray 1994, 1996; Hanak and Stryjewski 2012a). As discussed below, however, transfers from CVP or SWP contractors to users in the other system do require State Water Board approval.

water among CVP users, as well as transfers of project water to parties who are not CVP contracting agencies (CVPIA § 3405(a)).

There is significantly less statutory guidance on groundwater transfers, and the California Legislature has generally deferred to local policies on groundwater trading. For example, a 1984 statute prohibits groundwater exports from the Sacramento and Delta-Central Sierra basins without the approval of the boards of supervisors *and* the voters of the counties that overlie the groundwater basin (Water Code § 1220). And a 1992 enactment bans groundwater substitution transfers unless the transfer is either consistent with the local groundwater management plan or "approved by the water supplier from whose service area the water is to be transferred." (Water Code § 1745.10)

SGMA continued this general deference to local governance in SGMA by empowering Groundwater Sustainability Agencies (GSAs) to include in their groundwater sustainability plans (GSPs) rules authorizing water transfers within their respective boundaries (Water Code § 10726.4(a)(3) & (4)). The specifics of SGMA's water trading and regulatory structures are described in more detail in part one.

In addition to these general laws, California has 30 adjudicated groundwater basins and many of these have their own water trading policies (DWR 2021a).[4] The judgments in these cases define the safe yield of the aquifer and establish specialized rules on water rights administration, water management, and (in some cases) water transfers. (See Box 1.) Although SGMA generally exempts adjudicated basins from its directives (Water Code § 10720.8), the water transfer policies set forth in many of these judgments may serve as examples for GSAs and other agencies that seek to create their own groundwater trading programs.

[4] Twenty-nine of the adjudicated basins are listed in SGMA (Water Code § 17020.8(a)-(d)). The thirtieth and most recent, the Borrego Valley Groundwater Basin, is described in Box 3.

Box 1: Adjudicated Groundwater Basins

California law authorizes the adjudication of all water rights within a groundwater basin. The judgments in most of these cases define the safe yield of the aquifer and many assign pumping rights that allocate shares of the safe yield to individual water right holders. Many of these judgments embody settlements among the parties to the litigation, although some also articulate new rules of law that the courts have imposed on water right holders who declined to stipulate to the terms of the judgment. In some of these cases, the courts have entered judgments that essentially equalize water right priorities (Blomquist 1992; Mojave Basin Judgment 1996; Antelope Valley Basin Judgment 2016; Garner et al. 2020). In others, the courts have altered water right priorities based on prescription or limited them through the doctrine of reasonable use (California Supreme Court 1975, 2000; California Court of Appeal 2012, 2021b; Chino Basin Restated Judgment 2012; Garner et al. 2020).

Although the rules governing the 30 adjudicated basins are varied, most share two important features: the judgments limit aggregate groundwater extraction to the safe yield of the basin, and they quantify individual pumping rights (although most exempt small or "*de minimis*" users). Most judgments also authorize groundwater trading among users with decreed pumping rights (Langridge et al. 2016), and several call for the conjunctive management of groundwater and surface water—especially for purposes of groundwater recharge (Babbitt et al. 2017; Garner et al. 2020).

In addition, most judgments create a court-appointed watermaster who is charged with monitoring groundwater extraction, enforcing pumping limits, and preventing well interference and other third-party harms (Langridge et al. 2016). The watermaster also usually supervises the importation of surface water for recharge and direct use (Blomquist 1992; Garner et al. 2020). Because these judgments require sustainable groundwater use and establish comprehensive water management and enforcement systems, SGMA generally exempts adjudicated basins from its GSA and GSP directives (Water Code § 10720.8).

In 2015, the California Legislature enacted a bill to expedite comprehensive groundwater adjudications. The legislation encourages the "compromise and settlement of comprehensive adjudications . . . consistent with the achievement of groundwater sustainability within the timeframes of the Sustainable Groundwater Management Act." (Civil Procedure Code § 830(b)(3) & (4)) It also directs the courts to ensure that their judgments are consistent with the reasonable and beneficial use requirements of Article X, Section 2 of the California Constitution (Civil Procedure Code §§ 849 & 850).

In addition, the statute authorizes the courts to conduct an integrated adjudication of groundwater and surface water rights if inclusion of the latter "is necessary for the fair and effective determination of groundwater rights in the basin." (Civil Procedure Code § 833(c)) Although it was adopted before the 2015 law was enacted, the Mojave Basin judgment is an example of integrated water rights adjudication (Mojave Basin Judgment 1996, ¶ 6).

Although California's adjudicated groundwater basins function largely outside of SGMA's purview, the rules that govern these basins may offer useful examples for GSAs and groundwater users alike. Moreover, if the members of a GSA cannot agree to workable pumping allocations and sustainability policies, adjudication under the new expedited rules and procedures may provide a necessary alternative.

For a detailed analysis of California's adjudicated groundwater basins, see Langridge et al. (2016).

What We Talk About When We Talk About Groundwater

Before embarking on an analysis of groundwater trading, it is necessary to define the resource in question. This in turn requires an understanding of the legal definition (or definitions) of groundwater.

Although it is a common practice to think of groundwater as a single resource, California law recognizes several types of groundwater and groundwater rights.[5] Three of these categories are especially important for the analysis that follows:

Native groundwater is water that makes its way into aquifers through percolation from surface sources within the basin—including rivers, streams, wetlands, and diffuse surface water produced by rainfall or snowmelt—and from migration of underground waters from adjacent aquifers and subsurface streams. Post-irrigation percolation and percolation following other beneficial uses of surface water that originates in-basin are also classified as native groundwater.

Imported water is surface water that originates in another basin and recharges (or otherwise makes its way into) a groundwater basin. Imported water includes water that is directly stored in the aquifer and percolation following surface uses of the imported supplies.

Other developed water is water that, like imported water, "would not be present within a basin but for human efforts." This category includes water produced by "salvage" (e.g., capture of floodwaters and stormwater runoff that otherwise would have escaped the basin without naturally recharging the aquifer) and water produced by recycling (Garner et al. 2020).

This classification of groundwater has significant consequences for water rights and water management. As described in more detail in part one, SGMA authorizes GSAs to assign groundwater extraction allocations to each user within the GSA's jurisdiction. These allocations define each water right holder's right to pump native groundwater from the basin.

In contrast, imported and other developed surface water that is present in the aquifer is the exclusive property of the importer or developer. This rule applies to the initial extraction of the imported or developed water from the aquifer. It also applies to the extraction of imported or developed water that

[5] State law also distinguishes between percolating water as defined in the text and water in "subterranean streams flowing through known and definite channels," including the underflow of surface streams (Water Code § 1200). The former is legally classified as groundwater and is exempt from the State Water Board's permitting and licensing system. The latter is defined as surface water. Diversions of surface water for non-riparian uses commenced after December 19, 1914 (the effective date of the Water Commission Act of 1913) are subject to the board's permitting and licensing jurisdiction (Water Code § 1201). For an analysis of the potential difficulties of distinguishing between these two categories of underground water, see California Court of Appeal (2006).

percolates into the aquifer following its initial surface use if the importer or developer manifests an intent to retain its paramount right of reuse and does not abandon the water (California Supreme Court 1943, 1975; California Court of Appeal 2012, 2021).[6]

The purpose of the rule is to credit the importer or developer with the "fruits of his endeavors in bringing into the basin water that would not otherwise be there." (California Supreme Court 1975) The rule also recognizes that imported and developed surface water benefits *all* groundwater users within the receiving water basin. This occurs because the imported water raises the groundwater table (and thus reduces pumping costs), and it reduces aggregate demand for native groundwater to the extent that users draw on imported and developed supplies—either directly or from surface storage—in lieu of pumping (California Court of Appeal 2012).

If native and non-native groundwater could be separated from one another, the administration of California's aquifers would be relatively straightforward. Extraction allocations established under SGMA would apply to native groundwater aquifers, and water developers and importers would have plenary rights to the water that they store in the same aquifers. In reality, of course, the distribution of groundwater is not that regimented. The groundwater present in most of the state's aquifers is a blend of native and imported supplies, and this hydrologic complexity affects all aspects of groundwater management.

Creation of accounting systems to distinguish among the various types of water rights within the basin therefore will be an essential aspect of SGMA implementation, and the statute confers significant authority on GSAs to determine and administer water that is present in the basin from different sources (Babbitt et al. 2018; Garner et al. 2020). For example, SGMA directs GSAs to investigate groundwater and surface water rights within the basin, to require users to report diversions of surface water to underground storage, and to identify surface water used or available for groundwater storage and in-lieu uses (Water Code §§ 10725.4(b), 10726, & 10727.2(d)). The statute also authorizes GSAs to manage groundwater recharge and other conjunctive use programs that rely on imported and developed water to augment native supplies (Water Code §§ 10726.2(b) & (d)).

In addition, robust accounting systems are a necessary foundation for groundwater markets. These accounting rules also must distinguish between extraction allocations for native groundwater (which usually may only be transferred intra-basin) and non-native supplies (which are transferable both within the basin and to transferees located outside the basin). Such accounting systems are a common feature of adjudicated groundwater basins, as well as those that are home to groundwater banks (Thomas 2001; Smith 2013). They also may be found in some basins that rely heavily on imported or developed surface water to augment limited native supplies. The Rosedale-Rio Bravo Water Storage District's new Water

[6] Water Code § 1210 codifies this principle for recycled water:
The owner of a waste water treatment plant operated for the purpose of treating wastes from a sanitary sewer system shall hold the exclusive right to the treated waste water as against anyone who has supplied the water discharged into the waste water collection and treatment system, including a person using water under a water service contract, unless otherwise provided by agreement.
Although the statute declares the rights to treated wastewater as between the immediate source (e.g., homes and businesses that discharge their waste into a municipal wastewater treatment system) and the recycler, it is ambiguous as to ownership of treated wastewater where the original source was imported or developed water, rather than the native groundwater of the basin. According to a recent analysis, "it does seem evident that either the importer or treatment plant owner has the right to treated wastewater as against any native water users, [and] GSAs should treat such water as separate from the native groundwater for allocation purposes." (Garner et al. 2020)

Accounting and Trading Platform, which is described in more detail later in Box 9, is an illuminating example (RRBWSD 2020).

The process of quantifying and distinguishing between native and non-native groundwater can be complicated, and GSAs, water users, and other water agencies will have to address a variety of questions regarding storage and extraction rights.[7] But the benefits of an accounting system that facilitates the unencumbered trading of imported and developed supplies are well worth the effort.

Part One: SGMA and Groundwater Rights Law

As described above, SGMA expressly authorizes groundwater transfers; the creation and administration of groundwater trading programs will largely be the provenance of the GSAs, other local water agencies, and groundwater users. Several aspects of California law will influence the structure of groundwater trading, however. These include common law definitions of groundwater rights and various rules (both common law and statutory) that protect third-party interests. This section reviews these laws and explains how SGMA addresses many of the ambiguities and uncertainties that may affect the administration of groundwater markets.

Groundwater Rights, SGMA, and Water Markets

The creation and successful administration of groundwater markets depends on at least four essential factors:

1. Extraction rights must be quantified and assigned to individual users.
2. Each holder of an extraction right must have authority to decide how best to use its pumping allocation—e.g., by applying the water to beneficial uses on its own land or by earning income from the sale or lease of all, or a portion, of the allocation to another groundwater user.
3. The eligibility requirements and geographic scope of the market must be well-defined and understood by potential participants.
4. There must be clearly defined and enforceable rules to monitor and enforce extraction and trading limitations and to protect third parties that may be affected by water transfers.[8]

As described in the main report, there are a variety of economic incentives for the creation of groundwater markets. These include increased net revenues, enhanced water use efficiency, reduced capital investments, more productive and valuable water allocation, and reduction of the risk of drought (Ayres et

[7] A 2018 report on SGMA implementation by the Environmental Defense Fund and New Current Water and Land identifies some of the questions regarding imported and developed water—in addition to quantification and delineation—that GSAs and their members must answer. For example, "if the recharge is undertaken by an irrigation district, does the credit accrue to the landowners within the district boundaries? If landowners within the district do not utilize imported surface supplies, do they benefit from the indirect recharge activities?" The authors conclude that "it will be necessary for GSAs to develop policies for making these determinations and apply them consistently . . . [and] to monitor such efforts on an ongoing basis." (Babbitt et al. 2018) More extensive analyses of the hydrologic and legal issues associated with groundwater recharge and banking—including recommendations for avoiding or minimizing harm to users of native groundwater—may be found in Thomas (2001) and Smith (2013).

[8] This is not, of course, a comprehensive list. In addition to the factors described in the text, successful markets generally require accessible information about the quantities, timing, and pricing of water available for sale, as well as a means of connecting potential buyers and sellers. Most importantly, successful markets require buy-in from a large majority of users within the basin. For additional information about the establishment of groundwater markets, see Babbitt et al. (2017); Green Nylen et al. (2017); Ayres et al. (2021a).

al. 2021). Yet, outside of some adjudicated basins, there has been little trading of groundwater in California.

Although this is a result of several factors, one important cause is the common law of groundwater rights. This law—laid down by the courts in the late 19th and early 20th centuries—essentially defines groundwater as a common resource. Groundwater rights are imprecise, variable, and unquantified; groundwater use has generally been unmonitored and unregulated. (See Box 2.) These characteristics are important in the context of groundwater trading, because they fail all of the prerequisites to the establishment of groundwater markets described above.

Box 2: Common Law Groundwater Rights

California recognizes three main types of rights to native groundwater: overlying, appropriative, and prescriptive.

Overlying rights—which arise from the ownership of land that overlies a groundwater basin—confer on each water right holder a "correlative" share of the "safe yield" of the aquifer. Safe yield is the maximum aggregate quantity of water that may be extracted from a basin over time without causing a sustained lowering of the groundwater table. Overlying rights are based on each extractor's reasonable use—defined in relation to the other overlying owners' reasonable uses—of the shared resource (California Supreme Court 2000). This means that individual rights may vary over time as other extractors increase their pumping, as new wells go online, and as hydrologic changes alter the safe yield of the aquifer.

Overlying rights may be active or dormant. An overlying landowner therefore may sink a new well or increase its pumping at any time, and the newly extracted water carries the same correlative rights as those of all other overlying rights. Overlying landowners as a group—including active and inactive users—have senior rights to the safe yield of the aquifer. As the name connotes, however, water obtained pursuant to an overlying right may only be used on land that overlies the aquifer from which it is extracted (Littleworth and Garner 2019).

In contrast, appropriative rights arise from the act of extracting water from the aquifer (rather than on ownership of land), and they are quantified based on the appropriator's historical rates of pumping and application to beneficial use. Unlike overlying rights, there are no place-of-use restrictions on appropriative rights. Appropriative rights extend only to "surplus" water that is available within the safe yield of the aquifer after the reasonable demands of all overlying owners are fulfilled. Moreover, the water available to appropriators is allocated based on temporal priority of beneficial use (i.e., first-in-time, first-in right). Appropriative rights therefore may be vulnerable during periods of drought when natural recharge of the aquifer is diminished and overlying users initiate new pumping, or increase pumping from existing wells, to replace scarce surface supplies (Littleworth and Garner 2019).

Under California law, municipal water service providers have appropriative rights—rather than overlying rights—even if their service areas are entirely on land that overlies the aquifer (Garner et al. 2020). This means that most cities and other municipal systems have relatively junior rights in their respective groundwater basins.

Finally, in certain cases where aggregate extractions exceed the safe yield of the basin for a period exceeding five years, users may obtain prescriptive rights that supersede the overlying and appropriative rights. In some adjudications, the courts have essentially equalized all water right priorities by applying the doctrine of "mutual prescription." This doctrine is based on the theory that, during periods of sustained overdraft, all pumping in excess of the safe yield is unlawful and all users therefore gain prescriptive rights vis-à-vis one another. Later cases have recognized mutual prescription, but protected cities and municipal water supply agencies from alteration of their water rights (California Supreme Court 1949, 1975).

Unless modified by judicial judgment in a basin-wide adjudication, these common law principles govern the exercise of all groundwater rights. In addition, the courts have held that all water rights—regardless of relative priority—must be exercised in compliance with the reasonable use mandate of Article X, Section 2 of the California Constitution (California Supreme Court 2000).

California's surface water rights system has a similar hierarchy. Riparian rights—which are based on ownership of land that is adjacent to a watercourse—have a shared first priority to the natural flow of the river, and appropriators follow in order of priority of beneficial use. Non-riparian diversions of surface commenced after December 19, 1914 are governed by permits or licenses issued by the State Water Board (Littleworth and Garner 2019).

Although most of California's surface water and groundwater resources are hydrologically interconnected—or were connected before overdraft lowered the groundwater table in some areas to sever the hydrologic linkage—state law continues (with a few exceptions) to govern surface water and groundwater rights as separate systems (Hanak et al. 2011; Gray et al. 2015).

SGMA addresses many of the impediments to groundwater trading posed by the common law definition of groundwater rights, because it grants GSAs broad powers to define and regulate extraction rights and to incorporate groundwater transfers into its sustainability planning. Yet SGMA does not resolve all of the problems created by the common law, because the statute provides that neither it nor any GSP adopted pursuant to its authority "determines or alters surface water rights or groundwater rights under common law or any [other] provision of law." (Water Code § 10720.5(b)) This means that groundwater users within a basin who may object to a GSA's extraction allocation, trading, or enforcement decisions may assert their underlying common law water rights. In these situations, judicial resolution of the conflict may be necessary.

SGMA Reforms

One of SGMA's most important reforms is to allow GSAs to quantify pumping rights. The Act authorizes GSAs to require their members to register all "groundwater extraction facilities" (Water Code § 10725.6), and it provides that the agencies may "control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the

aggregate." (Water Code § 10726.4(a)(2)) This includes authority to establish "groundwater extraction allocations" for individual wells.[9]

SGMA also authorizes GSAs to address the potential disruptive effects of new users entering the system, or of existing users increasing their pumping capacity in a manner that would interfere with the sustainability requirements of the GSP. The Act provides that the regulatory powers described above also extend to "construction of new groundwater wells, enlargement of existing groundwater wells, or reactivation of abandoned groundwater wells." (Water Code § 10726.4(a)(2))[10]

In addition, SGMA grants GSAs authority to monitor and enforce the individual pumping allocations. This includes the power to compel each extractor to install meters or other water-measuring devices and to file an annual report of actual pumping during the preceding year (Water Code § 10725.8(a)-(c)). As described in more detail below, the statute also allows GSAs to collect civil penalties for violations of individual pumping allocations (Water Code § 10732).

SGMA also states that GSAs may "authorize temporary and permanent transfers of groundwater extraction allocations within the agency's boundaries." (Water Code § 10726.4(a)(3)) This authority is subject to two limitations. First, "the total quantity of groundwater extracted in any water year," including water made available for transfer, must be "consistent with the provisions of the groundwater sustainability plan." Second, individual water transfers are "subject to applicable city and county ordinances," as well as to the terms of the GSP and other conditions established by the GSA (Water Code § 10726.4(a)(3)).

Finally, SGMA authorizes GSAs "to establish accounting rules to allow unused groundwater extraction allocations . . . to be carried over from one year to another and voluntarily transferred, if the total quantity of groundwater extracted in any five-year period is consistent with the provisions of the groundwater sustainability plan." (Water Code § 10726.4(a)(4))

These reforms will significantly aid GSA compliance with SGMA's sustainability directive, and they will enable GSAs to create and administer groundwater trading programs tailored to the needs of their respective basins. Indeed, SGMA addresses all of the deficiencies in the common law of groundwater rights listed above:

- **Quantification:** GSAs have authority to quantify groundwater extraction rights, to assign these rights to all users, and to establish allocation trading programs. The defined allocations will not alleviate hydrologic uncertainties, but they will enable individual users to make more predictable and reliable business decisions.
- **Autonomy:** This includes the ability of individual extractors to decide whether use their allocation themselves or to transfer all or a portion of their annual allocation to willing purchasers. GSAs have the option of authorizing groundwater sales or exchanges and to allow the parties to engage in multi-year trading arrangements.

[9] For a detailed analysis of how GSAs should structure their extraction allocation programs, including an evaluation of alternative allocation methodologies, see Babbitt et al. (2018) and Garner et al. (2020).

[10] SGMA requires each GSA's groundwater extraction regulations to be "consistent with the applicable elements of the city or county general plan, unless there is insufficient sustainable yield in the basin to serve a land use designated in the city or county general plan." (Water Code § 10726.4(a)(2)) The statute also preserves some aspects of the counties' traditional land use powers over well permitting by prohibiting GSAs from issuing permits "for the construction, modification, or abandonment of groundwater wells, except as authorized by a county with authority to issue those permits." (Water Code § 10726.4(b))

- **Scope:** The geographic scope of authorized groundwater markets is defined by the GSA's jurisdictional boundaries, which in turn define the participant class and comport with the underlying place-of-use restrictions on the exercise of overlying groundwater rights described in Box 2.
- **Trading Rules:** GSAs have authority to monitor and enforce groundwater extraction limits and to supervise groundwater trading. This includes enforcement of rules that protect water users who are not parties to particular trades and other third parties who may be affected by individual transfers.[11]

Lingering Uncertainties and Water Rights Adjudications

Despite SGMA's reforms, there remain a few significant questions about the effects of the underlying groundwater rights law on the allocation and transferability of native groundwater that is subject to a GSA's regulatory authority. These questions stem from SGMA's general preservation of existing water rights described above (Water Code § 10720.5(b)) and from the Act's additional caveat that a "limitation on extractions by a groundwater sustainability agency shall not be construed to be a final determination of rights to extract groundwater from the basin or any portion of the basin." (Water Code § 10726.4(a)(2))

Most of the uncertainties created by this express recognition of underlying water rights are likely to arise in the context of extraction allocations and restrictions on individual pumping rights established by the GSA. But they also could undermine a GSA's efforts to establish a groundwater market by undermining potential buyers' and sellers' confidence in the quantity of water that will be available for transfer.

For example, some existing users might object to their assigned extraction allocations and continue pumping at levels that exceed their individual pumping limits. Or, overlying landowners who have never exercised their groundwater rights might demand an extraction allocation based on their dormant overlying rights for the purpose of selling their allocations to other users within the basin. In both cases, the assertion of underlying—and expressly preserved—groundwater rights could destabilize administration of the GSP by jeopardizing compliance with the sustainability mandate. But they also could undermine potential water transfers by creating uncertainty about the quantity of water the transferor can guarantee the transferee over the term of the transfer agreement.[12]

California law provides two ways of resolving these types of disputes. The first is administrative or judicial enforcement of the extraction allocations and pumping limits. SGMA authorizes GSAs to impose civil penalties of up to $500 for each acre-foot of excess pumping (Water Code § 10732(a)(1)).[13] A GSA may assess these penalties through its own administrative action, following notice and an opportunity for a hearing (Water Code § 10732(b)), or it may seek to enforce them in court.

Alternatively, a GSA or groundwater users who claim that the extraction allocations violate their underlying water rights may file a comprehensive adjudication of all water rights in the basin. SGMA directs that such adjudications shall be conducted in accordance with the expedited adjudicated

[11] The laws that protect third parties from potential harm from groundwater extraction and water trading are detailed and extend beyond the terms of SGMA. They are therefore analyzed separately in the following section.

[12] This uncertainty could arise because the "noncompliant" pumping that exceeds individual SGMA allocations requires all other extractors to further limit their pumping to offset the excess—thus reducing the quantities that sellers are willing to make available on the market. Uncertainty also could arise in situations where the noncompliant pumping causes a cone of depression (see below) that makes it impossible for a transferee to extract the water to which it is entitled under the transfer agreement. For an analysis of these potential conflicts, see Garner et al. (2020).

[13] GSAs also may assess civil penalties of up to $1,000 for violations of any other rules, plus $100 per additional day for continuing violations if the violation persists more than 30 days after notice (Water Code § 10732(a)(2)).

procedures described above in Box 1 (Water Code § 10737). That statute, enacted as a companion to SGMA in 2015, "applies to actions that would comprehensively determine rights to extract groundwater in a basin, whether based on appropriation, overlying right, or other basis of right." (Civil Procedure Code § 833(a))[14] Resolution of claims that underlying water rights take precedence over SGMA's allocational rules implicates all extraction rights within a groundwater basin. If the objecting parties succeed in their claims to a greater share of the sustainable yield of the basin, there must be a concomitant reduction in the extraction allocations assigned to the users who have agreed to comply with the GSA's aggregate extraction limits. The 2015 Act therefore confers jurisdiction for adjudication of these types of water rights disputes.[15]

Comprehensive groundwater rights adjudications have advantages and disadvantages. As with most litigation, they can be contentious. Moreover, because these adjudications may include hundreds or thousands of individual water right holders, they are often protracted and expensive. Past adjudications have taken from five to 19 years to complete (Langridge et al. 2016).

Yet comprehensive adjudications also can be constructive. A series of adjudications of Southern California's groundwater basins led to negotiated settlements and judgments that addressed overdraft, seawater intrusion, harm to surface sources, salt loading, and other water quality problems. These judgments also created long-term programs for conjunctive management of native groundwater and imported surface water. Several established water trading programs (Blomquist 1992; Mojave Basin Judgment 1996, Chino Basin Restated Judgment 2012; Antelope Valley Basin Judgment 2016; Garner et al. 2020).

The 2015 statute creates additional incentives for GSAs and water users to employ comprehensive adjudications to resolve potential conflicts over extraction allocations and other GSP requirements. The Act authorizes the trial court to implement a variety of expedited procedures, including more efficient service of process and case management (Civil Procedure Code §§ 835-841). It also empowers the court to issue a preliminary injunction once it determines that the basin is "in a condition of long-term overdraft." (Civil Procedure Code § 847(a))[16] In addition, the court may stay the adjudication for a period of one year to allow the GSP to revise its sustainability plan to address the issues in the litigation and to attempt to resolve the conflicts by negotiated settlement (Civil Procedure Code § 848).

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[14] The adjudication statute has several exemptions, including actions that involve "only allegations that a groundwater extraction facility, or group of facilities, is interfering with another groundwater extraction facility or facilities and does not involve a comprehensive allocation of the basin's groundwater supply" and for those that "can be resolved among a limited number of parties and does not involve a comprehensive determination of rights to extract groundwater within the basin." (Civil Procedure Code § 833(b)(1) & (3)) For the reasons stated in the text, these exemptions do not preclude comprehensive adjudications to resolve water rights claims.

[15] The recently concluded Las Posas groundwater adjudication is an example. In 2018, a group of overlying landowners sued to challenge a 2014 ordinance enacted by the Fox Canyon Groundwater Management Agency. The complaint alleged that the ordinance assigned extraction rights in a manner that unlawfully favored municipal water suppliers that hold junior appropriative rights and ignored the plaintiffs' senior overlying rights. The plaintiffs also claimed that the agency intended to use the allocation scheme as the basis for extraction allocations and pumping limits its upcoming GSP. The complaint named all groundwater right holders as defendants (Las Posas Water Rights Coalition 2018).
In response to the lawsuit, the agency revised its extraction allocations to eliminate the disparity between overlying landowners and municipal water suppliers. The revised allocations are based on a percentage of each user's average pumping during a five-year base period of 2009-13, or during 2015, whichever was greater (FCGMA 2020). The court accepted the stipulated judgment in 2020.

[16] The preliminary injunction can address many of the uncertainties created by claims that some users' underlying water rights exempt them from complying with the GSA's extraction allocations and other rules. Thus, a preliminary injunction may include: (1) a moratorium on new or increased appropriations of water; (2) a limitation on, or reduction in, the diversion or extraction of water; (3) an allocation among the parties establishing amounts of extraction allowed during the pendency of the comprehensive adjudication; and (4) procedures for voluntary transfers (Civil Procedure Code § 847(c)).

Most important for this analysis, though, are three provisions of the statute that grant the trial courts significant authority to deviate from strict water rights priorities in adjudicating claims that underlying water rights supersede extraction allocations established by GSAs.

First, the Act states that the court "shall have the authority and the duty to impose a physical solution on the parties in a comprehensive adjudication where necessary and consistent with Article 2 of Section X of the California Constitution." (Civil Procedure Code § 849(a))[17] The physical solution doctrine is "an equitable remedy designed to alleviate overdrafts and the consequential depletion of water resources in a particular area, consistent with the constitutional mandate to prevent waste and unreasonable water use and to maximize the beneficial use of this state's limited resource." (California Court of Appeal 2012) The California Supreme Court has emphasized, however, that "an equitable physical solution must preserve water right priorities to the extent those priorities do not lead to unreasonable use." (California Supreme Court 2000)

Second, the statute directs the court to ensure that its judgment fulfills three criteria:

1. The judgment must be consistent with Article X, Section 2.
2. It must be consistent with the water rights of all non-stipulating parties.
3. The judgment must treat all objecting parties "equitably as compared to the stipulating parties." (Civil Procedure Code § 850(a))[18]

If at least 50 percent of the extractors accounting for 75 percent of groundwater pumping offer a stipulated judgment, however, the statute shifts the burden of proof to the objecting parties to demonstrate that the proposed judgment "substantially violates" their water rights or would be unreasonable under Article X, Section 2 (Civil Procedure Code § 850(b)).

Third, the Act authorizes the court to relegate unexercised overlying groundwater rights to a priority below that of other active groundwater rights (Water Code § 830(b)(7)). This is consistent with several judgments that have categorically terminated unexercised overlying rights or imposed a fee on overlying users who activate their rights or increase the volume of pumping after entry of the judgment (Chino Basin Restated Judgment 2012, ¶ 8; Antelope Valley Judgment 2016, ¶¶ 5.1.2 & 7.3). Indeed, the Court of Appeal recently held that "the protection of the interests of correlative rights holders who are actually using all available water for reasonable and beneficial purposes may (under appropriate circumstances) permit a court to craft a physical solution which recognizes [unexercised overlying rights] but subordinates any future use by those [parties] to their fellow correlative rights holders who are presently using the available supply." (California Court of Appeal 2021a)

Together, these provisions grant the courts significant discretion to ensure that water rights claims by noncomplying parties do not undermine a GSA's fair and reasonable extraction allocation scheme or impede compliance with SGMA's sustainability directive. The comprehensive adjudication statute emphasizes that all water rights must be exercised reasonably in light of the realities of the basin—including the GSA's plan for achieving SGMA's sustainability directive and the fact that a majority of water users within the basin have agreed to the GSP as a viable and feasible means of managing their

[17] The statute also requires the court to "consider any existing groundwater sustainability plan or program" before it adopts a physical solution (Civil Procedure Code § 849(b)).

[18] The second and third criteria also apply to *de minimis* pumpers who are exempted from the adjudication. This group includes those who claim extraction rights of five afa or less and whose pumping "would not have a material effect on the groundwater rights of other parties." (Civil Procedure Code § 833(d))

collective groundwater resources. Indeed, the 2015 legislation added a final provision to SGMA, which states that for basins covered by a GSP, the court may only enter judgment if it concludes that the judgment "will not substantially impair the ability" of the GSA, the State Water Board, or DWR to comply with SGMA and "to achieve sustainable groundwater management." (Water Code § 10737.8)

For these reasons, it is likely that some GSAs will use the comprehensive adjudication procedures to confirm the legality of their extraction allocations and to resolve potential disputes regarding underlying water rights. Constructive negotiations and well-crafted settlements in these adjudications can bring much-needed certainty—both to the GSAs' administration of the extraction allocations confirmed in the judgment and to the creation of water trading programs, which require reliable allocations and rights of use. The recently concluded Borrego Valley Adjudication, described in Box 3, is an example.

Box 3: The Borrego Valley Groundwater Adjudication

The Borrego Valley, located in the northeastern corner of San Diego County, is a critically overdrafted groundwater sub-basin. Most residents live in the town of Borrego Springs, which has a population of about 3,500. The valley is a popular recreation destination. It also is home to a variety of tree and citrus farms, with about 30 percent of land use in the valley in agricultural production. Groundwater is the sole source of water supply for the valley (Maven 2020a).

Following the enactment of SGMA, the Borrego Water District (BWD), county representatives, groundwater right holders, and other stakeholders began meeting to form a GSP; in 2018 they began negotiations to draft a GSP for the sub-basin. The parties were able to agree on the volume of aggregate overdraft and on extraction allocations to divide the safe yield among the various groundwater users (Poole 2021). The individual allocations were based on each active user's highest level of pumping during a base period of 2010-14 (Krieger et al. 2021). Because most wells were not metered, the parties agreed to use "aerial mapping and records of what crops or turf areas were planted during those years, and then heavily negotiated factors for the vegetation were applied." (Maven 2020a) The draft GSP also included land fallowing standards, air and water quality monitoring, and various mitigation requirements (Poole 2021).

"Near the end of Borrego's GSP development process, representatives of the vast majority of Basin pumping in all sectors (agriculture, recreation and municipal) chose the fast-track option [provided by the 2015 comprehensive adjudication legislation] and took all the facts, findings and recommendations from the GSP and created a Groundwater Management Plan (GMP) for an Expedited Adjudication." (Poole 2021) In January 2020, BWD filed suit in Superior Court and submitted the GMP as the basis for a stipulated judgment. The complaint stated that the proposed judgment was "supported by more than 50 percent of all parties who are groundwater extractors in the basin or use the basin for groundwater storage and is supported by groundwater extractors responsible for at least 85 percent of the groundwater extracted in the basin during the five calendar years before the filing of the complaint." (BWD 2020)

In January 2020, consistent with the terms of the settlement agreement, "BWD filed a 'friendly adjudication' naming the other settling parties as well as other pumpers of groundwater in the Subbasin." As required by the comprehensive groundwater adjudication statute, it served notice on the owners of approximately 5,000 parcels across the Borrego Valley. "Very limited opposition was expressed to the terms of the proposed judgment." (Krieger et al. 2021)

Judge Peter Wilson of the Orange County Superior Court entered judgment in April 2021. The judgment is binding on all landowners and water extractors in the basin. It requires a 5 percent annual reduction in aggregate groundwater pumping from approximately 20,000 afa (acre-feet/acre) to 5,700 afa by 2040 (Krieger et al. 2021). The judgment will be administered by a five-member Watermaster Board "comprised of representatives of Agriculture, Municipal and Recreational pumping, as well as a representative from the Borrego Community." (Poole 2021) The judgment requires all active pumpers to install meters on their wells and to report their extraction of groundwater to the Watermaster. Users who exceed their annual extraction allocations must pay a volumetric fee to the Watermaster (Krieger et al. 2021). In addition, the judgment authorizes the Watermaster to create a water trading program, and it establishes an environmental working group that will focus on habitat management and restoration programs funded by assessments on pumping (Maven 2020a).

Pursuant to SGMA's recognition of the judgments in new comprehensive groundwater adjudications, the parties have submitted the judgment and GMA to DWR for review. If approved by DWR, the Watermaster will have authority to manage groundwater use in the basin according to the terms of the GMA and final judgment.

"The Borrego Adjudication and judgment appear to represent a positive method for parties to work together to meet SGMA goals, while also determining groundwater rights." (Krieger et al. 2021) To the extent that stakeholders in other basins are willing to work together to reach a constructive and certain outcome, the adjudication also may serve as a model for other GSAs to resolve potential conflicts between their water management objectives and underlying water rights.

Groundwater Trading and Protection of Third-Party Interests

A long-standing condition on water trading is that the changes associated with water transfers may not deprive other legal users of water to which they are entitled or cause unreasonable harm to other third parties, including the environment. In simple form, this condition was part of the common law, and it is now embodied in a variety of statutes (Littleworth and Garner 2019).[19]

[19] Statutory limitations on surface water transfers include Water Code §§ 1435(b), 1439, 1702, 1707(b), 1725 & 1736. Although the legislature has not expressly codified the common law protections for third parties potentially affected by groundwater transfers, SGMA's sustainability directive to avoid six defined "undesirable results" of excessive groundwater extraction provides statutory support for claims that a groundwater transfer violates third-party rights (Water Code §§ 10721(u) & (x)). The applicability of this aspect of SGMA to groundwater transfers is described below.

Harm to Other Water Right Holders

A common risk to third parties from groundwater transfers is interference with adjacent wells that may occur if the transferor or transferee increases, or alters the timing of, groundwater extractions to accomplish the transfer.[20] Increased pumping can cause a "cone of depression" that lowers the groundwater table below the level of adjacent wells. This, in turn, can reduce the reliability of neighboring wells (in some cases causing them to run dry entirely) and force the affected third parties to incur capital and increased pumping costs of deepening their wells. "Well interference . . . sometimes develops quickly, with potentially devastating results for those pumpers affected." (Governor's Commission 1978)

In addition, cones of depression can draw pollutants into the pumping zone of adjacent wells, and in coastal aquifers they may allow sea water to mix with fresh water supplies. Groundwater extraction also can increase the concentration of pollutants already present in the aquifer. Prolonged overdraft may cause broader third-party harm, including land subsidence, compaction of the aquifer, and attendant damage to surface structures (California Water Sciences Center 2018; Hanak et al. 2019).

Although the common law affords those injured by well interference a claim for damages and injunctive relief, the standards by which these cases are adjudicated are vague. The court must determine that, considering all circumstances, the increased pumping is unreasonable because of the attendant well interference (Aiken 1992). "Relief has rarely been granted in such proceedings," however, and "civil suits are expensive and may be too slow to provide water when it is needed." (Governor's Commission 1978)

SGMA will help to correct these deficiencies by authorizing GSAs to monitor groundwater pumping and to take enforcement action against extractors who cause harm to third parties. The statute directs GSAs to achieve sustainable groundwater management within their respective jurisdictions. This sustainability goal requires long-term management of the basin "within its sustainable yield" and avoidance of six specified "undesirable results." (Water Code § 10721(u)-(w)) These include:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. . . .
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water (Water Code § 10721(x)).[21]

[20] Most intra-basin groundwater transfers do not physically transfer water between users. Rather, because both the seller and purchaser have rights in a common aquifer, the easiest and least expensive means of executing the transfer is for the seller to decrease its pumping by a specified quantity over a defined period of time, which allows the purchaser to increase its pumping by an equivalent amount. This contrasts with most inter-basin transfers—especially surface water transfers—in which the seller physically conveys water to the purchaser.

[21] DWR has promulgated regulations to guide SGMA implementation, including various "sustainability criteria" that will be used to define and monitor compliance with the statute's sustainability directive (23 California Code of Regulations §§ 350-358.4). An important regulatory requirement is that each GSP must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site." These "minimum thresholds," which must be expressed as numeric values, "represent a point in the basin that, if exceeded, may cause undesirable results." (23 California Code of Regulations § 354.28(a)) DWR also has published draft best management practices to implement the six sustainability criteria (DWR 2017).

The statute requires GSAs to include in their sustainability plans "measurable objectives [and five-year interim milestones] to achieve the sustainability goal in the basin within 20 years of the implementation of the plan," as well as a "description of how the plan helps meet each objective." (Water Code § 10727.2(b)(1) & (2))

GSAs therefore must take affirmative actions to avoid the defined undesirable results—both from existing groundwater pumping and from changes in extraction patterns that may occur from water transfers. These protections may take several forms.

SGMA authorizes GSAs "to impose spacing requirements on new groundwater well construction to minimize well interference." It also grants GSAs the power to establish "reasonable operating regulations on existing groundwater wells to minimize well interference, including requiring extractors to operate on a rotation basis." (Water Code § 10726.4(a)(1) & (2)) Although the purpose of these standards is to minimize conflicts between groundwater users, they also can be employed to ensure that increased pumping associated with transfers does not unreasonably interfere with adjacent wells in the area in which pumping is increased. GSAs can incorporate this regulatory authority into their water transfer policies.

Indeed, in adjudicated basins groundwater transfers usually require review and approval of the watermaster based on criteria designed to avoid well interference and to prevent other types of harm. In some basins, these criteria require the watermaster to make a qualitative determination that the transfer will not cause "material injury" to other wells or beneficial uses (Chino Basin Watermaster 2019a; Antelope Valley Judgment 2016, ¶¶ 16.1 & 17). Other basins have more categorical third-party protections (Mojave Basin Judgment 1996, Exhibit F). These differing criteria are described in Box 4.

An alternative means of protecting third-party well owners and other beneficial uses is to conduct a hydrogeological evaluation of the aquifer to determine which areas can support a specified volume of water transfers without significant risk of third-party harm. Transfers between users in these areas could be expedited. In other areas, where there is a significant risk of harm—for example, because of concentrated location of wells, inadequate recharge, the potential for deep drilling, or other factors—the GSA, county, or other agency with regulatory capabilities could create a more incisive review and approval process.

Box 4: The Chino and Mojave Basins

Two of California's most prominent adjudicated groundwater basins are the Chino and Mojave basins. In both cases, the courts created a watermaster to administer the final judgments and physical solutions. Both judgments recognize that imported and developed water are important aspects of sustainable management of the basin, and they authorize water transfers. Although the Chino and Mojave trading programs have many common features, they vary both in their classification of user groups and in the ways in which they seek to protect third parties from potential harm caused by groundwater transfers.

Chino Basin. The Chino Basin judgment divides groundwater extractors into three groups or "pools": overlying agricultural (which includes state properties), overlying non-agricultural (mostly commercial and industrial users), and appropriative (predominantly cities and other municipal suppliers). The judgment authorizes members of the overlying non-agricultural pool to transfer water within the pool and to the watermaster, either for recharge or for resale to members of the appropriative rights pool. In addition, all unused groundwater assigned to the overlying agricultural pool is automatically made available for purchase by the appropriators on an annual basis. Finally, members of the appropriative pool may trade water among themselves (Chino Basin Restated Judgment 2012, 8 & Exhibit G; Chino Basin Watermaster 2019a).

Water transfers must be approved by the watermaster to ensure that the transfer does not "result in any Material Physical Injury to any party to the Judgment or the Basin." The rules governing water transfers define "material physical injury" *inter alia* as injury that is attributable to the transfer of water, including "degradation of water quality, liquefaction, land subsidence, increases in pump lift (lower water levels) and adverse impacts associated with rising groundwater." (Chino Basin Watermaster 2019a)

Groundwater trading among the parties to the Chino Basin judgment is now routine, with more than 780,000 acre-feet transferred over the past 20 years. Most of these transfers are short-term, although there have been several permanent transfers of production rights from industrial users within the overlying non-agricultural pool to members of the appropriative rights pool (Chino Basin Watermaster 2019b).

Mojave Basin. The Mojave Basin Judgment equalizes all water rights priorities, and with minor exceptions abolishes all distinctions between types of water users. It does divide the basin into five subareas, however, and it grants down-gradient subareas rights to specified minimum water supplies *vis-à-vis* up-gradient subareas (Mojave Basin Judgment 1996, ¶¶ 10 & 13).

Water may be transferred within or between subareas, and the judgment recognizes both permanent and limited-term transfers. Intra-subarea transfers only require notice to the Mojave Basin Watermaster; inter-subarea transfers must also have the watermaster's approval. Transfers may include all or a portion of the transferor's annual production right, including carryover rights. The judgment states, however, that transfers may not cause an increase in the consumptive use of water. It therefore limits the transferable agricultural and municipal water to 50% of the transferor's actual groundwater extractions (Mojave Basin Judgment 1996, Exhibit F).

To protect each sub-basin's rights to minimum annual water supplies, the judgment also includes special limitations on inter-subarea transfers. These transfers are limited to leases not exceeding one year in duration, and the aggregate annual quantity of water that may be transferred from the source subarea may not exceed the subarea's aggregate replacement water requirement of the preceding year (Mojave Basin Judgment 1996, Exhibit F). In other words, if a subarea runs a water deficit in one year, the amount of that deficit will limit the volume of groundwater that subarea users may transfer the following year. This is significant because the judgment allows groundwater users to exceed their annual production rights if they purchase imported "replacement water" from the SWP to help recharge the aquifer. Transfers are an alternative means of meeting this replacement requirement.

Groundwater trading plays an important role within the Mojave Basin, with more than 650,000 acre-feet transferred since 1996. The lion's share of this trading has been within the Alto subarea, where 50 percent of the multi-year and permanent transfers of production rights have been from agricultural users to cities. The most significant inter-sub-basin annual transfers have been between Alto and the Centro sub-basins. The selling parties in Centro essentially agree to reduce their annual pumping, which in turn reduces the Alto's minimum supply obligation as the up-gradient subarea. This allows the purchasers in Alto to continue pumping their full production rights from their own wells (Ayres 2020; Ayres et al. 2021b).

Harm to Surface Water Uses and Groundwater-Dependent Ecosystems

A robust groundwater table supports a variety of surface resources, including streams, wetlands, and other freshwater habitat. Groundwater extraction can diminish water supplies to these resources, and a declining groundwater table can dewater wetlands and cause rivers to run dry (Barlow and Leake 2012; Jasechko et al. 2021). Indeed, in some parts of the San Joaquin Valley, overdraft has severed the connection between groundwater and surface resources (Howard and Merrifield 2010). A well-structured water trading program therefore must recognize the potential effects of changes in the volume and timing of pumping resulting from transfers on "groundwater dependent ecosystems" and guard against these externalities.

As described above, SGMA's sustainability mandate requires GSAs to avoid two "undesirable results" associated with surface resources: (1) "Significant and unreasonable land subsidence that substantially interferes with surface land uses"; and (2) "Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water." (Water Code § 10721(x)(5) & (6)) In their sustainability plans, GSAs also must address, "where appropriate and in collaboration with the appropriate local agencies," the effects of water management and use on groundwater-dependent ecosystems (Water Code § 10727.4(*l*)).[22]

[22] DWR's regulations implementing SGMA define groundwater-dependent ecosystems as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." (23 C.C.R. § 351(m)) GSPs must consider the effects of groundwater management and use on these resources if the surface water "is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted." (23 C.C.R. § 351(o))

Although long-term overdraft has depleted some aquifers to levels that have severed their connection with surface resources, there are a number of basins in which the groundwater table continues (at least under some conditions) to support surface streams. Prominent examples include the Cosumnes, Scott, and Russian river systems (Mount et al. 2001; Tolley et al. 2019; Nishikawa 2018). In addition, groundwater-dependent ecosystems are broadly distributed throughout California (Howard and Merrifield 2010).[23]

GSPs adopted in these areas will have to consider the potential effects of water transfers on these resources and, where significant risks are presented, adopt water trading rules that protect surface resources.[24] As with well interference, these rules could take a variety of forms—ranging from seasonal and drought-related limitations on increased pumping from at-risk areas to replacement water requirements and other mitigation measures.[25] The Mojave Basin Judgment, described in Box 5, provides a useful example of how GSAs can incorporate protection of groundwater-dependent ecosystems and surface water flows into their sustainability plans.

[23] "Groundwater dependent ecosystems are widely, although unevenly, distributed across California. Although different types of GDEs are clustered more densely in certain areas of the state, watersheds with multiple types of GDEs are found in both humid (e.g., coastal) and more arid regions. Springs are most densely concentrated in the North Coast and North Lahontan, whereas groundwater dependent wetlands and associated vegetation alliances are concentrated in the North and South Lahontan and Sacramento River hydrologic regions. The percentage of land area where stream discharge is most dependent on groundwater is found in the North Coast, Sacramento River and Tulare Lake regions." (Howard and Merrifield 2010)

[24] A recent NGO study of 31 GSPs that were submitted to DWR in January 2020 suggests that many GSAs are not adequately evaluating the potential effects of their management programs on groundwater-dependent ecosystems (GDEs) and other surface resources. The authors conclude that only five of the 31 surveyed GSPs identified GDEs consistent with SGMA regulations and only 15 included water demands for native vegetation in their water budgeting. Similarly, of the ten GSAs that have authority over managed wetlands, only half of them included wetlands water demands in their water budgets (American Rivers et al. 2021).

[25] In those basins where a hydrologic connection between groundwater and a surface stream exists (or feasibly can be reestablished), groundwater extractors also may be required to limit their pumping to protect water quality, fish, and other public trust resources in the surface stream. (California Court of Appeal 2013, 2018) These obligations are independent of SGMA's sustainability directives, although GSAs have authority to incorporate the water quality, endangered species, and public trust standards into their sustainability plans. (Gray 2018; Cantor et al. 2018)

Box 5: Surface Flows and Groundwater-Dependent Ecosystems in the Mojave River Basin

The Mojave River is an intermittent river that flows north from its headwaters in the San Bernardino Mountains through the eponymous high desert and northeast to its terminus at the Mojave River Wash and Soda Lake. Although most stretches of the river are underground, there are several reaches where the river flows in surface channels. Along these reaches, the groundwater table supports both the surface river and its riparian forest. This groundwater-dependent ecosystem is habitat to more than 25 plant and animal species, including the California red-legged frog, desert tortoise, least Bell's vireo, southwestern willow flycatcher, western yellow-billed cuckoo, bald eagle, Swainson's hawk, prairie falcon, and other raptors.

The Mojave Basin Judgment creates three areas along more than 30 miles of the Mojave River for protection of these resources. These stretches are designated as the Victorville-Alto, Lower Narrows-Transition, and Harvard-Eastern Baja riparian zones. Because pumping may lower the groundwater table to a level that jeopardizes surface flows and riparian habitat, the judgment stipulates that the maximum depth of the groundwater table below the surface may not exceed seven feet in the Victorville-Alto and Harvard-Eastern Baja zones and ten feet in the Lower Narrows-Transition zone. (It also requires standing surface water at a depth of at least one foot in portions of the Harvard-Eastern Baja zone.) The judgment then grants the watermaster authority to recommend adjustments of the water users' free production allowances (i.e., pumping rights) of up to 5 percent to ensure compliance with these depth standards (Mojave Basin Judgment, Appendix H, 1996).

The judgment directs the watermaster to purchase replacement water as needed to maintain the minimum groundwater levels within the Transition Zone. It also authorizes the watermaster to establish a Biological Resources Trust Fund, which the California Department of Fish and Wildlife may use to protect flows and habitat in the protected zones if groundwater levels fall below the levels described above. This program is funded by an assessment of $0.96 (for FY2020-21) on each acre-foot of groundwater extracted in the Mojave Basin.

The judgment states that stipulating parties created these special protections in recognition of their obligations to comply with applicable water quality standards, endangered species protections, and public trust requirements.

In its most recent report to the court, the watermaster observed that monitoring wells in the Transition Zone water level "indicate seasonal fluctuation and year over year stability" since 2008. Moreover, "decreasing seasonal water level fluctuation is an indication of an equilibrium condition in the Transition Zone." It also reported that, since entry of the judgment in 1996, "there has not been a mandatory replacement obligation in the Transition Zone." Discharges from the Victor Valley Wastewater Reclamation Authority's treatment plant have augmented river flows over this period, however (Mojave Water Agency 2021).

A recent study published by The Nature Conservancy concludes that "small and gradual changes in groundwater levels . . . result in minor adverse biological responses, such as a reduction in vegetative growth, whereas prolonged or abrupt changes in groundwater levels can result in major adverse biological responses, such as higher rates of vegetation mortality and a higher prevalence of opportunistic non-

native species that are better adapted to deeper groundwater than native species." (Rohde et al. 2018) This analysis would support water market rules, or conditions on individual transfers, that govern the rate of change of pumping needed to facilitate a water transfer.

The report also recommends that GSAs direct surface water available for aquifer recharge to areas that could serve multiple beneficial uses. For example, in some places, imported or developed water designated for groundwater recharge might also be used to replenish seasonal wetlands or to create new habitat for migratory birds and terrestrial wildlife (Rohde et al. 2018).[26] These types of multi-benefit programs could aid water transfers by mitigating potential effects of increased groundwater extractions on groundwater-dependent ecosystems or by providing substitute wetlands and aquatic habitat for that which might be at risk from groundwater transfers.

The Fox Canyon Groundwater Market, which is described in Box 6, offers several other examples of how water trading programs can provide benefits both to groundwater users and to groundwater-dependent ecosystems and other surface water resources.

Box 6: The Fox Canyon Groundwater Market

The California Legislature created the Fox Canyon Groundwater Management Agency (FCGMA) in 1982 to address overdraft and seawater intrusion into the coastal aquifer of the Santa Clara River Basin in Ventura County. The agency has authority over most of the Oxnard and Pleasant Valley sub-basins that comprise the aquifer. As part of its GSP for the Oxnard sub-basin, the agency has authorized the creation of the Fox Canyon Groundwater Market—an idea initially proposed by The Nature Conservancy and developed by TNC, the Center for Economic Research and Forecasting at California Lutheran University, the Ventura County Farm Bureau, area farmers, and FCGMA staff (FCGMA 2019).

Ventura County is the 11th most productive agricultural county in the United States, with annual farm revenues exceeding $2 billion. The county has nearly 96,000 irrigated acres of farmland, half of which are within the Oxnard and Pleasant Valley sub-basins. "Area farmers grow a diverse mix of annual and permanent crops, ranging from berries, flowers and vegetables to citrus and avocado orchards. This heterogeneity in both the season and water demand of the region's crops creates opportunities for a water market," and was one motivation for farmers in the basin to create a groundwater market (Heard et 2019).

More than 500 active wells extract groundwater from the basin to support irrigated farmland (60%) and municipal and industrial uses (40%). The sub-basins have been in critical overdraft for most of the past four decades. This overdraft both allows seawater to intrude into the freshwater aquifer and diminishes flows and wetlands along the Santa Clara River. To achieve the GSP's sustainability directives, aggregate pumping reductions of up to 35 percent may be required (Heard et al. 2019).

[26] Location, timing, and landscaping are important variables for successful multi-benefit recharge projects. For more information on these structural and operational factors, see Schiller (2020).

Pursuant to its special statutory authority and SGMA, the FCGMA has established allocations for all groundwater extractors in the sub-basin. The allocations are a percentage of each extractor's average annual pumping during the ten-year period preceding SGMA's enactment. Each allotment holder may pump groundwater up to this limit or sell all or a portion of its allocation on the Fox Canyon Groundwater Market. The terms of transfers are limited to one year or less, reflecting farmers' concerns that long-term and permanent transfers could encourage further urbanization in the region (Heard 2019).

Trading is conducted by a computer system operated by California Lutheran University, and all transactions—including quantity, price, and identity—are private and known only by the parties and FCGMA for accounting and billing purposes. The market is currently open only to agricultural allotment holders, although it will be extended to cities, environmental users, and other landowners in the near future. All groundwater pumping is metered, and extraction data are transmitted via AMI telemetry every 15 minutes. To protect farmers' proprietary information, however, the AMI vendor only reports cumulative pumping data to FCGMA on a monthly basis (Heard et al. 2019 and author interviews).

Following two pilot programs, the Fox Canyon Groundwater Market opened in March 2020 with more than 100 participating allotment holders. The Nature Conservancy and other stakeholders "hope to demonstrate that market-based approaches can be a meaningful, fair, and sustainable way to achieve water conservation while engaging and supporting agricultural producers." (Schumacher 2020) Conservation goals include compliance with the sustainability objectives set forth in the GSP, elimination of seawater intrusion, support of the Santa Clara River, and restoration of wetlands and other surface resources. The Nature Conservancy owns more than 4,000 acres of agricultural and riparian land along the river. It manages these lands for farming, habitat restoration, and promotion of biodiversity. TNC is a participant in the Fox Canyon Groundwater Market (Heard 2019; TNC 2020).

Harm to Drinking Water Supplies

Public water suppliers and individual users who depend on groundwater for their drinking water supplies also may be injured by groundwater extraction and changes in pumping associated with water transfers. Domestic wells and community well systems are especially vulnerable to interference by stronger and deeper pumping, because they are generally "shallower than those used for irrigation or large urban water systems." (Jezdimirovic, et al. 2020) Although this is primarily a condition of overdraft, groundwater transfers may exacerbate the risk to shallow wells that are within enlarged cones of depression caused by a transferee's increased pumping as authored by the transfer agreement (Ores et al. 2020).

During the 2012–16 drought, "2,600 well-dependent households reported water shortages across the state; almost 80% of these were in the San Joaquin Valley." Moreover, "many shallow wells serve economically disadvantaged communities, making the stakes especially high." (Jezdimirovic, et al. 2020) Few of these

users have access to alternative sources—such as surface water or connections from larger municipal supply systems—and most lack the funds needed to deepen their own wells (London et al. 2018).[27]

Increased groundwater extraction also can cause water quality problems for domestic well users and community well systems. Cones of depression caused by deeper adjacent pumping may draw pollutants present in the aquifer—including nitrate, arsenic, selenium, and other metals—into the pumping zone for the domestic wells, contaminating drinking water supplies. These pollutants present serious, long-term risks to human health (Harter and Lund 2012; Environmental Integrity Project 2016; Chappelle et al. 2021).

Domestic and community wells are protected by the same laws that govern well interference generally. Yet, as noted above, litigation to declare neighboring pumping unreasonable is often lengthy, expensive, and beyond the means of most individual domestic well owners and community water systems. And even if a court were to find the deeper pumping to be unlawful, it could take years to restore groundwater levels to elevations above the intakes of the shallower wells or to deepen the wells themselves. Moreover, pollutants drawn into a cone of depression will continue to contaminate domestic water supplies long after the unlawful pumping ceases (Harter and Lund 2012). During this period of litigation and implementation of court-ordered relief, the affected well users lack access to safe drinking water supplies.

In addition, because community water systems have appropriative rights (see Box 2), their extraction pumping rights are often among the most junior in the basin. In disputes between groundwater right holders, this relative priority often is determinative. Indeed, it is common during periods of drought and sustained overdraft for agricultural users to assert the seniority of their rights *vis-à-vis* junior domestic users (Blomquist 1992).[28]

As with well interference generally, SGMA addresses many of the deficiencies of the common law rules. For example, the statute authorizes GSAs to define the spacing of new wells and to regulate existing wells to prevent well interference—including interference with domestic water supplies (Water Code § 10726.4(a)(2)). In addition, SGMA's sustainability mandate includes the obligation to address "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies." (Water Code § 10721(x)(4)) The act also directs GSAs to include in their sustainability plans protections against the "migration of contaminated groundwater." (Water Code § 10727.4(c))

To achieve these requirements, GSAs have authority to designate "wellhead protection areas" for the "surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field." The

[27] A recent Water Foundation study of groundwater overdraft in the San Joaquin Valley presents even more dire results: of the 45,000 known domestic wells in the region, "approximately 7,000 have already been dewatered due to declining groundwater levels and another 13,000+ could not be analyzed due to insufficient data." (Water Foundation 2020) For a more comprehensive, statewide assessment of threats to safe and reliable drinking water supplies, see SWRCB (2021a).

[28] The California Court of Appeal's recent decision in the *Antelope Valley Groundwater Cases* has further complicated the ability of community water systems and other domestic water suppliers to seek legal redress for well interference. The court rejected a community water service district's claim that the statutory priority for domestic uses set forth in Water Code § 106 (described below in the text) should entitle the district to pump water from an overdrafted basin along with competing overlying landowners. The court determined that the district began pumping groundwater after overdraft commenced and therefore no surplus water was lawfully available. Accordingly, the court held that the district could not assert its statutory rights because it does not have a water right to appropriate under these circumstances. Rather, the court concluded, Section 106 "appear[s] to only be relevant to assigning and protecting priorities among existing water rights holders." (California Court of Appeal 2021a)

GSA then may prohibit, or closely regulate, pumping from these areas (Water Code §§ 10721(ab); 10727.4(b)).

In addition, GSAs must incorporate into their sustainability plans two statutory priorities that give heightened protection for domestic water supplies, including those from domestic wells and community well systems. The first is the legislature's declaration that "the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation." (Water Code § 106) The California Supreme Court has held that the primary purpose of this directive is "to establish priorities between competing appropriators," but that Section 106 also "declare[s] principles of California water policy applicable to any allocation of water resources." (California Supreme Court 1983)

The second statute is the legislature's recognition of a human right to water. This law declares it to be "the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." It also directs all state agencies to consider this human right to water "when revising, adopting, or establishing policies, regulations, and grant criteria." (Water Code § 106.3(a) & (b))

Although these rules generally govern GSA water planning and management responsibilities, they apply equally in the context of groundwater trading. They empower GSAs to establish pumping limits for groundwater transfers, to impose well-spacing requirements for transferee wells, and to designate "non-trading zones" within the aquifer to create a buffer to minimize risks of increased pumping to vulnerable community and domestic wells (Water Code § 10726.4(a); Ores et al. 2020).

Well-crafted and responsible sustainability plans—as well as water trading and recharge programs that operate under their auspices—therefore should include rules that protect domestic and community wells from interference from adjacent deeper wells and from increased pumping that may draw contaminants into areas from which domestic supplies are drawn.[29]

The statutory mandates do not necessarily mean that GSAs must prohibit pumping that interferes with community wells or increases the risk of contamination to domestic water supplies. The California courts have held that in appropriate cases, the most efficient remedy to correct an unreasonable use of water may

[29] According to four recent studies, the preliminary indications are not promising:

- A PPIC survey of 36 GSPs for the San Joaquin Valley shows that most of the plans in the areas of highest domestic well failure during the 2012-16 drought either fail to evaluate the risks to domestic water supplies or acknowledge the problem, but do not include mitigation measures. For example, three of the plans for the Kings Basin predict that roughly 600 domestic wells may go dry, but do not consider this to be a significant and unreasonable impact of continued overdraft (Jezdimirovic, et al. 2020; Hanak et al. 2020).
- A Water Foundation study of 26 San Joaquin Valley GSPs estimates that, unless the plans are significantly revised and faithfully implemented, "between roughly 4,000 and 12,000 drinking water wells will go partially or completely dry by 2040," and "46,000 and 127,000 people will lose some or all of their current water suppl[ies]." It also estimates that the cost to restore access to safe drinking water for these users will be between $88 million and $359 million (Water Foundation 2020).
- A UC Davis analysis of 37 San Joaquin Valley sustainability plans finds that 765 to 5,400 domestic wells are at pumping depths above the minimum threshold (MT) set forth in the relevant GSP to protect against "undesirable results." The report also notes that there is "significant variability in [predicted] domestic well failure across SJV GSPs. Some areas have no wells whose pump locations are vulnerable to MT water levels, while others have 80-100% of their wells vulnerable." The highest number of vulnerable domestic wells are in the Merced GSP (Bostic et al. 2020).
- An NGO study of 31 GSPs concludes that, although 27 GSAs identify disadvantaged communities within their boundaries, only 14 plans analyze the direct impacts of authorized pumping (including well interference) on community and domestic wells and only five evaluate indirect effects such as impairment of drinking water quality (American Rivers 2021).

be a physical solution that maximizes the beneficial use of water for all parties (Littleworth and Garner 2019).

In the context of groundwater sustainability planning generally, and groundwater trading specifically, the physical solution doctrine could allow GSAs or groundwater users to continue deep pumping on the condition that they provide alternative sources of supply to adversely affected domestic well owners and community well systems. Depending on the circumstances, this could take the form of payment for the costs of deepening shallow domestic and community wells (including future added pumping costs), connecting to a nearby municipal water system, or installation and operation of water treatment facilities to remove contaminants.[30]

In those areas where water in the aquifer is safe to drink, the deepening of domestic and community wells may be the most cost-effective solution.[31] Although remediation of the effects of deep pumping may be expensive, creation of a satisfactory physical solution is the best means of ensuring that GSAs and groundwater extractors will not be vulnerable to claims that their water use and water trading jeopardize statutory rights to safe, affordable, and reliable domestic water service.

Part Two: Local Control of Intra- and Inter-Basin Transfers

Water trading also raises questions of local law, as transfers often cross jurisdictional lines. This is because county and agency boundaries bear little relation to hydrologic basins, and there are a variety of local ordinances and policies that limit the trans-boundary transfer and use of groundwater and surface water as a means of protecting (or, in some cases, preferring) local interests. Although these local interests are important, there are countervailing interests in facilitating inter-agency and inter-basin water trading. These types of transfers can enhance the overall efficiency of water use and water distribution. They also are likely to play an important role in SGMA implementation and compliance (Ayres, et al. 2021a).[32]

This part begins with an analysis of county groundwater ordinances that may limit water transfers and concludes with a review of local water agency rules on intra- and inter-agency water trading. In both cases, the interplay between local agency interests and SGMA's broader state and regional goals of encouraging efficient water use and achieving sustainable groundwater management is a point of focus.

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[30] To comply with the statutory mandates described in the text, as well as safe drinking water standards, the replacement water service must be safe, affordable, *and* reliable. Provision of bottled water or trucked-in water tanks, which occurred during the 2012-16 drought, therefore is generally considered to be an emergency or stopgap measure (US Climate and Health Alliance 2015; London et al. 2018).

[31] GSAs in the Chowchilla and Madera groundwater basins have compared the costs of reducing agricultural pumping to maintain relatively high water levels with the costs of replacing domestic wells impaired by deeper pumping. "At a cost of $25,000 per well, the full costs of replacing affected domestic wells in Chowchilla ($130,000) and Madera ($770,000) are orders of magnitude lower than the costs of reducing agricultural pumping sooner ($581 million in Chowchilla and $968 million in Madera). This shows that it can be more cost effective for a basin to provide assistance to domestic well owners than to set restrictive water level thresholds that would result in large and abrupt losses in the local economy." (Jezdimirovic, et al. 2020)

[32] For example, a recent PPIC study concluded that intra-basin trading of groundwater and surface water has the potential to reduce the costs of SGMA compliance in the San Joaquin Valley by 40 percent. It also found that inter-basin transfers of surface water could cut compliance costs by an additional 20 percent (Hanak et al. 2020).

County Restrictions on Groundwater Exports

In a 1994 decision, the California Court of Appeal confirmed the authority of counties to regulate groundwater extraction and use within their respective jurisdictions, finding that nothing in state law preempts this aspect of the counties' land use regulatory powers (California Court of Appeal 1994).[33] This decision followed on the heels of the 1986–92 drought, which focused public attention on the potential effects of groundwater transfers and groundwater substitution transfers on local interests.

In 1991, DWR created a water trading program to connect willing sellers with buyers in regions suffering from acute water shortages. One of the most controversial aspects of the Drought Water Bank was the transfer of surface water from users in the Sacramento River Basin to water agencies in the San Joaquin Valley and Southern California. Although water sold to the water bank came from diverse sources—including stored water and water conserved by fallowing and crop-shifting—the groundwater substitution transfers garnered the most criticism (Gray 1994).[34] Public scrutiny increased in 1992 and 1994 when the Water Bank's purchases came "entirely from groundwater substitution and from the handful of suppliers in a position to sell excess water in surface storage." This led to claims that sales to the Water Bank by users in Butte County were causing neighboring wells to go dry (Hanak 2005).

Concern over these groundwater substitution transfers, as well as the possibility of direct transfers of groundwater, led counties in both the Sacramento Valley and the San Joaquin Valley to enact groundwater extraction ordinances. Most counties have laws that require permits for new wells, and many also require groundwater pumpers to comply with local groundwater management plans and avoid overdraft. The county export ordinances go further by placing additional restrictions on transfers of groundwater (including groundwater substitution transfers) to uses outside the county. Today, 24 of California's 58 counties have groundwater export ordinances (Hanak and Stryjewski 2012a; Brownstein Water Group 2015).[35]

A Survey of County Regulatory Strategies

Eight of these county ordinances (three from the Sacramento Basin, four from the San Joaquin Basin, and one from the Central Coast) illustrate the range of approaches to regulation of groundwater exports. The seven inland counties—Tehama, Butte, Yolo, San Joaquin, Stanislaus, Tuolumne, and Merced—cover areas of the state that (at least in the eyes of more water-short regions) may be sources of future export for groundwater recharge and conjunctive management.[36] San Luis Obispo's groundwater basins are more

[33] The court considered the common law of groundwater rights, the legislature's creation of various groundwater management agencies, and a 1984 statute—Water Code § 1220(a), which prohibits the export of groundwater extracted from the Sacramento and Delta-Central Sierra basins "unless the pumping is in compliance with a [county] groundwater management plan [and] is subsequently approved by a vote in the counties or portions of counties that overlie the groundwater basin." (California Court of Appeal 1984)

[34] The direct transfer of groundwater would have been illegal under Water Code § 1220(a). The exports also would have violated the place-of-use restrictions on overlying rights described above, relegating the transferred water to a priority below that of all overlying and existing appropriative uses (Gray 1994).

[35] The localized effects of groundwater transfers and groundwater substitution transfers remain of great concern to many counties. In 2019, for example, the Bureau of Reclamation and San Luis & Delta-Mendota Water Authority identified 18 potential sellers that would make surface water available for transfer to users in the San Joaquin Valley by idling agricultural lands, crop-shifting, or groundwater substitution. The counties from which the water would be transferred include Shasta, Glenn, Colusa, Butte, Sutter, Yuba, Yolo, Solano, Sacramento, and Merced (USBR/SLDWA 2019). In May 2020, several environmental organizations filed a lawsuit challenging the long-term transfer program. They allege that the lead agencies violated NEPA and CEQA by failing to adequately consider the effects of these transfers on groundwater resources in the source regions (Maven 2020b).

[36] Brief summaries of several other county groundwater export ordinances appear in Hanak and Dyckman (2003), DWR/SWRCB (2015), and DWR/USBR (2019). For an analysis of the economic effects of county export restrictions in the Sacramento Valley, see Hanak (2005) and Bigelow et al. (2019). These studies conclude respectively that the county restrictions have limited water exports from the source counties and increased local transactions, but that the economic benefits to landowners and water users (measured by changes in property values) is inconclusive.

isolated, but its ordinance is noteworthy because it applies both to groundwater exports from the county and exports from the aquifer from which the water is extracted.

These ordinances have many common characteristics, but they also diverge in several significant ways. The shared features include statements of purpose and creation of a permitting system for groundwater exports (and in some cases for groundwater substitution transfers that export water out of the county). The ordinances differ, however, in their comparative treatment of in-county vs. export transfers, the rigor of their permit review processes, and the restrictiveness of the criteria by which they regulate groundwater extraction for export uses.

Although it is often stated that these ordinances ban the export of groundwater beyond their respective county borders, that is not technically accurate. All of the ordinances reviewed below express strong preferences for in-county use, but they recognize certain circumstances in which groundwater may be transferred for uses beyond county borders. Yet these laws also create a variety of barriers to out-of-county transfers that, in practice, may be tantamount to categorical prohibitions. And these barriers can deter or stymie water transfers and recharge arrangements that could provide regional and statewide benefits. A thematic survey of the eight ordinances is illustrative:

Sequence and Context of Enactment: Some of these differences are attributable to the different contexts in which the ordinances were enacted. For example, the Tehama ordinance (enacted in 1994) and the Butte and Yolo ordinances (enacted in 1996) were reactions to the controversies surrounding the 1991, 1992, and 1994 state water banks described above. Each reflects the growing concern that continued inter-basin transfers of surface water made available through groundwater substitution could create significant environmental and economic problems within their jurisdiction (Gray 1994; Hanak 2005).

In contrast, the San Joaquin ordinance (also enacted in 1996) focuses more on existing groundwater overdraft within the county, which had harmed agricultural uses in the eastern part of the county, allowed saline water from the Delta to degrade groundwater quality in the Stockton area, and jeopardized urban development in the southwest portion of the county (San Joaquin County Ordinances § 5-8100(d)-(n)).[37]

The Stanislaus, Merced, and San Luis Obispo ordinances were enacted almost two decades later during the period of increasing state scrutiny of groundwater management that led to the enactment of SGMA in 2014.[38] All three reflect the concern that surface water and groundwater supplies are likely to be limited for the foreseeable future and that local areas should better manage and conserve their native supplies. Indeed, the Merced ordinance, the first to be enacted after SGMA, expressly references the new world of groundwater management—asserting that the "risks to health, safety and well-being in Merced County from the mining and export of groundwater require the county to take immediate action while Merced County transitions to implementation of [SGMA]." (Merced County Ordinances § 9-27.020.10)

Statements of Purpose: With one exception, all of the ordinances declare that groundwater resources are essential to the economy and environment of the county and its people.[39] Two provide specific

[37] The Tuolumne ordinance is a bit of an outlier, as the county is primarily a headwaters region whose watershed supplies its downstream neighboring counties with both surface water and native groundwater recharge. The ordinance therefore focuses on the importance of conserving local groundwater sources as part of broader conjunctive management initiatives (Tuolumne County Ordinances § 13.20.010(D) & (F)).
[38] The Stanislaus ordinance was enacted in 2013 and amended the following year. The Merced and San Luis Obispo ordinances were both enacted in 2015.
[39] The exception is the Tehama County ordinance, which is one of the earliest groundwater export laws. It omits any statement of purpose. As described in the text below, it is one of the most even-handed ordinances as it applies generally to groundwater mining—whether for export or in-county uses.

information about the importance of groundwater for agricultural production and to meet the needs of a growing population (San Luis Obispo Ordinances § 8.95.10; San Joaquin County Ordinances § 5-8100). Yolo County's ordinance also asserts that protection of its groundwater "from harm resulting from extraction . . . for use on lands outside the County" is for the "public benefit of the State." (Yolo County Ordinances § 10-7.101(c))

Beyond this similarity, the ordinances vary significantly in their characterization of groundwater exports. For example, the San Joaquin County ordinance "recognizes the principle developed in the case law of California that water may be appropriated from a groundwater basin if the groundwater supply is surplus and exceeds the reasonable and beneficial needs of overlying users." It also "encourages development of conjunctive use projects that would positively impact the critically overdrafted groundwater basin." (San Joaquin County Ordinances § 5-8100(b) & (m)) The Tuolumne County and San Luis Obispo County ordinances contain similar declarations (Tuolumne County Ordinance § 13.20.010(C) & (F); San Luis Obispo Ordinances § 8.95.10(14) & (20)).

Other ordinances manifest a presumptive hostility toward groundwater exports. The strongest of these are the Stanislaus County and Merced County laws, which expressly link export transfers with groundwater overdraft.[40] These ordinances declare that the "unsustainable extraction of groundwater resources within the county *and* the export of water outside of the county each could have adverse environmental impacts . . . and economic impacts on the county." (Stanislaus County Ordinances § 9.37.020(4) & (5); Merced County Ordinances §§ 9.27.020(4) & (5) (emphasis added))[41] In addition, both counties assert that "the unsustainable extraction of groundwater *and* the export of water outside of the county are presumptively inconsistent with [Article X, Section 2 of] the California Constitution and [Section 100 of] the California Water Code." (Stanislaus County Ordinances § 9.37.020(6) (emphasis added); Merced County Ordinances §§ 9.27.020(6) (emphasis added))

The San Luis Obispo ordinance draws a similarly hard line against exports. It declares it "essential for the protection of the health, welfare, and safety of the residents of the county, and the public benefit of the state, that immediate action be taken to ensure that the groundwater resources of the county be protected from harm resulting from the exportation of groundwater." (San Luis Obispo Ordinances § 8.95.18)

Scope: The eight county ordinances also vary in scope. For example, two of the laws regulate groundwater extraction for certain types of in-county and out-of-county uses. The Tehama County ordinance requires a permit for the pumping that lowers the groundwater table and for groundwater pumping "for the purpose of using the water or selling the water for use on other than the parcel of land upon which the extraction occurs." (Tehama County Ordinances §§ 9.40.020 & 9.40.030) In both cases, however, the permit requirement applies regardless of whether the groundwater is used or transferred within or beyond county boundaries. Similarly, the San Luis Obispo ordinance defines groundwater exports as "the extraction of groundwater underlying the county for use outside the boundaries of the

[40] The term "groundwater mining" is a shorthand for unsustainable aggregate overdraft of an aquifer. In SGMA terms, groundwater mining is synonymous with exceedance of the "safe yield" of an aquifer (Water Code § 10721(w)).

[41] These adverse impacts include "increased groundwater overdraft, land subsidence, uncontrolled movement of inferior quality groundwater, the lowering of groundwater levels, and increased groundwater degradation," as well as the "loss of arable land, a decline in property values, increased pumping costs due to the lowering of groundwater levels, increased groundwater quality treatment costs, and replacement of wells due to declining groundwater levels, replacement of damaged wells, conveyance infrastructure, roads, bridges and other appurtenances, structures, or facilities due to land subsidence." (Stanislaus County Ordinances § 9.37.020(4) & (5); (Merced County Ordinances §§ 9.27.020(4) & (5))

groundwater basin from which the groundwater is derived, or for use outside of the county." (San Luis Obispo Ordinances § 8.95.20(8))

In contrast, the other ordinances focus their regulatory requirements exclusively on groundwater extraction that supplies uses outside the county. The Butte County ordinance is typical, declaring that "it shall be unlawful to extract groundwater underlying county for use of that groundwater so extracted, outside county without first obtaining a permit." (Butte County Ordinances § 33-5) All of these county ordinances apply both to groundwater transfers and to groundwater substitution transfers (Butte County Ordinances § 33-6; Yolo County Ordinances § 10-7.301; San Joaquin County Ordinances 5-8300; Stanislaus County Ordinances § 9.37.030(7); Tuolumne County Ordinance § 13.20.040; Merced County Ordinances § 9.27.030).

Permit Review Processes: Another common feature of the ordinances is that applications to export groundwater are subject to a rigorous review process. The Tuolumne County ordinance is a good example. Permit applicants must describe the project in detail—including the location, size, depth, and spacing of extraction wells and quantity of water that will be pumped for export. They also must include a certified geologist's report that contains a monitoring plan and identification of "monitoring wells to measure groundwater levels, evaluate gradient, flow direction and water quality [and] the impact of the extraction proposal on surrounding pre-existing wells and surrounding springs pre-existing in use as domestic supplies, considering complete build out of the area." And they must provide information needed to conduct a CEQA analysis (Tuolumne County Ordinance § 13.20.070).

In addition, permit applications must be submitted to the regional water quality control board, as well as to potentially affected cities and water agencies. These agencies then may review the proposal to decide whether it is consistent with the basin plan, municipal laws, water district policies, and relevant groundwater management plans. There also is a 30-day public notice and comment period in which any member of the public may support or protest the application (Tuolumne County Ordinance § 13.20.080(B)).

Permit Approval Standards: The ordinances apply similar criteria to the permitting decision. The Yolo County ordinance is instructive. The board of supervisors may approve an application only if it determines that the extraction will not cause or increase overdraft, adversely affect long-term storage or transmission of groundwater, contribute to an exceedance of the safe yield of the county's aquifers, injure other reasonable and beneficial uses, or harm any authorized water replenishment, storage, or restoration project. If the board grants the permit, it must impose limitations needed "to prohibit overdraft or other adverse conditions." The board also may include mitigation requirements and "other conditions that it deems necessary for the health, safety and welfare of the people of the County." (Yolo County Ordinances § 10-7.305)[42]

Two of the ordinances have additional directives that make it unlikely that the county could approve any export transfer. Both the Stanislaus County and Merced County ordinances authorize the issuance of a permit for a groundwater export "to the extent that such practice is consistent with the statements of

[42] The San Joaquin County ordinance has an elaborate set of mandatory conditions that embellish these criteria (San Joaquin County Ordinances § 5-8340). Several of the ordinances also require that permit conditions include measures to prevent subsidence and/or saltwater intrusion into the aquifer (Butte County Ordinances § 33-11; Tehama County Ordinances § 9.40.070; San Joaquin County Ordinances § 5-8335; San Luis Obispo Ordinances § 8.95.070).

county policy set forth in [the ordinance], and provided that such practice is for a reasonable and beneficial use of groundwater resources, supports sustainable groundwater management, and promotes the public interest." (Stanislaus County Ordinances § 9.37.060(B); Merced County Ordinances § 9.27.060(B))[43] As noted above, however, the cross-referenced policy declares *all* groundwater exports—even those that are not based on unsustainable groundwater extraction—to be presumptively unreasonable under Article X, Section 2 of the California Constitution and detrimental to the environmental and economic well-being of the county (Stanislaus County Ordinances § 9.37.020(4)-(6); Merced County Ordinances § 9.27.020(9)).

Exemptions: All of the ordinances contain exemptions that allow some groundwater to be used, or transferred, beyond county boundaries. Common exemptions include extraction of groundwater for use on the overlying owner's adjoining lands in a neighboring county, removal of groundwater from the rootzone of crops, and emergency pumping to prevent flooding (Butte County Code of Ordinances §§ 33-5 & 33-7; Yolo County Ordinances § 10-7.301; San Joaquin County Ordinances § 5-8300).[44]

Several counties also have recognized that the export of groundwater (or groundwater substitution transfers) might be valuable components of regional conjunctive use programs or useful tools for complying with regulatory requirements. For example, the San Joaquin County ordinance limits the term of export permits to three years, but it makes an exception for pumping that is "part of a conjunctive use groundwater replenishment project." The terms of these permits may extend for the duration of the conjunctive use program (San Joaquin County Ordinances § 5-8380). The DREAM project, described in Box 7, illustrates the potential scope of these exemptions for conjunctive use programs.

Similarly, the Stanislaus County and Merced County ordinances allow groundwater users to participate in recharge programs within a hydrologic basin that transcends county boundaries. They stipulate, however, "the amount of recaptured groundwater transferred out of the area should not exceed the amount of water used to recharge the aquifer." (Stanislaus County Ordinances § 9.37.050(B)(4); Merced County Ordinances § 9.27.50(C)(3))[45] The ordinances also exempt from their permitting systems the "reasonable use of groundwater resources to supplement or replace surface water released for other reasonable and beneficial purposes, including, but not limited to, fisheries, ecosystem habitat or downstream water quality or quantity needs, when required pursuant to federal and state law, regulations, licenses or permit conditions." (Stanislaus County Ordinances § 9.37.050(B)(2); Merced County Ordinances § 9.27.50(C)(1))[46]

These two ordinances also create a potentially expansive exemption that would allow water agencies within the county to transfer groundwater—or to engage in groundwater substitution transfers—"in compliance with applicable state law that authorizes public water agencies to transfer water outside its usual place of use." (Stanislaus County Ordinances § 9.37.050(B)(3); Merced County Ordinances § 9.27.50(C)(2)) The state law to which this refers allows water agencies to transfer water that is surplus to their needs, as well as

[43] The terms of these permits may not "exceed the remaining term of any applicable groundwater sustainability plan." (Stanislaus County Ordinances § 9.37.060(B))

[44] In addition to these exemptions, the Stanislaus County, Merced County, and San Luis Obispo ordinances exempt exports of "contaminated groundwater that is pumped and treated to remove contaminants that are in violation of standards for beneficial uses." (Stanislaus County Ordinances § 9.37.050; Merced County Ordinances § 9.27.050; San Luis Obispo County Ordinances § 8.95.040) The Tehama County ordinance also exempts pumping to supply municipal water systems (Tehama County Ordinances § 9.40.030), and the Tuolumne County ordinance exempts the export of groundwater that is bottled within the county but exported for sale (Tuolumne County Ordinances § 13.20.060).

[45] The Merced County limitation uses the words "will not exceed," rather than "should not exceed." (Merced County Ordinances § 9.27.050(C)(3))

[46] The Merced County exemption is phrased slightly differently (Merced County Ordinances § 9.27.050(C)(3)).

conserved water made available by fallowing, crop shifting, or other demand reduction measures (Water Code §§ 1745.05 & 1705.06). This statute is described in more detail in the next section.

Box 7: County Export Ordinances and Inter-Regional Conjunctive Management: The DREAM Project

The Demonstration Recharge Extraction and Aquifer Management (DREAM) project—a partnership that includes the North San Joaquin Water Conservation District (NSJWCD), Eastern Water Alliance, the East Bay Municipal Utility District (EBMUD), and San Joaquin County— illustrates how inter-regional groundwater banking and conjunctive management may be conducted consistent with county export restrictions.

The project agreement authorizes EBMUD to deliver up to 1,000 afa of its Mokelumne River supplies to irrigation users within NSJWCD, which is located in northeast San Joaquin County. These surface water supplies will allow the recipient farmers to reduce groundwater pumping by a commensurate amount. In dry years, the agreement grants EBMUD the right to pump groundwater from the basin in quantities up to 50 percent of the district's surface water deliveries. This in turn will allow EBMUD to retain more water in its Mokelumne River reservoirs, which it may use to meet water quality standards and to supply its own users (EBMUD 2019).

"San Joaquin County issued the DREAM groundwater export permit in 2017 and has been monitoring groundwater levels since 2018 in advance of groundwater extraction . . . . All DREAM groundwater extractions are subject to the export permit conditions and will be controlled by North San Joaquin Water Conservation District." (EBMUD 2019) To date, EBMUD has only delivered 150 acre-feet of surface water as part of the pilot phase of the project. COVID-19 restrictions have delayed construction required to enable greater deliveries and withdrawals. EBMUD expects the project to become fully operational in 2021 or 2022 (EBMUD 2019).

The DREAM project has engendered broad support, despite the county's general restrictions on groundwater exports. According to San Joaquin County Supervisor Chuck Winn, the project "will not only help agriculture, fish, recreation, and the environment, but it will also provide a drought buffer for local communities in Eastern San Joaquin County by providing an alternative water source when surface water is unavailable. This project serves as a model for other regions to follow." (EBMUD 2019)

Summary of County Export Ordinances

The dominant theme of the eight ordinances reviewed here is protection of each jurisdiction's groundwater resources coupled with permitting standards that make it difficult to transfer or use groundwater beyond county boundaries. To the extent that these ordinances guard against overdraft and promote sustainable use, they are justifiable applications of the counties' long-standing regulatory powers. Where these laws bar groundwater exports for the principal purpose of preferring in-county uses to those in other counties and regions, however, the ordinances undermine efficient use and allocation of water.

The unjustifiable burden on groundwater exports results from three features of the ordinances:

- **Unequal treatment of in-county vs. export uses.** All eight ordinances expressly discriminate against out-of-county uses by requiring permits for export pumping while generally exempting pumping that serves in-county uses. Even those ordinances that require extraction permits for certain in-county uses apply stricter standards to export pumping. For example, Stanislaus County and Merced County impose permitting requirements on all extractions from new wells that may cause or contribute to unsustainable overdraft, but also require permits for *all* export extractions—regardless of whether they cause or contribute to overdraft.
- **Arbitrary protection of safe yield and sustainable use.** All eight surveyed ordinances assert a preference for in-county uses—regardless of whether water transferred beyond county boundaries would be used on lands that overlie the aquifer of origin.[47] The San Luis Obispo ordinance applies both to groundwater exports to out-of-county uses and to uses "outside the boundaries of the groundwater basin from which the groundwater is derived." Inclusion of the latter, however, does not justify special regulation of the former in situations where the out-of-county use would nevertheless remain within the boundaries of the aquifer from which the groundwater is extracted.

  As described above, the common law has long recognized overlying rights as superior to appropriative rights because return flow and percolation from overlying use replenishes the aquifer from which the groundwater was extracted. In contrast, there is no functional relationship between county boundaries and hydrological basins, as most Central Valley counties overlie multiple groundwater basins and most Central Valley aquifers cross county boundaries (DWR 2021b). Thus, there is no water policy justification for county export restrictions other than a preference for the county's residents and economic uses over those in other counties that overlie the same aquifer.
- **Disparate permit approval criteria.** In most counties, the standards that govern review and approval of groundwater exports are well-tailored to the types of third-party effects that may result from increased pumping—including interference with adjacent wells, disruption of groundwater migration, introduction of contaminants into domestic wells, and protection against overdraft. These criteria are appropriate if applied to *all* groundwater extraction (or at least to all changes in pumping to facilitate new uses and transfers), but few counties have such comprehensive groundwater regulatory programs.[48]

  Moreover, as described above, the approval criteria set forth in Stanislaus County and Merced County ordinances stack the deck against export transfers. It is difficult to conceive of a proposed export of groundwater from either county (other than those that are categorically exempt) that could overcome the presumptions that such transfers are detrimental to the economic and environmental interests of the county and are unreasonable under Article X, Section 2 of the California Constitution.
- **Inconsistent treatment of native and non-native groundwater.** All of the ordinances apply to groundwater generally, rather than distinguishing between native and non-native supplies. Three of the counties—San Joaquin, Stanislaus, and Merced—allow groundwater to be exported beyond county boundaries as part of conjunctive use and recharge programs. The last two of these significantly limit the quantity of groundwater that may be exported, however, even if the

[47] Most of the ordinances allow non-permitted pumping for out-of-county uses on land that straddles county borders and is under common ownership, but this is a limited exception. Potentially broader exceptions are those in the Stanislaus County and Merced County ordinances for groundwater recharge programs described in the text above.

[48] Most counties do have permitting requirements for the construction of new wells, including repair or deepening of existing wells.

groundwater originated as surface water imported from another basin or from in-basin developed surface water sources.[49]

A majority of the ordinances considered in this review may therefore impede the development of groundwater banks and other conjunctive use programs that extend beyond county borders. Moreover, in those areas where groundwater supplies are derived from imported and developed surface water sources, the ordinances are in tension with the doctrines discussed in the introduction that plenary rights to the reuse of this *surface* water remain with the importing water agencies or their members even after it percolates into the groundwater basins following irrigation or dedicated recharge.

The Consequences of SGMA for County Export Ordinances

The counties' interests in protecting their groundwater resources from overdraft and unsustainable use are legitimate and important, but there are now better ways to achieve these purposes than through export ordinances that discriminate against out-of-county uses. SGMA requires the GSAs that operate within the counties to implement management policies that promote sustainable groundwater use. These policies protect all legitimate county interests in sustainable groundwater management that are potentially affected by in-county *and* export uses.

Indeed, SGMA's sustainability mandate—including the directive to avoid the six undesirable results—tracks many of the interests asserted in the county ordinances reviewed above. These include protection of groundwater supplies and storage capabilities, prevention of water quality degradation (including migration of pollutants and saltwater intrusion), and avoidance of land subsidence and depletions of hydrologically connected surface water (Water Code § 10721(v) & (x)). SGMA adds a broader perspective, however, declaring that sustainable groundwater management also includes integrated management of groundwater basins (and sub-basins), increased groundwater storage and conjunctive use, and removal of impediments to recharge (Water Code §§ 10720.1, 10726.2(b)&(d) & 10727.2(d)).

The statute also directs that "groundwater management . . . shall be consistent with Section 2 of Article X of the California Constitution." (Water Code § 10720.5(a)) The constitution in turn requires that "the water resources of the State be put to beneficial use to the fullest extent of which they are capable, . . . with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare." (California Constitution Art. X, § 2) In its most recent groundwater decision, the California Supreme Court reiterated the long-standing principle that determinations of reasonable use must be based on the facts of each case in the context of "statewide considerations of transcendent importance." (California Supreme Court 2000)

These broader directives are especially important for the statewide achievement of SGMA's sustainability mandate. Intra-basin groundwater transfers can add flexibility as GSAs reduce individual extraction allocations and water users adjust their operations as needed to bring aggregate water use within defined levels of sustainable groundwater management. Although inter-basin transfers of groundwater are likely

[49] For example, the Turlock Irrigation District delivers Tuolumne River water (which flows through Tuolumne and Stanislaus counties) to portions of Merced County to the south. This water derives from two of DWR's designated groundwater basins (the Tuolumne River bisects hydrologic basins 5-022.02 and 5-022.03) and is partly used in hydrologic basin 5-022.04 (TID 2019; DWR 2021b). Percolation that recharges the aquifer underlying Merced County therefore is likely imported water or at least some of it is developed water as it would not be present in the aquifer without TID's canal and distribution facilities.

to be rare, groundwater substitution transfers can enhance groundwater recharge during wet-year conditions and provide water to areas of acute shortage during periods of drought. The same is true for transfers that are part of groundwater banking and other conjunctive use programs.[50]

County ordinances that impede these types of transfers are in tension with SGMA's objectives and directives. A consistent policy would facilitate water transfers and conjunctive management programs—including those that cross county boundaries—unless increased pumping in connection with a transfer would violate an applicable groundwater sustainability plan.

Local Water Agency Transfer Policies

California's myriad local water agencies also have significant influence over water transfers. These agencies include irrigation districts, water districts, water agencies, county water agencies, water conservation districts, reclamation districts, water storage districts, and many other special water districts (LAO 2002). Most of these agencies supply surface water to their members, although some also provide flood control and manage groundwater storage, recharge, and distribution (ACWA 2019).[51] The range of agency authority over groundwater is described briefly in Box 8.

Box 8: Local Agency Authority Over Groundwater Resources

Agency control of groundwater resources varies significantly across California. Many agencies provide only surface water and exert little or no control over their members' use of groundwater. Some, such as the Rosedale–Rio Bravo Water Storage District, are primarily groundwater managers, delivering imported, developed, and acquired surface supplies for groundwater recharge and extraction by member farmers (RRBWSD 2020).

A few agencies, such as the Westlands Water District, have established programs that integrate groundwater owned by their members into their general water supply systems. Westlands invites eligible groundwater extractors to have the district take title to existing wells or to install new extraction facilities on their property. Participating users then "pump groundwater according to Westlands schedules and are charged a cost-based fee for groundwater pumped." (WWD 2020)

[50] As noted above, a recent PPIC study of groundwater management and SGMA implementation in the San Joaquin Valley evaluated a portfolio approach that would significantly mitigate the economic losses that are likely to result from valley farmers' compliance with the statute's sustainability mandate. This portfolio includes water transfers within the valley (both intra-basin and inter-basin), water imports during periods of high flow, improvements in storage and conveyance, and expanded groundwater recharge and conjunctive use. The authors conclude:
This combined approach could reduce land fallowing by more than one-quarter, from 750,000 acres to 535,000 acres. Annual revenue losses from crops, dairy, beef, and processing would fall from $5.3 to $3.9 billion (26% lower). Annual declines in regional GDP would fall from $2.1 to $1.3 billion (37% lower). And annual job losses would fall from 21,000 to less than 13,000 (40% lower). With this portfolio, GDP and job losses equal roughly 4 percent of today's agricultural economy, and less than 1 percent of the total regional economy (Hanak et al. 2019, updated in Hanak et al. 2020).

[51] There are more than 1,200 water agencies in California (LAO 2002). Because of their number and diversity, it is impossible here to analyze all of their water transfer policies—or even to focus on a representative sample as was done with county water ordinances. Rather, this section will describe the consequences of agency control over the surface water (and, in some cases, groundwater) that they deliver to their member farmers.

Several agencies—mainly urban water suppliers that have some irrigation customers—deliver water from a diverse portfolio of imported and developed local surface supplies, native and recharged groundwater, and treated recycled water and stormwater directly to their members and customers. The Alameda County Water District, Orange County Water District, and Santa Clara Valley Water District ("Valley Water") are examples of this model (ACWD 2014; OCWD 2015; SCVWD 2019). The Orange County Water District has additional statutory authority to regulate groundwater pumping as a means of guarding against overdraft by equalizing the costs of surface water and groundwater supplies (Schneider 1977). The Inland Empire Utilities Agency has a similar integrated portfolio and conjunctive management program, but groundwater extraction within its service area is regulated through the Chino Basin Watermaster (IEUA 2021).

More common, however, are water agencies that conjunctively manage surface water and groundwater, without regulating groundwater pumping by their member farmers. These programs allow the agencies to use the aquifers beneath their members' property for groundwater storage and recharge and to manage their surface water and groundwater supplies as an integrated resource. Member farmers are free to pump groundwater—including that which is attributable to percolation of imported and developed surface supplies provided by the agency—as part of this conjunctive management. The Turlock Irrigation District provides a good example.

Growers utilizing flood irrigation contribute to the replenishment of the groundwater supply by allowing water to soak into the ground where a portion of it eventually reaches the underground aquifer. In normal and wetter years, surface water makes up the bulk of the supply, with groundwater being drawn upon to a lesser extent. In those years, growers using flood irrigation are net groundwater rechargers, providing more water to the aquifer than is pumped out. In dry years, this stored groundwater can be utilized to help meet irrigation demand that cannot be supplied by surface water alone. (TID 2020)

This diversity of policies makes it difficult to make broad characterizations, or to reach general conclusions, about the efficacy of agency groundwater management in California. Following the enactment of SGMA, however, many local water agencies have designated themselves groundwater sustainability agencies or have become members of multi-party GSAs. In this context, interest in developing more sophisticated accounting systems is growing. These systems will help the agencies delineate between native and non-native groundwater supplies, manage groundwater extraction and recharge, and administer water trading programs.

California law has long recognized that water agencies may obtain water rights, as well as contract rights to water, and that the agency holds this water in trust for its members. Individual farmers (or other users) within the agency have rights to water service, but they do not share in the water or contract rights held by the agency. As the California Court of Appeal recently explained in a case involving the Imperial Irrigation District's relationship with its members: "Irrigating landowners . . . possess an equitable and beneficial interest in the District's appropriative water rights that is appurtenant to their lands and consists

of a right to service. . . . The farmers may have a vested, appurtenant right, but that right consists of an appurtenant right to service, not an appurtenant water right." (California Court of Appeal 2020a)[52]

Water agencies have broad discretion to distribute available water supplies and to create rules governing water use. Irrigation districts, for example, "must treat all categories of users equitably . . . consistent with the interests of the users, the District's purposes, and California water policy." These policies include rules that prevent waste, promote water use efficiency, prevent harm to third parties, and comply with statutory directives such as the domestic use priority set forth in Water Code§ 106. Agencies also have authority to create water trading programs and to allow their members to engage in water transfers (California Court of Appeal 2020a).

Although most inter-agency transfers involve surface water, the distinction between surface water and groundwater in this context is far from precise. Water agencies have engaged in, or authorized, surface water transfers that allow for groundwater substitution, which may affect groundwater balances when the transferor increases its pumping to replace the transferred surface water. Moreover, in many areas, much of the groundwater that agency members extract for their own uses derives from imported or developed surface water supplied by the agency (TID 2020). As noted in the preceding section, transfers of this category of groundwater are more accurately characterized as transfers of surface water stored underground for the benefit of the water agency and its members.[53] Despite these nuances, unless otherwise specified, the analysis that follows focuses on the transferability of surface water supplied by water agencies.

Intra-Agency Transfers

Many water agencies allow their members to trade water among themselves. Although documentation of these transfers has been less than comprehensive, studies have shown that informal, short-term transfers have been a common feature of water resources management in regions of California (Robinson and MacDonnell 1990; Gray, Driver, and Wahl 1991; Hanak 2002; Hanak and Stryjewski 2012a). These types of transfers increased in volume and urgency during the 2012–16 drought, providing "farmers and other users . . . flexible and equitable adjustment mechanisms for drought conditions" and affording sellers substantial economic gains as spot market prices for water spiked (Howitt 2015).

Unfortunately, "smaller internal markets and intra-district transfers are not recorded with regularity," and few agencies have rules or formal programs to administer such transfers. Moreover, "many agricultural water districts do not even grant their farmers transferable rights." (Park 2017)

One exception is the Westlands Water District, which has had an extensive intra-district water trading program for more than three decades. The district's rules allow any member to transfer water to a user in any area of the district with simple notice to the Westland's general manager (WWD 2017a). More than 90 percent of Westlands' farms have participated in this internal market, with aggregate annual transfers

[52] The Water Code also contains a variety of provisions that define the relationship between water agencies vis-à-vis their members (Water Code §§ 22250 – 22264 (Irrigation Districts); §§ 35420 – 35429 (Water Districts); §§ 43000 - 43007 (Water Storage Districts); §§50910 – 50914 (Reclamation Districts); §§ 74520 – 74527 (Water Conservation Districts)).

[53] As described in the introduction, few water agencies have accounting systems that delineate between native groundwater and groundwater that is the derived from imported and developed surface supplies and stored in the basin as recharge or percolation following irrigation or other uses.

often exceeding 100,000 acre-feet (Brozovic, Carey, and Sunding 2017).[54] Westlands also has created a Distribution System Integration program that allows its members "to use the District's distribution system to convey groundwater to other points of use within the District." (WWD 2017b)[55]

Water transfers are an important tool to respond to water shortages, to move water from lower- to higher-value agricultural production, and to replace groundwater pumping that may be restricted because of overdraft or SGMA compliance (Ayres et al. 2020). This is especially true when transfers are integrated into conjunctive management programs that allow users to shift between groundwater and surface water sources as hydrologic and economic conditions warrant (Hanak et al. 2018).

As sustainability plans adopted under SGMA go into effect and individual pumping allocations are assigned, the flexibility afforded by water transfers will become even more important, and it is likely that more water agencies will adopt water trading programs. One of the forerunners is the Rosedale–Rio Bravo Water Storage District in Kern County, which recently partnered with the Environmental Defense Fund (EDF) "to build the first online, open-source water trading platform in the Central Valley." This intra-agency transfer program is described in Box 9.

Box 9: The Rosedale–Rio Bravo Water Storage District's Water Accounting and Trading Program

The Rosedale–Rio Bravo Water Storage District manages the aquifer that underlies approximately 27,500 acres of irrigated cropland and 7,500 acres of urban development in central Kern County. "Nearly all water users within Rosedale rely on surface water obtained by the district and pumped into the ground versus direct delivery of surface water." (RRBWSD 2020) The district's water portfolio comprises imported SWP supplies, developed water from the Kern River, flood flows, spot-market purchases, and a small amount of native groundwater. Although the district delivers water to a few customers, most of its "water supplies are recharged into the groundwater aquifer. By replenishing the aquifer, Rosedale is able to keep water levels high and reduce the pumping costs." (RRBWSD 2021)

After several years of planning, stakeholder workshops, and mock training sessions, the district has created an online, open-source Water Accounting and Trading Platform. The purpose of the platform is "to help the district and its landowners manage their available water supplies and comply with SGMA." The accounting platform went online in March 2020, and the district "will launch the trading section when needed, possibly in 2021. When implemented, the trading portion of the platform will allow landowners to buy and sell allocations of available water supplies via a web-based marketplace." (RRBWSD 2020)

[54] This study analyzed 8,611 transfers that occurred from 1993-1996. About 75 percent of these transfers were between lands within a common farming operation, the ownership of which was divided to comply with the 960-acre limitation of the Reclamation Reform Act of 1982. The other 25 percent were arms-length transactions that included price-motivated sales and water exchanges (Brozovic, Carey, and Sunding 2017).

[55] The district explains that "conjunctive use of surface and groundwater improves overall water supply reliability by making more efficient use of water that is available. In wet periods, use of surface water is encouraged to preserve groundwater supplies. In droughts, greater flexibility in the use of groundwater is facilitated to extract the maximum benefit from this resource." (WWD 2017b)

The water accounting platform is notable both for its detail and ease of administration. Each user's water use data "comes from OpenET, a web platform being developed by NASA, EDF and the Desert Research Institute. OpenET uses satellite-based data to calculate evapotranspiration—a key water metric that is particularly well-suited to tracking water use given Rosedale's geography. The platform can be tailored to incorporate additional water use data based on data availability and regional needs." (RRBWSD 2020) The platform also combines water supply and use data to provide each landowner with a water budget for the year. This enables landowners "to check their water budget and outstanding balance online, similar to how they check their bank account online. The platform also features a water manager dashboard to track and account for water across a water district." These features enhance the district's ability to "monitor and report groundwater use, evaluate the hydrologic impacts of groundwater pumping, and facilitate the transfer of allocations at the request of landowners." (RRBWSD 2020)

The planned water trading platform is notable for its gains in water use efficiency and its ease of administration. Intra-district transfers will "help landowners more flexibly manage their water resources." (RRBWSD 2020) They will be able "to post an offer to sell or buy water on the platform, similar to other platforms like Craigslist or eBay. Other users can then respond to the offer, either with a counter-offer or by agreeing to the initial price. A buy/sell page will show users all outstanding offers." The initial offer and acceptance process is anonymous, although the parties to a transfer ultimately "will need to disclose their identity in order to communicate outside the platform to sign an agreement and complete the financial transaction. After the agreement is final, they will use the platform to notify Rosedale, and the groundwater balances in the buyer and seller's accounts will be adjusted accordingly." (EDF 2019)

Although the district will monitor water trades between its members, it does not plan to require permits for individual transfers. The district will have authority, however, to ensure that changes in pumping to facilitate transfers do not impair adjacent wells, increase contaminant levels, or harm disadvantaged communities. It also plans to use the accounting and trading data to encourage transfers and other changes in groundwater extraction that would provide third-party benefits to domestic well owners and community water systems (RRBWSD 2020).

The Rosedale-Rio Bravo online market will serve as a model for other water agencies. As more agencies create their own programs, it will be desirable for them to coordinate their trading rules and databases. This would enable agencies that share a groundwater basin or sub-basin to engage in cross-agency trading, which in turn would help to facilitate integrated implementation of the sustainability plan for the basin and address supply/demand imbalances that may result from enforcement of individual pumping allocations.

Readers interested in engaging in mock trades on the Rosedale–Rio Bravo platform may do so at EDF (2020). More details are available on the project's Story Map.

Inter-Agency Transfers

California law also expressly authorizes water agencies to transfer conserved and surplus water both to their own members and to other agencies and water uses (Water Code §§ 1745-1745.11). The statute defines conserved water as water made available from:

1. Conservation or alternate water supply measures taken by individual water users or by the water supplier.
2. Water developed pursuant to a contract by a water user to reduce water use below the user's allocation or to eliminate the use of water during the water year, including a contract to grow crops without the use of water from the water supplier, to fallow land, or to undertake other action to reduce or eliminate water use. (Water Code § 1745.05(a))[56]

Before an agency may transfer water, it must have allocated the available water to its own members and ensured that none of them "will receive less than the amount provided by that allocation or be otherwise unreasonably adversely affected without that user's consent." (Water Code § 1745.04)[57]

Although individual members may participate in these water transfers,[58] the statute makes clear that they may do so only with the agency's consent. It stipulates that nothing in the authorization of agency transfers:

(a) Creates in any person a right to require any water supplier to enter into a contract providing for the reduction or elimination of water use or for the transfer of water; [or]

(b) Creates in any person reducing water use any interest in the water rights of the water supplier. (Water Code § 1745.09(a) & (b))

In short, individual water users have the right to transfer conserved or surplus water, but only with the approval of the agency or by participating in a transfer program between the agency and another water supplier or water user.[59]

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[56] The statute places a soft limit on transfers of water made available by fallowing, stating that such transfers "may not exceed 20 percent of the water that would have been applied or stored by the water supplier in the absence of [the transfer] in any given hydrological year, unless the agency approves, following reasonable notice and a public hearing, a larger percentage." (Water Code § 1745.05(b))

[57] As described in the preceding section, the statute also limits groundwater substitution transfers, which must be either consistent with a groundwater management plan or approved by the water agency based on findings that the transfer "will not create, or contribute to, conditions of long-term overdraft in the affected groundwater basin." (Water Code § 1745.10) It does make an exception, however, for transfers of "previously recharged groundwater from an overdrafted groundwater basin . . . if the recharge was part of a groundwater banking operation carried out by direct recharge, by delivery of surface water *in lieu* of groundwater pumping, or by other means, for storage and extraction." (Water Code § 1745.11)

[58] The statute provides, for example, that the water agency "may, for a consideration to be specified in the contract, contract with persons entitled to service within the supplier's service area to reduce or eliminate for a specified period of time their use of water supplied by the water supplier." (Water Code § 1745.02)

[59] In the Central Valley Project Improvement Act of 1992, Congress sought to limit the power of CVP contracting agencies over transfers proposed by their members. The Act authorizes recipients of CVP water to transfer all or a portion of their allocations "to any other California water user or water agency, State or Federal agency, Indian Tribe, or private non-profit organization for project purposes or any purpose recognized as beneficial under applicable State law." (CVPIA § 3405(a)) Transfers must be approved by the Bureau of Reclamation and by the contracting agency that supplies project water to the transferor. The Act exempts from agency review, however, transfers of water up to 20 percent of the agency's contract entitlement (CVPIA § 3405(a)(1)).
This reform apparently has had little practical effect. As of 2011, there were no reported transfers of CVP water undertaken without the contracting agency's approval (Bickett 2011). One transfer proposal did come close to fruition. In 1993, former U.S. Representative Rusty Areias and his two brothers signed a 15-year contract to transfer a total of 32,000 acre-feet of water to the Metropolitan Water District of Southern California. The agreement was made over the objections of the Central California Irrigation District, which supplies CVP water to Areias Farms. MWD eventually backed out of the deal following widespread protests (Erie and Brackman 2006).

Many California water agencies engage in transfers of surface water, and the volume of water transferred has increased dramatically since 1980, when the legislature first sought to encourage water marketing (Hanak and Stryjewski 2012a; Hanak, Jezdimirovic, and Sencan 2019). These transfers are structured in different ways. Some transfer stored surplus water or water conserved by the agency through infrastructure improvements.[60] Others involve agency-initiated programs that encourage members to conserve water—or shift to alternative sources such as groundwater—and the agency then delivers the conserved water to the transferee agency. Important examples include:

- **Palo Verde Water District-Metropolitan Water District Fallowing Program.** PVID has a 35-year contract to deliver conserved water to MWD. This water is made available by the annual rotational fallowing of up to 29 percent of the irrigated lands within the district. The agreement, which runs from 1994 through 2029, supplies as much as 111,300 afa to MWD (Park 2017).
- **Imperial Irrigation District-San Diego County Water Authority Conservation Program.** As required by the 2003 Quantification Settlement Agreement (QSA), the Imperial Irrigation District has a 45-year contract to deliver conserved water to the San Diego County Water Authority. For the first 15 years of the program, the QSA required water to be made available by fallowing within IID. The conserved water was used both for transfer to San Diego and for environmental mitigation in the Salton Sea (Park 2017). In 2018, the state assumed exclusive responsibility for implementing the mitigation and restoration components of the QSA. Since then, all of the transferred water derives from a combination of system improvements and on-farm efficiency measures. Farmers "voluntarily propose conservation measures, delivery reduction volume, contract duration, and a cropping plan for IID consideration. After review and consultation, IID accepts proposals until conservation obligations are fulfilled." (IID 2020b)
- **Yuba Accord Conjunctive Use/Groundwater Substitution Transfer Program.** As part of the 2007 Yuba Accord, the Yuba Water Agency signed a long-term contract to sell up to 480,000 afa of water to DWR, of which 60,000 afa is designated for water quality and environmental uses. It also has dry-year option agreements to sell up to 120,000 afa to CVP and SWP contractors located south of the Delta. The transferred water is from surface storage and groundwater substitution. YWA has conjunctive use agreements with its member agencies pursuant to which individual farmers agree to increase groundwater pumping and concomitantly reduce their surface water deliveries from YWA. This allows YWA to release water to meet instream flow requirements under the Accord (DWR and YCWA 2007; Ugai 2017).[61]
- **San Joaquin Exchange Contractors Conservation Transfer Program.** In 2013, the Bureau of Reclamation created a 25-year water transfer program with the San Joaquin River Exchange Contractors Water Authority.[62] The agreement authorizes the transfer of up to 150,000 afa in non-

[60] The most prominent examples of surplus water transfers were from the Yuba Water Agency (formerly the Yuba County Water Agency) to various buyers in the Bay Area, San Joaquin Valley, and Southern California during the 1986-92 drought. These include sales to the Drought Water Bank operated by DWR during the last two years of drought (Gray 1994). Between 1987 and 2005, Yuba transferred more than 1.2 million acre-feet of stored water, the most from any single transferor over that time period (Park 2017). As described below in the text, Yuba continues to transfer substantial quantities of water each year pursuant to the 2007 Yuba Accord.
The best example of the transfer of water made available primarily through investments in infrastructure (e.g., construction of regulating reservoirs, concrete lining of canals, and water delivery improvements) is the 35-year transfer from the Imperial Irrigation District to MWD. These investments have made more than 100,000 afa available to MWD (Gray 2015; IID 2020a).

[61] This long-term transfer required approval of the State Water Board to authorize changes in the place-of-use and point-of-diversion in YWA's water rights permits. From 2008 through 2018, YWA transferred more than 1.1 million acre-feet, of which approximately two-thirds derived from storage and one-third from groundwater substitution (YWA 2021).

[62] The four water districts that comprise the Authority have preferential contract rights to CVP water service based on their pre-project water rights. Under the Exchange Contract, the Bureau must deliver a minimum of 75 percent of the Exchange Contractors' contractual allotments—even under drought

critical water years. "The Exchange Contractors propose to make water available through tailwater recovery, water conservation, and temporary land fallowing." The principal purchasers of the water will be CVP and SWP contractors, although during periods of low CVP water allocations, most of the water will be transferred to purchasers within the San Luis & Delta-Mendota Canal Authority service area. The program also authorizes the Bureau to purchase water for delivery to state and federal wildlife refuges in the San Joaquin Valley (USBR 2013 & 2015).

These water transfer programs illustrate the constructive synergy that exists when water agencies work with their members who are willing to conserve water, fallow land, conjunctively manage their groundwater and surface water supplies, and take other measures to free up water for sale. Although these programs are not without controversy, they often benefit the transferor agency and its members by increasing net revenues—both for the agency and for farmers who participate in the transfer program—and by improving the efficiency of water use within the agency (Hanak and Stryjewski 2012a).[63]

For example, from 1999-2018, the Oakdale Irrigation District sold more than 667,000 acre-feet of surplus water. The largest purchasers were the U.S. Bureau of Reclamation and the Stockton East Water District, with which the district had long-term sales contracts. Short-term buyers included DWR on behalf of several SWP contractors, San Luis & Delta-Mendota Canal Contractors, and individual users on lands adjacent to the district that lack regular access to surface water supplies (OID 2019, 2021).[64] Through 2017, these sales generated more than $69 million in revenues, of which the district has invested $67.8 million in infrastructure improvements and water efficiency measures. The improvements have allowed the district and its members to reduce aggregated groundwater pumping by 17 percent and to increase groundwater recharge by 54 percent and to reduce pumping by 17 percent (OID 2017).

The IID-SDCWA long-term transfer—probably the most contentious transfer in California history—also has produced significant revenues for the district, its member farmers, and the community. For example, in 2018, IID earned more than $92 million from the water sales to San Diego, and it distributed $33 million to farmers who participated in the fallowing program (IID 2019).[65] The district used the remaining revenues for Salton Sea mitigation, canal lining, seepage recovery, on-farm efficiency improvements, and other projects. In addition, the parties to the transfer agreement created a $50 million community fund that has compensated local businesses and workers for possible losses caused by the fallowing program (IID 2018).[66]

Of course, water trading also benefits purchasing agencies and their members. Transfers provide vital water supplies during drought, they provide water for groundwater recharge, and they can help to offset pumping limitations required by SGMA implementation. A recent study by the Public Policy Institute of California, for example, estimates that inter-basin trading of surface water within the San Joaquin Valley

conditions when other CVP contractors may receive little or no project water. Indeed, in most years, the Exchange Contractors receive 100 percent of their contract entitlements. This makes the Exchange Contractors a reliable source of water for transfer.

[63] Several other important long-term water supply partnerships are described in Escriva-Bou et al. (2021).

[64] In 2016, OID approved a one-year pilot program to transfer water made available by fallowing up to 3,000 acres within the district to the San Luis & Delta-Mendota Water Authority. The state courts invalidated this pilot program, finding that the district had violated the California Environmental Quality Act by not preparing an environmental impact report (California Court of Appeal 2018). The one-year fallowing program did generate almost $1 million for participating farmers, however (Stapley 2018).

[65] These farmers fallowed more than 12,000 acres, which yielded 48,040 acre-feet for transfer to SDCWA (IID 2018). The district estimates that these revenues will rise to $150 million in 2021, with on-farm payments exceeding $58 million (IID 2019).

[66] The $50 million community funding included job retraining programs and contributions to the Imperial Valley Food Bank. The last community grants were made shortly after the conclusion of the fallowing program in 2017 (IID 2018).

could generate $600 million annually in regional GDP and save nearly 6,000 regional jobs by enabling purchasers to irrigate high-value croplands that otherwise would go out of production because of SGMA's mandates (Hanak et al. 2019).

Despite these potential benefits, few local water agencies have written policies to authorize and manage water transfers—either directly by their members or by the agency itself.[67] Yet there are several steps that agencies can take to position themselves for inter-district and inter-basin trading that may develop under SGMA. These include:

- **Evaluation of the benefits and risks of incorporating trading programs into their water management portfolios.** This requires identification of the hydrologic conditions during which transfers may be advantageous to the local agency and its members. It also requires definition of members' individual rights to transfer water for use beyond the agency's boundaries, as well as an explanation of the agency's role in reviewing, facilitating, and managing such transfers.
- **Analyses of the potential environmental effects of transfers on the water, lands, and other resources within the agency.** Preparation of a programmatic environmental impact report would help to expedite transfers that would cause little disruption to the basin's overall water supplies, while also identifying areas where the potential for third-party effects may preclude transfers or require mitigation. This is especially important for local agencies that anticipate transfers based on fallowing or groundwater substitution.
- **Incorporation of water trading programs and the accompanying environmental analysis into the groundwater sustainability plans for the basin.** This type of integrated planning is especially important for inter-basin trading because transfers can affect the water budget for the basin. For example, surface water transfers may alter recharge, and groundwater substitution transfers can increase aggregate pumping from the basin. The Yuba Water Agency's sustainability plan is an excellent example of this type of integrated and cooperative planning (YWA 2019).[68]

With common agreement on these types of transfer policies, individual users will know their trading rights and have access to efficient and fair water markets. Without these types of reforms, there is a risk that trading will be stymied by *ad hoc* decision making that prefers local water security without regard to countervailing uses in other neighboring agencies or other regions. This type of parochialism can hinder the state's policy of promoting efficient water use and allocation, groundwater recharge, compliance with SGMA's sustainability mandates, *and* freedom of choice among water users who seek to use their surface water allotments in ways that best achieve their economic interests.[69]

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[67] Even the Westlands Water District has only brief written policies for inter-agency transfers. Its rules authorize individual members to transfer surface water out of the district, and to purchase water from outside sources, with the district's prior approval. The rules contain no criteria to govern export transfers. For purchases, the rules require the district's general manager to "cooperate to a reasonable extent with any user in connection with that water user's efforts to obtain water" from non-district sources and state that an import application may be denied if it "would impair the District's ability to obtain sufficient other water, reduce the quantity of other water obtained by the District or delay or otherwise negatively affect the delivery to the District of other water obtained by the District." The rules also allow individual members to use excess capacity in the district's canals to deliver imported water to their places of use. Members must reimburse the district for all costs associated with the transfer (WWD 2017a). Although Westlands is an active purchaser of surface water, it seldom offers water for export.

[68] YWA drafted its GSP for the North Yuba and South Yuba sub-basins in cooperation with the two other GSAs with jurisdiction over these sub-basins: the City of Marysville and the Cordus Irrigation District. YWA also consulted with 17 other stakeholders, including its eight member agencies and Yuba County. The water budgets set forth in the plan include the YWA's conjunctive use water transfer program described above (YWA 2019).

[69] A recent example from the Westlands Water District illustrates the perils of *ad hoc* agency decision making for individual water users. At its October 2020 meeting, the Westlands' board of directors considered a request by one of its members to transfer 30 acre-feet to his own land within the Panoche Water District. WWD's Supervisor of Resources supported the request. The grower does not pump groundwater, so there was no risk that the proposed surface water transfer would increase groundwater extraction within the district. WWD's General Manager also advised the board that "this exact type of transfer has happened before many times and is allowed if it is a neighboring district with a landowner with property in both districts." Although several

Part Three: CVP and SWP Water Transfer, Groundwater Banking, and Wheeling Policies

Implementation of SGMA's sustainability mandate will require a combination of demand reduction, improvements in groundwater management, and augmentation of supplies through groundwater recharge and banking. Two large water projects—the federal Central Valley Project and California State Water Project—play a large role in this context, because their interrelated systems of canals and reservoirs often provide the best means of transporting surface water across regions and hydrologic basins (Mount et al. 2018). This is true both for transfers of water among CVP and SWP contractors and for transfers of non-project water that is "wheeled" through CVP or SWP facilities.

This part begins with an overview of CVP and SWP water transfer policies and a description of the types of transfers and exchanges in which the projects have engaged or facilitated over the past several decades. It then focuses on several important changes to these policies that are designed to expand opportunities for water trading, wheeling, and groundwater banking and recharge. The part concludes with an analysis of the CVP and SWP "carriage water" rules that apply to water transfers that pass through, or originate in, the Sacramento–San Joaquin River Delta and make use of project facilities.

CVP and SWP Transfer Policies

Water transfers are regular features of CVP and SWP administration. Indeed, water trading within the two projects accounts for approximately 40 percent of all water transfers (by volume) in California (Hanak and Stryjewski 2012b).

The Bureau of Reclamation's authority over water transfers by its contractors is governed by the Central Valley Project Improvement Act of 1992. The statute grants CVP contractors the right to transfer all or a portion of their project water "to any other California water user or water agency, State or Federal agency, Indian Tribe, or private non-profit organization for project purposes or any purpose recognized as beneficial under applicable State law." (CVPIA § 3405(a)) Transfer proposals must be reviewed and approved by the Bureau under a variety of criteria, including findings that the transfer would not significantly reduce the quantity or quality available for fish and wildlife or impair its ability to deliver water to fulfill its fish and wildlife obligations, including refuge water supplies (CVPIA §3405(a)(1)(H) & (L)).[70] The statute generally limits transfers to project water "that would have been consumptively used or irretrievably lost to beneficial use during the year or years of the transfer," although it excepts transfers between CVP contractors "within countries, watersheds, or other areas of origin" from this condition (CVPIA §3405(a)(1)(I) & (M)).

In addition, the CVPIA declares that all transfers must be consistent with California law, including the environmental review requirements of the California Environmental Quality Act (CEQA), the laws

directors stated that the transfer would have no significant effects on Westlands' surface or groundwater supplies and that "it might be a good thing to have some flexibility for transfers with neighbors," the board voted to deny the transfer. The majority was concerned that the transfer might set a precedent for similar inter-agency transfers of larger quantities, which would not be in the district's interests as "SGMA looms." (Wright 2020)

[70] The statute allows the Bureau to approve certain transfers that could harm fish and wildlife, but subject to conditions and mitigation and with conditions that minimize the unavoidable harm (CVPIA § 3405(a)(1)(L)). The Act originally required the Bureau to determine that the proposed transfer would "have no significant long-term adverse impact on groundwater conditions in the transferor's service area." (CVPIA § 3405(a)(1)(J)) This criterion expired, however, in 1999 (CVPIA § 3405(a)(3)). For a more complete review of the review and approval criteria, see Gray (1996).

governing changes in water rights permits and licenses subject to the jurisdiction of the State Water Board, and the statutes that govern the wheeling of water described below (CVPIA §3405(a)(1)(D)). Transfers between CVP contractors generally may be accomplished without the board's review and approval, because the Bureau's water rights permits are broadly written and authorize multiple points-of-diversion, purposes-of-use, and places-of-use throughout the CVP service area (Gray 1994; SWRCB 2013). Transfers of project water to purchasers located outside the CVP service area, however, would require the State Water Board's approval.[71]

For many years, the Bureau of Reclamation has facilitated short-term transfers among contractors located within the same project division, including the Sacramento River contractors, the San Joaquin River Exchange Contractors, and contractors along the Friant-Kern Canal. These types of transfers occurred before enactment of the CVPIA (Gray, Driver, and Wahl 1991), and they have increased since that time (Hanak 2002; USBR 2010, 2015, 2016). The Bureau also has authorized transfers between CVP contractors in different project divisions, including several permanent transfers of project water allocations (Hanak and Stryjewski 2012b; USBR 2014).[72] More recently, it has granted multi-year, programmatic approval of transfers between contractors within the same project division, as well as some inter-basin transfers. For example, the Bureau recently created an inter-basin water trading program designed to facilitate long-term transfers from water users (including CVP contractors) in the Sacramento River basin to CVP contractors located south of the Delta and in the Bay Area (USBR 2019).[73]

DWR's authority over water transfers derives principally from its ownership and management of the SWP facilities that are the primary means of transporting water between willing sellers and buyers in many regions of the state. This is especially true for transfers from the Sacramento River Basin to users in the Bay Area, the San Joaquin Valley, and Southern California, as these transfers require the use of SWP pumping facilities in the South Delta to divert (or redivert) the transferred water and the California Aqueduct to wheel it to its new place-of-use (DWR 2021c).[74]

California law requires public agencies that operate water conveyance facilities to make up to 70 percent of their unused pumping and aqueduct capacity available for use by their own contractors, as well as by third parties (Water Code §§ 1810 & 1814). The owners of the facilities have the right to impose reasonable conditions on the parties to the wheeling agreement, "including operation and maintenance requirements and scheduling, quality requirements, term [of] use, priorities, and fair compensation." (Water Code § 1812(b))[75] The statute also states that the commingling of wheeled water shall not diminish the quality of project water transported in through project facilities. In addition, the wheeling

71 Transfers of project water to non-CVP users also are subject to a $25 per acre-foot surcharge (1992 dollars) that is payable to the Fish and Wildlife Restoration Fund established by the Act (CVPIA § 3407(d)(2)(A)).

72 For a detailed explanation of CVP transfer policies and procedures, see USBR (2013).

73 This inter-basin transfer program is described in more detail below.

74 According to DWR, "water transfers are voluntary actions proposed by willing buyers and sellers, they are not initiated by State agencies." (DWR 2021c) While this is generally true, the department did create three water banks during and after the 1986–1992 drought that established fixed sales and purchase prices for water transferred between water agencies that chose to transfer water through the banks (Gray 1994). As described in the preceding section, DWR also has a long-term contract to purchase water from the Yuba Water Agency and uses a portion of this water to help fulfill its own water quality, endangered species, and other environmental obligations in the Delta.

75 The statute defines "fair compensation" as "the reasonable charges incurred by the owner of the conveyance system, including capital, operation, maintenance, and replacement costs, increased costs from any necessitated purchase of supplemental power, and including reasonable credit for any offsetting benefits for the use of the conveyance system." The precise meaning of this term has been the subject of contentious litigation between the San Diego County Water Authority and the Metropolitan Water district over SDCWA's use of the Colorado River Aqueduct to wheel water acquired from the Imperial Irrigation District as part of the QSA described above (SDCWA 2020).

must not injure other legal users of water, "unreasonably affect fish, wildlife, or other instream beneficial uses," or unreasonably affect "the overall economy or the environment of the county from which the water is being transferred." (Water Code § 1810(b) & (d))

As with the CVP, transfers of water between SWP contractors are not subject to review by the State Water Board, because DWR's water rights permits are broad and authorize multiple points-of-diversion, purposes-of-use, and places-of-use of project water (Gray 1994; SWRCB 2013). This allows DWR, for example, to wheel water from an agricultural SWP contractor in the San Joaquin Valley to the Metropolitan Water District of Southern California (also a SWP contractor) without having to seek State Water Board authorization. Transfers of SWP water outside the SWP service area—as well as transfers of most non-project water through SWP facilities—would require board approval, however, because the transfers would require changes in the place-of-use (and perhaps the point-of-diversion or purpose-of-use) of the transferred water. For example, water sold by the Yuba Water Agency (YWA) and wheeled through SWP facilities to CVP or SWP contractors in the San Joaquin Valley is subject to the State Water Board's change in water rights jurisdiction (DWR & SWRCB 2015).

DWR has approved a variety of short- and long-term transfers between SWP contractors, and it has facilitated the transfer of non-project water through SWP facilities. These include emergency drought-related transfers of more than one million acre-feet through the 1991, 1992, and 1994 state water banks; 320,000 acre-feet in 2001 and 2002 transferred through dry-year purchase programs; and 76,600 acre-feet through a renewed state water bank in 2009 (DWR and SWRCB 2015).

As noted above, DWR also has delivered more than one million acre-feet of water made available by the Yuba Water Agency to SWP contractors and other users south of the Delta, and it has purchased an additional 500,000 acre-feet from for Delta water quality purposes. In addition, DWR has wheeled water stored in Kern County's water banks for the benefit of water agencies in the Bay Area, the San Joaquin Valley, and Southern California. And it has authorized the long-term exchange of 60,000 afa of SWP supplies between the Coachella and Desert Water Agencies and the Metropolitan Water District of Southern California (DWR and SWRCB 2015).

In addition, the Bureau and DWR have coordinated project operations to enable water transfers and exchanges. These cooperative policies include the joint use of CVP and SWP pumping facilities to wheel CVP supplies through the SWP South Delta pumps and California Aqueduct to CVP contractors in the South Bay and the San Joaquin Valley (SWRCB 2018).[76] They also have allowed CVP and SWP contractors to exchange project water supplies (including exchanges between CVP and SWP contractors) and to transport project water to various groundwater banks (SWRCB 2019). In addition, the two agencies coordinate project operations to enable users along the Cross-Valley Canal to exchange project and non-project water supplies (Cross Valley Canal Contractors 2016).

[76] The joint use of CVP and SWP facilities is authorized by the Coordinated Operation Agreement of 1986 (COA), as amended, and SWRCB orders that temporarily authorize changes in the points of diversion and places of use set forth in the projects' water rights permits (USBR and DWR 1986; SWRCB 2018). In 2018, DWR agreed to divert and transport up to 195,000 acre-feet of CVP water through reaches 1, 2A, and 2B of the California Aqueduct no later than November 30 of each year so long as such diversions do not adversely affect SWP operations or conflict with SWP contracts (USBR and DWR 2018).

Building on this history, the Bureau and DWR have adopted a variety of policy changes to enhance the transferability of water by their contractors, to define the terms under which water may be wheeled through their facilities, and to facilitate groundwater banking.

The Draft Water Transfer White Paper

In 2019, the Bureau of Reclamation and DWR released the latest update of their draft Water Transfer White Paper. The purpose of this document is "to help facilitate temporary water transfers [i.e., those for terms of one year or less] that require conveyance through Project Agencies' facilities or otherwise require Project Agency approval." The white paper includes a variety of policies, including (1) criteria for the use of CVP and SWP Delta pumping facilities and canals to convey transferred water; (2) criteria to evaluate transfers involving crop-shifting, conservation, groundwater substitution, and stored water to protect third parties who may be affected by water transfers; and (3) reporting and monitoring requirements to ensure compliance with these criteria (USBR and DWR 2019).[77]

The white paper contains a variety of policies that incorporate the statutory protections for third parties set forth in the California wheeling statutes described in the preceding subsection. They include categorical limitations for transfers involving land idling and crop shifting, evaluative conditions for groundwater substitution transfers that mirror the statutory directives, and an absolute prohibition on the use of project facilities to enable direct transfers of groundwater.

Land Idling and Crop-Shifting

To ensure that transfers involving land fallowing and crop-shifting do not diminish the water available to other legal users, the white paper limits the volume of "transferable water" based on the evapotranspiration of applied water (ETAW) of each crop (USBR and DWR 2019).[78] This represents the transferor's net or "consumptive" water use, rather than the total amount of water applied during irrigation (Escriva-Bou et al. 2016). Only the ETAW produced by fallowing or changing to a less water intensive crop may be transferred through project facilities.

Fallowing transfers are subject to the additional restriction that, "to receive full credit for the expected water savings, idled land cannot be irrigated during the transfer season." (USBR and DWR 2019)[79] In addition, to "minimize the socioeconomic effects on local areas and to minimize effects on special status species," the projects "will not approve water transfers via cropland idling if more than 20 percent of recent harvested crop acreage in the county for each eligible crop, including rice, would be idled." (USBR and DWR 2019) Consistent with Water Code § 1745.05(b), however, the white paper allows the local

[77] According to the white paper, "the approval criterion to which the information in this document chiefly pertains is the avoidance of injury to other legal users of water, through the determination of whether the water proposed for transfer is transferable. Much of the information required in this document is necessary for the Project Agencies to determine if the proposed transfer would cause injury to other legal users of water. This determination, frequently referred to as a 'new water or real water determination,' is the net addition of water to the downstream system that would not be available but for the transfer." (USBR and DWR 2019)

[78] The white paper defines ETAW as "the portion of applied water that is evaporated from the soil and plant surfaces and actually used by the crop." ETAW values "are based upon crop water requirements reflecting average rainfall and evaporative demand." (USBR and DWR 2019)

[79] The white paper also categorically prohibits transfers of water made available by land idling or cropping changes involving specified crops, including orchards, vineyards, pasture, grasses, and alfalfa grown outside the Sacramento Valley floor. These crops "are not eligible for idling or shifting transfers because it is too difficult to determine the amount of new water made available due of a lack of authoritative ETAW values, substantial variability in cultural practices, and other crop-specific issues." (USBR and DWR 2019)

agency that supplies the transferred water to approve a higher percentage of fallowing to make water available for transfer.

Although there is no general requirement that fallowing-based transfers avoid unreasonable harm to the environment, the white paper does "recognize that rice fields and irrigation/drainage ditches can provide habitat for terrestrial wildlife and waterfowl species." It therefore encourages transferors "to incorporate measures in their crop idling proposal to protect habitat value in the areas to be idled," and it states that the California Department of Fish and Wildlife "can advise landowners in the use of non-irrigated cover crops or natural vegetation [for] waterfowl, upland game bird and other wildlife habitat." (USBR and DWR 2019)

Groundwater Substitution

In contrast to the categorical limitations on land idling and crop-shifting transfers, the white paper requires individual review of transfers that involve groundwater substitution. CVP and SWP administrators will review these transactions to ensure that the transfer of surface water and the concomitant increase in groundwater pumping will not injure other legal users of water or "unreasonably affect fish, wildlife, other instream beneficial uses, or the environment." This includes analysis of "the extent to which transfer-related groundwater pumping decreases streamflow (resulting from surface water-groundwater interaction), and . . . the timing of those decreases in available surface water supply." (USBR and DWR 2019)

Transferors also must avoid or mitigate a variety of other potential third-party effects, including contributions to long-term overdraft, well-lowering, land subsidence, degradation of water quality, and disruption of the hydrology and ecology of surface streams and wetlands. Notably, although the white paper calls for monitoring plans that include measures to comply with groundwater sustainability plans and local groundwater ordinances, it states that the actual compliance with these legal standards "will be the responsibility of the entity proposing the groundwater substitution transfer." (USBR and DWR 2019)

Despite this disclaimer, the white paper's myriad limitations on transferable water—and concomitant protections of third-party interests—essentially incorporate state and local law. Although CVP and SWP personnel will independently evaluate potential harm to other legal water users and the environment in most settings, the white paper makes clear that the projects are also committed to ensuring that water transfers using project facilities comply with the general laws that govern groundwater use, water transfers, and protection of third-party interests. Thus, while clarifying CVP and SWP wheeling policies, the white paper does not alter the existing impediments to inter-basin and inter-jurisdictional water transfers described in the preceding parts of this appendix.

Groundwater Transfers

In contrast, for direct transfers of groundwater, the white paper expands the limitations in existing law. The white paper states simply that "the Project Agencies will not approve the direct transfer of groundwater from one area to another." Although this policy is based on Water Code § 1220, it goes well beyond the terms of the statute. As described previously, Section 1220 prohibits the export of groundwater from the combined Sacramento and Delta-Central Sierra basins—*unless the export pumping is consistent with an approved groundwater management plan.* The white paper contains no similar exemption (USBR and DWR 2019).

In addition, the white paper does not distinguish between native groundwater and imported and developed water that is present in Central Valley aquifers as a result of CVP and SWP operations. This includes floodwaters and other salvaged water captured and stored in project reservoirs, which is distributed to CVP and SWP contractors and finds its way into valley groundwater basins as post-irrigation percolation. According to the white paper, this water may not be transferred through project facilities, even though it originated as project water, rather than from native sources. This policy also may go beyond the requirements of California law, as it is not clear whether Section 1220 applies to non-native groundwater (Foley-Gannon 2000).

Transfers of Stored Water

The last category addressed by the white paper—water made available by releases from storage—focuses on the potential effects of these types of transfers on other water right holders, including the projects themselves. The white paper explains that "water is made available for transfer by reservoir release when the seller releases water from their reservoir in excess of what would be released annually under normal operations." It also notes that the water "must also be released at a time when it can be captured and/or diverted downstream." (USBR and DWR 2019)

According to the white paper, this can create two problems. First, "refill of the reservoir storage space vacated by the water transfer can adversely affect downstream water users if it is done at a time when other downstream legal users of water could have utilized reservoir releases." To prevent this, the white paper provides that "the refill of vacated space from a water transfer [generally] will be restricted to periods when the refill quantity is in excess of the needs of any legal user of water downstream of the point of diversion." (USBR and DWR 2019)[80]

Second, "transfers through the Delta or affecting Delta water supply in the summer and fall have the inherent potential to adversely affect the SWP and the CVP physically and from a water accounting perspective." The white paper then states that if the transferred water "is not new water to the system, it will necessarily come instead out of [CVP and SWP supplies]" and thereby cause "impermissible 'legal injury'" to the projects.[81] Accordingly, "the Projects must be assured that the water made available for transfer is new water that would not be in the system but for the transfer activity" and that "the water supply to which their Project contractors are legally entitled is not unlawfully diminished by the transfer." (USBR and DWR 2019)

The projects' concerns are not unfounded. Yet the white paper offers no criteria to explain how they will make this determination when reviewing individual transfers and wheeling requests.[82] Nor has the State Water Board set guidelines for its review of transfers of non-project water through CVP and SWP

[80] The white paper offers two examples: (1) "If a transfer of reservoir storage originates above another reservoir, refill will not be considered to occur until the downstream reservoir goes into flood control operations." (2) "If a transfer source directly affects the inflows to the Delta, refill will not be considered to occur until the Delta is declared to be in excess conditions as defined in the [Coordinated Operation Agreement] between Reclamation and DWR." It acknowledges that "each transfer proposal is unique," however, and "refill criteria must be developed for each proposal and must be tailored to these unique circumstances." (USBR and DWR 2019)

[81] According to the white paper, this is because "the Projects together have the shared responsibility for meeting Delta water quality requirements and are junior to all lawful in-basin water diversions of natural flow under the watershed protection statutes. Because the Projects only export natural flow after all in-basin uses have been met, and [they] must operate to meet Delta flow-related standards, transfers that do not provide new water to the system (or insufficient new water) will require the SWP and CVP to release water from storage or curtail diversions in order to maintain regulatory compliance." (USBR and DWR 2019)

[82] The white paper does cross-reference a draft DWR staff report that describes in general terms the concepts of "real water" available for transfer, legal injury to third parties, and "responsible" transfers. This report does not establish water transfer and wheeling criteria, however (Anderson 2012).

facilities to ensure that the conditions imposed by the projects serve legitimate water supply and water quality interests. This lack of clarity and specificity has the potential to frustrate, or unjustifiably burden, some transfers of water from sources upstream of the Delta.

Long-Term Transfers and Groundwater Banking

Although the Draft White Paper applies only to short-term transfers, the Bureau of Reclamation and DWR have also recently addressed long-term transfers and groundwater banking. These policy changes include the Bureau's Long-Term Water Transfer Program, its amendments to the CVP groundwater banking guidelines, and DWR's Water Management Amendment to the SWP contracts.

CVP Long-Term Water Transfer Program

As noted above, the Bureau of Reclamation has increasingly sought to facilitate long-term transfers of water by identifying potential willing sellers, connecting them with potential purchasers, and creating a foundation for a long-term relationship between the two. An essential component of this long-term transfer program is programmatic analysis of the transfer capabilities of the source region, the means of transporting the water, and the demands and opportunities for direct use and groundwater banking in the purchasing region. This analysis covers both the economic benefits of long-term transfers and the potential environmental costs in the source and recipient regions.

A prominent example of this strategy is the Long-Term Water Transfer Program to facilitate voluntary transfers from CVP and non-CVP sellers located primarily in the Sacramento River basin to CVP contractors in the San Joaquin Valley and the Bay Area, which the Bureau approved in 2020 (USBR 2020a).[83] The program objectives are to develop supplemental water supplies for participating buyers during times of shortage and to meet their demands for "a water supply that is immediately implementable, flexible and can respond to changes in hydrologic conditions and CVP allocations." It includes transfers of water conveyed through CVP facilities, as well as those that may use the SWP south Delta pumping station and local facilities to divert and transport the water (USBR and SL&DMWA 2019).

The EIS/EIR for the program states that potential buyers have identified demands for transferred water of up to 250,000 afa, which the Bureau believes is less than the maximum potential transferable water offered by willing sellers. Water would be made available through conservation, fallowing, crop-shifting, and groundwater substitution. The Bureau states that it will verify transferable supplies and protect third-party interests based on the policies set forth in the Draft White Paper and the requirements of local, state, and federal law—including water quality standards and endangered species limitations (USBR and SL&DMWA 2019).

[83] The final EIS/EIR for the project, promulgated in conjunction with the San Luis & Delta-Mendota Water Authority, lists 38 potential sellers, 20 of which are located along the Sacramento River, four in the American River basin, two in the Yuba River basin, seven in the Feather River basin, four in the Delta, and one in the Merced River basin. It also identifies 12 potential buyers, ten of which are members of the San Luis & Delta-Mendota Water Authority. The other two are the Contra Costa Water District and East Bay MUD (USBR and SL&DMWA 2019).
If non-project water is stored in or transferred through CVP facilities, federal reclamation law requires the parties to sign a "Warren Act contract" with the Bureau. 43 U.S.C. § 523. These contracts are named after the Warren Act of 1911, which authorized the Bureau to store or transport non-CVP water when excess capacity exists. For a list of recent Warren Act contracts, see USBR (2020b).

Although there are concerns about the adequacy of environmental review and protection of third parties,[84] the program does suggest the potential for increased surface water transfers from users in the Sacramento River Basin for groundwater recharge and storage (as well as other uses) in the San Joaquin Valley. Two features stand out.

First, the program contemplates long-term contracts between willing sellers and purchasing agencies that currently lack reliable sources of supply. These contracts can be structured to permit annual transfers triggered by well-defined hydrologic conditions that include both drought and conditions of water abundance. For example, "dry-year option agreements" grant purchasers the right to place a call for a specific quantity of water to meet critical drought needs. Participating sellers agree to make this water available by conservation, fallowing, crop-shifting, or groundwater substitution. Conversely, during periods of relative water abundance, sellers could agree to transfer stored or surplus water for groundwater recharge in the purchasing region.

Second, the long-term transfer program shows that many of the environmental questions and potential effects on third-party users can be evaluated in advance through programmatic analysis. A programmatic EIS or EIR can identify those areas from which surface water can be transferred without causing significant risks to other legal users, sustainable groundwater management, water quality, flows, habitat, or other surface resources in the source region. This analysis then can serve as a template for individual water transfer agreements that specify the places from which water may be transferred, the quantity of land that may be fallowed, the cultivated acreage that qualifies for crop-shifting, volumetric limits on groundwater substitution, and other terms needed to comply with the limitations set forth in the draft white paper and the other requirements of local, state, and federal law.[85]

The programmatic analysis will not resolve all questions associated with water transfers, but it can provide project operators—as well as other water agencies and regulators—a foundation on which to make expeditious decisions whether to approve individual wheeling requests when triggered by the long-term agreements.

CVP Groundwater Banking Guidelines

The Bureau of Reclamation also recently revised its groundwater banking policies for CVP contractors. The revised guidelines generally authorize banking and groundwater recharge, but also contain several restrictions that unduly limit inter-basin water management and conjunctive use.

The guidelines allow CVP contractors to store project water underground for recharge and subsequent use. They also authorize contractors to transfer water withdrawn from underground storage and to create

[84] In 2018, a federal district court enjoined implementation of an earlier version of the program, concluding that the 2015 EIS/EIR was invalid because it failed adequately to consider measures to mitigate the effects of groundwater substitution transfers on groundwater supplies and surface resources. The court also voided the biological opinion for the program, finding that it did not adequately evaluate the potential effects of rice field fallowing on giant garter snake habitat. (U.S. District Court 2018) In response, the Bureau revised the programmatic EIS/EIR and reinitiated consultation with the U.S. Fish and Wildlife Service. After the Bureau approved the revised program in April 2020, a group of three environmental organizations and two Delta water agencies sued to enjoin implementation. (Maven 2020b) This litigation is pending.

[85] The Yuba Accord and the series of transfers from YWA to CVP and SWP contractors located south of the Delta provide useful examples of the benefits of programmatic planning—especially in the challenging context of Sacramento-Basin-to-San Joaquin-Basin transfers that may affect water quality in the Delta.

"in-lieu exchanges" in which one of the parties agrees to use surface water during specifically defined conditions, thus allowing a commensurate quantity of groundwater to remain in the aquifer.

Groundwater banking and exchanges of project water must comply with state and federal law, must be approved by the Bureau, and may "not result in adverse third-party impacts." In addition, the contractor must "document coordination with the Groundwater Sustainability Agencies overlying the subbasin and document how the subbasin will benefit from the Banking and Recovery Actions in the water banking proposal." (USBR 2019)

Groundwater banking is currently limited to 11 "Acknowledged Water Banks"—all of which are located in the Tulare Basin and within the existing CVP service area.[86] The Bureau states that it may authorize storage of project water in other banks, but this determination would be preceded by environmental review to analyze "groundwater storage capacity, recharge rates, ability to recover, recovery rates, water quality, groundwater flow and movement, water losses, degree of aquifer confinement, and impacts associated with the operation of the proposed groundwater bank." (USBR 2019)

The guidelines also create several place-of-use restrictions on the banking and withdrawal of project water:

- The underground storage must be within the same sub-basin as the CVP contractor's service area or in a neighboring hydrologically connected sub-basin.
- When stored groundwater is withdrawn, the recovered water must be used within the CVP contractor's service area, unless otherwise approved by the Bureau.
- If previously banked project water is recovered through an exchange of non-CVP water, the non-project water must be used both within the CVP contractor's service area and within the authorized place-of-use for the non-project water.
- Conversely, "the exchanged CVP Water must be used within the permitted CVP place-of-use, unless relevant State Water Resources Control Board orders or decisions and Reclamation approval are issued." (USBR 2019)

These place-of-use restrictions have two apparent purposes. First, they limit the banking of project water to the same sub-basin that underlies the CVP contractor's service area. This ensures that the underground storage recharges roughly the same area that would be recharged by incidental percolation if the contractor (and its member farmers) had instead used the water for direct irrigation of crops. Second, the restrictions keep project water used for groundwater banking within the CVP service area as defined by statute and the Bureau's state water rights for the project. This principle also applies to banked non-project water that a CVP contractor withdraws for use through an exchange agreement.

These are rational goals, but they are inconsistent with the more liberal policies of the Central Valley Project Improvement Act, which expressly authorizes the transfer and use of CVP water beyond the boundaries of the project. Indeed, the purpose of this expansion of the authorized place-of-use was "to assist California urban areas, agricultural water users, and others in meeting their future water needs," by

[86] Ten of the 11 acknowledged banks—which vary widely in capacity—are operated by: North Kern Water Storage District, Rosedale-Rio Bravo Water Storage District, Semitropic Water Storage District, Tulare Lake Basin Water Storage District, Cawelo Water District, Lakeside Irrigation District, Kaweah Delta Water Conservation District, Kern Water Bank Authority, Meyers Farms Family Trust, and the West Kern Water District Groundwater Bank. (USBR 2019) The eleventh, the Pixley Water Bank Project, never became operational.

allowing them to use acquired CVP supplies "for project purposes *or for any purpose recognized as beneficial under applicable State law*." (CVPIA § 3405(a) (emphasis added))

Groundwater banking serves an array of purposes, including augmenting storage, recharging depleted aquifers, aiding SGMA compliance, minimizing overdraft and well interference, and enhancing the flexibility of overall water management through conjunctive use and exchange agreements (Hanak et al. 2018; Ayres et al. 2021). Yet the Bureau has declared that the "water transfer provisions of [the Act] do not apply to . . . water banking and recharge actions outside of the contractor's boundaries [or to] water for water exchanges." (USBR 2015) This effectively restricts the potential benefits gained from groundwater banking and exchanges of project water by ignoring the geographically broader scope of the CVPIA.

The Bureau's revised guidelines do not explain this disconnect between its water transfer policies and its groundwater banking rules. A more expansive policy for underground storage, recovery, and exchange, however, would allow CVP contractors to take advantage of existing groundwater banks that lie outside the boundaries of the project. Consistent with policies of the CVPIA, it also would share the benefits of conjunctive management of CVP supplies to users throughout California.

The SWP Water Management Amendment

DWR also has broadened its water transfer rules by adding a "Water Management Amendment" to the SWP contracts.[87] This amendment, which has been accepted by most of the SWP contractors, authorizes long-term transfers between project contractors, as well as transfers from storage (DWR 2020a).

For the past several decades, DWR has allowed transfers between SWP contractors, but only for terms of one year or less.[88] It also has operated a "Turn-Back Water Pool," which permits a contractor to sell a portion of its SWP "Table A allocation" that it will not use in a single water year.[89] In both cases, the price of the transferred water must be approved by DWR (DWR 2020b).[90]

The Water Management Amendment expands SWP water transfer policies in several important ways:

- Contractors may transfer water on a short-term or long-term basis, up to the terms of their existing SWP contracts.
- DWR will no longer set the price for water transfers, and the parties to the transfer may negotiate price and other terms.

[87] DWR published a final EIR on the Water Management Amendment in August 2020 (DWR 2020d).

[88] Article 53 of the SWP contracts, added as part of the 1994 Monterey Agreement, authorized several agricultural contractors to permanently reduce and transfer up to an aggregate total of 130,000 acre-feet of their annual project water allocations. This article applies only to six specific contractors—Kings County, the Dudley Ridge Water District, Empire West Side Irrigation District, the Kern County Water Agency, Oak Flat Water District, and the Tulare Lake Basin Water Storage District—and does not allow term-limited transfers of project water (MWD 2005).

[89] The SWP Table A allocation is the quantity of project water that DWR supplies each year to each of its 29 contractors, based on the allocations set forth in their respective contracts. Although maximum Table A allocations are fixed in the contracts, actual annual Table A deliveries vary widely based on hydrologic conditions and the limitations contained in DWR's water rights permits for the project. The SWP contracts also recognize "carryover" rights. "Carryover water" is a portion of each contractor's annual Table A allocation that it may save (or carryover) for delivery in the following year. "When contractors request carryover for next year's delivery, that water is stored in the SWP's share of San Luis Reservoir. . . However, storing carryover water in San Luis reservoir has a low operating priority and so brings a risk. SWP contractors can lose this stored carryover water when San Luis Reservoir fills." (Osario 2020)

[90] The price of water from the Turn-Back Water Pool is either 50 percent or 25 percent of the Delta Water Rate for the year in which the Table A water is transferred. The rate varies depending on the timing of the transfer (DWR 2020b, 2020c). SWP contractors have described this as "pennies on the dollar" relative to their costs for SWP water.

- Contractors can transfer up to 50 percent of their carryover water stored in San Luis Reservoir, although the term of these transfers may not exceed one year.
- DWR also will allow SWP contractors to enter into long-term exchange agreements—including dry-year option agreements—for the exchange of San Luis carryover storage. These exchanges are limited, however, to 50 percent of the contractors' carryover storage in a single year (DWR 2020c).[91]

In addition, DWR has discretion to approve the transfer of a portion of a SWP contractor's "Article 21 water" to another contractor "where there is a special need for the water."[92] The amendment does not define "special need," but it does require DWR to prepare criteria to guide its review of transfers of Article 21 water. These criteria will be especially important as there have been several recent challenges to proposed transfers and exchanges of SWP water on the ground that they violate Article 21 (DWR 2020c).[93]

Transfers and exchanges of project water will be scheduled in accordance with existing SWP priorities, and the amendment stipulates that deliveries of this water "cannot impact" other contractors (DWR 2020c).[94] DWR believes that the amendment will "provide a more resilient SWP water portfolio for the [contractors] to meet . . . changing needs." (DWR 2020a)

If adopted, the Water Management Amendment should improve SWP water transfer policies by bringing them more into line with California's general policies encouraging water trading. The amendment recognizes that long-term transfers—as well as multi-year exchanges and dry-year option agreements—can diversify regional water portfolios, increase the long-term efficiency of water use and water allocation, and move vital supplies more quickly during periods of drought. The amendment also allows market incentives to drive the transfer process by permitting the parties to the negotiations (rather than DWR) to set the price of the transferred water.

In addition, the transferability of carryover storage is likely to reduce spillage (and hence potential waste) of water stored in San Luis Reservoir, because SWP contractors will be able to transfer some of the stored water to other contractors—either for direct use or local groundwater storage.

Finally, as shown in Box 10, the amendment may help to facilitate the creation of multi-benefit transfers and exchanges that provide a supplemental source of income for sellers, more reliable supplies for buyers,

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[91] DWR has explained that these exchanges do not have to involve the same amount of water. For example, a contractor could agree to transfer two units of carryover storage in wet years in exchange for one unit of the other contractor's carryover storage in dry years. The authorized exchange ratio, however, could not exceed 5:1 (DWR 2020c).

[92] The Water Management Amendment authorizes four contractors—the Tulare Lake Basin Water Storage District, Empire Westside Irrigation District, Oak Flat Water District, and Kings County—to transfer a portion of their Article 21 water to other SWP contractors (DWR 2020b). This category of project water, which takes its name from Article 21 of the SWP contracts, allows the contractors "to take deliveries above approved and scheduled Table A amounts" when surplus water is available. This "unscheduled" or "interruptible" supply is usually available only in wet years (Osario 2020).

[93] The Kern Fan Groundwater Storage Project, proposed by the Rosedale-Rio Bravo Water Storage District and the Irvine Ranch Water District, is an example. The project would create a regional water bank to store up to 100,000 acre-feet of Article 21 water in the aquifer beneath the lower Kern River delta. Rosedale-Rio Bravo then would be able to withdraw the stored water during drier years for use in their respective service areas. In addition, 25 percent of the stored water would be assigned to an "ecosystem account" managed by DWR. In drier years, DWR could draw on this water to meet its Table A contract obligations, while reserving an equivalent amount in Oroville Reservoir to provide short-term ecosystem pulse flows (California Water Commission 2021). "The ecosystem account was a major factor in helping the $171-million Kern Fan project secure more than $67 million in public funding from Proposition 1, which was passed by voters in 2014." (Henry 2021)
The City of Bakersfield and the Kern County Water Agency have filed litigation to challenge the EIR for the project. Included among many claims is KCWA's allegation that the Article 21 water stored in the groundwater bank should be allocated to it and other SWP contractors (Henry 2021). The litigation is ongoing.

[94] Article 12(f) of the existing SWP contracts establishes the following priorities for the delivery of project water: (1) project water to meet scheduled deliveries of the contractors' annual entitlements; (2) interruptible water to the extent that annual entitlements for that year are not met by the first priority; (3) project water to fulfill delayed deliveries; (4) previously stored project water; (5) non-project water to fulfill annual entitlements not met by the first two priorities; (6) additional interruptible water in excess annual entitlements; (7) additional non-project water in excess of annual entitlements (MWD 2005).

augmented flows for fish, flexibility in complying with regulatory standards, *and* additional water for groundwater storage and recharge.[95]

Box 10: The Chino Basin Program

The Chino Basin Program illustrates the multiple benefits that can be obtained through transfers, exchanges, and conjunctive management of State Water Project supplies.

The Inland Empire Utilities Agency (IEUA) supplies water to 875,000 residents in western San Bernardino County. Its water portfolio includes native groundwater, recycled water, and stormwater that it treats and stores in the Chino Basin, as well as SWP water that it imports through the Metropolitan Water District. The SWP water accounts for about 25 percent of IEUA's overall supplies (IEUA 2020).

In 2018, the California Water Commission made a conditional $207 million grant of Proposition 1 funds to IEUA for construction of an advanced water treatment plant as part of the agency's Chino Basin Program. The new facility will treat and store up to 15,000 afa, which will augment the agency's local water supplies and reduce salinity in the Chino Basin aquifer (IEUA 2020).

To comply with Proposition 1 grant requirements, the program also includes an environmental water component. Once the plant becomes operational, the recycled water will reduce IEUA's reliance on the SWP water that it imports via MWD. This in turn will allow MWD to reduce its SWP demands, which will free up water in Oroville Reservoir that can be released to provide spring pulse flows in the Feather and Sacramento rivers for Chinook salmon and other fish. IEUA estimates that the Chino Basin Program will provide up to 50,000 acre-feet for pulse flows during dry years (IEUA 2018, 2020).

"The proposed water exchange [is] the first of its kind and the first recycled-water project dedicated to tangibly benefitting Northern California ecosystems." (Braxton Little 2019) It also serves as a model for other creative transfers and exchanges of project water that can improve water use efficiency, enhance water quality, promote flexible allocation among project users, and assist with SGMA implementation and compliance.

Note: Proposition 1, formally known as the Water Quality, Supply, and Infrastructure Improvement Act of 2014, authorized $7.5 billion in general obligation bonds to fund ecosystem protection, watershed restoration, and water supply infrastructure projects—including drinking water improvements and surface and groundwater storage.

Delta Carriage Water Requirements

Transfers of water through the Delta may affect concentrations of salinity at various locations by altering the flow of freshwater into the Delta from the Sacramento River and by changing the timing and volume of CVP and SWP pumping as needed to facilitate the transfer. These water quality and flow changes can

[95] For a more detailed analysis of the scope and potential benefits of these types of partnerships, see Escriva-Bou et al. (2021).

affect the projects' compliance with water quality criteria established under state and federal law and with state and federal endangered species requirements (Gartrell and Gray 2017).

To mitigate the potential effects of through-Delta transfers, the CVP and SWP impose a "carriage water" requirement on all transfers that use project facilities (including the Delta Cross-Channel, the Contra Costa Canal intake, and the south Delta pumps).

Carriage water is the additional water needed for Delta outflow to compensate for the additional exports made on behalf of a transfer to assure compliance with the water quality requirements of the SWP and CVP. . . . In practice, carriage water is assessed by dedicating a portion of the transfer water as Delta outflow to keep Delta salinity at the same level as it would have been in the baseline (or without-transfer) conditions. . . . Since 2008, carriage water has varied between 20 and 35 percent of the transfer amount depending upon hydrology and other operational parameters. (Fock 2019)

The carriage water requirement applies only to water transfers from the Sacramento River basin, although the projects "currently assess a conveyance loss of 10 percent" on transfers of San Joaquin River water (Fock 2019).

While there is a valid hydrologic basis for a Delta carriage water charge, some water users have criticized the projects for failing to explain how they set the 20-35 percent dedication requirement for individual transfers. For example, the Association of California Water Agencies (ACWA) has called on the projects to provide "a transparent discussion [of] the components of Delta carriage losses and how they are computed and applied to water transfers." (ACWA 2016)

In response, DWR's State Water Project Analysis Office has drafted an overview of the CVP and SWP carriage water methodology, explaining that they take a three-step approach. First, DWR uses a Delta simulation model (DSM-2) to develop a "carriage water estimate" of the amount of water potentially transferred through the Delta "with an assumed pattern, forecasted hydrology, and forecasted operations." The projects then apply this estimate to "all transfers during the entire transfer period to negate temporal disparities of daily transfer amounts, avoid any priority conflicts, and address the effects of the antecedent water quality conditions to compliance concerns." Second, the projects monitor Delta salinity levels during the transfer period and are prepared "to implement proper mitigation measures or suspend the water transfer if [it] results in an incremental impact to water levels and/or water quality." Third, recognizing that the actual quantity of carriage water needed to mitigate the costs to the projects may differ from the pre-transfer estimate, DWR develops a "final carriage water value." (Fock 2019)

This overview provides useful information about the details of the carriage water calculation, but it does not adequately tailor the Delta carriage water requirements to individual transfers. Although the accounting procedures require DWR to prepare a "final carriage water value" for each individual transfer, many transfers are charged based on the original estimated carriage water determination, rather than the final adjusted value.

For SWP contractors, if the final carriage water value is higher than the estimated charge, "DWR reduces the buyer's Table A carryover amount to compensate for the adjustment." If the final value is lower than the estimate, DWR increases the purchaser's Table A carryover amount. In both cases, "there is no change to the actual overall quantity of water delivery for that year." (Fock 2019)

For non-SWP contractors, however, "the process is more complicated and not as flexible." As the SWP Analysis Office has explained:

There is no means for reclassifying the transfer water . . . should the final carriage water value differ from the estimated value. Therefore, the estimated carriage water is defined as a fixed value in the conveyance agreement. The lack of reclassification is a result of the fact, that should the final carriage water be lower than the estimated carriage water, there is no simple way to return the water to the buyer. Likewise, should the final carriage water be higher than the pre-transfer estimation, there is no simple way for the buyer to return the water to DWR. (Fock 2019)

This policy is difficult to justify, because it treats SWP and non-SWP transfers unequally and there is a ready means by which the projects could avoid disparate treatment of SWP and CVP contractors. The Coordinated Operation Agreement authorizes the projects to coordinate project operations for water supply (including Delta pumping and conveyance) and for compliance with Delta water quality standards and other regulatory requirements. This includes authority to adopt coordinated accounting standards for carriage water adjustments (USBR and DWR 1986, 2018).

Thus, for through-Delta transfers of CVP water that use SWP facilities, the projects could agree to adjust CVP storage rights in San Luis Reservoir to account for the differences between estimated and final carriage water requirements. The Bureau could then adjust the carryover storage rights of the CVP contractor that purchased the transferred water—just as DWR adjusts the Table A carryover amounts of its own contractors as described above. Moreover, the projects could use a similar accounting methodology for transfers involving non-project water. For example, if the Yuba Water Agency transfers water to the Westlands Water District (a CVP contractor) or the Kern County Water Agency (a SWP contractor) via the California Aqueduct, the projects could adjust the purchaser's carryover rights in San Luis Reservoir to account for the difference between estimated and actual carriage water.

The existing policy of basing carriage water charges for non-SWP transfers on preliminary modeling estimates—rather than on adjusted values determined by hydrologic conditions during the actual transfers—is problematic. Accounting procedures exist to tailor the final charges to the circumstances of the individual transfers. In the absence of such an accounting, there is a risk that the carriage water requirements will be viewed as a tax, rather than as appropriate mitigation for the regulatory and operational costs to the project for facilitating the transfer. Indeed, the projects' assessment of a 10 percent charge on transfers of water from the San Joaquin River system—despite their acknowledgement that "exporting transfer water originating from the San Joaquin River does not affect salinity" at the three primary monitoring stations (Fock 2019)—is evidence of this risk.

Part Four: Diversions of High Flows for Groundwater Recharge and Restrictions on Delta Exports

This final part reviews two state policies that may affect the use of surface water for groundwater recharge. The first is the State Water Board's new streamlined permitting guidelines for the diversion of

high flows to underground storage. A principal purpose of the guidelines is to aid SGMA implementation by augmenting existing groundwater recharge programs with surface water that is not otherwise available for appropriation (Hanak et al. 2018).

The second is the Delta Stewardship Council's policy of reducing reliance on the waters of the Sacramento–San Joaquin River Delta. Although its purposes are to protect the resources of the Delta and to promote regional self-reliance, the policy could limit some beneficial inter-basin transfers as well as high-flow diversions earmarked for groundwater recharge and banking in the San Joaquin and Tulare basins (Ayres et al. 2021).

Streamlined Permitting for Groundwater Recharge

In 2019, the State Water Board created streamlined permitting guidelines for the diversion of high-water flows for groundwater recharge. As the board explained:

Groundwater recharge is likely to be an important part of achieving sustainability in groundwater basins, but local agencies may lack the water rights to divert and use that water later. The streamlined permitting process for diversion of high flows to underground storage was developed, in part, to assist local agencies to obtain necessary water rights. Those water rights will, in turn, help Groundwater Sustainability Agencies . . . reach their sustainability goals more quickly. (SWRCB 2019b)

The new permitting option applies both to projects that divert and store water within the same basin and to projects that divert water for export to another basin. The program will be especially important for inter-basin projects, because most of the available flood flows are in the Sacramento and San Joaquin River basins, while most of the critically overdrafted groundwater basins and existing groundwater banks are located in the Tulare Basin (Escriva-Bou 2018).

Under the new program, the board may grant permits for the diversion of specified high flows for underground storage and subsequent beneficial use. Applications that meet a variety of criteria are eligible for expedited review and permitting. These criteria include identification of the point-of-diversion and location of underground storage, as well as completion of environmental analyses required by CEQA. Applications by GSAs and other local groundwater management agencies with authority to implement SGMA are granted a preference (SWRCB 2019b).

The streamlined permits are available only for "high-flow events," which the guidelines define as:

- Diversions when "streamflow at the point of diversion is above the 90th percentile, calculated on a daily basis from the gage data during the period-of-record," if the "diversion rate is limited to 20% of the total streamflow"; and
- "Diversions only when flows in the source waterbody at or near the point of diversion exceed thresholds that trigger flood control actions necessary to mitigate threats to human health or safety, according to established written flood management protocols adopted by a flood control agency." (SWRCB 2019b)

These criteria are important for two reasons. First, they protect existing legal water users by limiting streamlined diversions to water that has not previously been appropriated by existing water right holders.

Second, they protect water quality, fish and wildlife, and other *in situ* uses by ensuring that the new diversions do not unduly diminish the ecological services provided by seasonal high flows.[96]

Although applications that fail to meet these criteria may remain eligible to divert high-water flows, "these criteria describe applications that are likely to avoid delays in the permitting process." Indeed, compliance with the criteria is especially important because the "criteria and analyses will ensure applications are unlikely to injure other legal users, adversely affect fishery resources, or other public trust resources." (SWRCB 2019b)[97]

The State Water Board has determined that "groundwater recharge is not a beneficial use of water on its own, but rather is one method of diverting and storing water that takes advantage of the natural storage capacity of groundwater aquifers. To obtain a water right to divert water to underground storage, [the applicant] must identify the eventual beneficial use of the water just as with above-ground surface water storage projects." (SWRCB 2020) This limitation is required by statutory law, which provides that the underground storage of surface water is a beneficial use "if the water so stored is thereafter applied to the beneficial purposes for which the appropriation for storage was made." (Water Code § 1242)

Nevertheless, the board has broadly defined beneficial use in this context. The term includes the panoply of long-recognized beneficial uses for water that is withdrawn from storage, "including irrigation, municipal and domestic supplies, and industrial purposes." But is also encompasses a variety of *in situ* beneficial uses from the underground storage itself. "Examples of non-extractive beneficial uses include use as a seawater intrusion barrier, for prevention of subsidence, or to support groundwater-dependent ecosystems." Indeed, the board has encouraged GSAs and other local agencies to develop underground storage projects using high-flow diversions to address the six "undesirable results" from groundwater overdraft as defined by SGMA (SWRCB 2020; Water Code § 10721(x)).

The State Water Board's streamlined permitting guidelines build on 2019 legislation, AB 658, which authorized it to issue temporary permits to GSAs and other local water management agencies to divert surface water to underground storage "for beneficial use that advances the sustainability goal of a groundwater basin." (Water Code § 1433.1(a)) Before the board may grant a temporary permit under this program, it must determine that the water "may be diverted and used without injury to any lawful user of water, including the user's ability to meet water quality objectives." (Water Code § 1433.1(b)(2)(A))[98] It also must ensure that the storage of water in, and withdrawal of water from, the groundwater basin will not injure other legal users of water (Water Code § 1433.1(b)(2)(B)).[99] The board may issue temporary permits for underground storage for terms of up to five years (Water Code § 1433.5).[100]

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[96]Seasonal flooding serves a variety of ecological functions, including moving sediment, flushing pollutants, cleansing habitat, cycling nutrients, cueing species migration, and freshening the estuary in a manner that resembles the conditions under which native fish species evolved before significant human alteration of the ecosystem (Yarnell et al. 2015).

[97] For a more thorough analysis of the streamlined permitting guidelines, see Fritz and Green Nylen (2020a, 2020b).

[98] The statute requires the board to make two specific findings: (1) "Flow in the source waterbody exceeds the claims of all known legal users who divert water downstream of the proposed point of diversion"; and (2) "Unregulated flow in the source waterbody will be sufficient below the proposed point of diversion to meet instream flow requirements and water quality objectives." (Water Code § 1433.1(b)(2)(A))

[99] To fulfill this criterion, the permittee must be able to account for the storage and extraction of water from the groundwater basin, either through its GSP or by adopting other acceptable accounting and reporting procedures (Water Code § 1433.1(b)(2)(B)).

[100] AB 658 also empowered the board to make temporary changes to existing permits and licenses held by GSAs and other local water agencies to authorize temporary diversions for underground storage (Water Code § 1443.1(a)). The diversion rights created by these temporary change orders also have a maximum term of five years (Water Code § 1443.5)

AB 658 also added several provisions to the board's general authority to issue temporary urgency permits. These permits, which include diversions to underground storage, have maximum terms of 180 days. The board may grant temporary urgency permits only if it concludes that the "proposed temporary diversion and use is necessary to further the constitutional policy that the water resources of the state be put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented." (Water Code § 1425(c))[101] These short-term permits "work well for pilot projects, or when applicants need to get a diversion authorized quickly, as these permits can be issued faster than other types of permits." (Maven 2020b)

Although the temporary permits and change orders authorized by AB 658 are valuable, the best means of harvesting high-water flows to serve California's important interests in groundwater recharge and sustainable groundwater management is to recognize long-term rights to divert and store water during these high-flow events. Only long-term rights—with identified and enforceable priorities to divert the available high flows—can provide the security needed to encourage and protect investments in new conveyance infrastructure and recharge facilities.[102]

The State Water Board's groundwater recharge permitting program is in its early stages, and many questions of flow measurement, diversion capabilities, transportation infrastructure, and recharge processes remain unanswered. Some of these questions will be addressed by DWR's Flood-MAR Research and Data Development Plan described in Box 11. Others will depend on cooperation among the myriad parties interested in—and potentially affected by—high-flow diversions and groundwater recharge. The most contentious questions may include:

- Is the State Water Board's 90th percentile threshold for high-flow diversions sufficiently protective of the senior rights of downstream water users?
- Do the 90th percentile threshold and 20 percent diversion limitation adequately ensure that the diversions do not diminish vital ecological services that high flows provide to the river systems from which the waters are diverted?
- Does the board's definition of permissible beneficial uses of stored waters—which includes non-extractive uses such as prevention of saltwater intrusion barrier, prevention of subsidence, and support of groundwater-dependent ecosystems—exceed its statutory authority under Water Code § 1242?
- Conversely, should the definition of beneficial uses in this context go even further and recognize groundwater recharge itself as a beneficial use, regardless of whether it addresses one or more of the undesirable results identified in the groundwater sustainability plan?

The board is likely to refine its groundwater recharge permitting rules as it gains more information from permit applications, project design and performance, and monitoring of the hydrologic data that underpins

[101] The board also must determine that the temporary diversion and use will not injure any other legal water user or have unreasonable effects on fish, wildlife, or other instream beneficial uses. (Water Code § 1425(b)).

[102] As State Water Board staff have explained: "Neither the 180-day nor the 5-year temporary permit is meant to be a solution for groundwater sustainability agencies looking to have a long-term water supply to supplement their basin. The long-term pathway is the standard permit, which is a permanent authorization. A standard permit has a huge benefit over a temporary permit in that it secures a permanent priority date over other projects that come after it." (Maven 2020c)

the high-water diversion program. This information will help the board address the first two questions, which entail mixed questions of science and law.[103]

In contrast, the last two questions—which focus on the definition of groundwater recharge as a beneficial use—are less fact-dependent, and legislative guidance may be needed. The questions are important, because uncertainty whether high-flow diversions for groundwater storage will be recognized as serving lawful beneficial uses can deter investments in necessary diversion, transportation, and recharge infrastructure and potentially impair efforts to implement and comply with SGMA (Weiser 2018).[104]

Box 11: Flood-MAR Planning

In 2019, DWR published a Flood-MAR Research and Data Development Plan to identify "the priority information needed by those making management decisions about the where, when, and how of capturing available flood water to replenish California's depleted aquifers." The plan defines Flood-MAR as "an integrated and voluntary resource management strategy that uses floodwater resulting from, or in anticipation of, rainfall or snowmelt for managed aquifer recharge (MAR) on agricultural lands, working landscapes, and managed natural landscapes, including refuges, floodplains, and flood bypasses." It also notes that Flood-MAR "can be implemented at multiple scales, from individual landowners diverting flood water with existing infrastructure, to using extensive detention/recharge areas and modernizing flood management infrastructure/operations." (DWR 2019)

[103] For a detailed analysis of the delineation between high-water flows and "normal" river flows, see Kocis and Dahlke (2017). The report focused on "high-magnitude streamflow—i.e., flow above the 90th percentile, that exceeds environmental flow requirements and current surface water allocations under California water rights. The study included a "comprehensive analysis of the magnitude, frequency, duration and timing of high-magnitude streamflow (HMF) for 93 stream gauges covering the Sacramento, San Joaquin and Tulare basins in California." The data showed that "high-magnitude flow occurs, on average, during 7 and 4.7 out of 10 years in the Sacramento River and the San Joaquin-Tulare Basins, respectively, from just a few storm events (5–7 1-day peak events) lasting for 25–30 days between November and April." According to the authors, "the results suggest that there is sufficient unmanaged surface water physically available to mitigate long-term groundwater overdraft in the Central Valley." (Kocis and Dahlke 2017)
A more recent study analyzed the projected effects of climate change on inter-basin Flood-MAR programs in California. The authors conclude that "a warming climate will likely exacerbate existing regional differences in water availability by elevating WAFR [water available for recharge] in Northern California and decreasing it in Southern California. Elevated regional differences in WAFR are likely to place increased burdens on California's already taxed water infrastructure systems." (He et al. 2021)

[104] For an illuminating analysis of the relationship between Water Code § 1242 and SGMA, see Miller et al. (2018). Contrasting opinions on the desirability of defining "beneficial use" to include groundwater storage that addresses at least some of some of SGMA's "undesirable results" may be found in Weiser (2018) (interview with Erik Ekdahl) and Miller (2019).

DWR has acknowledged that there remain a variety of potential barriers to high flow capture and storage. These include technical and hydrologic questions—such as forecasting of flood conditions and measurement of flows, management of infrastructure for conveyance and recharge, and assessment of the effects of high-flow diversions on water quality in the source river system and groundwater quality in the receiving water basin (DWR 2019).

Some of the plan's recommendations dovetail with themes in the main report and this appendix. These include programmatic analysis of common questions relating to hydrology, water quality, cropping patterns, and aquifer characterization that can be used as a foundation for analysis and permitting of individual high-water diversion and recharge proposals. The report also calls for "improved statewide water accounting to support the kinds of agreements and incentives needed for Flood-MAR, SGMA-related water plans, water markets, and enforcement of surface water rights." In addition, it recommends that analysis of potential recharge areas give special attention to those that would benefit surface water habitat and groundwater-dependent ecosystems, as well those that are home to shallow domestic wells and groundwater-reliant disadvantaged communities (DWR 2019).

DWR also notes that several legal and institutional issues are likely to arise both under Flood-MAR and in the State Water Board's evaluation of individual permit requests, ranging from fragmented decision-making to uncertainty over water rights. The plan then identifies several "priority actions" to address these potential pitfalls. These include:

- Coordination and enhanced communication among GSAs and land use planning agencies, including consistency of data reporting and analysis.
- Decision-making tools to address water quality issues associated with Flood-MAR projects.
- Modeling of groundwater rights and surface and subsurface water transactions to enable better analysis of the benefits and costs of Flood-MAR projects.
- Guidance for high-water diversion permit applicants who request inclusion of "other" beneficial uses for non-extractive purposes of use related to the SGMA.
- Coordination of federal, state, and local environmental rules to facilitate implementation of Flood-MAR (DWR 2019).

When completed, these guidance documents should help to identify the most promising opportunities for diversion of high-water flows. They also will inform and expedite the State Water Board's analysis of individual high-flow and groundwater recharge permit applications (SWRCB 2021b).

Several recent reports evaluate the opportunities for, and constraints on, managed aquifer recharge programs in the San Joaquin Valley. These include analysis of the potential hydrologic and economic benefits of Flood-MAR in the Kings Groundwater Basin (Reznik et al. 2021) and a broader study of climate change uncertainties and infrastructure limitations on inter-basin transfers of water for aquifer recharge (He et al. 2021). Two other recent papers analyze the range of potential benefits and costs of Flood-MAR projects across groundwater basins. Because "it can be difficult for regulators to establish an 'optimal' allocation of flood-MAR," the authors recommend that the state auction diversion permits (Bruno, Ayres, and Asinas 2019; Ayres 2020).

Delta Plan Water Transfer Restrictions

In the Delta Reform Act of 2009, the California Legislature declared that it is the state's policy "to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency." It then mandated that "each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts." (Water Code § 85021) The Delta Stewardship Council, the agency with responsibility for implementing the Act, has explained that this directive is essential to the achievement of the legislature's co-equal goals of "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." (Water Code § 85054; DSC 2013)

As part of the Delta Plan, originally adopted in 2013 and revised most recently in 2019, the Delta Stewardship Council has articulated a regulatory policy to "reduce reliance on the Delta through improved regional water self-reliance." This policy, also known as WR-P1, states that "water shall not be exported from, transferred through, or used in the Delta," if all of the following apply:

1. One or more water suppliers that would receive water as a result of the export, transfer or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance . . . ;
2. That failure has significantly caused the need for the export, transfer, or use; and
3. The export, transfer, or use would have a significant adverse environmental impact in the Delta. (DSC 2013)[105]

If a "covered action" fails to meet these criteria, the Delta Stewardship Council cannot certify it for consistency with the Delta Plan. Diversions of water from the Delta, and transfers that move water through the Delta, are covered actions that require certification from the council.[106]

WR-P1 serves the important state interest in fulfilling the co-equal goals of the Delta Reform Act by reducing long-term reliance on the Delta—thereby enhancing the Delta ecosystem—and by promoting regional water portfolios—thus strengthening water supply reliability. There is a risk, however, that this regulatory policy could be applied to block high-flow diversions (and perhaps some inter-basin transfers of surface water) that neither pose risks to the Delta ecosystem nor perpetuate long-term reliance on the waters of the Delta.

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[105] To comply with the first criterion, the water supplier must have an approved urban or agricultural water management plan that creates locally cost-effective and technically feasible programs that reduce reliance on the Delta and that identifies "the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance." The Delta Stewardship Council defines this as "the reduction in the amount of water used, or in the percentage of water used from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code Section 1011(a)." (DSC 2013)

[106] The Delta Reform Act defines "covered action" as a "plan, program, or project . . . that meets all of the following conditions:
(1) Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh.
(2) Will be carried out, approved, or funded by the state or a local public agency.
(3) Is covered by one or more provisions of the Delta Plan.
(4) Will have a significant impact on achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta." (Water Code § 85057.5)
The Delta Stewardship Council has stated that the types of transfers described in the text are "covered actions" within the terms of the statute (DSC 2013).

As described above, SGMA requires GSAs to achieve sustainable groundwater management and use—over a 20-year planning and implementation period—through a combination of demand reduction, land use changes, conjunctive use, and (where feasible) supply augmentation. In turn, SGMA's directives were a principal reason behind the State Water Board's creation of a permitting program for the diversion and underground storage of high-water flows. The board recognized that, under appropriate conditions, the importation of floodwaters can help GSAs recharge depleted aquifers and bring long-term groundwater supplies and demands into balance.

A significant percentage of the surface water available for recharge of depleted groundwater basins in the San Joaquin Valley is likely to come from the Sacramento River basin in the form of inter-basin surface water transfers and capture of high-water flows (Escriva-Bou 2018; Hanak et al. 2018, 2019).[107] WR-P1 could impede these types of supply augmentation and conjunctive use programs, however, in cases where a GSA proposing to divert high flows (or to import transferred surface water) for groundwater recharge has not yet improved regional self-reliance—even though SGMA grants the GSA 20 years to achieve sustainable groundwater management.[108]

Moreover, the Delta Stewardship Council has acknowledged that inter-basin transfers of water (at least during wet years) and temporary diversions during high-water conditions are unlikely to create the type of long-term reliance on the Delta that is the focus of the Delta Reform Act and the Delta Plan. For example, in explaining the need to limit exports from the Delta, the plan extensively analyzes the effects of water development and the exercise of water rights on the Delta ecosystem. But it also states that one of the keys to achieving the co-equal goals of the Act "is to harvest and store the water that is available from Central Valley rivers in the wettest years, at the least environmental cost." It also notes that "much more water storage space exists right under our feet in groundwater basins, or aquifers," and it "calls for a rededication to the conservative idea of using aquifers like bank accounts to be filled up in wet times, in order that they may be drawn from in dry." (DSC 2019)

Clarification of the applicability of WR-P1 to these types of programs will be essential to the achievement of SGMA's sustainability mandate.[109]

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[107] During wet years, high-water flows in the Sacramento River basin average 2.68 million acre-feet from November through April and 1.3 million acre-feet in the San Joaquin River basin (Kocis and Dahlke 2017). Excess SWP and CVP supplies diverted from the Delta recharged San Joaquin Valley aquifers in 2016-17 (a wet year that followed the 2012-16 drought), and "there is high demand for Delta imports to help redress problems of overdraft in the valley. How much additional Sacramento River water can be harnessed in this region will depend on system capacity issues—including the ability to take water from the Delta in 'big gulps' when large excess Sacramento River flows are available—as well as regulatory issues governing Delta outflows and pumping." (Hanak et al. 2018)

[108] During interviews conducted for the main report, Delta Stewardship Council staff confirmed that WR-P1 does apply to diversions of high-water flows by projects that operate within the Delta, including those that use CVP or SWP facilities to transport water through, or pump water from, the Delta. As shown in the text above, WR-P1 expressly applies to inter-basin transfers of surface water (DSC 2013).

[109] Four questions about the applicability of WR-P1 to through-Delta transfers and high-flow diversions are especially pertinent:

(1) How should progress in implementing groundwater sustainability plans influence the council's decision whether a GSA has "improved regional self-reliance" under WR-P1?

(2) Under what circumstances should lack of progress bar through-Delta transfers and diversions of floodwaters?

(3) How should the State Water Board's decision to approve a transfer, or to grant a permit for diversion and underground storage of floodwaters, affect the council's determination whether the "export, transfer, or use would have a significant adverse environmental impact in the Delta"?

(4) Do the board's threshold criteria—streamflow at the point-of-diversion must be above the 90th percentile, with diversions limited to 20% of the total streamflow—adequately protect beneficial uses within the Delta, including ecological services from flood flows? Or should the council and the board set different criteria to ensure protection of the Delta?

Resolution of these questions should be made in light of the constitutional directive that "the water resources of the State be put to beneficial use to the fullest extent of which they are capable." (California Constitution, art. X, § 2)

Conclusion

As the foregoing indicates, there is a vast and diverse array of legal and policy questions that will affect GSA efforts to establish groundwater markets and to comply more generally with SGMA's sustainability mandate. Clarification of rights, integrated surface water and groundwater management, assurances for third parties, and efficient deployment of California's available water resources will be key features of this work.

More specific answers to these questions are best addressed in the context of the broader policy analysis of the main report, and they appear throughout that document. As noted at the outset, the purpose of this Appendix has been to provide detailed background information to support that analysis and the policy recommendations that flow from it.

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