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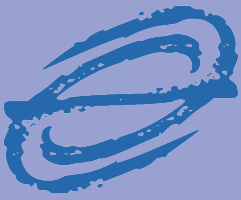
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Allocating Under Water: Reforming California's Groundwater Adjudications

By M. Rhead Enion

Executive Summary

Overdraft of groundwater basins threatens the reliability of California's future water supply. California leads the nation in groundwater extraction.¹ On an average year, groundwater makes up thirty percent of California's total water supply.² Cities throughout the Central Valley, including Fresno, rely exclusively on groundwater.³

At the same time, California's dysfunctional water law has made regulation of groundwater use difficult. Each overlying landowner has the right to share in that scarce resource for a given groundwater basin in California. More so than with surface water, it is difficult for the right holders to self-regulate groundwater use. Withdrawals from the basin occur out-of-view, and underground water levels are typically unseen and unknown. This mix of easy public access; limited oversight; and gradual, unseen consequences sets up a classic tragedy of the commons.

California, unlike other western states, lacks a statewide groundwater regulatory regime. Other states, such as Colorado and Arizona, have statewide groundwater management regulations or permit groundwater just as they permit surface water appropriation.⁴ Most western states, but not California, have moved to integrate groundwater and surface water management.⁵ Yet, for antiquated reasons, California law has

long artificially distinguished groundwater from surface water rights, permitting and regulating the latter but not the former.

Absent state regulation and permitting of groundwater rights, the main recourse for disputes over the use of that groundwater in California has been with the courts. Groundwater users in southern California turned to litigation when faced with serious overdraft and potential destruction of groundwater resources. In twenty-two instances to date, litigation over groundwater has resulted in court adjudication of a groundwater basin. These groundwater adjudications have been informed by California's unrealistic distinctions between surface and groundwater rights. Either for strategic reasons or for lack of perceived legal authority, groundwater adjudications tend to ignore interconnected surface water users.

While perhaps the best of a poor set of alternatives, judicial adjudications of groundwater in southern California are hardly a model of water management efficiency. Court adjudications of groundwater basins in California have been time-consuming (some lasting decades) and resource-intensive. The settlement agreements that result are sometimes overly protective of the property interests of a few large water users in the area and do not typically impose aggressive measures to protect the basins

M. Rhead Enion was the Emmett/Frankel Fellow in Environmental Law and Policy at UCLA Law School for 2010-2013. He is grateful to all who reviewed and provided input on earlier drafts of the paper. He would like to thank Cara Horowitz, Andy Sawyer, Harrison "Hap" Dunning and Madelyn Glickfeld for providing invaluable comments on earlier drafts. He would also like to thank Brian Daly for his assistance in researching this topic.

from overdraft. Adjudicatory judgments have often ignored environmental concerns, particularly water quality issues in basins. While successful by some measures, adjudications have not led to the definitive determination of groundwater rights that parties have sought. Nor have adjudications led to the type of efficient exchange of allocations and water rights that one might expect of defined property rights.

This paper unearths the history of groundwater adjudications in California, draws lessons from that history and from California's water rights system, and makes recommendations to improve groundwater management through adjudications.

Recommendations

The overarching goal of the recommendations in this paper is to facilitate the market-based exchange of water rights within an adjudicated basin. To accomplish this goal, I recommend a set of modifications to the management of adjudicated groundwater rights to make it easier to exchange water entitlements and water allocations, mindful of the constitutional restrictions on governmental takings and existing water rights. Some adjudicated basins have already sought amendments to the court judgment to make transfers and water storage easier to accomplish.

I focus on two types of potential reforms. Recommendations described in Part 4.A offer changes that could be implemented through the California legislature or the courts to make litigation over groundwater run more smoothly. Recommendations described in Part 4.B seek to improve the management of adjudicated groundwater basins.

Reforms to improve litigation of groundwater basins (See Part 4.A):

Courts should exercise their equitable power to acquire jurisdiction over users of both groundwater and connected surface water in an adjudication. Courts should require the joinder of relevant surface rights holders in groundwater adjudications in order to fully determine groundwater rights

while also protecting existing surface water rights.

The Legislature should revisit the recommendations for streamlining court adjudications outlined in the Governor's Commission. The 1978 Governor's Commission offered many procedural and substantive improvements to streamline judicial groundwater adjudications that remain worthy of consideration today.

The Legislature should remove all references to "subterranean streams" from the Water Code. The antiquated legal concept of "subterranean stream" is without physical basis. All groundwater should be considered "percolating" under the law.

Establish a state water court. The California legislature should establish a specialized water court, similar to the system used by Colorado, to handle all water litigation, including groundwater adjudications.

Improve the tracking of groundwater use statewide and consolidation of local groundwater data. A state database tracking groundwater use would limit the time spent researching such questions in adjudications.

Reforms to improve management of current and future adjudicated basins (See Part 4.B):

Create entitlement shares to represent each right holder's portion of the groundwater resource. Right holders should each receive entitlement shares, which would represent their right to a portion of the water resources in the basin.

Periodically award allocation shares to entitlement owners. Entitlement holders should receive periodic allocation shares. Each allocation share would represent a portion of the safe yield, distributed in proportion to the number of entitlement shares.

Use extraction rights, tied to the land, to prevent localized harm from excess groundwater production. In order to extract groundwater from land overlying

the basin, the owner of that land must have an extraction right. A watermaster, by regulating extraction rights, could prevent excessive local extraction on a given piece of land.

Account for environmental liabilities before allocating water in the basin.

Environmental water needs should be considered in advance of defining the safe yield and subsequent water allocations. In addition, an environmental entitlement should be used to help protect inflow water use.

Use a storage license to prevent harm to the basin and require those who seek to store water in the basin to convert the right to stored water to basin allocation share.

To protect the basin from improper recharge and storage use, the watermaster should require storage licenses that are functionally similar to the storage agreements required in some adjudications today. When a licensee stores water in the basin, he should receive—in exchange for that stored water—an appropriate number of allocation shares.

Instead of “carry-over” credits in a basin, require periodic retirement of unused allocations.

To improve flexibility and safe yield accounting, allocations shares should gradually expire and carry-over credits should be depreciated.

Increase exchange of water allocations and entitlements.

Watermasters should establish rules for market-based trading of allocation and entitlement shares. Unlike prior attempts at exchange pools, prices for trading should be market-based with only regulatory oversight by the watermaster.

Introduction

California leads the nation in groundwater extraction.⁶ On an average year, groundwater makes up thirty percent of California’s total water supply.⁷ Cities throughout the Central Valley, including Fresno, rely exclusively on groundwater.⁸

California depends on groundwater use and takes advantage of the connection between surface and groundwater for water storage and water transfer. For example, an intricate web of laws, responsibilities, agencies and infrastructure manage much of the water supply for the City of Los Angeles through the use of spreading grounds in the San Gabriel River along with flows from the San Gabriel River through the Whittier Narrows.⁹

Groundwater, however, is a scarce resource. Overdraft of groundwater basins threatens the reliability of California’s future water supply. At the same time, California’s dysfunctional water law has made regulation of groundwater use difficult.

Each overlying landowner has the right to share in that scarce resource for a given groundwater basin in California. More so than with surface water, it is difficult for the right holders to self-regulate groundwater use because withdrawals from the basin occur out-of-view and underground water levels are typically unseen and unknown. This mix of easy public access; limited oversight; and gradual, unseen consequences sets up a classic tragedy of the commons problem.

California has attempted to reform its groundwater management before. Pursuant to an executive order by Governor Jerry Brown, the Governor’s Commission to Review California Water Rights Law issued its final report in 1978.¹⁰ Many of the Commission’s general recommendations and specific legislative initiatives concerned California’s groundwater management and groundwater rights.¹¹ Included in those recommendations were changes “designed to facilitate the adjudicatory process and to ‘reduce the length and cost of adjudications.’”¹² While many of these recommendations remain viable and a few have been indirectly adopted,¹³ the recommendations failed at the legislative level.¹⁴

Absent the political will for state regulation and permitting of groundwater rights, the main recourse for disputes over the use of that groundwater, besides local negotiation, is with the courts. While successful by some measures, court adjudications^a of groundwater have not led to the definitive determination of groundwater rights that parties have sought. Court adjudications of groundwater basins in California have been time-consuming (some lasting decades) and resource-intensive. The settlement agreements that result are sometimes overly protective of the property interests of a few large water users in the area and do not typically impose aggressive measures to protect the basins from overdraft. Adjudicatory judgments have often ignored environmental concerns, particularly water quality issues in basins. Nor have adjudications led to the type of low-transaction-cost exchange of water allocations and water rights that one might expect of defined property rights.

Before describing court adjudications of groundwater in Part 3, it is necessary to first understand the science and law governing groundwater use. (See Parts 1 and 2, respectively.) Groundwater and surface water are typically interconnected, yet California water law often treats the two as distinct and unconnected. Excessive groundwater withdrawal harms the state's water resources, as well as basin water users and connected surface water users,

^a Unless otherwise specified, this paper uses "adjudication" to refer to judicial, not statutory, adjudication. Reform of statutory adjudications is beyond the scope of this paper.

yet California has left groundwater mostly unregulated. Unsurprisingly, groundwater users facing such harms from overdraft of a basin have sometimes turned to the courts for equitable relief.

After Part 3 describes the role of the courts in adjudicating groundwater in California, Part 4 turns to potential reforms to California's groundwater adjudications. While judicial adjudications are far from an ideal system of water management, adjudications may be the best of relatively few alternatives given California's stubborn inability to adequately regulate groundwater use.¹⁵ Adjudications are the closest that California has come to defining individual rights and imposing extraction limits on groundwater basins. Adjudications can consider the rights of surface and groundwater users simultaneously when necessary. And the combination of population growth, development, and climate change impacts threatens to put more pressure on California's groundwater basins, making future adjudications more likely.

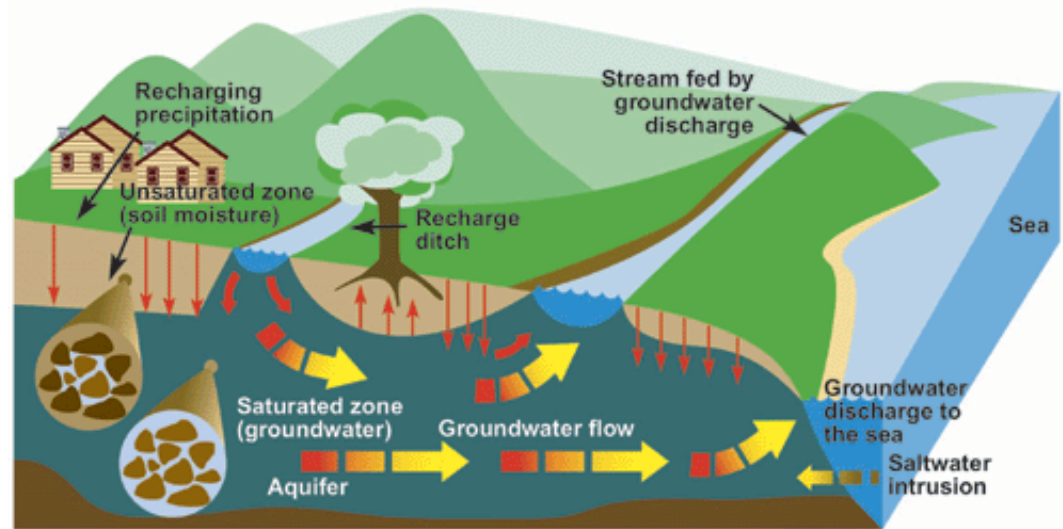
To combat these increasing pressures on water use, particularly in southern California, California would be better served by a water management system that allowed for the exchange of defined, individual groundwater rights. Such a system would make it easier to both protect the environmental integrity of the basin and encourage increased water conservation and more economically efficient water use.

To that end, Part 4.A offers reforms, to be implemented by the California legislature or judiciary, to improve the ability of state

Watermaster

The watermaster is the designated entity or person given oversight and management of an adjudicated basin. The watermaster may be appointed by the court or by some or all of the parties. The watermaster may serve indefinitely or for fixed terms, and typically serves at the discretion of the court. A local water district is often appointed as watermaster.

Watermaster duties may include adopting rules and regulations to manage the adjudicated basin, collecting data, inspecting and testing measuring devices, enforcing rules, assessing fees on producers, and reporting on the state of the basin to the parties and the court.

Figure 1 | Basics of Groundwater Flow

Source: Environment Canada

courts to define water rights within the watershed of a groundwater basin in a timely manner. Part 4.B offers reforms, to be implemented in coordination with watermasters in adjudicated basins, to facilitate market-based exchange of water rights while improving protection of the physical and environmental integrity of the groundwater basin.

By unbundling a groundwater right into transferable water entitlement and water allocation shares, along with appurtenant extraction rights and storage licenses, the watermaster would gain flexibility to regulate groundwater production while water users would gain flexibility in water planning and use.

Unbundling of groundwater rights would also make it easier for water regulators and water users to protect the physical and environmental integrity of the groundwater basin. As part of a larger water management reform for California, these recommendations provide a potential structure for allocating groundwater rights in basins throughout California, preferably without the need to adjudicate each and every basin.

I. Groundwater Basics

To better understand groundwater adjudications in California, an overview of

groundwater hydrology and groundwater law is helpful. Groundwater and surface water are connected, such that withdrawal of groundwater from a basin may affect the water level of nearby surface streams and rivers and vice versa. Excessive groundwater withdrawal leads to overdraft in a basin, which simply means that more water is extracted from the basin than taken in by the basin. Overdraft is associated with a variety of harms, including land subsidence, pumping failures and water quality problems.

For more background on groundwater's importance to California's water supply system and the connection between groundwater and surface water, see my earlier Pritzker Brief in this series, *Under Water*.¹⁶

A. Groundwater and surface water are connected

Groundwater and surface water are physically connected parts of the larger hydrologic cycle.²¹ Groundwater basins can be recharged from the spring flood in a river. During a summer drought, a river may obtain much of its baseflow from an adjacent groundwater basin.

All water—both surface and groundwater—moves in response to gravity and pressure.

Groundwater Terms

Groundwater is water that completely fills empty spaces between rocks or sediment underground.¹⁷ More porous rocks or sediments—that is, sediments with a higher ratio of void space to total volume—can hold a larger amount of water per volume. Of the water contained by a particular sediment type, the specific yield measures the amount of water that is available for extraction.¹⁸

An aquifer is an area of rock or sediment that can yield¹⁹ significant amounts of groundwater. An aquitard is the converse: while it may hold significant amounts of water, it has low specific yield and thus cannot yield significant amounts of groundwater. A groundwater basin is an aquifer or series of aquifers with a definable bottom and reasonably well-defined lateral boundaries. Such boundaries could include aquitards, faults, or surface water features, such as a stream or ocean. A groundwater basin may be divided into subbasins for political or management reasons.²⁰

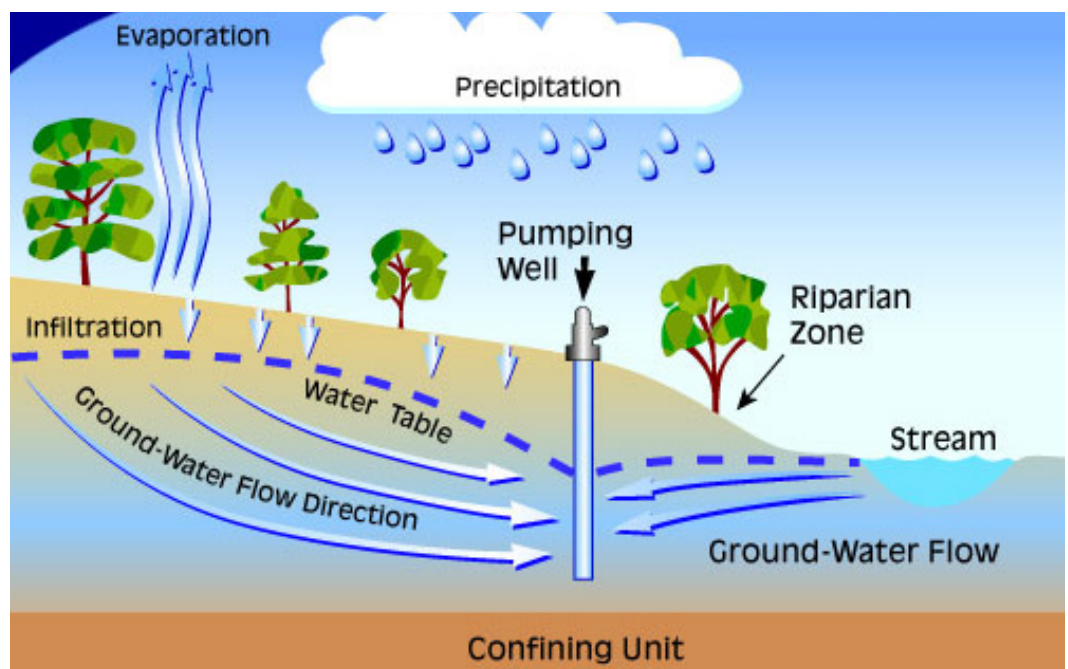
Surface and groundwater move in response to elevation and pressure differentials.

Contrary to popular belief, water does not flow uphill towards money.²² Rather, water is driven by a combination of elevation and pressure differentials, known as potential energy. Higher elevation and higher pressure are higher energy areas; lower elevation and lower pressure are lower energy areas.

Groundwater flows towards lower energy areas, which generally means that groundwater flows, often downhill, from areas of recharge to areas of discharge. Discharge areas are lower pressure

because at these points, the groundwater is “escaping” from the ground to the surface.²³ Natural discharge occurs where groundwater reaches the land surface, feeding a stream or river, for example. Withdrawal of surface water from a stream can lower the potential energy of the groundwater connected to that stream, literally “pulling” the groundwater out of the basin and into the stream. Conversely, discharge of groundwater from a basin can pull water from an adjacent stream into the basin.

Figure 2 | Groundwater and Well Interaction



Source: *Tap Into Quality* (adapted from USGS)

Water Table

The water table is the point at which the top of the groundwater has pressure equal to that of the atmosphere.²⁴ In general, the water table can be thought of as the dividing line above which the ground is no longer saturated with water. Wells must be sunk below the water table in order to extract water. A water table near the ground surface increases the risk of flooding for an area.

B. Excessive groundwater withdrawal harms water resources, overlying land and neighboring water users

Excessive groundwater withdrawal is associated with a variety of harmful effects. A primary concern in California groundwater adjudications is how a lowered water table can increase the costs of extraction and strand shallower wells.²⁵

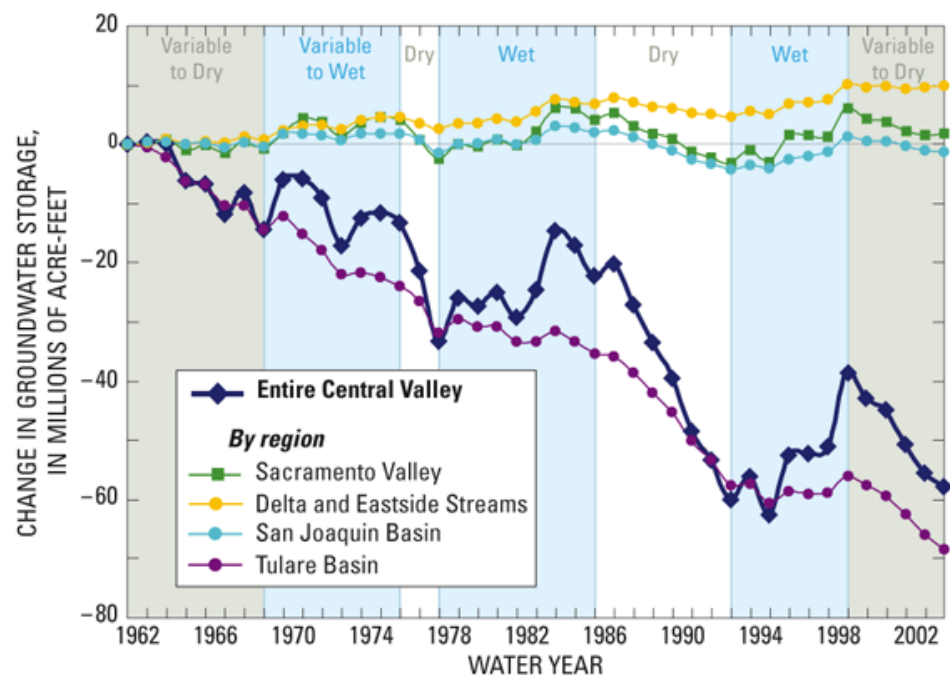
Manmade discharge (“water extraction”), primarily through groundwater wells by water users (“producers”), creates pumping depressions around the extraction points. These “cones of depression” that form around groundwater wells mean that the potential energy—and eventually the water

table—in that area decreases over time, thus requiring deeper wells and more energy to pull out the same amount of water from nearby wells. Thus excess extraction at any one well can harm neighboring well users.

Excess extraction may similarly begin to affect water levels in adjacent streams and rivers, thanks to the connection between groundwater and surface water. This may adversely affect the diversions of surface water users as well as instream beneficial uses.

Removal of underground water can cause the land to subside, harming overlying structures and reducing available storage in the basin, sometimes irrevocably.²⁶ Depletion of groundwater and associated effects on surface water systems threatens

Figure 3 | Diminishing Central Valley Groundwater Supply, by Year



Source: U.S. Geological Survey, “California’s Central Valley Groundwater Study,” Fact Sheet, 2009

surface vegetation and wetlands habitat.²⁷ Decreased groundwater pressure near the coast allows salt water intrusion; decreased groundwater pressure in other areas can allow polluted water to contaminate cleaner parts of the basin.²⁸ Less water also means less dilution of harmful pollutants in the basin, again resulting in degradation of water quality.²⁹

II. California Groundwater Law

California, unlike other western states, lacks a statewide groundwater regulatory regime. Other states, such as Colorado and Arizona, have statewide groundwater management regulations or permit groundwater use just as they permit surface water appropriation.³⁰ Most western states, unlike California, have moved to integrate groundwater and surface water management.³¹

Competing legal structures have complicated groundwater management in California, influencing and encouraging groundwater adjudications in southern California. First, parts of the California water code treat groundwater as distinct from surface water, creating an artificial distinction between the two that has led to adjudications that consider one but not the other.³² In particular, California's permitting and licensing system does not apply to percolating groundwater. Second, the California constitution's reasonable

use requirement for water, which prohibits waste and unreasonable use of water, has sometimes been at odds with other areas of water law, leading to some confusion in judicial doctrine. Third, local control over regional groundwater basins has been largely ineffective and has increased the need for adjudications in southern California.

A. California law artificially distinguishes surface and groundwater rights

California water law has never been particularly concerned with physical reality. Most prominently, the disconnect between physical reality and law manifests itself in two areas of water rights: the disparate treatment of groundwater and surface water rights, and the artificial distinction between "subterranean streams" and "percolating groundwater."

With regard to surface water use, California recognizes both riparian and adjudicative water rights.³⁴ An owner of land adjacent to a surface stream or lake has a riparian right to take water from that stream or lake to use on his adjacent land. Such use must be reasonable and may not harm fellow riparians.³⁵ Essentially, all riparians share the water. The riparian right attaches to the land (it is "appurtenant") and typically cannot be transferred.³⁶ The right extends only to

California water law has never been particularly concerned with physical reality.

Categories of Groundwater Rights

A **overlying right** allows landowners to use groundwater from a basin under their land. Extracted water may be used only on land owned by the diverter that overlies the aquifer and may not be transferred to other property. Overlying right holders share the basin's water resources and may put the groundwater to reasonable use so long as fellow right holders are not harmed. This is sometimes referred to as a **correlative right**.⁴⁵

Someone who extracts groundwater for use on non-overlying land may obtain an **appropriative right** to that groundwater. As with surface water appropriations, the appropriative right is first-come, first-serve. An appropriation is for a fixed amount of water, sometimes defined by the pattern of use at the time of first appropriation.⁴⁶

If someone uses water in a way that is adverse to another's existing right, he may eventually acquire a **prescriptive right**. The adverse use must be open and notorious under a claim of right for five years.⁴⁷ For groundwater, taking water from an overdrafted basin has been considered by the courts to be example of adverse use that, if perfected, would be a prescriptive right to water in that basin.⁴⁸ Prescriptive rights cannot be acquired against public agencies or public utilities.⁴⁹

the natural flow of the stream and must be shared with other riparian rightsholders.³⁷ While riparian rightsholders do not need State permits, they do file statements of water diversion and use.³⁸ This allows California to document their water use and inform them of applications for upstream water use that may impact their riparian rights.³⁹

In addition, anyone can take water from a surface stream for reasonable use on non-adjacent land: this is an appropriative right. Since 1914, state water laws have provided meaningful oversight to surface appropriative water rights, requiring water permits and licenses.⁴⁰ The State Water Resources Control Board (SWRCB) administers the system.⁴¹ SWRCB publishes notice of the application and notifies downstream users.⁴² In the case of a protest, SWRCB may hold a hearing.⁴³ Upon approval, the applicant receives a water right decision, complete with conditions for the proposed appropriation.⁴⁴

Some aspects of the law of groundwater are analogous to surface water rights. Under the law, landowners whose land overlies a groundwater basin have overlying rights to use water from that basin.⁵⁰ Like riparian rights, overlying rights are correlative; overlying rights allow for reasonable use so long as fellow overlying landowners are not harmed.

One can obtain a groundwater appropriative right if she sinks a well and extracts water for use on non-overlying land.⁵¹ (This appropriative right is analogous to appropriative rights for surface water.) As with surface appropriations, groundwater appropriations are generally first-come, first-serve.

Despite these similarities, and the physical connection between groundwater basins and adjacent surface streams, regulators have generally treated groundwater and surface water completely separately. Groundwater extractions are not governed by an analogous system of permitting and licensing with state oversight. And despite apparent legal authority to apply the law to both surface and groundwater users equally, courts have often adjudicated groundwater rights, but not all water rights, within a region.⁵²

To further complicate matters, the California water code considers “subterranean streams” to be legally equivalent to surface water.⁵³ According to the law, this water directly underneath a riverbed⁵⁴—in supposed contrast to “percolating groundwater”—should be treated as part of the river; we would not want someone to sink a well into the riverbed thereby depriving downstream users of the flow of the river.⁵⁵ In reality, of course, use of percolating groundwater near a river is likely to have similar effects on the downstream surface flow.

As Professor Joseph Sax has noted, “‘subterranean streams’ and ‘percolating groundwater’ bear little, if any, relationship to geological realities. Indeed, these water law terms are geographic concepts fundamentally at odds with science’s understanding of water’s movement.”⁵⁶ The State Water Resources Control Board agreed, calling this legal distinction “meaningless.”⁵⁷

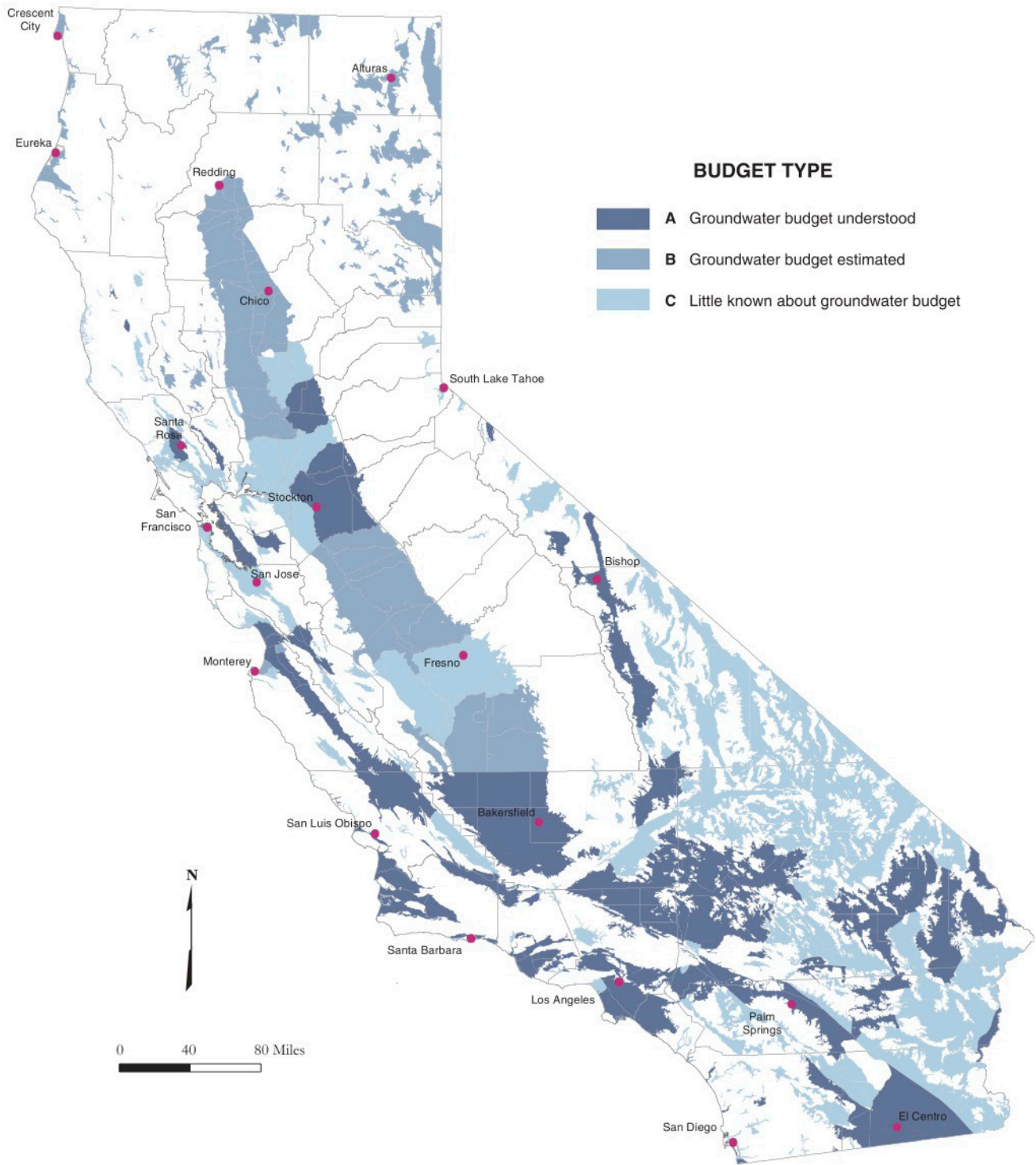
B. California water law requires reasonable use

A 1928 amendment to the California

Overdraft, Safe Yield and Water Production

Adjudications are relatively consistent in defining **overdraft** to be when total annual production exceeds the safe yield.⁸¹ **Production** is the withdrawal of water from the basin by a water user, typically via a well. **Safe yield** is the amount of groundwater that can be produced (extracted) without significant harm to the rights of water users or to the basin or environs. Often, however, courts have defined safe yield without regard to instream beneficial use or environmental harm. Such definitions focus incorrectly on only the amount of water that could be extracted without harming long-term supply from the basin.⁸²

Figure 4 | Basin and Subbasin Groundwater Budget Types in California



Source: California Department of Water Resources

“People who have access to groundwater can just pump it. They need no one’s permission, and no one regulates their use. Water users like it this way; groundwater is a sort of ace-in-the-hole. When surface water supplies are restricted, they can pump groundwater as a substitute, and so it functions as one form of insulation against both drought and increasing regulation. One may wonder why surface water users tolerate this situation, since a good deal of groundwater pumping draws on waters tributary to surface supplies, and diminishes them. It is a good question, and there is no obvious answer to it. Of course, a great many surface water users are also groundwater pumpers, so they may receive both benefits and detriments from the existing situation. Probably the most plausible answer is that water users of all stripes dislike the existing regulatory system, and feel the less regulation, the better.”

— Professor Joseph Sax³³

Constitution limited all water use to “reasonable beneficial use.”⁵⁸ Reasonable is not equivalent to beneficial; a use of water could be unreasonable in the amount consumed while still providing some benefit to the user’s lands, for example.⁵⁹ What constitutes unreasonable use may vary over time and depend on the overall context of the use.⁶⁰ The State Water Board and the courts have applied the unreasonable use doctrine to prevent, for example: excessive use of water by riparians; wasteful conveyance losses; harm to wine grapes by aggregate riparian and appropriative diversions of water; an upstream diversion that harmed downriver recreational use; and excessive groundwater use in an overdrafted basin.⁶¹

The California Supreme Court noted in 1935 that rights to percolating groundwater are, like surface water rights, subject to this reasonable and beneficial use limitation.⁶² Relying on the reasonable and beneficial use mandate, courts may reallocate water use—and the underlying water right—from outmoded to more socially valuable, more reasonable uses.⁶³

C. California water law defines priority of use

In order to adjudicate competing water right claims, it is necessary to consider the priority of use. For surface water, riparian rights must be satisfied prior to appropriative rights.⁶⁴ Appropriators do not share their water allocations as riparian right holders do in times of drought. Instead, water allocations are distributed by a priority system based

on seniority of the claim.⁶⁵ Appropriative rights are first-come, first-serve in that the senior (older claim) appropriator receives his entire allotment before any water goes to a junior (newer claim) appropriator.

As to groundwater rights, the California Supreme Court set forth the hierarchy in *City of Pasadena v. City of Alhambra*:

[B]etween overlying users, no temporal priority exists. Rather, in times of shortage, each is entitled to a reasonable share of the common supply. As between appropriators, temporal priority exists; the rights of a pumper first in time are senior to those of a later appropriator. As between overlying users and appropriators, overlying users have priority, regardless of the date of the inception of the overlying use. Prescriptive rights-holders can quantify their rights as against both prior appropriators and overlying owners under formulas developed by the courts. In sum, the appropriator’s use is limited to the amount of the surplus water in the groundwater basin. If there is no surplus water, the appropriator is not entitled to take any water, unless he has acquired prescriptive rights.⁶⁶

Reasonable use, as a constitutional imperative, can trump priority of use.

D. California groundwater tends to be controlled at the local level, if at all

While withdrawal of water from a surface stream is subject to permitting and

regulation, overseen by the State Water Resources Control Board,⁶⁷ groundwater extraction remains largely unregulated.⁶⁸ In California, city and county governments have authority to implement groundwater management ordinances under their police powers.⁶⁹ Voters may also establish “special districts” that can regulate water use with varying authority.⁷⁰ Occasionally, the California legislature will imbue water districts with broad regulatory authority over groundwater.⁷¹

Special districts are meant to protect groundwater resources in an area for the “common benefit of water users.”⁷² Districts can adopt groundwater management plans that allow the district to operate and regulate groundwater replenishment programs, limit and regulate groundwater extraction, allocate groundwater storage space, and restrict unreasonable or unauthorized use of groundwater.⁷³ Some districts are authorized to restrict groundwater exportation and most have the power to define and quantify groundwater rights in times of shortage.⁷⁴ Districts may monitor and regulate groundwater use, mainly through the use of well registration and extraction statements.⁷⁵ Special districts receive funding by charging groundwater users via a “pump tax” (on groundwater extraction) or administrative fees.⁷⁶

Recently, the California legislature established the California Statewide Groundwater Monitoring program (CASGEM) to encourage local agencies and counties to monitor groundwater levels.⁷⁷ By providing financial incentives for local monitoring of groundwater elevations, CASGEM “entrenches the status quo rather than uprooting it.”⁷⁸ CASGEM protects local agency authority to manage groundwater and relegates the state to an advisory role.⁷⁹ Unlike surface water use, groundwater use remains unpermitted and unregulated by the state.

Part I.C. in *Under Water* describes local control of groundwater use in more detail. In *Under Water*, I describe how local governments have thus far failed to effectively manage groundwater and recommend a series of steps to improve local and regional groundwater oversight and enforcement.

III. Why Reform California Groundwater Adjudications?

An adjudication, in water law, is litigation to determine water rights between competing water users. One or more water users file a quiet title action to water rights of a stream or a groundwater basin, requesting that the court determine their respective rights to the water resource. For groundwater rights, the impetus for such a suit is the various harms caused by excessive groundwater depletion, described in Part 1.B. The adjudicating court may limit the water usage of one or more parties, define their water rights, and award restitution for harm done to a party’s water rights.

Part 3.A below explores the development of groundwater adjudication law and precedent by referencing a few key groundwater adjudications. The adjudication of Raymond basin, the first such adjudication in California spanning 1937–1944,⁸⁰ became the model for future adjudications and introduced the mutual prescription doctrine, by which the court could apportion groundwater rights on an equitable basis without reference to priority of those rights. The West Coast basin adjudication followed from 1946–1961, as concern with seawater intrusion forced water users to respond to increasing overdraft in this coastal basin. Reviewing the San Fernando Valley basin adjudication, the California Supreme Court in 1975 rejected the trial court’s use of mutual prescription, marking a shift towards increased reliance on priority of rights in court adjudications.

Following the *San Fernando* decision, the Chino basin adjudication, completed in 1978, failed to fully define overlying rights thanks to this move away from mutual prescription doctrine. Then, in 1985 a California court of appeal remanded the adjudication of Goleta basin back to the trial court after determining that the trial court had impermissibly subordinated future, unexercised overlying rights to present exercised appropriative rights. Once again, defining individual overlying rights became more challenging. Lastly, the California Supreme Court reiterated that courts may not ignore priority of rights when apportioning a basin’s groundwater, while

The history of California groundwater adjudications reveals a time-consuming, resource-intensive process.

reviewing the adjudication of the Mojave River in 2000.

Examining this history of California groundwater adjudications reveals a time-consuming, resource-intensive process that has typically been driven by a few large water users in a basin. Groundwater adjudications are notoriously complex because their proper resolution requires examination of the rights of essentially every water user in the basin. Most adjudications are planned by one or more major water users who will often prepare a draft settlement among all major parties before even setting foot in court. While successful by some measures, adjudications have not led to the definitive determination of groundwater rights that parties have sought. Nor have adjudications led to the type of easily exchanged^b water allocations and water rights that one might expect of defined property rights.

These adjudications display several flaws that I aim to address with the recommendations in Part 4. First, adjudications can either fail to define individual water rights or define such rights in an extremely convoluted manner. Second, court jurisdiction over surface water users is sometimes unclear, thanks in no small part to California's arcane water rights code. Third, lack of monitoring, oversight and enforcement of groundwater has complicated court adjudications. Fourth, adjudications often contain various provisions and loopholes that can make it difficult to protect the environmental integrity of the groundwater basin. Fifth, adjudicated basins are a testament to the status quo, sometimes protecting the interests of a few large water users while making it difficult for outsiders or smaller water users to flexibly obtain and use groundwater.

Part 3.B explains that California's groundwater adjudications have been partially successful but remain a rather inefficient means to manage groundwater. Lack of an effective market mechanism to exchange water rights and water allocations contributes to that inefficiency. Furthermore, anticipated climate-related changes to

^b By "easily exchanged," I am mainly referring to the need for low transaction costs for such an exchange.

precipitation and water runoff along with shifting demographics, development and over-dependence on groundwater overdraft may lead to an insufficient supply of water to satisfy the needs and legal claims of California's adjudicated basins. (See Part 3.C).

A. History of a few key groundwater adjudications in California

By the early 1900s, substantial groundwater pumping gave rise to litigation between competing producers in California.⁸³ A decades-long drought, beginning in 1894, and the introduction of the deep-well turbine pump exacerbated the problem.⁸⁴ Seawater intrusion became more obvious in coastal basins; in 1912 Southern California Edison abandoned its Redondo Steam Plant well in West basin because seawater had contaminated the well.⁸⁵ Because the newly formed State Water Commission had authority only over surface water rights, groundwater users had little recourse other than the courts.⁸⁶

The California Supreme Court established the rule of overlying rights (often referred to as correlative rights) for groundwater in *Katz v. Walkinshaw* in 1903. *Katz* rejected the application of the English common law rule of capture (still used in Texas), which allows users to pump without regard to long-term sustainability or their effects on other water right holders. With correlative rights, however, overlying water users still lack easily defined (or easily enforced) limits on their groundwater extractions, particularly given the inconspicuous nature of groundwater extraction as compared to surface water diversions.⁸⁷ Ironically, Justice Shaw rejected this problem in *Katz*, proclaiming that "[t]he objection that this rule of correlative rights will throw upon the court a duty impossible of performance, that of apportioning an insufficient supply of water among a large number of users, is largely conjectural."⁸⁸ Future adjudications would make this conjecture a reality.

Conflicts over groundwater use in the Valley did not result in court adjudications. Instead, a proliferation of local water districts worked

“We never know the worth of water till the well is dry.”

—Thomas Fuller,
Gnomologia, 1732

A decades-long drought beginning in 1894 along with the introduction of the deep-well turbine pump in the early 1900s led to increased groundwater extraction in California. Southern California responded by creating Metropolitan Water District and constructing an aqueduct to obtain supplemental water from the Colorado River.

and fought with federal and state authorities to secure more surface water in light of the groundwater shortages from 1920 to 1960.⁸⁹

Raymond basin adjudication (1937–1944; California Supreme Court decision, 1949).

The Raymond basin adjudication set forth the “blueprint” for future groundwater adjudications in California. The adjudication demonstrated the need to have up-to-date information on the physical state of the basin and accurate monitoring of groundwater use. Parties relied on a settlement in part because they feared unpredictable judicial adjudication given California’s complicated water law. The court applied a doctrine now known as “mutual prescription” that considered all water rights in the basin to be of equal priority. And the court approved settlement created the first exchange pool used to transfer water rights among the basin’s users.

In 1937, the City of Pasadena sued after negotiations between it and other producers failed to redress the overdraft

problem in Raymond basin, in eastern Los Angeles County. *City of Pasadena v. City of Alhambra*,⁹⁹ the first basinwide adjudication of California groundwater rights, took 13 years and a California Supreme Court decision to resolve.

Much of the time was initially expended by an investigation into the physical facts pertaining to the water rights determination. Applying the Court Reference Procedure under the California Water code for the first time, the trial court asked the Division of Water Resources to submit a report on the state of the basin and historical water use by producers.¹⁰⁰ The problem for the Division, of course, was that the basin was not well studied and historical water use not well documented—a problem that persists in most California groundwater basins to this day.

Following the final Division report to the court in 1943, all but two parties quickly agreed to a stipulated settlement. California’s peculiar treatment of groundwater rights under the law influenced the negotiating strategy for

The Role of Metropolitan Water District (MWD)

A group of southern California cities organized Metropolitan Water District in 1928.⁹⁰ MWD is a quasi-municipal corporation with the power to levy taxes, created under the Metropolitan Water District Act.⁹¹ The “first objective” of MWD was to construct the Colorado River aqueduct to deliver water to the Cajalco reservoir near Riverside.⁹² The Cajalco dam and dike was completed in 1938.⁹³

To become a member of MWD (and gain the ability to directly purchase MWD’s imported Colorado River water), an area needed to first create a public water district.⁹⁴ Then, pursuant to a public vote, the water district was annexed to MWD, at which point voters paid additional taxes to both the local water district and MWD.⁹⁵

To protect its water rights to the Colorado River, MWD need to find a beneficial use for its water imports. Gaining customers (both taxpayers and water buyers) meant annexing sufficiently large areas.

Even though Orange County Water District was not a member agency of MWD, MWD did not object to selling water to it indirectly via member agencies beginning in 1948 in order to increase MWD’s water use.⁹⁶

Notably, MWD imports were much more expensive than groundwater. This was particularly true prior to basin adjudications, when the costs of groundwater withdrawals were distributed, almost invisibly, across an entire basin of users. The City of Pasadena, for example, turned to litigation to avoid having to purchase MWD water while others continued to over-rely on inexpensive groundwater.⁹⁷ To avoid purchasing MWD water in the 1950s, Los Angeles increased imports from its own aqueduct that pulled water from Mono basin and Owens Valley.⁹⁸

Physical Solution and Equitable Apportionment

In a court adjudication, a physical solution is a means to define contested water rights that maximizes beneficial use and limits waste. Key elements of a physical solution may require a senior right holder to accept a substitute water source or improve the efficiency of his diversion or water use, paid for by the junior right holder, in order to both benefit the junior right holder and achieve a more reasonable and beneficial use of a limited water supply.¹⁰⁴

The equitable apportionment doctrine allows the court to divide a limited water resource among users. In *City of Barstow v. Mojave Water Agency*, the California Supreme Court clarified that such equitable apportionment “must preserve water right priorities to the extent those priorities do not lead to unreasonable use.”¹⁰⁵

A California court of appeal elaborated on the limits and power of a physical solution in a 2010 opinion concerning the Seaside basin adjudication:

“A physical solution 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. Courts are vested with not only the power but also the affirmative duty to suggest a physical solution where necessary, and it has ‘the power to enforce such solution regardless of whether the parties agree.’ ‘It must be remembered that in this type of case the trial court is sitting as a court of equity, and as such, possesses broad powers to see that justice is done in the case.’ . . .

The solution must not, of course, unreasonably or adversely affect the existing legal rights and respective priorities of the parties.”¹⁰⁶

the parties. Parties feared a court trial, with unpredictable judicial adjudication of their water rights.¹⁰¹ With a stipulation, parties defined their own rights and the safe yield that in turn would limit use of those rights.

The stipulation’s rather clever legal mechanism for treating all rights equally, eventually adopted by the trial court and California Supreme Court in *City of Pasadena* in 1949, became known as the “mutual prescription doctrine.” Because every pumper contributed to the overdraft situation, every pumper was held to have legally invaded (mutually prescribed) the rights of every other pumper in the basin. The court divided the safe yield of the basin

among the pumpers pro rata, based on their maximum diversionary capacity over the five years prior to the start of the litigation.¹⁰² The court effectively treated every pumper’s rights “equally and independently of any priority dates.”¹⁰³ The resulting adjudicated rights benefited those large water users who could most easily document their recent water use (and who had the most foresight to increase their water use immediately prior to litigation). But this equal treatment also allowed the court to define individual water rights, including overlying rights. It also implied a closed system: currently unexercised overlying rights would, at best, receive a lower priority to exercised rights in any future litigation.

The Water Year

A **water year** delineates the period over which a party may use its adjudicated right. The water year is an accounting mechanism. Typically, a water year is defined as a twelve-month period, which may start on January 1 or some other date.¹⁰⁹

Larger municipal producers, such as Pasadena, arguably benefited from the stipulation's treatment of competing claims. Without a lawsuit, Pasadena would have needed to cut its own production in half, most likely importing expensive Colorado River water from the newly formed MWD while other users continued to exploit the groundwater basin.¹⁰⁷ The stipulation avoided deciding the parties' pumping priorities based on legal doctrines of overlying and appropriative groundwater rights and instead treated the rights of all parties as equal in priority. In particular, large producers are more likely to have had appropriative water right claims that California law would have treated as lower priority to overlying rights.¹⁰⁸

The settlement for Raymond basin introduced the idea of an exchange pool. To avoid drastic cuts in groundwater use, suggested by the Division of Water Resources' report on the status of the basin, the settlement anticipated fewer cuts along with imported water to make up the difference. The settlement required each party to offer for sale, with a set maximum price, any excess water rights before the beginning of each Water Year. The exchange pool was meant to accommodate water users that lacked access to MWD imported water. It was also meant to improve flexibility in water use. The exchange pool in Raymond basin has been essentially abandoned since the 1950s in favor of leasing or selling decreed rights (the actual adjudicated right, in its entirety).¹¹⁰

West Coast basin adjudication (1946–1961). As a coastal basin, West Coast basin demonstrates the risk of seawater infiltration into an overdrafted basin. The adjudication built upon the foundation established in the Raymond basin adjudication, with reliance on the Division of Water Resources to investigate the condition of and rights within the basin, a negotiated settlement that avoided deep cuts in extraction, and a mandatory exchange pool.

The need to adjudicate the West Coast basin was driven in part by the interconnection of groundwater basins and surface water. By 1933, urban water use in

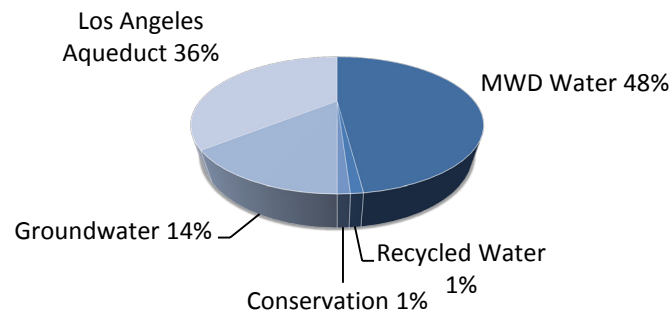
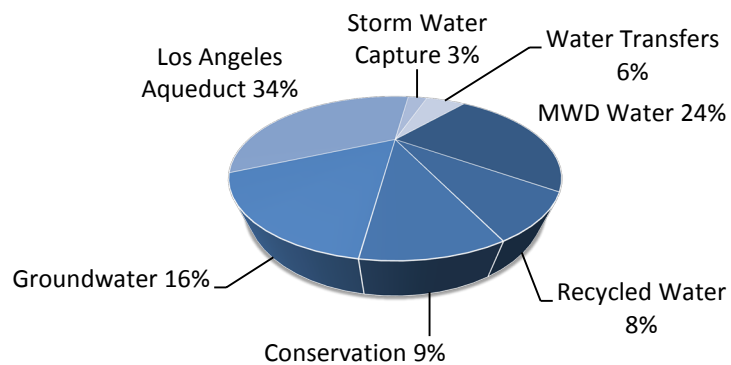
the coastal West basin had shifted from a seaward-sloping to a concave gradient.¹¹¹ Water—including seawater from the Pacific Ocean—moved towards the center from all sides.¹¹² Eventually fresh water flow from the adjacent Central basin decreased as the water level in Central basin also fell. Groundwater use in West Coast basin had pulled water out of Central basin, at least until overdraft in Central basin began to reverse that flow.

As with the Raymond basin litigation, the court requested a report on the status of the basin from the Division of Water Resources.¹¹³ In the Division's report, it found that the basin had been in overdraft condition since 1920 and recommended limiting production by two-thirds.¹¹⁴ This would have been a far greater cut than the one contemplated by the parties to the Raymond basin adjudication, and would serve as "a great motivator" for settlement.¹¹⁵

Motivated in part by the potential drastic across-the-board cut in groundwater extractions, fifty of the largest producers signed an interim agreement to reduce their pumping by twenty-five percent in 1955. As would become typical for southern California adjudications, the parties would rely on groundwater recharge via imported water to make up the difference between their 25% reduction in extraction and the Division's proposed 66% reduction.

The West Coast basin adjudication sets forth elaborate rules for an exchange pool. Sixty days before the start of each water year, every producer within the basin is required to offer one-half of their excess water for sale. A formula in the adjudication sets the maximum price.¹¹⁸ The market clearing price is the weighted average of the offered prices. In other words, some sellers of water in the West Coast basin may receive less than their asking price and those sellers may not back out of the sale regardless of the market clearing price.

None of these exchange pools, including West, Raymond and a similar pool for Central basin, relied on market forces for establishing sale prices; the watermaster acted as a central broker and pricing authority. The Central basin exchange even allowed "paper trades" for some categories

Figure 5 | Sources of LADWP Water**In Year 2010****Projected for Year 2035**

Courts cannot ignore or abrogate the priority of rights by relying on mutual prescription.

Source: Natural Resources Defense Council, "Imported vs. Local Water Supplies: The Planning Decisions Facing Southern California Water Agencies," 2011 (adapted in part from the Los Angeles Dept. of Water and Power's 2010 Urban Water Management Plan)

of buyers even when the corresponding seller lacked the necessary water to trade. Category (a) exchange pool requests—for up to 150% of the buyer's allocation—are fulfilled regardless of actual supply.¹¹⁹ While such paper trades avoid transaction costs, they have the potential to obliterate any safe yield determination for the basin.

In 1961, fifty-six parties signed a stipulated judgment, later ratified by the court against all remaining parties. Two appeals followed, with the later affirming the trial judgment in 1964. In all, the West Coast basin adjudication took nineteen years.¹²⁰

San Fernando Valley basin adjudication (1955–1979; California Supreme Court decision, 1975). The San Fernando Valley

basin adjudication, also known as the Upper Los Angeles River Area adjudication, marked a turning point in the common law governing groundwater adjudications. In 1975, the California Supreme Court reversed the trial court's use of mutual prescription to equitably allocate groundwater rights in San Fernando Valley without regard to priority. Because overlying rights are correlative, and thus require a shared approach to the basin resource, defining those rights at an individual level becomes difficult without abrogating the priorities of those rights.

LADWP had long controlled the San Fernando Valley basin, which it used to store imported water from the Los Angeles Aqueduct, Owens Valley and Mono basin. Los Angeles believed that it had paramount

rights to all groundwater in the basin,¹²¹ thanks to a combination of pueblo rights and its longstanding use of the basin by LADWP to store imported water. But the long drought that began in 1945, together with increased groundwater extractions in the Valley threatened LADWP's stored groundwater. Los Angeles sued San Fernando extractors in 1955.

At the trial court, Judge Moor applied mutual prescription, rejecting Los Angeles' theory of paramount rights and its overdraft definition.¹²² This was perhaps unsurprising, given Judge Moor's previous oversight of the Central basin adjudication and San Gabriel River adjudication.

On appeal, the California Supreme Court severely limited the mutual prescription doctrine in 1975.¹²³ It held that priority of rights could not be ignored or abrogated through prescription.¹²⁴ Furthermore, the Court ruled that a section of the California Civil Code, § 1007, prohibited users from obtaining prescriptive rights against a public entity, such as LADWP. In the end, Los Angeles was awarded pueblo rights to the entire native safe yield of the San Fernando sub-basin but was enjoined from pumping more.¹²⁵ Los Angeles, Glendale, Burbank and San Fernando all received rights to import return flows; each city can receive credit and pump a percentage of water imported into the subbasin.¹²⁶

Water quality has been a continuing problem for the basin, exacerbated perhaps by long-term overdraft. Areas of heavy pumping in San Fernando basin have high levels of volatile organic compounds, such as TCE and PCE.¹²⁷ EPA designated the area a Superfund site in the 1980s.¹²⁸ Due to diminishing availability and increased cost of imported water, in June 2013 Los

Angeles Department of Water and Power announced its intention to construct two groundwater treatment plants over the Superfund site.¹²⁹

Chino basin adjudication (1975–1978). Also in 1975, Chino basin water users sought adjudication because they “wanted vested rights protected and accorded an economic value.”¹³⁰ The Chino Basin Municipal Water District, in cooperation with the Chino Basin Protective Association of water users, used a pump tax to fund necessary studies before filing the complaint naming 1300 parties.¹³¹ Unfortunately, the *San Fernando* decision threw their pre-planned stipulation into disarray.¹³² Overlying groundwater rights could no longer be equally allocated using mutual prescription and would be treated differently than appropriators.

According to historian William Blomquist,

*The San Fernando decision robbed California groundwater basin management of one of its most efficiency-enhancing aspects: the ability of water rights owners to exchange, lease, and sell their rights. The Chino basin judgment contains numerous provisions for accounting manipulations that have been implemented [in the absence of simple transfer rules] in order to allow water production to move from agricultural to urban and suburban uses*¹³³

Without individually defined water rights, exchange of rights becomes difficult or impossible. The *San Fernando* decision meant that courts could no longer ignore the shared, correlative nature of overlying rights. If overlying users can extract as much as they need, up to their share of the total basin resource, then why would such

Without individually defined water rights, exchange of rights becomes difficult or impossible.

The Role of the Water Replenishment District of Southern California

The Water Replenishment District of Southern California (WRD) monitors groundwater, manages projects to combat seawater intrusion and operates groundwater replenishment basins in southern Los Angeles County.¹¹⁶ WRD's purpose is to protect the groundwater resources of the Central and West Coast basins.¹¹⁷ Replenishment of these groundwater basins and prevention of seawater intrusion are key to the continued effectiveness and functionality of the adjudications in these two basins.

users want their rights defined (and thus limited)? And if overlying rights are superior in priority to appropriative rights, then why would an overlying right holder trade with an appropriative right holder? By placing such rights on unequal footing, rather than the all-equal approach of mutual prescription, the court limited the ability and desire of users to simply exchange such rights.

The final stipulation, signed in 1978, split rights into three pools. Appropriators, preferring definitive water rights, bypassed mutual prescription issues by stipulating that their appropriative rights had equal priority.¹³⁴ The appropriative pool was thus split equally as a percentage share of safe yield *after* overlying rights had been satisfied.¹³⁵ I will recommend, in Part 4.B below, a similar structure (of split overlying and appropriative pools) to facilitate the allocation of water among entitlement shares.

The Chino basin stipulation, however, failed to define all individual groundwater rights. The stipulation defined the rights of the twelve overlying nonagricultural users in a second pool but did not define individual rights for overlying agricultural users.¹³⁶ Instead, overlying agricultural users were supposed to share a third pool.¹³⁷ The desire of Chino basin water users to quantify their rights and make such rights transferable “was thwarted by the *San Fernando* decision’s reiteration of the status of overlying water rights in California groundwater law.”¹³⁸ Instead of taking on the thorny issue of defining individual overlying rights, the Chino basin stipulation sidesteps it entirely, essentially reintroducing a system of shared overlying rights that helped create the overdraft in the first place.

Monitoring and enforcement for the overlying agricultural pool, perhaps unsurprisingly given the lack of defined rights, “proved problematic.”¹³⁹ Eventually, the appropriative pool paid for meter installation and the watermaster sued 142 noncomplying members of the agricultural pool.¹⁴⁰ Since that time (and after “years of negotiation”), Chino basin users and the Court approved “Peace Agreements” in 2000 and 2007 to formalize the Watermaster governance structure.¹⁴¹

Goleta basin adjudication (1973–1989).

The significance of the Goleta basin adjudication lies primarily in how the appellate court dealt with the distinction between exercised and unexercised overlying rights. “Exercised” in this instance means those rights on which a user is currently relying to extract water from the basin. An “unexercised” right, conversely, may be relied upon in the future—if a landowner sinks a new well, for example—but is not currently associated with water extraction. According to the appellate court, future unexercised overlying rights, although potentially unmeasurable at the time of adjudication, are of higher priority than current appropriative use.

As with the West Coast basin, the history of the Goleta basin involves the transition from agricultural land use to residential and commercial development along with a subsequent overdraft. Initially, farmers used groundwater for fruit and nut orchards and other agriculture. In 1925, the La Cumbre Mutual Water Company was formed to provide water service to nearby landowners. La Cumbre would rely solely on groundwater from the basin until the 1960s. In 1963, Goleta Water District also began groundwater pumping.¹⁴²

Beginning in the 1940s, the area overlying Goleta basin saw drier than average weather and increasing residential and commercial growth. Agricultural groundwater use declined rapidly, due to both competing land use and water availability from nearby Lake Cachuma.¹⁴³ By the 1970s, La Cumbre and Goleta Water District accounted for the majority of groundwater extractions from Goleta basin.¹⁴⁴

In 1973, overlying landowners in the North-Central basin sued Goleta Water District, who in turn cross-complained against 220 additional parties. In 1979, the court determined the safe yield for the basin and allocated extraction rights to the parties. On appeal, the appellate court reversed and remanded the initial judgment.¹⁴⁵ Finally, the trial court issued its revised judgment in 1989, sixteen years after the start of the adjudication.¹⁴⁶

In a 1985 opinion, *Wright v. Goleta Water*

District, the Second District Court of Appeal restricted the ability of the trial court “to subordinate an unexercised [overlying] right to a present appropriative use.”¹⁴⁷ In the Goleta basin, this meant that the water district, as an appropriator, could be limited in the future if overlying users later appeared to present their claims.¹⁴⁸ Furthermore, present overlying users who later increase their use could also, in theory, petition the court (or watermaster) for additional usage rights at the expense of the water district.¹⁴⁹

The final 1989 Judgment demonstrated the imprecise nature of overlying water rights in an adjudicated basin. The court concluded that the basin was significantly overdrafted. The judgment allowed private landowners with overlying rights, however, to increase their extraction amounts without court approval.¹⁵⁰ The court assigned a total amount to those landowners (which could change over time) and did not define individual limits on their overlying rights. The District, as junior appropriator, was left to absorb whatever cuts were needed to protect the safe yield of the basin.

Nevertheless, this adjudication seems to have yielded good results. Both La Cumbre and the District have drastically reduced their groundwater pumping and have periodically stored water in the basin. The court found the basin to be in hydrologic balance in 1998.¹⁵¹

Mojave River basin adjudication (1966–1976; 1990–1996; California Supreme Court decision, 2000). The *San Fernando* decision and basic problems of defining groundwater under California law negatively impacted attempts to adjudicate the Mojave River basin. Overlying users had little incentive to negotiate with appropriators without the threat of mutual prescription. The court lacked flexibility in defining individual water rights. And no one could agree on the basic physical facts: was the water at issue contained in one basin, multiple basins or underground streams?

Problems of water governance in the Mojave River basin began with the fact that “[t]he Mojave Water Agency bore no relation to the hydrologic boundaries of local water supplies.”¹⁵² In addition, between the 1940s

and the 1960s, population and agriculture boomed in the Mojave Desert. Growing alfalfa in the desert did little to help the increasing overdraft in the basin.¹⁵³

The Mojave Water Agency wanted to treat groundwater along the Mojave River as “the collective property of those who have been using it for the last five years” and apply “coequal treatment” to all types of right holders.¹⁵⁴ But no consensus existed even as to the question of overdraft. Nor did water users agree as to whether the Mojave River area was one or more groundwater basins along a stream or rather an “underground stream” that should be permitted, under California law, as surface water.¹⁵⁵

Litigation to adjudicate the Mojave River basin was filed in 1966, with the support of the Mojave Water Agency.¹⁵⁶ But the stipulation never reached its needed number of signers, and after municipal elections in 1976, a new anti-adjudication majority of the MWA Board deposed the MWA director and voted to dismiss the adjudication, after 10 years and \$1 million in costs to the parties.¹⁵⁷

In 1990, the City of Barstow filed a complaint against upstream defendants in the Mojave River basin, again reopening the issue of adjudication in the basin.¹⁵⁸ At that time, water users in the area still did not agree as to the existence or extent of overdraft. Water users also lacked “a shared picture of their water supplies and water use. . . [D]isagreement still remain[ed] about whether Mojave River water supplies should be treated as an underground stream, a single groundwater area, or multiple groundwater basins.”¹⁵⁹

The second attempt at adjudication in Mojave River basin would take six more years, only to have the trial court decision largely reversed on appeal four years later. In *City of Barstow v. Mojave Water Agency* (2000),¹⁶⁰ the California Supreme Court ruled that a trial court may not, as it did in the Mojave River adjudication, use equitable apportionment that does not consider the priorities of legal water rights in the basin.

Case law simply does not support applying an equitable apportionment to water use claims unless all

*claimants have correlative rights; for example, when parties establish mutual prescription. Otherwise, cases like City of San Fernando require that courts making water allocations adequately consider and reflect the priority of water rights in the basin.*¹⁶¹

Furthermore, the trial court could not fall back on a physical solution premised on disregard of parties' priority rights.

*Although it is clear that a trial court may impose a physical solution to achieve a practical allocation of water to competing interests, the solution's general purpose cannot simply ignore the priority rights of the parties asserting them. In ordering a physical solution, therefore, a court may neither change priorities among the water right holders nor eliminate vested rights in applying the solution without first considering them in relation to the reasonable use doctrine.*¹⁶²

Thus *City of Barstow* reaffirms the rejection of mutual prescription, logically extending *City of San Fernando*. But, as with Chino basin, the reluctance of the courts to use an equitable solution can mean that overlying rights, in particular, are not defined and thus remain difficult to transfer. Even more problematic, the quantity allotted for these overlying rights could change in the future. Without a defined individual right, overlying right holders are free to increase their use if they can demonstrate a need to increase their beneficial use on their overlying land.

B. California's groundwater adjudications are a promising, but currently flawed, means to manage groundwater rights

This history reveals some benefits of adjudication, but also some areas in which one might reduce procedural, environmental and economic inefficiencies.

In some respects, adjudications of groundwater in southern California have been quite successful. Compliance by adjudicated users with water use limitations or requirements has been high.¹⁶³ The

earlier adjudications have generally seen a rebound in water levels in their respective basins, through a combination of increased water imports and limitation of water demand.

More recent adjudications continue to rely on *City of Barstow* and *City of San Fernando* as the template for allocating water rights within a groundwater basin. To date, Californian courts have adjudicated twenty-two basins.¹⁶⁴ United States federal courts have adjudicated one basin: Santa Margarita basin. The longest adjudication—San Fernando Valley basin—took twenty-four years, not counting that the Mojave River basin has been litigated on-and-off for at least thirty years. Most, but not all, of those adjudications have resulted in court judgments that limit groundwater extractions.¹⁶⁵

Adjudications are also relatively inexpensive. Compared to admittedly limited alternatives, costs of adjudication have been relatively low when annualized over time. Historian William Blomquist calculated (using 1985 dollars) that with reference to total basin management costs, adjudications in Raymond, West, Central, Main San Gabriel, San Fernando and Chino basins were all more cost-efficient—by up to an order of magnitude—than the supply-side management approach of the unadjudicated Coastal Plain basin of Orange County.¹⁶⁶ Replacing adjudicated management of a basin with a combination of surface storage and imported water would have increased water costs by approximately 3x–5x, again according to calculations by Blomquist.¹⁶⁷

Groundwater adjudications, however, are hardly perfect. In general, although water levels in adjudicated basins have recovered, they have not returned to historic averages (and may never return to those averages).¹⁶⁸ In other words, current levels in water basins may still be low enough to substantially infringe on adjoining surface water uses; conversely, surface water diversions may have made the historical water level now unattainable in many basins.

The combination of *City of Barstow*, *City of San Fernando* and *Goleta Water District* makes it difficult for courts to define individual overlying rights in an adjudicated basin (and

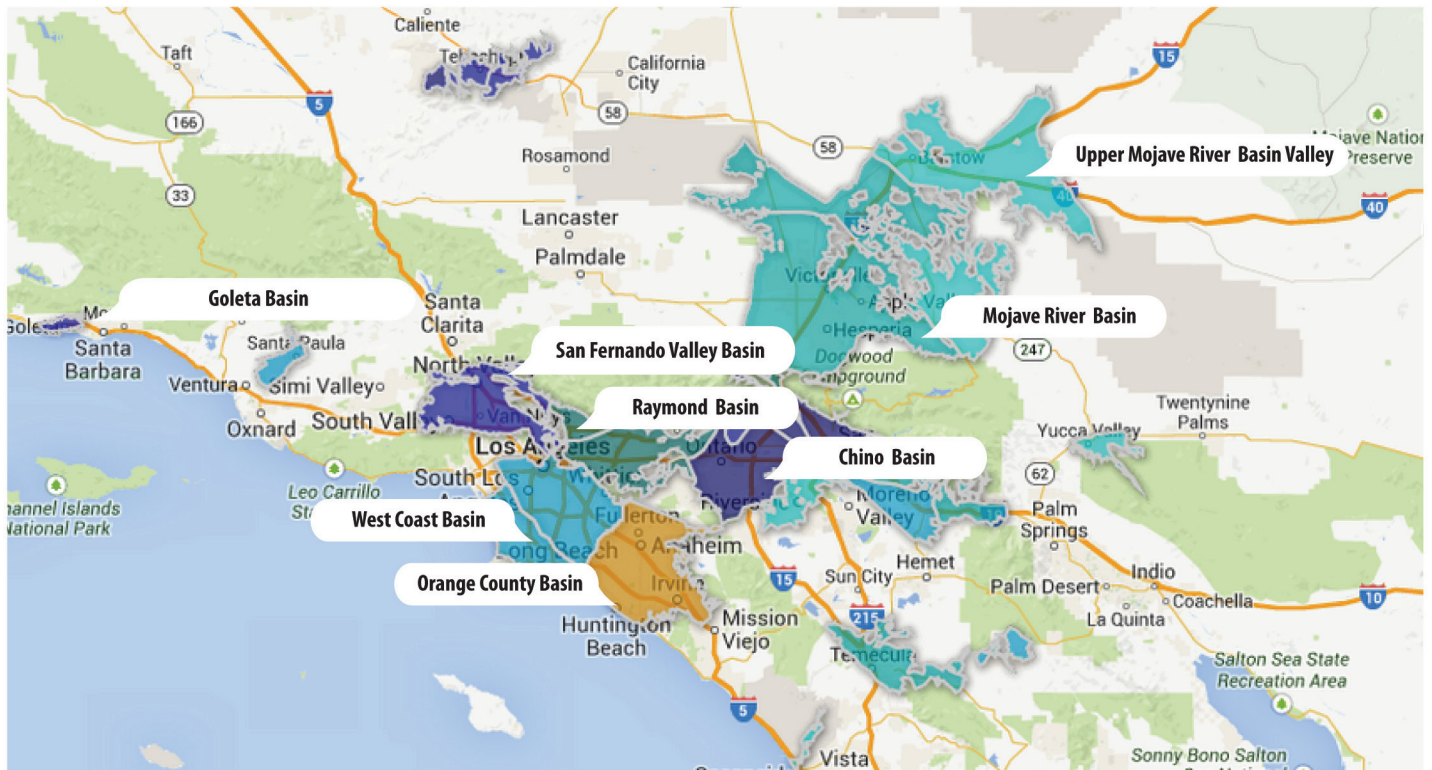


Figure 6 | Map of Orange County Basin & Neighboring Adjudicated Basins

The combination of City of Barstow, City of San Fernando and Goleta Water District makes it difficult for courts to define individual overlying rights in an adjudicated basin.

consequently, define appropriative rights to that basin). The recommendations in Part 4.B below offer a means around this issue, by using entitlement and allocation shares for a basin that allow for new users to be added as necessary without necessitating a new round of water rights adjudication. The use of stipulated agreements, prevalent in many adjudications, is another means around this potential issue. Finally, the court of appeal in *Goleta Water District* left open the (“theoretical”) possibility that a “judicial determination may provide complete resolution of water rights in an underground basin,” an option not taken by the trial court in that case. Seeking a complete resolution would likely involve the joinder of all relevant surface and groundwater users, which forms the basis of the first recommendation in 4.A. below.

Thanks in no small part to the convoluted water code, groundwater adjudications present a series of inefficient compromises, bypasses and kludges. Some result in procedural inefficiencies, drawing out and

complicating water litigation. Others result in environmental inefficiencies, failing to fully account for water quality and environmental needs. Still others lead to economic inefficiencies, making it difficult for water right holders to shift to high value water uses. Each of these types of inefficiency is discussed below, drawing from historical case studies.

Procedural inefficiencies. Procedural inefficiencies increase the time and resources needed to litigate groundwater rights. Past failures to adequately catalog and monitor groundwater rights and groundwater use prolong the investigatory stage of adjudications. The inability or reluctance of courts—and settling parties—to definitively determine individual rights risks future litigation concerning those same rights and complicates groundwater management within the basin. Confusion over the artificial statutory distinction between percolating water and underground streams has prolonged litigation. And courts have not exercised their equitable

Orange County Water District

Many offer up Orange County, with its managed but non-adjudicated basin, as an alternative to basin adjudication.¹⁶⁹ “[B]ecause these districts [special and general act districts] are ‘regulated’ by the state through the Water code, they appear to treat groundwater more like a public resource than a court adjudicated property right.”¹⁷⁰ Some advocate moving away from the adjudicated model—conceptually based in increased privatization and exchange of water rights—towards a model that treats water as a communal public resource.

While the basin remains unadjudicated, however, Orange County Water District took full advantage of upstream adjudications in attempts to secure inflow to the basin. And the District’s supply-side management strategy has come at high cost relative to arguably cheaper adjudications in nearby basins. Its continued dependency on imported water and its rejection of water transfers is arguably unsustainable.

The California legislature created the Orange County Water District in 1933.¹⁷¹ Orange County’s water management initially focused solely on increasing supply of water into the basin.¹⁷² Orange County Water District shifted course in the 1960s away from simply supply-side management to conjunctive management. The District has attempted to not only increase supply, but alter use patterns and conserve basin water for use during emergencies and peak periods.

The District has successfully limited overdraft and held back seawater intrusion, but at relatively high cost.

“[T]he decision not to assign and limit pumping rights in Orange County has resulted in some loss of efficiency and some increase in risk. Without defined and transferable pumping rights, basin users have no means of moving groundwater production from lesser- to higher-valued uses. Users who stop pumping from the basin benefit other users but receive nothing in return.”¹⁷³

By relying on imported water instead of pumping limitations, Orange County is particularly vulnerable to extended droughts, when importers may choose to curtail water deliveries.¹⁷⁴ As environmental attorney Kelly Hart argued, “[t]his [Orange County] system is not a sustainable method of preventing overdraft since it relies entirely on artificial recharge by imported surface water from the Colorado River and the Northern California State Project.”¹⁷⁵ Part 3.C. below elaborates on why California may be unable to continue to depend on imports from the Colorado River and State Water Project.

Procedural inefficiencies increase the time and resources needed to litigate groundwater rights.

jurisdiction over the rights of all affected parties—surface and groundwater.

Adjudications are often criticized, rightfully so, for wasting time and legal resources on drawn-out, complex litigation. Lack of monitoring, oversight and enforcement of groundwater withdrawals has complicated court adjudications, requiring courts to spend years sorting through competing claims of historical use often without a strong evidentiary record upon which to rely. The Mojave River basin serves as an example of how overlying water users, lacking defined water rights, may have

little incentive to allow measurement and monitoring of their water use.

It is often assumed that a court adjudication of a groundwater basin results in a reliable, definitive determination of rights in that basin.¹⁷⁶ This assumption, however, is subject to several caveats. While Western courts, including California courts, have developed sophisticated procedures to deal with multi-party litigation over water rights, finality of judgment has eluded the courts, particularly concerning groundwater apportionment.¹⁷⁷ Nor does every adjudication result in a determination of

water rights for every user in the basin. Part of this is because large, influential water users in an adjudication are inherently self-interested parties whose concerns do not always overlap with a strict definition of rights in the basin. These parties exert significant power in settlement negotiations. Furthermore, while adjudicatory judgments can impose needed regulatory structure on groundwater use within a basin, that structure does not necessarily result in the type of defined property right in water that would result in a competitive water trading market. The closest that adjudications have come to a functional water trading market are the mostly abandoned exchange pools that used prices usually defined by the watermaster instead of the market.

The imaginary distinction between underwater streams and percolating groundwater leads to particularly pernicious inefficiencies in adjudications. In Mojave River basin, for example, confusion over whether users had rights to an underwater stream or a percolating groundwater basin helped prolong litigation over water rights in the basin.¹⁷⁸

Finally, to be a reliable determination of water rights, an adjudication would need to consider all relevant surface and water rights within the same proceeding. Courts have been unwilling or unable to do this. Courts should exercise their equitable power to acquire jurisdiction over users of both groundwater and connected surface water in an adjudication. Because surface water rights are statutorily defined and permitted by the State Water Resources Control Board, groundwater users are perhaps unlikely to benefit from adding surface water rights to groundwater litigation. Thus the onus must be on the court to join all necessary parties.

Environmental inefficiencies. For this paper and in the context of a groundwater adjudication, an environmental inefficiency is any a mechanism or structure that externalizes environmental benefits. This externality would be seen as a systemic failure to properly value the environmental benefits, by not devoting adequate groundwater for high-value environmental uses. Lack of authority and attention to water quality problems, reliance on water

imports instead of efficiency improvements in water use, and the difficulty in regulating localized groundwater use are all examples of environmental inefficiencies in past groundwater adjudications.

Adjudications have reflected, perpetuated, or given rise to several types of environmental inefficiencies. One example relates to the issue of water quality. Water quality has been a continuing problem for adjudicated basins, resulting in contamination from volatile organic compounds, seawater and nitrates, to name a few examples. Originally, watermasters lacked authority to regulate or address water quality concerns, although many adjudication judgments have since been modified to increase oversight of water quality concerns.

Improving water quality in a basin can be complicated. For example, a rising water table may bring the groundwater in contact with various contaminants in the soil, such as increased nitrate concentrations.¹⁷⁹ Prevention of seawater intrusion may require a combination of strategic pumping, recharge and creation of coastal barriers.

Another environmental inefficiency revealed by the adjudications relates to the magnitude of reliance on imported water in basin settlements. Significant reliance on imported water suggests that adjudications have not encouraged more efficient uses of water in-basin but have, instead, simply exported inefficiencies. Imported water is considered outside the adjudicated basin system, a groundwater recharge bonus that has allowed adjudicated parties to propose settlements that avoid strict restrictions on groundwater extractions. This reliance on imports can be seen in many of the adjudications, which encourage importation of water from outside the basin as a response to decreased local groundwater supply. “The common pattern has been to allow overdraft in a basin in order to permit the building of an economy that could finance the purchase of supplemental imported water supplies.”¹⁸⁰ And, in fact, California’s groundwater overdraft decreased from 4.4 maf to 2.3 maf between 1957 and 1974.¹⁸¹ That decrease may be attributable almost entirely to California’s surface water projects and the importation of water from

An environmental inefficiency is any a mechanism or structure that externalizes environmental benefits.

the Colorado River.¹⁸²

A third example of environmental inefficiency is the difficulty in restricting groundwater production in localized areas. In theory, with jurisdiction over water quality issues in a basin, the watermaster can restrict any party from pumping—even if doing so would restrict that party from using its full water allocation.¹⁸³ Such a restriction, however, would prove to be politically unwise.¹⁸⁴ The party would be faced with no viable alternative to pumping. Absent the ability to sell their water allocation to a user elsewhere in the basin, it would be, as a practical if not legal matter, forfeit. Furthermore, watermasters have been unwilling or unable to impose localized pumping taxes to achieve the same result. This leads us to the problem of economic inefficiency.

Economic inefficiencies. In adjudicated groundwater basins, economic inefficiencies limit or prevent the shift from low- to high-value water uses. The reluctance of the courts to use an equitable solution, as discussed above the Chino, Goleta, and Mojave River basins, can mean that rights are not fully defined and thus remain difficult to transfer.

Water exchange pools were meant to overcome this difficulty and facilitate efficient transfers, but their restrictive rules and non-market based pricing schemes limited their usefulness. The transfer of water in an exchange pool is the transfer of part of the allocation right from the seller to the buyer. Because the buyer and seller obtain their water from the same basin, the buyer simply gains the right to withdraw additional water from the basin using the buyer's own wells over the next water year. The seller, conversely, agrees to produce less water over the next water year.

Repeated attempts to establish exchange pools in basins such as Raymond, Central and West have resulted in a complex set of rules and the use of non-market price setting. Prices are generally set by the watermaster, using complicated formulas that have little to do with actual supply and demand for groundwater within the basin. The water exchange's restrictive rules,

meant to construct a regulated monopoly in water transfers, prevent a meaningful, economically efficient market in water rights.

Water exchanges have subsequently fallen out of favor in most basins. The Tehachapi Watermaster, whose basin suspended water sales in 2007, noted that such sales were unnecessary due to land use and water rights changes and that exchange provisions in other basins are now also unnecessary.¹⁸⁵ And in fact, water exchange pools or water trading within the respective adjudicated basins appears quite limited in practice.

As an alternative to exchange pools, sales or leases of individual water rights are possible within adjudicated basins. But water rights transfers—through the sale or lease of the water right—present their own set of problems. While it is true that water rights transfers have seen some success—for example, in the Main San Gabriel basin¹⁸⁶—the use of water rights sales and leases has been limited due to high transaction costs. Transfer restrictions prevent liquidity and raise transaction costs in any potential water trading market. If rights can be transferred, they can only be done if the purchaser of those rights subjects himself to the jurisdiction of the adjudicating court. Often, transfers of appropriative rights require written notice and approval by the watermaster and/or the court.¹⁸⁷ Transfers outside the basin are generally prohibited by the court judgment or watermaster rules. Furthermore, such rights transfers are generally done on a one-to-one basis, limiting the type of transparency and public disclosure required for a functional exchange.

Some adjudications, particularly in regard to overlying rights, have failed to define individual pumping rights. Orange County also lacks individually quantified rights. “[A]bsent defined and transferable pumping rights, users have no incentive to move from lesser to higher valued uses.”¹⁸⁸

A market exchange in water should not depend on pricing determinations by the regulator. A market exchange in water should operate full-time, not on a yearly basis. A market exchange should have publicly available prices and trade histories.

Economic inefficiencies limit or prevent the shift from low- to high-value water uses.

And a market exchange should not necessarily limit sales to only adjudicated parties.¹⁸⁹ I recommend in Part 4.B below a more substantive system of market-based transfers for both water entitlement and water allocation shares.

C. Climate change and shifting development put California's groundwater adjudications at risk of failure

Climate-related changes in precipitation and shifting development threaten the integrity of California's adjudications. California already uses more water than it has, and relies on groundwater overdraft for a significant portion of its supply. At the same time, public realization and support of the importance of environmental water uses has led to increased surface water diversions for such uses. On top of the oversubscription, climate change will further reduce California's available water supply. The combination of development, population growth and shifts in precipitation could undermine the delicate balance of cooperative water management inherent to California's adjudications. It could also give rise to the need for new adjudications.

Adjudications have typically divided water rights in a basin based on historical use and historical averages. Annual management by watermasters tend to focus backward on historical use and historical averages in order to project safe yield and annual allocations. This is particularly true in basins that used mutual prescription formulas to allocate rights. Climate change may bring a detrimental precipitation shift that would decrease annual recharge in a basin and make less water generally available. To make up the difference between safe yield and basin water rights, adjudicated basins have relied on the same imports that are threatened with saline contamination, environmental concerns and decreased spring runoff.

California's long-term trend over the past 100 years has been a demographic shift from rural to urban sector growth.¹⁹⁰ Per capita water use has decreased somewhat over

time.¹⁹¹ California's population increase,¹⁹² however, means that future water use forecasts project increased urban water use, with a likely decrease in agricultural water use and an increase in environmental use.¹⁹³ This scenario may be compounded by the loss of some Colorado River water, along with efforts to address the Bay-Delta and aquifer overdrafting.¹⁹⁴

California cannot continue to assume that the past 100 years of hydrologic conditions will be repeated for the next 100 years.¹⁹⁵ Ellen Hanak, for example, identifies twelve likely changes that will affect California water, including expanded environmental protections, transformation of the Delta from sea level rise, and population growth.¹⁹⁶ When a watermaster defines safe yield with reference to historical rainfall patterns, historical water use or average inflow, the watermaster risks locking in a groundwater management regime that slowly drifts further away from our shifting hydrological reality.

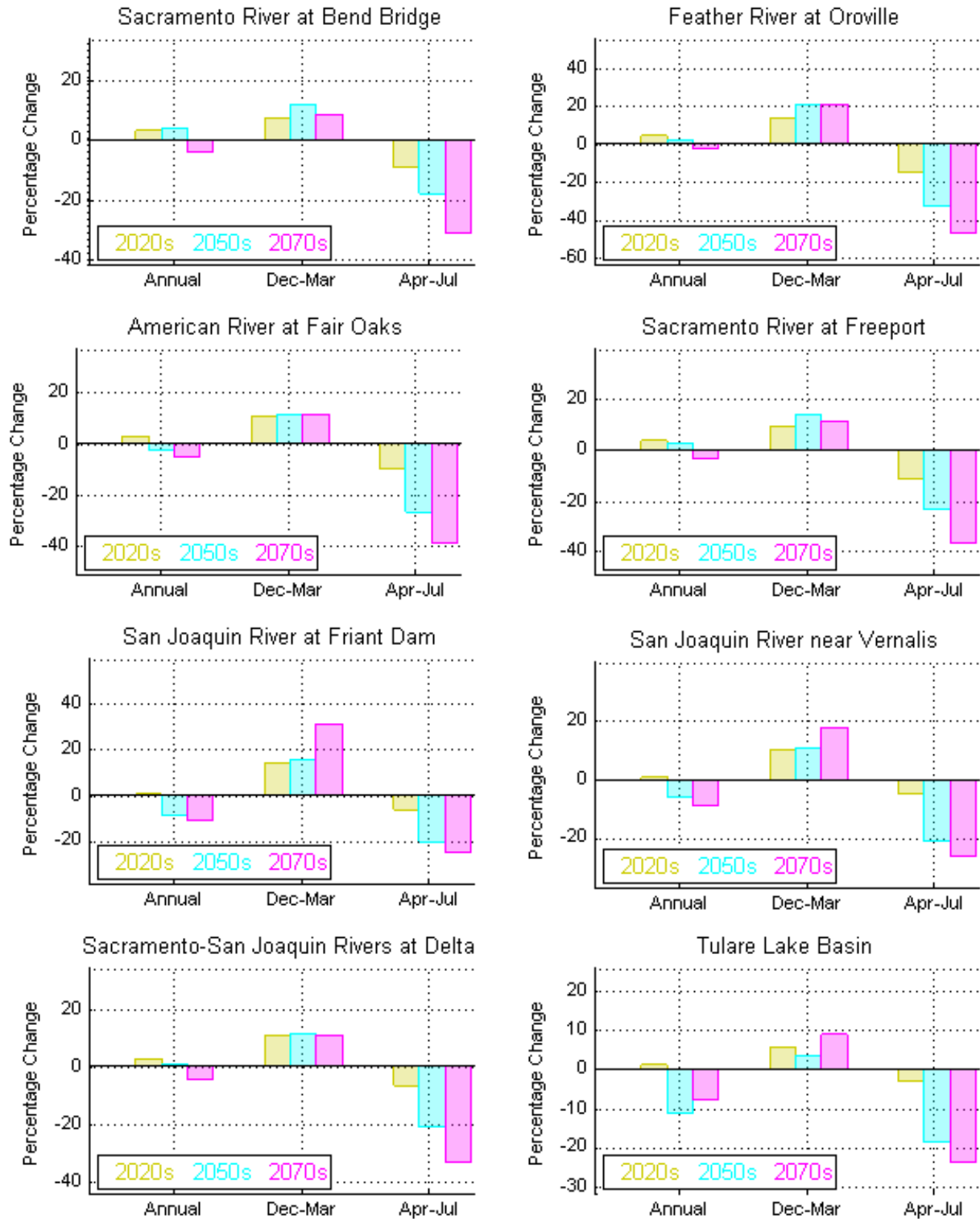
Southern California has seen an increase in average mean temperature of 2.5°F since 1950.¹⁹⁷ The Sacramento and San Joaquin River basins have seen mean-annual temperature increase by 2°F over the 20th century.¹⁹⁸ The Bureau of Reclamation forecasts that the Sacramento and San Joaquin basins will see a strong decrease in summer runoff and an increase in winter runoff in the 21st century as warming continues.¹⁹⁹ The total annual runoff will, on average, remain the same or decrease slightly during this time period.²⁰⁰ The end result may be an increase in seasonal droughts. California will no longer be able to depend on water storage via the winter snowpack. Instead, more winter precipitation will occur in the form of rain, and the winter/early spring runoff will increase. This early runoff cannot be captured in reservoirs, which must keep adequate space to avoid spring flooding. The end result is no runoff during summer months, when the Central Valley sees little to no precipitation. In addition, increased average temperatures will increase the average rate of evapotranspiration for a given region.

Rising sea level could adversely affect the

California cannot continue to assume that the past 100 years of hydrologic conditions will be repeated for the next 100 years.

Figure 7 | The Projected Effects of Climate Change on Runoff for several CA Basins

* shown as mean runoff as compared to 1990 baseline conditions



Source: U.S. Bureau of Reclamation, "SECURE Water Act Section 9503(c) - Reclamation Climate Change and Water," 2011

availability and reliability of MWD's imports. Rising sea level could increase the salinity of Delta water.²⁰¹ Today, MWD blends high-salinity Colorado River water with low-salinity Delta water,²⁰² a process that it may not be able to take advantage of in a future world of higher-salinity Delta water. Even if the Delta water exports remain at low-salinity levels, less water exports from the Delta will nevertheless harm MWD's ability to blend sufficient quantities with high-salinity Colorado River water.

To the extent that California has mitigated overdraft of its groundwater basins—both adjudicated and unadjudicated—it has done so through increased reliance on water imports. Even at current water import prices, relying on water imports to address overdraft problems is economically infeasible. As water imports become less reliable and more expensive, overdraft will increase.

For all of these reasons, we can expect the management of adjudicated basins to become increasingly contentious and the incentives to begin litigation in unadjudicated basins to also increase.

To give one extreme example, lack of regulation over the various basins and subbasins in the Central Valley will make water management in that 14.4 million acre region increasingly untenable. Currently, groundwater overdraft in the Central Valley is extremely high, and can even be measured from space by examining gravitational differences.²⁰³ As pressures in this region mount, groundwater users may turn to the courts for relief, through adjudication.

Yet adjudication in the Central Valley under current law is almost unthinkable. The region has many more overlying groundwater right holders, with a more complicated overlay of surface water rights, than basins that have so far been adjudicated. A court adjudicating the Central Valley would encounter irrigation districts, municipal water utilities, and the often conflicting interests of farmers, all while dealing with the complex system of canals and aqueducts that move water from the Delta to southern California.

Anticipating this future of increased water scarcity, additional adjudications, and

increased pressure on the courts to define water rights, Part 4 offers a set of reforms to make groundwater adjudications a more effective water management tool.

IV. Reforms to Improve Efficiency and Effectiveness of California's Groundwater Adjudications

California's system of groundwater rights and management must be reformed. Ideally, the California Legislature would undertake a comprehensive effort. The political climate for groundwater management reform, however, is admittedly poor. While reform of the state's water rights, as was proposed by the Governor's Commission in 1978, may remain unreachable, modifications to future adjudications and current adjudicated basins may be a more easily achievable goal. Currently, only a relatively few basins are adjudicated in California. Changes affecting those basins and future unknown adjudications may not engender the strong stakeholder opposition seen with proposals for statewide groundwater reform.

The below recommendations focus on smaller changes, short of full-scale reform, that attempt to make groundwater adjudication more legally and economically efficient while still protecting groundwater as an important public resource. Part 4.A offers changes that could be implemented through the California legislature to improve future groundwater litigation. Part 4.B offers changes that could be implemented through an agreement between the watermaster and adjudicated parties in order to provide more flexibility for the watermaster to regulate groundwater production and storage while providing water users with more flexibility in how and when they use water. This second set of reforms could benefit the management of adjudicated basins today as well as management of future adjudicated basins.

A. Reforms to improve litigation of groundwater basins

The California legislature and the judiciary could work to ensure that future adjudications

run more smoothly than past adjudications. To protect the rights of all water users in a watershed, a court should assert jurisdiction over both groundwater and surface water users. The California legislature could go further, requiring that groundwater users be permitted and otherwise treated just as surface water users in the state. To decrease the burden on state trial courts and help ensure fair judicial outcomes, California should establish a water court. And to speed up adjudications, California could take several steps towards more consistent statewide groundwater monitoring.

Exercise equitable power to acquire jurisdiction over users of both groundwater and connected surface water in an adjudication.

Courts have significant equitable power to join necessary parties to litigation if those parties are necessary to accord complete relief to the litigants in an action.²⁰⁴ Courts should exercise this power when adjudicating a groundwater basin. To adequately define groundwater rights through a judicial adjudication means defining those rights not just in reference to other groundwater right holders, but also to permitted surface water rights that may affect groundwater in the surrounding basin. Courts should be more aggressive in requiring joinder of relevant surface right holders, both to fully determine the rights of groundwater users and to protect existing surface water rights.

Considering simultaneously the rights of both surface and groundwater users may expand the equitable options and settlement possibilities available to the court. *City of San Fernando* and *City of Barstow* have limited the threat of equitable apportionment that was used in earlier adjudications to bring overlying groundwater right holders to the settlement table. The rather uncertain set of priorities inherent in considering riparian, surface appropriation, overlying groundwater, and appropriative groundwater rights simultaneously makes an equitable apportionment with defined water rights a promising solution and could drive settlement.

Revisit the recommendations for

streamlining court adjudications outlined in the Governor's Commission.

The Legislature should revisit the recommendations of the Governor's Commission. In 1978, the Governor's Commission to Review California Water Rights Law offered a series of recommendations to streamline judicial groundwater adjudications.²⁰⁵ Many of these procedural and substantive improvements are still worthy of consideration today, and worth revisiting. In particular, prompt submission of a request to refer an adjudication to the board for investigation of physical facts,²⁰⁶ use of a preliminary injunction to prohibit increased pumping in an overdrafted basin²⁰⁷ and detailed notice and filing provisions could be useful for improving streamlining groundwater litigation.

Remove all references to "subterranean streams" from the Water Code.

The concept of a "subterranean stream" in statutory and case law belies the physical reality. The California legislature should remove all such references, thus making all groundwater percolating. Given the current legal presumption that groundwater is percolating, this change is not necessarily far-reaching. In its place, the Legislature should explicitly acknowledge the physical interconnection between surface and groundwater and request that courts and water management agencies consider this interaction when adjudicating or regulating water rights.

Establish a state water court.

State legislation clarifying procedures for judicial adjudication of groundwater basins could be part of a broader proposal to establish a water court with jurisdiction over all surface and groundwater rights litigation, including basin adjudications. Adjudications, and water law more generally, is a complex area of litigation both procedurally and legally. Early adjudications benefited from a few key players, such as Judge Moore and certain attorneys that worked on several adjudications. The Colorado water courts, specialized state courts with exclusive subject-matter jurisdiction over water rights and water use, could serve as the beginning

of a template for a water court system in California.²⁰⁸

A California water court would provide needed expertise and alleviate the burden on the general trial courts. Currently, parties to groundwater litigation must often pay for experts to provide independent advice to the court²⁰⁹ due to the complexities of the case. In a dispute over appointment of the watermaster for Chino basin, for example, the Judge sought the advice of both outside counsel and an independent engineer in order to “deal[] with the barrage of complex arguments hurled at him by the seasoned water lawyers who represented water producers.”²¹⁰ Specialized knowledge is particularly important in water cases, in which a few well-resourced parties can overwhelm a judge with both scientific jargon and obscure water law theory. One alternative that would not require legislation would be greater use of the court reference process, by which the court requests expert advice and an investigation of the basin by the SWRCB.

Improve the tracking of groundwater use statewide and consolidation of local groundwater data. The Legislature could continue to work to improve our understanding of California’s groundwater resources. Past adjudications have often stumbled over defining existing groundwater rights and use in the basin. Understanding the physical facts of a basin and historical water use, a task previously given to the Division of Water Resources, often took years of study and cost the parties substantial sums of money to fund. Thus, court adjudications could be greatly simplified if groundwater data was available and made reasonably consistent between basins.

Under Water, the first brief in this series, described the need for better groundwater monitoring and data collection statewide.²¹¹ In particular, I recommended that local water districts submit standardized data on groundwater elevation, use and quality. I also recommended accurate metering of all groundwater use, an inevitable requirement of any adjudication. Finally, I recommended the establishment of a publicly accessible,

statewide database to collate this data.

B. Reforms to improve management of adjudicated groundwater basins

Management of current and future adjudicated basins should be made more consistent, making it easier for water users to comply with requirements in multiple adjudicated basins and increasing the potential for market-based exchange of water rights. The water rights system should promote and reward efficient use of water and environmental protection.

The below recommendations explain how, by unbundling groundwater rights, the watermaster (potentially in coordination with the parties and the court) could accomplish these goals for an adjudicated basin. I recommend a new system for defining and using these unbundled rights. These are changes that can be implemented through amendments to the adjudication judgment, with no change in the underlying water law.

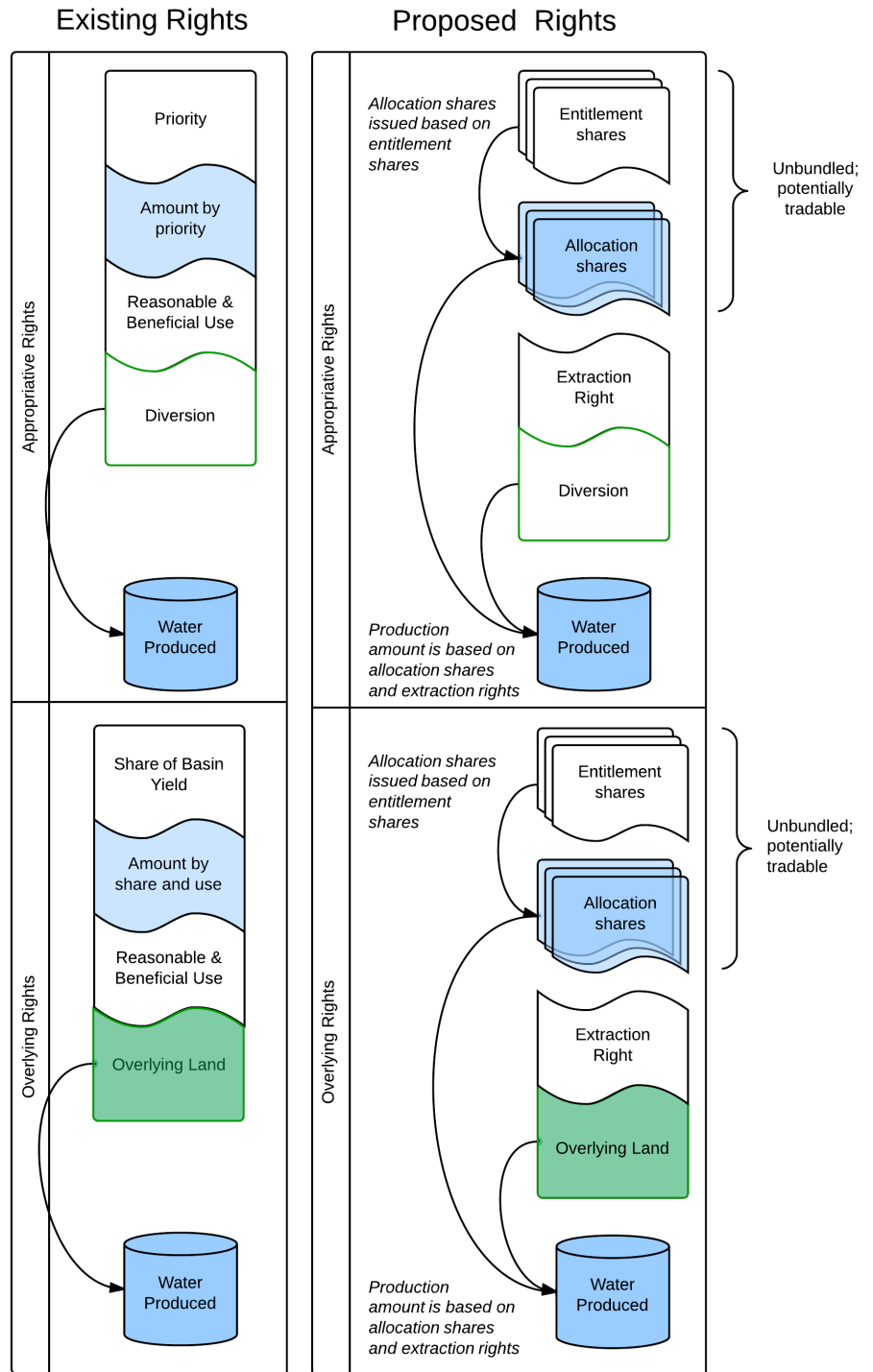
Create entitlement shares to represent each right holder’s portion of the groundwater resources. Under California water law today, part of the groundwater right—both overlying and appropriative—is the “entitlement” to a portion of the basin’s water supply. Under my proposed system, an entitlement share should be defined as the perpetual or ongoing right to exclusively access a share of water from a specified consumptive water pool. Separate pools would represent overlying and appropriative water rights, respectively.

The amount of water represented by the correlative and appropriative pools should be the total amount that could be claimed by all right holders, overlying and appropriative, respectively, in the basin. In an adjudication, this total represents each right holder’s defined right. Essentially, the court would tally all the claimed rights for each group—correlative and appropriative—in order to define the total number of shares for each pool. Entitlement shares, because they represent the total claims to the water in the basin, may exceed the amount of water

Figure 8 | Existing versus proposed groundwater rights systems

Under California's existing groundwater rights management system, a grouping of concepts makes up the right to produce water from a basin. The overlying right holder's share of the basin (and current need) defines the amount that he may periodically extract. Reasonable and beneficial use limits his right and the manner in which he uses his periodic share. His entire right is appurtenant, tied to the overlying land. An appropriative groundwater right works in a similar manner. The right to a share of the basin, however, is based on a priority system and the produced water can be used on another's land. Thus, appropriative rights are not appurtenant, but rather tied to a diversionary point.

Under my proposed groundwater rights management system, the distinct parts of the groundwater right are "unbundled," meaning that these parts can be referred to as distinct objects. The entitlement share embodies the idea of priority in appropriative rights or the basin share in overlying rights. The watermaster issues periodic allocation shares based on the entitlement, in much the same way that right holder's share of the basin (and any relevant priority) defines his periodic extraction. The extraction right remains tied to either the overlying land or the diversion. Here, the extraction right embodies the concepts of reasonable and beneficial use under the existing system. Together with the allocation, the extraction right limits the production amount.



that can safely be withdrawn from the basin. (Note that the amount of water each right holder may periodically withdraw, given their entitlement shares and the watermaster's determination of safe yield, is represented by allocations. Safe yield is not essential to defining entitlement shares.)

The Chino basin adjudication, for example, defined distinct pools for three groups: overlying agricultural, overlying non-agricultural and appropriative. The 1178 agricultural pool members shared 82,800 af/yr²¹² but the court did not further distinguish their individual share of that pool. The 12 members of the non-agricultural pool had individual rights that totaled 7,366 af/yr. The appropriative pool consisted of 22 producers whose individually defined rights totaled 49,834 af/yr.^c

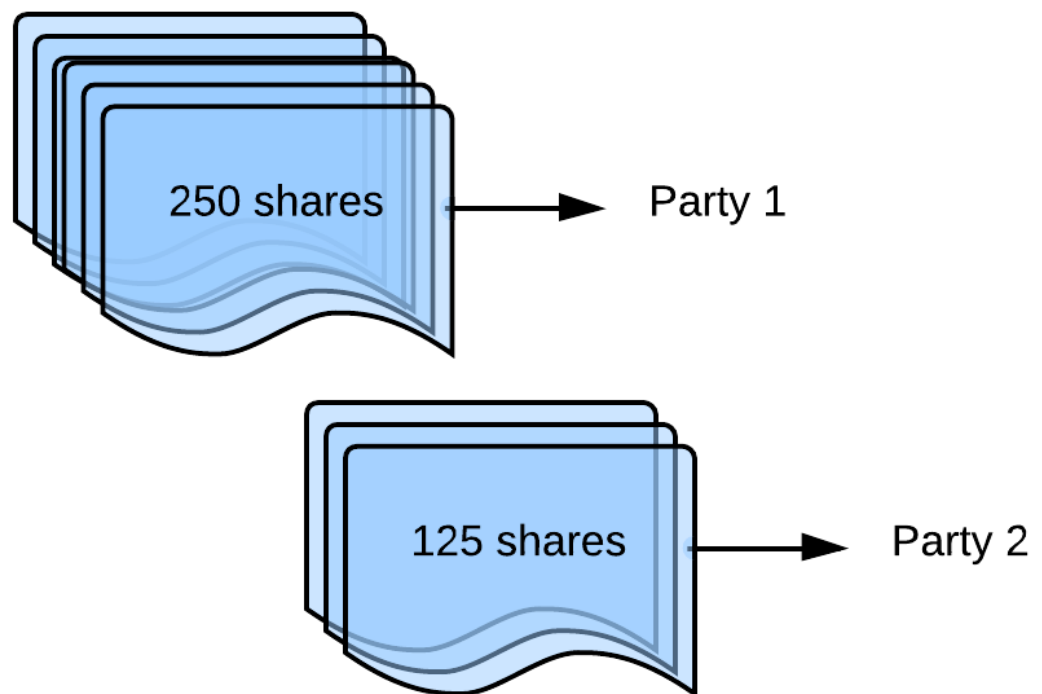
Under my recommendation for entitlement shares, Chino basin would have two pools: a correlative pool totaling 90,166 acre-feet worth of entitlement shares and an appropriative pool totaling 49,834 acre-feet worth of entitlement shares. Each right holder would receive entitlement shares representing his portion of the respective pool. Ideally, each agricultural pool member would receive individually-defined entitlement shares (and thus have individually defined overlying rights), although other means of apportionment could be used if necessary (such as using a committee to hold the entitlements in trust for all agricultural users equally, which could obviate the need to define individual rights for each member).

c For narrative simplicity, I am omitting some of

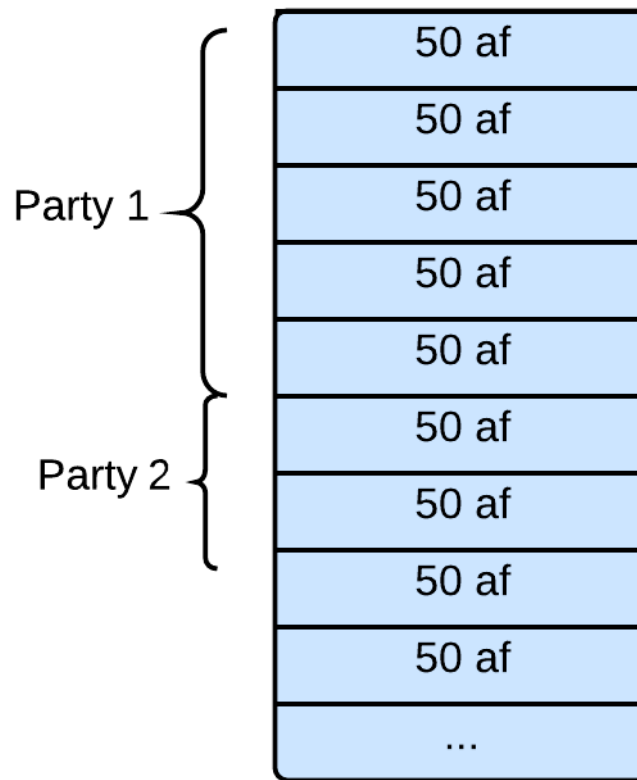
the details of these specifications.

An entitlement share should be defined as the perpetual or ongoing right to exclusively access a share of water from a specified consumptive water pool.

Figure 9 | Entitlements by Proportional Shares



Imagine a basin in which the overlying users currently have rights amounting to 1000 acre-feet. Using proportional shares, overlying user (1), holding rights to 250 acre-feet, would receive 250 entitlement shares of the correlative pool if each share was initially valued at 1 acre-foot. Overlying user (2), holding rights to 125 acre-feet, would correspondingly receive 125 entitlement shares.

Figure 10 | Entitlements by Amount

The correlative pool would represent the water rights of overlying users.

As in Figure 9, imagine a basin in which the overlying users currently have rights amounting to 1000 acre-feet. Using fixed amounts for entitlements, overlying user (1), holding rights to 250 acre-feet, would receive 250 acre-feet of entitlements to the correlative pool. Overlying user (2), holding rights to 125 acre-feet, would correspondingly receive 125 acre-feet of entitlements to the pool.

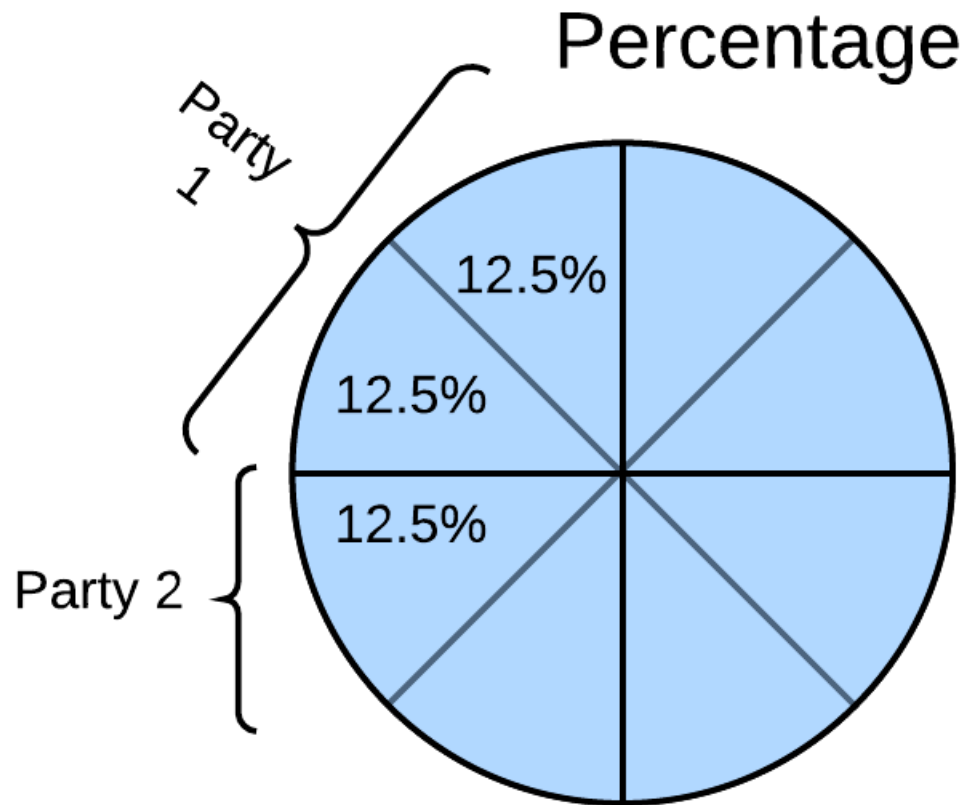
Correlative Pool. The correlative pool would represent the maximum potential water devoted to overlying rights. In other words, if all overlying right holders extracted water for beneficial and reasonable use on their overlying lands, the correlative pool would represent the water used. When creating entitlements to a correlative pool, the primary issue is how those entitlements represent an owner's right to a portion of the pool. An entitlement could represent the right to a fixed amount of the pool, a percentage of the total pool, or one of a number of equal shares—much like shares of stock in a company. I recommend that the watermaster take the latter approach, for the following reasons.

In my proposal, entitlements are defined in terms of shares, similar to the way

corporations issue shares of stock. An owner of 1% of all outstanding shares would be entitled to 1% of the correlative pool. Issuing new shares for new overlying uses would effectively dilute all existing shares, which corresponds to the idea that overlying right holders share the basin resource equally. Referencing past allocations and current water projections would allow entitlement owners to estimate the “worth” of each entitlement share in af/yr.

Using the Chino basin example, the correlative pool would consist of 90,166 shares. At the start, each share would represent approximately 1 af/yr. The twelve non-agricultural members would be awarded 7,366 shares of the total. The agricultural pool members would control the remaining shares.

Figure 11 | Entitlements by Percentage



As in Figure 9 and Figure 10, imagine a basin in which the overlying users currently have rights amounting to 1000 acre-feet. Using percentages for entitlements, overlying user (1), holding rights to 250 acre-feet, would receive entitlements worth 25% of the correlative pool. Overlying user (2), holding rights to 125 acre-feet, would correspondingly receive entitlements worth 12.5% of the correlative pool.

This proposal offers several benefits over competing options, including the status quo. Early adjudications, such as Raymond basin, relied on awarding each right holder a fixed amount of water from the basin. Entitlement shares could take a similar approach. One entitlement share, for example, could entitle the owner to periodic allocations of 1 acre-foot from the correlative pool. This would limit overlying rights holders to a fixed amount based on their reasonable beneficial use. But defining an entitlement as the right to a specific amount of the total correlative pool, though conceptually simple, does not easily account for an overdraft situation, in which no overlying right holder should receive his full share of the pool. I therefore do not recommend it.

Later adjudications, such as the Main San Gabriel River basin, have often awarded rightsholders a percentage of water from the basin. This allows the watermaster to periodically adjust the amount of water extracted from the basin. Under this approach, one entitlement share would represent a fixed percentage, say 0.1% of the total correlative pool. This communicates the idea that in an overdraft, each overlying user should share in the reduction. But it potentially allows overlying users to exceed their reasonable use, because a percentage share lacks any upper limit on the water entitlement.

Moreover, entitlements representing percentages would not easily allow

expansion for new use, as required by *Goleta basin* and *Mojave Water District*. The percentage represented by the existing entitlements should not exceed 100%, which means that the total number of entitlements could not be changed without changing the definition of what one entitlement share represented.

My proposed solution, defining entitlements in terms of shares, avoids these difficulties.

Appropriative Pool. The appropriative pool would represent the maximum potential water devoted to appropriative rights. The fact that appropriative rights are lower priority than correlative rights would be accounted for in the allocation shares, discussed below. To determine priority among appropriative right holders, I recommend that each entitlement share of the appropriative pool represent a fixed amount of water, say 1 af, with an assigned priority.

Groundwater appropriators typically have rights defined as a specific amount, based on their historical use. Unlike overlying users, there is no sense under California law in which appropriators share in the total groundwater yield; the appropriator with the oldest priority typically receives his entire share before any junior appropriators.²¹³

Totaling all appropriative rights claims in a basin will define the appropriative pool. Each entitlement share to that pool can be defined as the right to a specific amount, say 1 af, with a specific priority date. As discussed below, allocation shares will be periodically awarded based on this priority. Note that this means that junior priority entitlement shares would be more risky—and thus less valuable—than senior priority shares, because in any given year a junior priority share may not receive allocation shares equal to their full claim. This closely corresponds with how appropriative rights are currently handled in an adjudicated groundwater basin.

In the Chino basin example given above, the twenty-two appropriators would receive 49,834 entitlement shares, if each share represented 1 af.

Periodically award allocation shares to entitlement owners.

Another part of the groundwater right—again, both overlying and appropriative—under California law today is the right to periodically extract a specific volume of water from the basin. This right depends on safe yield. From this right I would define an “allocation share,” representing the right to withdraw a specific volume of water from the basin.

The value of the allocation—in acre-feet—would vary by year, from 0% to 100% of the holder’s entitlement, based on the watermaster’s estimate of safe yield. Granting allocation shares to entitlement holders is a bit like issuing dividends to stockholder. By periodically awarding allocation shares to entitlement holders, the watermaster is, in effect, allowing periodic withdrawals from the basin in proportion to each user’s right.

Based on the safe yield of the basin, the watermaster would periodically calculate a total amount of water that may be withdrawn from the basin. (I discuss the determination of the safe yield in more detail below.) The watermaster would then first devote all or some of that total amount to the correlative pool. Any excess amount would be devoted to the appropriative pool. This is the same type of split currently done pursuant to the common law and procedures customarily followed in each adjudicated basin.

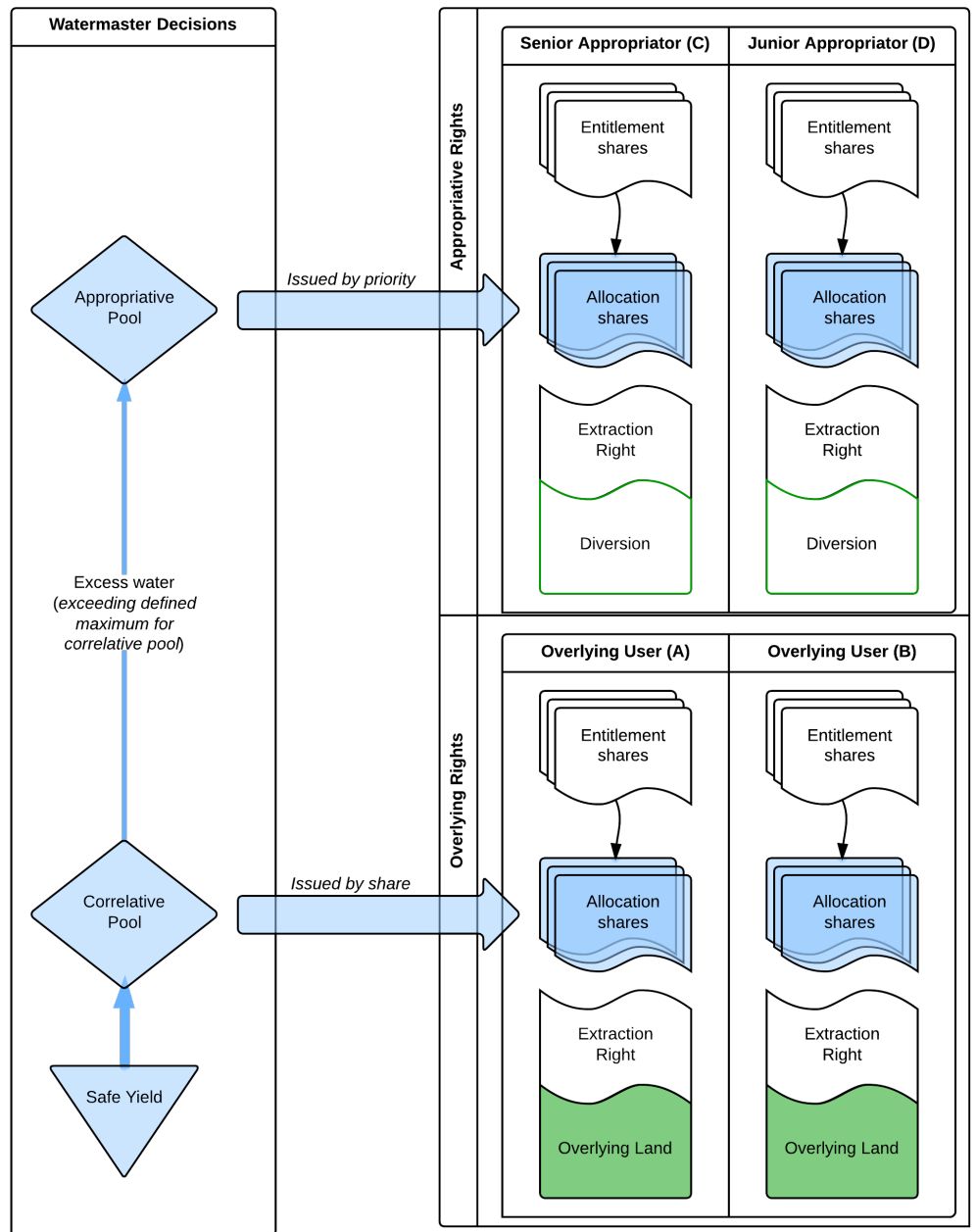
Currently, water users in an adjudicated basin generally have to file paperwork with the watermaster after each Water Year, detailing their water use for that Water Year. Excess use beyond their right can be penalized; unused water may be carried over to the following Water Year. This system of measurement after-the-fact may be efficient from a paperwork standpoint, but it limits the watermaster’s ability to respond to seasonal changes in water use and invites errors that would invalidate the safe yield of the basin.

Instead, a water user should not be allowed to extract *any* water without holding an appropriate number of allocation shares. One allocation share would allow the holder to extract a specific amount, say 1 af, from the basin. As discussed below, the holder

The appropriative pool would represent the rights of appropriators.

An allocation share, awarded to an entitlement holder, would represent the right to withdraw a specific volume of water from the basin.

Figure 12 | Issuing allocations to the appropriative and correlative pools



Once the watermaster determines the safe yield for a given period, he first looks to fulfill the correlative pool. If the defined maximum for the correlative pool is not met, then all of the water will be allocated to holders of entitlements to the correlative pool, in proportion to the shares held by each. If there is available water beyond the defined maximum for the correlative pool, then the excess goes to the appropriative pool. The watermaster first issues allocation shares for this pool to the senior appropriator (i.e., the person holding the senior entitlement shares). If any water remains available, the junior appropriator (i.e., the person holding the junior entitlement shares) would receive his allocation. Each water user may then use his allocation shares, in accordance with his extraction right, to produce water from the basin.

would have to have physical access to the basin, in the form of sufficient extraction rights, to actually use the allocation share to extract water from the basin. Allocation shares would be retired in conjunction with water extraction. For example, users could be required to submit to the water master extraction totals and sufficient allowance shares to cover that extraction on a monthly basis. There should be no distinction between allocation shares held by appropriators versus overlying users.

Defining water rights in an adjudicated basin in terms of entitlements and allocations should bring the rights closer to the initial conception of such rights under the law. Overlying users retain a sense in which they share in the yield of the basin because their entitlements are based on percentage shares. Appropriators can receive entitlements in line with their priority.

Correlative Pool. In most adjudications, groundwater appropriators have a lower priority than overlying users and thus receive water only after the needs of overlying users have been fulfilled. To reflect this priority, the correlative pool would have a defined maximum (reflecting the total potential overlying rights for the basin). In a flood year, the watermaster might be able to award the maximum amount to the correlative pool and entitlement holders would thus get 100% of their potential right. In a drought year, the watermaster might only award 50% of the maximum amount to the correlative pool.

I recommended above that overlying users be given entitlement shares, in order to allow for potential expansion due to use of formerly unexercised rights. Any new use approved by the watermaster would subsequently increase the defined maximum for the pool. Note that some adjudication judgment may not allow expansion of the total amount of water dedicated to the correlative pool.

In the Chino basin example, the defined maximum for the correlative pool is 90,166 acre-feet. Assume that each allocation share represents 0.1 acre-feet. If the watermaster determines that the safe yield allows withdrawal of 63,166 acre-feet, then the holder of one entitlement share would

receive 7 allocation shares allowing her to withdraw 0.7 acre-feet.²¹⁴ If the safe yield changes in the following year, entitlement holders will each receive more or less allocation shares accordingly.

Appropriative Pool. For groundwater appropriators today, users are periodically allowed to withdraw water from the basin in line with their priority. Presuming any water is left after accounting for overlying users, the watermaster then allows appropriators to withdraw water, starting with the most senior right holder. A junior right holder receives an allocation only after fulfillment of the senior right holder.

The same system would be used for allocation shares issued to entitlements for the appropriative pool. Allocations would be awarded to the holders of entitlement shares, in order of priority of those entitlement shares, until the remaining safe yield was allocated.

Imagine that, in the Chino basin example, the watermaster finds that users may withdraw 100,166 acre-feet total. The first 90,166 acre-feet would go to the correlative pool, discussed above. The remaining 10,000 acre-feet would go to appropriators. Of the twenty-two appropriators, assume that one holds the 5,000 most senior entitlement shares and another holds 10,000 second-most senior (“junior”) entitlement shares. Assume again that 1 allocation share is worth 0.1 acre-feet and each appropriative entitlement share is worth 1 acre-foot. Then appropriators are entitled to 100,000 allocation shares corresponding to the 10,000 acre-feet of the safe yield. The watermaster would issue 50,000 allocation shares to the senior holder. The junior holder would receive the remaining 50,000 allocation shares.

Use extraction rights, tied to the land, to prevent localized harm from excess groundwater production. Overlying rights under current California water law are appurtenant in part to protect against localized harm from excess production. Similarly, a watermaster can regulate the method of extraction of groundwater appropriators.

In place of appurtenancy of the entire water right, I would define an “extraction right” as the right to use a piece of land to pump groundwater. The watermaster would place appropriate limits on the amount of that extraction solely to protect the basin and neighboring users from harm. This extraction right would be appurtenant, and distinct from entitlement and allocation shares. In any given year, the extraction right may further constrain a right holder’s ability to produce water.

Regulation of extraction in a groundwater basin is extremely important for economic and environmental reasons. Oversight is required to avoid damage to the basin storage capacity, interference with neighboring wells, water quality problems, excessive adjacent streamflow reduction, and other environmental harms.²¹⁵ A watermaster may have reason to limit extractions in specific areas. Limiting extractions may prevent salt water intrusion near the coast. Limiting extractions may similarly prevent migration of contaminated groundwater. And some areas of a basin may require higher water levels due to physical characteristics, such as susceptibility to subsidence.

Under the common law, an overlying right is appurtenant to the land, meaning that is tied to the land and generally cannot be transferred without transferring the land along with the overlying right. An appropriation of groundwater similarly relies on a “diversion,” such as a groundwater pump, that is tied to the land. Linking the groundwater right to the land allows the law to consider and limit the above set of potential localized harms.

For groundwater users, then, extraction rights are already an inherent part of the “groundwater rights” bundle today. The combination of water law and California’s constitutional requirement that all water use be reasonable limits the practical use of one’s groundwater right. And all groundwater rights are tied to the overlying land or the relevant extraction point. Identifying and imposing water use limitations via an explicit extraction right thus should not constitute a taking, but rather simply a better system to enforce an existing limitation on groundwater rights.²¹⁶

Extraction rights would represent that part of the bundled overlying or appropriative right that is appurtenant to the land.

In my recommendations, however, neither entitlement nor allocation shares are appurtenant. Instead, the owner of a groundwater well would require two things in order to make use of that well: an allocation share representing the amount of water that may be withdrawn and an extraction right regulating the method of withdrawal. (The owner may have received an allocation share through owning an entitlement, or he could have purchased an allocation share on the open market). An extraction right could be limited by the watermaster pursuant to reasonable use to prevent harm to the basin. If the user reaches the extraction limit without using all of his allocation, he could either keep the allocation for use in another accounting period or transfer it (sell it) as the adjudication rules allow.

Account for environmental liabilities before allocating water in the basin.

“Safe yield” is perhaps the key term in an adjudication, because it provides the overarching limit on water withdrawals within the basin. The safe yield of the basin is supposed to be the amount of groundwater that may be produced without harming the rights of water users, long-term supply, or the environs. Sometimes, however, calculation of the safe yield seeks to prevent harm to the long-term water supply without accounting for these other potential harms. I recommend, therefore, that the safe yield of the basin—used for determining periodic allocation shares—include consideration of these various environmental liabilities. In addition, certain environmental needs—such as minimum streamflow—should receive dedicated, non-tradable entitlements from the correlative pool.

I use the term “environmental liabilities” to represent the environmental water need. This would include protecting minimum streamflow, compliance with environmental statutes (such as the Endangered Species Act) and court judgments, and other environmental concerns (such as protecting water quality). These are “liabilities” in the sense that water must be taken from the

An extraction right would represent the right to use a piece of land to pump groundwater.

total basin amount in order to fulfill these needs.

Besides environmental liabilities, at least two other types of water needs are worth noting. First, groundwater production should not interfere with surface rights. In part, this is why I recommended, in Part 4.A above, that courts require adjacent surface right holders to join in adjudication of a groundwater basin. Second, outstanding allocations would need to be tracked and accounted for prior to issuing a new round of allocation shares. Gradual retirement of allocation shares would limit the scope of this issue.

A system of entitlements and allocations can account for environmental water need in several ways. The state or interested parties could purchase allocations to protect water levels in certain areas.^d Or the environment could be granted a set of entitlement shares that are awarded allocations along with other entitlement holders. The best approach, however, would be to account for environmental liabilities before allocating water in the basin.

Because the environment does not “extract” groundwater in the same sense that water users extract groundwater, limiting environmental analysis to a defined entitlement would be overly restrictive. By only allocating water within the safe yield *minus* any environmental liabilities, environmental liabilities can be accounted for by the watermaster before any allocation occurs. Such liabilities would include the amount of water needed to reach specified water level targets, to reverse waterdraft or prevent seawater intrusion, for example.

Here, the watermaster’s determination of safe yield plays an essential role in protecting the basin and its environs. Defining safe yield appropriately means considering the time scale to measure limits

^d The state’s Environmental Water Account, premised on a similar theory of funding water purchases for environmental use, founded on the issue of continued taxpayer funding of those purchases. See Dave Owen, *Law, Environmental Dynamism, Reliability: The Rise and Fall of CalFED*, 37 ENVTL. L. 1145, 1198–1204 (describing the history and failings of CalFED’s environmental water account).

on extraction, the definition of significant harm and the role of artificial water supplies.

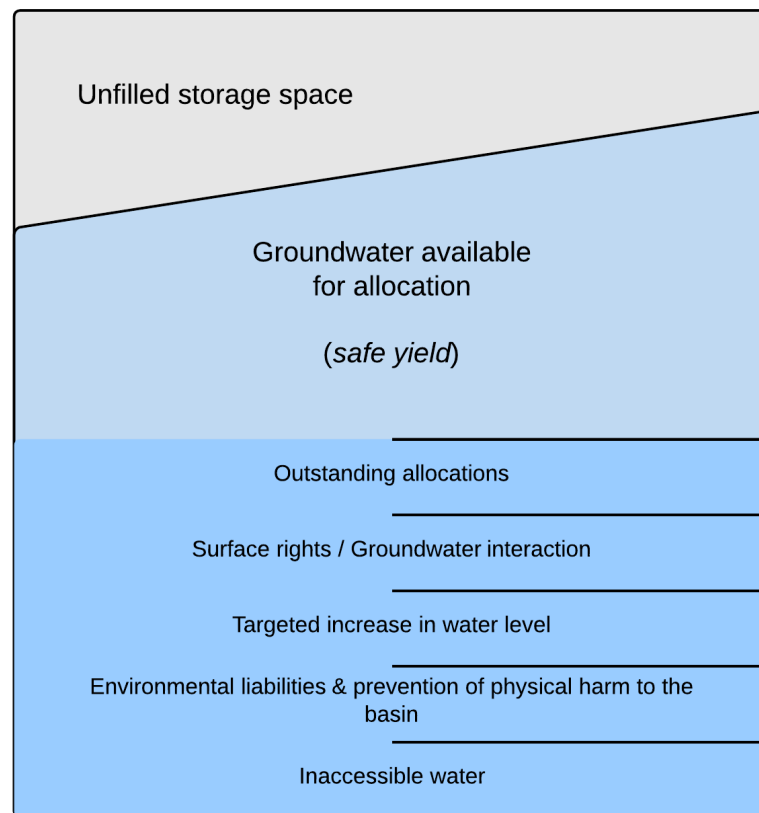
First, watermasters and courts should rely on models of future and present water conditions, not historical averages, when determining safe yield and water allocations for a basin. Most adjudications look to annual extractions but consider the limit to be a long-term average annual quantity. For example, the maximum extraction is often equated with the amount of recharge to the basin over a set number of years.²¹⁷ Judges tend to impose physical solutions at one point in time but may not account for changes in hydrologic conditions & human impacts.²¹⁸

Second, “significant harm” should be considered a spectrum, not a specified limit. Overdraft of a basin is desirable in times of drought so long as that overdraft is limited and storage space remains recoverable (presuming, of course, that the overdraft does not deprive connected streams of environmentally necessary baseflow). The adjudication for Central basin, as one good example, looks to “eventual depletion or permanent damage” in defining harm. An efficient definition of safe yield would allow for overdraft in times of drought but guarantee a return to an efficient water level for the basin.

Third, the safe yield need not distinguish artificial or imported water from natural recharge. Considering only natural supplies may result in a more consistent safe yield from year to year but may not reflect actual conditions, particularly in basins, such as Central, with high amounts of imported water. Adjudications take a varied approach to this question. Some do not explicitly consider artificial water supplies one way or another;²¹⁹ others explicitly distinguish natural safe yield from other forms of safe yield;²²⁰ and yet others consider artificial replenishment to be part of the safe yield calculation.²²¹

So long as allocation shares represent the total outstanding amount of potential withdrawals, how the water got into the basin remains relatively unimportant. Safe yield merely reflects the estimated amount of water that should remain *in* the basin at any given point in time. The safe yield

‘Safe yield’ is perhaps the key term in an adjudication, because it provides the overarching limit on water withdrawals within the basin.

Figure 13 | Division of the groundwater basin resources

The rectangle above conceptualizes a groundwater basin. Out of the total water available in the basin (in blue), the watermaster must periodically determine the safe yield. In order to do so, the watermaster must consider a number of competing water needs (represented in the dark blue rows).

does not vary based on where the water comes from; the crucial question, instead, is only whether a given amount of water is in the basin. I explain below how storage in a groundwater basin should result in the award of allocation shares, thus “balancing the books” between produced and imported water. And extraction rights can protect local areas of the basin from excessive extraction.

Notwithstanding the above discussion, an environmental entitlement would also be useful. An environmental entitlement, functionally equivalent to other groundwater entitlements, would vary in allocation based on normal climatic variation. Replicating such variability, even at drastically lower

levels of water flow because of human intervention, can improve the health of some aquatic ecosystems. In addition, extraction rights, defined above, can also safeguard against local environmental harms.

Use a storage license to prevent harm to the basin and require those who seek to store water in the basin to convert the right to stored water to basin allocation share.

Regulation of the storage of groundwater in a basin, as with the regulation of extraction, is extremely important for economic and environmental reasons. Groundwater basins are an economically efficient means to store water for later use, in order to reduce the harmful impacts of extreme droughts

or floods, avoid waste of reclaimed water discharged to water bodies, and encourage stormwater recapture in urban areas. Oversight is required to avoid damage to the basin water quality and damage via flooding—through negligent use of basin storage.

Watermasters in adjudicated basins should develop a consistent storage license that would allow the owner to use a piece of land, in a regulated manner, to store water in the basin. Because the potential negative effects of recharge are related to where and how the recharge occurs, this storage license should be tied to the land. And instead of a potentially undefined right to access that water in the future, the licensed storage user should receive—at the time of the storage—an appropriate number of allocation shares. The storage user would retain no further claim to the stored water.

Storage rights are (arguably) not part of the bundle of groundwater rights.²²² To date, California state courts have not allowed overlying owners either to exclude others from using aquifer storage space or to exact any type of compensation for such use.²²³ The right to store and subsequently withdraw water from a basin turns instead on whether one has access to a supply of imported, recycled or recaptured²²⁴ water, a spreading basin or similar recharge mechanism, and the means to later extract the water.²²⁵ Limitations on the storage right typically reference a reasonableness standard.²²⁶

One may wish to store water in the basin for a variety of reasons: to replace or replenish water use; to temporarily store carryover rights; to store natural runoff; or to store imported water.²²⁷ In some basins, there may be only a few large producers that take an interest in water storage. For example, the District and Golden Hills began a project in 2001 to enhance a spreading operation for storage of SWP water in the Tehachapi basin in 2001.²²⁸ LADWP has long taken an interest in storage of imported water in the San Fernando Valley basin.

When an adjudication considers water storage, the general approach has been to let any party²²⁹ use the basin for storage so long as they first obtain a storage agreement

from the watermaster. A party that obtains a storage agreement from the watermaster gains the right to place water into the basin. This water is typically imported from outside the basin. According to the typical storage agreement, when storing the water the party simultaneously gains the right to withdraw the water.

The watermaster ensures that the storage does not have adverse impacts on other producers or the region as a whole. The watermaster also verifies the amount of water stored and later recovered for use by the party.

In order to enforce a storage agreement, the watermaster must have the authority to limit third parties from extracting stored water. Because groundwater is essentially fungible, in practice this means that other users cannot extract more than their portion of the safe yield minus the stored amount. A watermaster may also require discretion to limit the total amount of groundwater stored. (Usually this is not a problem, as the adjudication typically occurs when there is *too little* water stored, not *too much*.)

My recommended shift to the use of a storage license is quite similar to existing use of storage agreements. The main difference affects how the watermaster accounts for stored water. Shifting to the use of a consistent storage license would help track the use of groundwater storage and make the use of such storage more flexible.^e The storage right would represent the maximum amount that can be stored via recharge on that piece of land, within guidelines set forth by the watermaster. When water is stored—that is, when the user causes artificial recharge to occur—the user would receive allocation shares equivalent to some percentage of the stored water.

^e Note that my recommendation concerning a storage license is not meant to supplant the State Water Resources Control Board's permitting authority for underground storage of surface water. The storage license regulates the use of the groundwater basin for storage, to limit potential harms to the basin, environment and users; the storage license is not meant to regulate potential issues with surface water rights. The Board's permitting would, conceivably, operate in parallel with the storage license and any related extraction right.

Watermasters in adjudicated basins should develop a consistent storage license that would allow the owner to use a piece of land, in a regulated manner, to store water in the basin.

(Because groundwater storage involves more unknowns than, say, a bank transfer, the ratio of stored water to allocation should not be 1:1.) The allocation shares would be equivalent to the allocation shares awarded to other holders of entitlements within the basin: the allocation would allow the holder to extract a specified quantity of water from the basin.

All water in the basin—stored or naturally recharged—would be potentially eligible for future allocation to entitlement holders, as the safe yield permits. Thus the right to extract stored water is integrated into the water management system.

Awarding allocation shares for recharge in combination with the use of an exchange market for allocations, per my recommendation below, would provide powerful incentives and flexibility regarding water storage. For example, a municipality might wish to capture stormwater in an urban area to recharge its groundwater basin. Presuming the municipality would otherwise have consumptive rights to the stormwater, it could acquire a storage license that awarded it allocation shares in exchange for stormwater recharge. The municipality could immediately sell those allocation shares on a market exchange in order to provide continued funding (or debt payment) for its stormwater recharge program.

Instead of “carry-over” credits in a basin, require periodic retirement of unused allocations. To allow for flexible use while improving enforcement of the basin’s safe yield, allocation shares should expire at a fixed rate. For example, an allocation share could be defined to lose 1/3 of its initial value—in acre-feet—per year from the issue date, thereby encouraging relatively prompt use of allocation shares while allowing for flexibility in use over a three-year period.

For various reasons, some administrative and some historical, the right to extract water from a basin is typically quantified in terms of amount extracted over the course of a Water Year. Use of the Water Year for accounting is simultaneously overly broad and overly restrictive. For some basins, the real concern may be excessive seasonal

withdrawals that necessitate a more restrictive accounting mechanism. Water users, on the other hand, would prefer more flexibility about when they can use their water allocations. For some basins, seasonal water allocations would better match basin conditions. One could allow such flexibility through better use of water transfers, discussed below, along with allocations that gradually lose value over time, instead of an all-or-none structure.

Producers are typically allowed to “carry over” a portion of their unused annual allocation to the next water year. Typically, the adjudication sets forth a hierarchy that establishes how water withdrawals are categorized. The first withdrawal of the water year may be deemed carry over water, if any is available. Once carry over water is used, then following withdrawals may be deemed trading pool water, then reduction of the producer’s annual allocation, etc.

Carry over provisions provide flexibility to producers but are typically limited in amount to avoid excessive withdrawals from the basin in any given year. In West Coast basin, for example, a producer can carry over 10% of her annual allocation or 2 af, whichever is larger.²³⁰ Other basins are more lenient. Producers in San Gabriel or Puente basins may carry over 100% of their annual allocation for one year. Santa Paula basin only restricts production over a seven-year period; there are no limits on a producer’s annual production or carry over so long as they remain within 7x annual allocation. Some judgments allow emergency carry over in addition to the annual carry over provision.²³¹

Instead of defining a “carry-over” percentage, the better accounting solution would be to retire older allowances on a fixed schedule. In West Coast basin, for example, a producer left with 1000 acre-feet allocation at the end of an entitlement period could be required to “retire” 90%, leaving him with 100 acre-feet allocation at the start of the next entitlement period (along with his new allocation for the new entitlement period). This last 100 acre-feet allocation would be retired if not used within the new entitlement period. This accounting would be functionally equivalent to the West

Requiring gradual “expiration” of entitlements would simplify basin management while allowing for flexibility in use.

Allocations and entitlements should both be transferable.

Coast basin's current 10% carry-over rule.

The difference between carry-over and retirement lies in the benefits of the latter for identifying liabilities in the basin and encouraging accurate pricing and exchange of allocations. As discussed above, the watermaster should be required to determine outstanding liabilities which are subtracted from the safe yield to determine the total allocation. Summing the total outstanding allocations is an easy way to calculate basin liability, and prevents the watermaster from "double-counting" and thereby granting allocations in excess of the safe yield.

If the basin rule requires 90% retirement in the first year followed by full retirement in the second year, older allowances become cheaper in an exchange market. It is obviously in the allocation owner's interest to use these older allowances first, thus obviating the need for complicated hierarchies of water use. And the exchange market similarly prices older allowances at lower value, knowing that they will soon be retired.

Increase exchange of water allocations and entitlements. The watermaster should encourage market-based trading of both allocation and entitlement shares. A modern water trading market would accommodate trading both within a groundwater basin and between basins. The market would need to be liquid—that is, with sufficient trading activity to encourage participation and decrease the risk of market abuse—and have relatively low transaction costs. Environmental and economic concerns would mean the market should remain highly regulated but these concerns would be chiefly addressed within the scope of the market rules.

Allocations and entitlements should both be transferable. As enforceable contracts in their own right, there is no particular reason to restrict their exchange to only parties within jurisdiction of the basin. Allocations and entitlements are only part of, not the whole, water right. An entitlement share only grants a right to periodic allocation shares of the safe yield within that basin, which ultimately remains under the jurisdiction

of the adjudicating court. An allocation is simply the right to an amount of groundwater from the basin; who owns that right is irrelevant. Furthermore, the allocation is useless without use of an extractive right, which is limited to parties of the adjudication because an extractive right is tied to the land.^f The extractive right, because it is tied to the point of extraction, could help alleviate concerns over the potential for transfers to negatively affect return flows, for example. The law would apply the limitations and rules for use of allocations and entitlements to any purchaser of those contracts.²³²

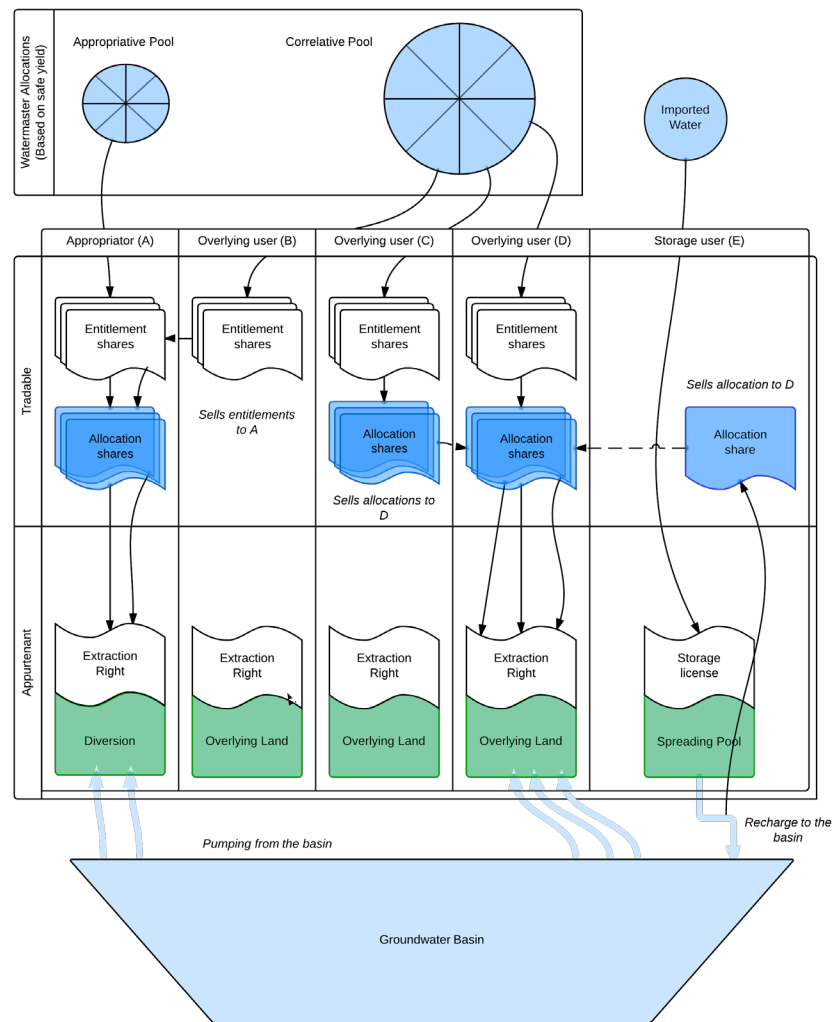
If a watermaster becomes concerned that excessive amounts of produced water would be used on land outside the basin (thus potentially lowering recharge to the basin), the appropriate response would be to limit the extraction rights accordingly, not the entitlement or allocation shares. In southern California, with its dependence on imported water, more trading between adjudicated basins would not necessarily be harmful given the rather artificial nature of the current urban ecosystem.

A functional exchange for entitlements and allocations provides a solution for producers who require additional water. Presuming that the producer would not exceed his extraction right—which would potential result in harm to the basin and be forbidden by the watermaster's rules—the producer could acquire additional allocations beyond his periodic allocation.

Furthermore, a water exchange market provides a more elegant solution to the issue of replacement water in an adjudicated basin. Today, when a producer pumps in excess of his annual allocation, the typical response in an adjudication is to require the producer to pay a replacement water assessment.²³³ That assessment is supposed to cover the cost to the watermaster to purchase water to replace the excess water pumped by the producer.

^f Note that transferable allocation shares means that overlying right holders could sell their allocation shares to appropriative right holders, and vice-versa. It is the extraction right, not the allocation share, that would be appurtenant. The allocation share should retain no limitation on place of use.

Figure 14 | Example Water Exchange of Entitlements and Allocations



The above figure represents a potential water exchange market. Each line with an arrow represents the transfer of shares and the corresponding water production associated with that transfer. The figure represents a point in time when the watermaster issues allocations based on the safe yield of the basin.

Overlying user (B) sells his entitlements to Appropriator (A). Overlying user (B) thus has no allocation shares and will not produce water at this time.

Appropriator (A) receives allocation shares from the appropriative pool and another set of allocation shares from the correlative pool (corresponding to the purchased entitlement shares from B.)

Overlying user (C) receives allocation shares from the correlative pool, which he then sells to overlying user (D).

Overlying user (D) uses his purchased allocations (from C and E) to extract much more than his “normal” amount from the basin. I presume here that D’s extraction right would not limit his use.

Storage user (E) has a storage license to recharge the basin. Upon verified recharge, E receives an allocation share that he sells to D.

Replacement water assessments are a financial risk for the watermaster. If replacement water costs spike, it is the watermaster left footing the bill. Alternatively, no replacement water may be obtained and the safe yield will thus not be met. Replacement water assessments are an inefficient, risky answer to the problem of producers who lack sufficient water access.

Instead, producers who require replacement water should have to purchase allocations on the exchange market. Water users, including the watermaster, with storage rights would generate allocations by storing imported water in the basin, which in turn could be sold to producers who formerly paid for replacement water. Requiring exchange of allocations instead of exchange of money protects the safe yield in the basin and the finances of the watermaster.

Conclusion

Together, these reforms provide a potential structure for defining groundwater rights in basins throughout California. Preferably this would occur as part of a larger water management reform for California, without the need to adjudicate each and every basin.

By beginning with structural reforms to existing groundwater management, southern California can begin to reap the benefits without waiting for statewide reform. Over the long run, however, either the California legislature will reform groundwater management or the legislature will leave it to the courts to adjudicate every major basin in California. For climate change, development and population growth will inevitably force a clash among groundwater users (and surface water users) statewide.

Endnotes

- 1 John Hedges, *Currents in California Water Law: The Push to Integrate Groundwater and Surface Water Management Through the Courts*, 14 U. DENV. WATER L. REV. 375, 378 (2011).
- 2 M. RHEAD ENION, UNDER WATER: MONITORING AND REGULATING GROUNDWATER IN CALIFORNIA (Pritzker Brief No. 1, July 2011), <http://law.ucla.edu/centers-programs/environmental-law/Pages/Publication.aspx?PubID=10>.
- 3 ENION, *supra* note 2; Hedges, *supra* note 1, at 379.
- 4 See Barbara T. Andrews & Sally K. Fairfax, *Groundwater and Intergovernmental Relations in the Southern San Joaquin Valley of California: What Are All Those Cooks Doing to the Broth?*, 55 U. COLO. L. REV. 145, 152–54 (1984); The Governor’s Commission to Review California Water Rights Law, Cal. Exec. Order No. B-26-77 (May 11, 1977) [hereinafter “Governor’s Commission”].
- 5 Barton H. Thompson, Jr., *Beyond Connections: Pursuing Multidimensional Conjunctive Management*, 47 IDAHO L. REV. 273, 279 & n.27 (2011) (describing how Arizona, California, Oklahoma and Texas have not integrated surface and groundwater management, although Arizona courts have moved that direction by broadly defining river subflow).
- 6 Hedges, *supra* note 1, at 378.
- 7 ENION, *supra* note 2.
- 8 *Id.*; Hedges, *supra* note 1, at 379.
- 9 See, e.g., LOS ANGELES COUNTY DEP’T OF PUBLIC WORKS, THE SAN GABRIEL RIVER CORRIDOR MASTER PLAN chpt. 2 (June 2006), http://dpw.lacounty.gov/wmd/Watershed/sg/mp/docs/SGR_MP-Chapter2-3.pdf.
- 10 Governor’s Commission, *supra* note 4. The Commission published their final report 1978. GOVERNOR’S COMMISSION TO REVIEW CALIFORNIA WATER RIGHTS LAW, FINAL REPORT (Dec. 1978), http://www.waterboards.ca.gov/publications_forms/publications/general/docs/l584a.pdf and http://www.waterboards.ca.gov/publications_forms/publications/general/docs/l584ab.pdf [hereinafter “GOVERNOR’S COMMISSION FINAL REPORT”].
- 11 See Karen D. Bettencourt, *Below the Surface: An Introduction to the Commission’s Recommendations on the Management of Groundwater Resources*, 36 McGEORGE L. REV. 405 (2005).
- 12 Eric L. Garner & Jill N. Willis, *Right Back Where We Started From: The Last Twenty-Five Years of Groundwater Law in California*, 36 McGEORGE L. REV. 413, 413 (2005); Governor’s Commission, *supra* note 4, at 237–50.
- 13 See Kevin M. O’Brien, *The Governor’s Commission’s Recommendations on Groundwater: Treading Water Until the Next Drought*, 36 McGEORGE L. REV. 435 (2006) (describing successes and failures of the Commission in the are of groundwater resources).
- 14 See Harrison C. Dunning, *The Governor’s Commission: Success or Failure?*, 36 McGEORGE L. REV. 17, 21 (2005) (“But in a larger sense, I believe that the Governor’s Commission failed in its task. The ultimate point was to tget legislation enacted to modify California water rights law, and little statutory change can be credited to the work of the Commission.”); Garner & Willis, *supra* note 12, at 414 (“[W]hile California has become much more reliant on groundwater and groundwater storage, the state of groundwater law and groundwater management remains as uncertain, if not more so, than it was when the Commission’s Final Report was issued.”). The groundwater management legislation eventually enacted in 1992 rejected the Commission’s recommendation for SWRCB involvement in groundwater management. Groundwater Management Act, 1992 Cal. Stat. ch. 947 (codified at Cal. Water Code §§ 10750–10755.4 (West Supp. 2004)); O’Brien, *supra* note 13, at 435.
- 15 See Hedges, *supra* note 1, at 383 (“[D]ue to political opposition, the California Legislature is not likely to pursue wholesale reform of its groundwater regime.”). Senator Pavley described the fight over climate change as “easy” compared to passage of her CASGEM bill, which merely provided financial incentives for local monitoring of groundwater. Felicity Barringer, *Rising Calls to Regulate California Groundwater*, N.Y. TIMES, May 13, 2009, <http://www.nytimes.com/2009/05/14/science/earth/14aquifer.html>.
- 16 ENION, *supra* note 2.
- 17 See *generally* CAL. DEP’T OF WATER RESOURCES, CALIFORNIA’S GROUNDWATER BULLETIN 118, at chpt. 6 (Update 2003) [hereinafter “BULLETIN 118”].
- 18 BULLETIN 118, *supra* note 20, at 83. Specific yield is defined as the percent of water that would drain freely from the sediment due to gravity. Specific retention is the amount retained within that sediment. Specific yield plus specific retention equals porosity.
- 19 “Significant yield” in this sense may refer to physical or economic limitations in the availability of water from the aquifer. See BULLETIN 118, *supra* note 20, at 85.
- 20 BULLETIN 118, *supra* note 20, at 83–90.
- 21 The Governor’s Commission recognized this connection in 1978: “Virtually all groundwater is to some extent connected with streamflow” GOVERNOR’S COMMISSION FINAL REPORT, *supra* note 10, at 29.
- 22 Anonymous, saying in the American West, quoted by Ivan Doig *in* MARK REISNER, CADILLAC DESERT (1986).
- 23 See BULLETIN 118, *supra* note 20, at 92–93.
- 24 *Id.* at 87.

- 25 Ella Foley-Gannon, *Institutional Arrangements for Conjunctive Water Management in California and Analysis of Legal Reform Alternatives*, 14 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 1105, 1107 (2008) (originally published in 6 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 273).
- 26 *Id.* at 1107.
- 27 *Id.*
- 28 See, e.g., Water Replenishment District of Southern California, *Battling Seawater Intrusion in the Central & West Coast Basins*, 13 WRD Technical Bulletin (Fall 2007), <http://www.wrd.org/engineering/seawater-intrusion-los-angeles.php>.
- 29 Foley-Gannon, *supra* note 26, at 1107.
- 30 See Andrews & Fairfax, *supra* note 4, at 152–54; Governor's Commission, *supra* note 4.
- 31 See Thompson, *supra* note 5, at 279 & n.27 (describing how Arizona, California, Oklahoma and Texas have not integrated surface and groundwater management, although Arizona courts have moved that direction by broadly defining river subflow).
- 32 Some parts of the Water Code do apply equally to surface and percolating groundwater. See, e.g., Cal. Water Code § 100 (reasonable and beneficial use); *id.* § 102 (water remains the property of the people); *id.* § 275 (enforcement to prevent waste and unreasonable use). The Porter-Cologne Water Quality Control Act applies to all state waters. Cal. Water Code div. 13. And the common law has recognized the interconnection since at least 1909. *Hudson v. Dailey*, 156 Cal. 617 (1909). A groundwater rights holder could be required to reduce his diversions to protect a senior surface water right holder, for example.
- 33 Joseph L. Sax, *We Don't Do Groundwater: A Morsel of California Legal History*, 6 U. DENV. WATER L. REV. 269, 270–71 (2003).
- 34 *Lux v. Haggin*, 69 Cal. 255 (1886). See generally STATE WATER RESOURCES CONTROL BOARD, A GUIDE TO WATER TRANSFERS 3-3 (Draft July 1999), http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/watertransferguide.pdf.
- 35 *Lux*, 69 Cal. at 300.
- 36 *Miller & Lux v. Enterprise Canal & Land Co.*, 169 Cal. 415, 440 (1915).
- 37 *Id.*
- 38 Cal. Water Code § 5100.
- 39 A GUIDE TO WATER TRANSFERS, *supra* note 37, at 3-3.
- 40 1913 Cal. Stat. 586, § 12, at 1018. BRENT M. HADDAD, RIVERS OF GOLD: DESIGNING MARKETS TO ALLOCATE WATER IN CALIFORNIA 39 (2000); Registration of rights began in 1914. A permit-application process began in the 1950s. HADDAD, *supra*, at 39.
- 41 SWRCB, Applications: Permitting and Licensing, http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/.
- 42 Cal. Water Code §§ 1300–35; SWRCB, Appropriate Water By Permit: Application Notices, http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/appropriations/.
- 43 Cal. Water Code §§ 1330–53; SWRCB, Protest Submittal Information, http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/docs/protestsubmittalinfo.pdf.
- 44 Cal. Water Code §§ 1375–94.
- 45 Besides referring to the overlying right as a correlative right, California courts used the phrase “correlative right” to describe how rights should be shared between surface and groundwater users. See *Hudson v. Dailey*, 156 Cal. 617, 627–28 (1909) (applying a “common source” or “correlative rights” doctrine to treat groundwater and surface water rights as an integrated whole, applying priority of use without regard to the source of the diversion).
- 46 The defined use can “relate back” as with surface water appropriations. See, e.g., *Shenandoah Min. & Mill. Co. v. Morgan*, 106 Cal. 409, 416–17 (1895).
- 47 *Pasadena v. Alhambra*, 33 Cal. 2d 908, 926 (1949); 12 Witkin, Summary of Cal. Law (10th), Real Property § 949.
- 48 *Pasadena*, 33 Cal. 2d 908.
- 49 Cal. Civ. Code § 1007; *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d 199, 207 (1975).
- 50 *Katz v. Walkinshaw*, 141 Cal. 116, 135–36 (1903) (“Disputes between overlying landowners, concerning water for use on the land, to which they have an equal right, in cases where the supply is insufficient for all, are to be settled by giving to each a fair and just proportion.”)
- 51 *Katz*, 141 Cal. at 135.
- 52 The distinction between groundwater and surface water in the California Water Code has, from time to time, had clear and direct impacts on the law of water rights in California. For example, absent the exemption of groundwater from regulations in the Water Code, it is unclear if the court of appeal in *Wright v. Goleta Water District*, 174 Cal. App. 3d 74 (1985), would have distinguished unexercised riparian rights—which can be subordinated to current exercised rights—from unexercised overlying rights—which the court of appeal ruled can not be subordinated to current exercised rights. See *Goleta Water Dist.*, 174 Cal. App. 3d at 87 (“*Long Valley*, *Shirokow*, and *National Audubon Society* all limit their discussions to riparian rights within the statutory scheme of the Water Code. Ground water is exempted from the extensive regulations of surface water. (Wat. Code, § 1200 et seq.)”). See discussion of *Goleta Water District*, *infra* at Part 3.1.5.

- 53 Cal. Water Code § 1200 (“[T]he terms stream, lake or other body of water . . . refer[] only to surface water, *and to subterranean streams flowing through known and definite channels.*” (emphasis added)). The California Supreme Court applied surface water right concepts to groundwater in *Katz* and rejected the distinction between subterranean streams and percolating groundwater in *Katz*. See *Katz*, 141 Cal. at 121 (“averment[s] that . . . water constitute[s] part of an underground stream may be regarded as *splusage*”; Sax, *supra* note 34, at 279–86 (recounting the judicial history of the subterranean stream distinction). *Hudson v. Dailey*, a few years later, went further in rejecting the distinction between surface and groundwater. 156 Cal. 617, 628 (1909) (“It is therefore important to determine the relative rights of the owner of the non-riparian land containing percolating water, which feeds a surface stream, and those who have acquired riparian or prescriptive rights in said stream, where the pumping of such percolating water and its use on the land in which it is found will diminish the surface stream, to the injury of those having such riparian or prescriptive rights therein.”).
- 54 Legally speaking, water underneath the riverbed is “underflow.” See, e.g., *City of Los Angeles v. Pomeroy*, 124 Cal. 597, 630 (1899), *aff’d* 188 U.S. 314 (1903). The concept has no scientific basis.
- 55 Sax, *supra* note 34, at 271–72.
- 56 *Id.* at 273; accord Thompson, *supra* note 5, at 280.
- 57 ENION, *supra* note; Hedges, *supra* note 1, at 385.
- 58 Cal. Const. art 10, § 2. See *Tulare Irr. Dist. v. Lindsay Strathmore Irr. Dist.*, 3 Cal. 2d 489 (1935) (extending reasonable use to groundwater).
- 59 See *Joslin v. Marin Mun. Water Dist.*, 67 Cal. 2d 132, 143 (1967) (distinguishing “beneficial” from “reasonable”).
- 60 *Envtl. Defense Fund v. E. Bay Municipal Utility Dist.*, 26 Cal. 3d 183 (1980).
- 61 CRAIG M. WILSON, SWRCB, THE REASONABLE USE DOCTRINE & AGRICULTURAL WATER USE EFFICIENCY 9 (Jan. 2011), http://www.waterboards.ca.gov/board_info/agendas/2011/jan/011911_12_reasonableusedoctrine_v010611.pdf.
- 62 *Peabody v. City of Vallejo*, 2 Cal. 2d 351, 375–76 (1935); *Tulare Irr. Dist. v. Lindsay-Strathmore Irr. Dist.*, 3 Cal. 2d 489, 525 (1935).
- 63 See, e.g., *Joslin v. Marin Mun. Water Dist.*, 67 Cal. 2d 132, 140 (1967) (rejecting a riparian’s use of water to deposit sand and gravel as unreasonable as a matter of law); Hedges, *supra* note 1, at 380 (discussing the importance of *Joslin*); Brian E. Gray, *The Modern Era in California Water Law*, 45 HASTINGS L.J. 249, 258 (1994) (describing *Joslin* as the “cornerstone of the modern era” in California water law).
- 64 *Cave v. Tyler*, 133 Cal. 566, 567 (1901); 12 Witkin, Summary of Cal. Law (10th), Real Property § 946.
- 65 Cal. Water Code § 1455; *Wishon v. Globe Light & Power Co.*, 158 Cal. 137, 140 (1910); 12 Witkin, Summary of Cal. Law (10th), Real Property § 949.
- 66 *City of Pasadena v. City of Alhambra*, 33 Cal. 2d 908, 926–27 (1949).
- 67 See State Water Resources Control Board, The Water Rights Process, at http://www.waterboards.ca.gov/waterrights/board_info/water_rights_process.shtml#process (describing surface water rights permitting).
- 68 Factors include whether the water flows through a definite channel; the rate and direction of subsurface flow; and the relationship between surface and subsurface hydrographs. *Cave v. Tyler*, 147 Cal. 454, 456 (1905); *Larsen v. Appollonio*, 5 Cal. 2d 440, 444 (1936); *Foley-Ganon*, *supra* note 26, at 1122 n.82. The law presumes groundwater is percolating. *Foley-Ganon*, *supra* note 26, at 1122 (citing *City of Los Angeles v. Pomeroy*, 124 Cal. 597, 628, 633–34 (1899), *aff’d* 188 U.S. 314 (1903)).
- 69 *Baldwin v. County of Tehama*, 36 Cal. Rptr. 2d 886 (Ct. App. 1994); *Bulletin 118* at 36–39. See Hedges, 14 U. Denver Water L. Rev. at 381 (discussing local groundwater management in California); Sandino, 36 McGeorge L. Rev. 471 (describing legislative and judicial changes that have consolidated local control over groundwater).
- 70 BULLETIN 118, *supra* note 20, at 33; Hedges, *supra* note 1, at 382.
- 71 BULLETIN 118, *supra* note 20, at 34–35; Hedges, *supra* note 1, at 382.
- 72 Cal. Water Code App. § 121-102.
- 73 *Foley-Ganon*, *supra* note 26, at 1135.
- 74 *Id.* at 1136.
- 75 *Id.* at 1137.
- 76 *Id.*
- 77 CASGEM, 2009 Cal. Legis. Serv. 7th Ex. Sess. Ch. 1 (S.B. 6) (codified at Cal. Water Code §§ 10920–36).
- 78 Hedges, *supra* note 1, at 390.
- 79 *Id.*
- 80 I reference here the dates of filing and the final trial court decisions. For a full list of adjudicated basins by date, see Dep’t of Water Resources, Water Facts No. 3: Adjudicated Groundwater Basins in California (July 2011), http://www.water.ca.gov/pubs/groundwater/adjudicated_ground_water_basins_in_california_water_facts_3_water_fact_3_7.11.pdf.
- 81 The City and SPBPA in Santa Paula basin, however, stipulated that the basin was not currently within a state of overdraft.

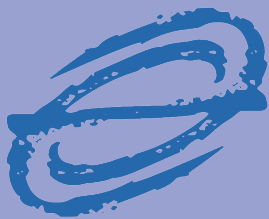
- 82 See, e.g., *Wright v. Goleta Water Dist.*, 174 Cal. App. 3d 74, 81 n.2 (1985) (“A ground water basin is in a state of surplus when the amount of water being extracted from the basin is less than the maximum that could be withdrawn without *adverse effects on the basins’ long term supply*” (emphasis added) (quoting *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d 199, 277–78 (1975)).
- 83 See *Andrews & Fairfax*, *supra* note 4, at 165–67.
- 84 BLOMQUIST, *supra* note 85, at 52–53, 58.
- 85 *Id.* at 99.
- 86 *Andrews & Fairfax*, *supra* note 4, at 166.
- 87 Some have argued that the principle of overlying rights established in *Katz* exacerbated overdraft in groundwater basins, because withdrawals could only be limited through expensive and time-consuming court litigation. See, e.g., Frank J. Trelease, Address, *Legal Solutions to Groundwater Problems—A General Overview*, 11 Pac. L.J. 863, 873 (1980).
- 88 *Katz v. Walkinshaw*, 141 Cal. 136 (1903).
- 89 *Andrews & Fairfax*, *supra* note 4, at 176.
- 90 THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, HISTORY AND FIRST ANNUAL REPORT 1–2 (1939) (commemorative ed. 2011), available at <http://www.mwdh2o.com/mwdh2o/pages/about/AR/AR1928.html>. Initial members were the cities of Anaheim, Beverly Hills, Burbank, Glendale, Los Angeles, Pasadena, San Marino, Santa Ana and Santa Monica. *Id.* at xiii.
- 91 Metropolitan Water District Act, chpt. 429, Calif. Statutes of 1927, p. 694 (reenacted by the legislature, Statutes 1969, chpt. 209), available at <http://www.mwdh2o.com/rsap/Act.pdf>. See *City of Pasadena v. Chamberlain*, 204 Cal. 653, 658–59 (1928) (defining a metropolitan water district); *Metropolitan Water District v. Whitsett*, 215 Cal. 400, 407 (1932) (noting that the legislature may vest a metropolitan water district with taxing authority).
- 92 THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, *supra* note 94, at 2.
- 93 *Id.* at 332.
- 94 BLOMQUIST, *supra* note 85, at 104.
- 95 *Id.* at 104.
- 96 *Id.* at 252.
- 97 *Id.* at 76.
- 98 *Id.* at 194.
- 99 *City of Pasadena v. City of Alhambra*, No. Pasadena C-1323 (Sup. Ct. Cal.) (as modified and restated, Mar. 26, 1984) (original judgment Dec. 26, 1944).
- 100 BLOMQUIST, *supra* note 85, at 77; Water Commission Act, Stats. 1913, § 24; Cal. Water Code §§ 2000–2050.
- 101 BLOMQUIST, *supra* note 85, at 78. La Canada Irrigation District joined the stipulation in 1944. The remaining party, California-Michigan Land and Water Company, took the case to trial.
- 102 *City of Pasadena v. City of Alhambra*, No. Pasadena C-1323, at 12 (County of Los Angeles Sup. Ct.) (as modified and restated Mar. 26, 1984).
- 103 *Andrews & Fairfax*, *supra* note 4, at 177 (quoting Victor E. Gleason, *Water Projects Go Underground*, 5 ECOL. L. Q. 623, 633 (1976)).
- 104 Harrison C. Dunning, *The ‘Physical Solution’ in Western Water Law*, 57 U. COLO. L. REV. 445, 460–64 (1986); Jason M. Miller, Casenote, *When Equity is Unfair—Upholding Long-Standing Principles of California Water Law in City of Barstow v. Mojave Water Agency*, 32 McGEORGE L. REV. 991, 1001 (2001) (discussing the use of physical solutions in California); *Peabody v. City of Vallejo*, 2 Cal. 2d 351, 380 (1935) (finding that a trial court may impose a physical solution, if any is available, with costs of the project to be provided by the junior user).
- 105 *City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224, 1243 (2000).
- 106 *Cal. Am. Water v. City of Seaside*, 183 Cal. App. 4th 471, 480 (Ct. App. 6th Dist. 2010) (citations omitted).
- 107 BLOMQUIST, *supra* note 85, at 77.
- 108 See *City of Pasadena v. City of Alhambra*, 33 Cal. 2d 908, 928 (1949) (“Respondents assert that the rights of all the parties, including both overlying users and appropriators, have become mutually prescriptive against all the other parties and, accordingly, that all rights are of equal standing, with none prior or paramount.”).
- 109 West Coast basin, Mojave basin and Central basin define October 1 to September 30 as the water year. The West Coast basin amended judgment required a transition to a fiscal year (July 1 to June 30) schedule. Six basins use a calendar year. The San Gabriel and Chino basins use a fiscal year (July 1 to June 30).
- 110 BLOMQUIST, *supra* note 85, at 88.
- 111 *Id.* at 99.
- 112 *Id.* at 99.
- 113 *Id.* at 106.

- 114 *Id.*
- 115 *Id.* (quoting Fossette, 1986: 95; Ostrom, 1965: 33).
- 116 Water Replenishment Dist. of S. Cal., About the Water Replenishment District, <http://www.wrd.org/about/about-water-replenishment-district.php>.
- 117 Water Replenishment Dist. of S. Cal., Water Replenishment District History, <http://www.wrd.org/about/water-district-history.php>.
- 118 The maximum price is based on the amount charged for water supplied by Metropolitan Water District to West Basin Water District
- 119 Exchange pool requests for Central basin fall into one of two tiers. Category (a) are requests for up to 150% of the buyer's allocation or 100 af, whichever is greater. Category (b) are requests that exceed 150% or 100 af, whichever is greater. Category (a) requests are all fulfilled before Category (b) requests. If there is insufficient supply for all Category (b) requests, the requests are filled pro rata. Category (a) requests are always fulfilled regardless of actual supply.
- 120 BLOMQUIST, *supra* note 85, at 106–09.
- 121 *Id.* at 196.
- 122 *Id.* at 199.
- 123 City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199 (1975).
- 124 Note, however, that previously finalized adjudications, such as Raymond and West basins, were not affected.
- 125 BLOMQUIST, *supra* note 85, at 205.
- 126 *Id.* at 206.
- 127 *Id.* at 207.
- 128 U.S. Env'tl. Prot. Agency, Pacific Southwest, Region 9: Superfund: San Fernando Valley, <http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/webdisplay/oid-87ab7077fd4dd34888256613007b884c>.
- 129 Louis Sahagun, *DWP to build groundwater treatment plants on Superfund site*, L.A. TIMES, June 23, 2013, <http://articles.latimes.com/2013/jun/23/local/la-me-water-20130624>.
- 130 BLOMQUIST, *supra* note 85, at 276 (citing Lipson, 1978: 75).
- 131 *Id.* at 278.
- 132 *Id.* at 279.
- 133 *Id.* at 292.
- 134 *Id.* at 280. This avoided applying Section 1007. *Id.*
- 135 *Id.* at 281.
- 136 *Id.*
- 137 *Id.*
- 138 *Id.*
- 139 *Id.* at 294.
- 140 *Id.* at 294.
- 141 See Chino Basin Watermaster, Thirty-Fourth Annual Report: Fiscal Year 2010–11, at 2 (2011), <http://www.cbwm.org/docs/annualrep/34th%20Annual%20Report.pdf>.
- 142 STEVEN BACHMAN, GROUNDWATER MANAGEMENT PLAN: GOLETA GROUNDWATER BASIN 3-20 (May 2010).
- 143 Wright v. Goleta Water Dist., 174 Cal. App. 3d 74 (1985).
- 144 BACHMAN, *supra* note 142, at 1-2.
- 145 *Goleta Water Dist.*, 174 Cal. App. 3d at 1.
- 146 Wright v. Goleta Water Dist., No. SM57969 (Cal. Sup. Ct. Nov. 17, 1989) (amended judgment).
- 147 *Goleta Water Dist.*, 174 Cal. App. 3d at 87. *Cf. In re Waters of Long Valley Creek Stream System*, 25 Cal. 3d 339 (1979) (allowing the State Water Resources Control Board to subordinate unexercised riparian claims with respect to all currently exercised rights); Nat'l Audubon Soc'y v. Sup. Ct., 33 Cal. 3d 419 (1983) (establishing that water rights are subordinate to public trust concerns).
- 148 *Goleta Water Dist.*, 174 Cal. App. 3d at 88.
- 149 *Id.* at 88.
- 150 Assuming no change in the type of use.
- 151 BACHMAN, *supra* note 142, at 1-3.
- 152 BLOMQUIST, *supra* note 85, at 219.
- 153 *Id.* at 221.
- 154 *Id.* at 226.

- 155 *Id.*
- 156 *Id.* at 228–29.
- 157 *Id.* at 235–36.
- 158 *Id.* at 240.
- 159 *Id.*
- 160 City of Barstow v. Mojave Water Agency, 23 Cal. 4th 1224 (2000).
- 161 *Id.* at 1248.
- 162 *Id.* at 1250.
- 163 BLOMQUIST, *supra* note 85, at 302.
- 164 Cal. Dep’t of Water Resources, Groundwater Management: Court Adjudications, http://www.water.ca.gov/groundwater/gwmanagement/court_adjudications.cfm.
- 165 Kevin M. O’Brien, Groundwater Adjudications in California (Presentation), http://sccounty01.co.santa-cruz.ca.us/eh/WaterResources/20100407_F1a4.pdf.
- 166 BLOMQUIST, *supra* note 85, at 307 tbl. 13.1. Orange County is most expensive, at \$152 / af-yr in 1985 dollars. Raymond cheapest at \$3.50. West: \$77, Central: \$75, Main San Gabriel: \$15, San Fernando: \$15, Chino: \$15. Calculated by dividing total 1985 expenditures for admin. and replenishment by number of af of GW produced that year. Adjudication costs amortized over 50 years at 5%.
- 167 *Id.* at 311 tbl. 13.2.
- 168 Some historical groundwater data is available online, but it generally dates only to the 1950s, which will not provide an accurate picture of the longer-term historical average. See, e.g., Cal. Dep’t of Water Resources, South Central Region Groundwater Level Monitoring, http://www.water.ca.gov/groundwater/data_and_monitoring/south_central_region/GroundwaterLevel/gw_level_monitoring.cfm.
- 169 Tara L. Taguchi, *Whose Space Is It, Anyway?: Protecting the Public Interest in Allocating Storage Space in California’s Groundwater Basins*, 32 Sw. U. L. REV. 117, 132 (2003) (noting that some have referred to Orange County Water District “as a leader in the water district non-adjudication approach to groundwater management (quoting JEFFERY S. ASHLEY & ZACHARY A. SMITH, GROUNDWATER MANAGEMENT IN THE WEST, 44 (1999)).
- 170 *Id.* at 133.
- 171 Cal. Code §§ 21040–20145.
- 172 BLOMQUIST, *supra* note 85, at 257 (“The OCWD simply poured more water into the basin than pumps pulled out.”).
- 173 *Id.* at 270
- 174 *Id.*
- 175 Kelly J. Hart, *The Mojave Desert as Grounds for Change: Clarifying Property Rights in California’s Groundwater to Make Extraction Sustainable Statewide*, 14 HASTINGS W.-N.W. J. ENVTL. L. & POL’Y, 1213, 1228 (2008).
- 176 See Trelease, *supra* note 91, at 1225 (“Unquestionably, adjudication by a court is the only reliable way to determine the rights of users from a groundwater basin.”); Michael P. Mallory, *Groundwater: A Call for a Comprehensive Management Program*, 14 PAC. L.J. 1279, 1290 (1983) (“[G]roundwater users have very uncertain ideas of what their respective rights are if the basin has not been adjudicated.”).
- 177 John E. Thorson et al., *Dividing Western Waters: A Century of Adjudicating Rivers and Streams*, 8 U. DENV. WATER L. REV. 355, 406 (2005). Some states turned to statutory adjudication procedures while others developed an administrative authority. California has done neither. California statutory law does provide a procedure by which a court may, in an adjudication, request the State Water Resources Control Board (formerly handled by the Division of Water Resources) to conduct an investigation into the physical facts and existing rights for a groundwater basin. See *supra* note 104 and accompanying text. Cal. Water Code § 2000.
- 178 See *supra* Part 3.1.6.
- 179 BLOMQUIST, *supra* note 85, at 288.
- 180 Russell Kletzing, *Imported Groundwater Banking: The Kern Water Bank—A Case Study*, 19 PAC. L.J. 1225, 1243 (1988); *id.* at 1257 (noting that Metropolitan, the CVP and the SWP have alleviated groundwater overdrafts in their respective areas via water importation).
- 181 Andrews & Fairfax, *supra* note 4, at 187.
- 182 See *id.* (attributing the reduction in overdraft to surface water projects in California).
- 183 Surface water adjudications work in this manner. Facing a water shortage, the regulating agency or watermaster for the river cut off water to junior users, to protect the rights of senior users.
- 184 Cutting off groundwater appropriators to benefit overlying users, for example, would likely mean cutting off major industrial or municipal users in order to allow an overlying user to irrigate his plot of land. With a functioning water transfers market, however, the choice becomes less stark.

- 185 Tehachapi-Cummings County Water Dist., Thirty-Eighth Annual Watermaster Report for Tehachapi Basin 15 (Calendar Year 2011), <http://tccwd.netxn.com/store/downloads/Tehachapi%20Basin%20Watermaster%20Report%20-%202011-Compressed.pdf>.
- 186 See BLOMQUIST, *supra* note 85, at 184 (“[W]ater rights transfers in the Main San Gabriel Basin help move groundwater production from those who value it less to those who value it more.”).
- 187 See, e.g. adjudications for West, Chino and Mojave River basins.
- 188 Hart, *supra* note 174, at 1227–28.
- 189 For example, with sufficient market liquidity, brokers or aggregators could facilitate trading of smaller lots of entitlement or allocation shares. Such brokers would require regulatory oversight, but would not necessarily be a party to the adjudication itself.
- 190 HADDAD, *supra* note 41, at 5.
- 191 CAL. LEGISLATIVE ANALYST’S OFFICE, CALIFORNIA WATER: AN LAO PRIMER 34 (Oct. 2008).
- 192 California’s population, currently at 39 million, could reach 60 million by 2050 and 85 million by 2100. ELLEN HANAK ET AL., MANAGING CALIFORNIA’S WATER 163 (2011), http://www.ppica.org/content/pubs/report/R_211EHR.pdf. By 2050, Southern California could see a 60% population increase, to 32 million people. METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, REPORT OF THE BLUE RIBBON COMMITTEE 29 (2011), <http://mwdh2o.com/BlueRibbon/pdfs/BRCreport4-12-2011.pdf> [hereinafter “MWD BLUE RIBBON COMMITTEE”].
- 193 CAL. LEGISLATIVE ANALYST’S OFFICE, *supra* note 189, at 35; HADDAD, *supra* note 41, at 5. California farmland decreased by 203,011 acres between 2006 and 2008, while urban land increased by 72,548 acres. Letter from Derk Chernow, Acting Director, Cal. Dep’t of Conservation, Mar. 2011, in CAL. DEP’T OF CONSERVATION, CALIFORNIA FARMLAND CONVERSION REPORT 2006–2008 (Jan. 2011).
- 194 HADDAD, *supra* note 41, at 5.
- 195 See HANAK ET AL., *supra* note 190, at 137 (“All major water projects in California were designed assuming that hydrologic conditions in the recent past represent future conditions.”)
- 196 *Id.* at 175.
- 197 MWD BLUE RIBBON COMMITTEE, *supra* note 190, at 31.
- 198 U.S. BUREAU OF RECLAMATION, SECURE WATER ACT SECTION 9503(C)—RECLAMATION CLIMATE CHANGE AND WATER, REPORT TO CONGRESS 131, 138 (Apr. 2011), <http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf>.
- 199 U.S. BUREAU OF RECLAMATION, *supra* note 196, at 146.
- 200 *Id.* at 147.
- 201 MWD BLUE RIBBON COMMITTEE, *supra* note 190, at 34; HANAK ET AL., *supra* note 190, at 140 (“Even modest rises in sea level will shift salinity landward enough to interfere with Delta water exports and agriculture in the western Delta (Fleenor et al. 2008; Chen et al. 2010).”).
- 202 MWD BLUE RIBBON COMMITTEE, *supra* note 190, at 34.
- 203 Cal. Inst. of Tech. Jet Propulsion Laboratory, NASA Data Reveal Major Groundwater Loss in California, Dec. 14, 2009, <http://www.jpl.nasa.gov/news/news.php?release=2009-194>.
- 204 Cal. Civ. Proc. Chpt. 8 § 389 (2010); Fed. R. Civ. P. Rule 19. In *Orange County Water District v. Riverside*, the court of appeal noted that “where adjudication is sought of rights to a stream the preferable course is, so far at least as is practicable, to ‘have all owners of lands on the watershed and all appropriators who use water from the stream . . . in court at the same time,’ and it would have been a proper exercise of the trial court’s discretion had it acceded to appellants’ motion to bring in at least the more important among the other appropriators from the river system.” 173 Cal. App. 2d 137, 173 (1959) (quoting *California v. United States*, 235 F.2d 647, 663 (9th Cir. 1956)). It is unclear if courts would be limited to permissive, rather than required, joinder of surface right holders in the typical groundwater adjudication.
- 205 GOVERNOR’S COMMISSION FINAL REPORT, *supra* note 10, at 237–50. The proposed legislation was meant to modify the rules of civil procedure in groundwater adjudications “to reduce the length and cost of adjudications.” *Id.* at 169.
- 206 GOVERNOR’S COMMISSION FINAL REPORT, *supra* note 10, at 241 (Art. 4, § 16915).
- 207 *Id.* at 245 (Art. 7, § 16940).
- 208 See, e.g., James L. Markham, *The California Legislature Should Establish Water Courts*, CAL. WATER L. & POL’Y RPTR., Feb. 2005, at 123. Similar water courts have been established in Montana. *Id.* at 123.
- 209 *Id.* at 125.
- 210 *Id.*
- 211 ENION, *supra* note 2.
- 212 The agricultural pool also could not exceed 414,000 acre-feet over a five-year period. *Chino Basin Muni. Dist. v. City of Chino*, No. 164327, at 25 (Cal. Sup. Ct. Oct. 26, 1989); BLOMQUIST, *supra* note 85, at 281.
- 213 The possible exception are those adjudicated basins under the mutual prescription doctrine, in which appropriative and overlying right holders may be now on equal footing. See, e.g., *supra* Parts 3.1.1 (Raymond basin) and 3.1.2 (West basin).

- 214 One share divided by 90,166 total outstanding shares, times the safe yield of 63,166 acre-feet, equals 0.7 acre-feet per entitlement share. If each allocation share represents 0.1 acre-feet, then 0.7 divided by 0.1 equals 7 allocation shares.
- 215 See *supra* Part 1.2 (describing harms from basin overdraft and misuse).
- 216 See, e.g., Andrew H. Sawyer, *Changing Landscapes and Evolving Law: Lessons from Mono Lake on Takings and the Public Trust*, 50 OKLA. L. REV. 311, 329 (1997) (“The California law of water rights imposes a number of limitations on the exercise of those rights that would make it very difficult to establish that any particular regulation or change in definition of water rights is a taking.”).
- 217 Kletzing, *supra* note 179, at 1242.
- 218 Hart, *supra* note 174, at 1233–34.
- 219 See, e.g., San Timoteo Watershed Mgmt. Auth. v. City of Banning (Beaumont basin judgment), No. RIC 389197, at 5 (Cal. Sup. Ct. Feb. 4, 2004) (defining “safe yield” only as the maximum quantity that can be produced with lowering the groundwater table).
- 220 See, e.g., Cent. & W. Basin Water Replenishment Dist. v. Adams, No. 786,656 (Cal. Sup. Ct. May 6, 1991) (second amended judgment) (defining “natural safe yield”);
- 221 See, e.g., S. Cal. Water Co. v. City of La Verne (Six Basins judgment), No. KC029152, at 7 (Cal. Sup. Ct. Dec. 18, 1998) (distinguishing “native safe yield” from “operating safe yield”).
- 222 “[S]ubsurface storage space is a public resource.” Cent. & W. Basin Water Replenishment Dist. v. S. Cal. Water Co., 109 Cal. App. 891, 905 (2003). The right to stored water is tied to the source of that water; it does not attach to the right to extract. *Id.* at 910. For example, imported water stored in a basin remains the right of the importer. One may divert surface water to underground storage, with the appropriate permit from the State Water Resources Control Board. A groundwater storage license would be distinct from any such surface water permits. If such a permit requires the extraction and reuse of stored water by a particular time or at a particular place, the storage user would use his allocation shares to guarantee such terms.
- 223 *Id.* at 910 (finding no linkage between storage and extraction rights and rejecting carryover rights as a provision that confers storage rights in the Central Basin); see also Peter J. Kiel & Gregory A. Thomas, *Banking Groundwater in California: Who Owns the Aquifer Storage Space?*, 18 NAT. RESOURCES & ENV'T 25, 28 (2003) (citing *City of Los Angeles v. City of Glendale* and *City of Los Angeles v. City of San Fernando*).
- 224 A user must have adequate rights to recaptured water, as would likely be the case in an urban coastal area where, without stormwater recapture, the water would flow directly to the ocean. Or the user may have imported surplus water from outside the basin. *Cf. City of Pasadena v. City of Alhambra*, 33 Cal. 2d 908, 925 (1949) (describing rights to exported surplus water).
- 225 See Kiel & Thomas, *supra* note 223, at 28–29 (describing how an importer likely can recover stored surface water from a basin provided it has the *intent* to recharge and recover).
- 226 *Id.* at 29.
- 227 *Cf. S. Cal. Water Co. v. City of La Verne* (Six Basins judgment), No. KC029152, at 17–18 (Cal. Sup. Ct. Dec. 18, 1998) (prioritizing loss of storage capacity, with highest going to replenishment water, followed by carryover, native, imported and then other water).
- 228 Tehachapi-Cummings County Water Dist., *supra* note 184, at 10.
- 229 Central basin appears to limit the use of storage in the basin to the Replenishment District. See *Water Replenishment Dist. of S. Cal. v. City of Cerritos*, 202 Cal. App. 4th 1063, 1066 (2012) (finding the trial court has jurisdiction to consider an amendment to the adjudicatory judgment on the question of underground storage space). The Second District has ruled that the trial court has jurisdiction to rule on, and develop a physical solution concerning, the issue of storage space allocation in West Coast basin. *Hillside Mem'l Park & Mortuary v. Golden State Water Co.*, 131 Cal. Rptr. 3d 146, 158 (2011).
- 230 Central basin: 20% or 20 af, whichever is larger. Six Basins & Tehachapi basin: 25%.
- 231 See, e.g., *Cal. Water Service v. City of Compton* (West basin judgment), No. 506,806, at 60–67 (Cal. Sup. Ct. Mar. 21, 1980) (amended judgment).
- 232 If the court retains *in rem* jurisdiction over the entitlement or allocation share, then the jurisdiction follows the share, not the owner. If the court retains *in personam* jurisdiction, then the limitations attached to use of the allocation or entitlement share follow the sale. The seller cannot sell these shares free of such limitations because the seller never owned a share free of those limitations.
- 233 See, e.g., *S. Cal. Water Co. v. City of La Verne* (Six Basins judgment), No. KC029152, at 26–27 (Cal. Sup. Ct. Dec. 18, 1998) (detailing the obligation to provide replacement water).



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