IMPROVING REGIONAL GROUNDWATER MANAGEMENT IN CALIFORNIA

PREPARED FOR THE NATURAL RESOURCES DEFENSE COUNCIL

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Executive Summary

Commissioned by the Natural Resources Defense Council, this report builds upon a 2011 working paper entitled *Uncommon Innovation: Developments in Groundwater Management Planning in California*, written by Rebecca Nelson and published by Water in the West, a joint initiative of the Woods Institute for the Environment and the Bill Lane Center for the American West at Stanford University. That publication presented promising and innovative approaches to local groundwater management, by analyzing a collection of groundwater management plans (GWMPs) prepared under the California Water Code.

This report goes further. It provides an overview of laws and policies that relate to groundwater management in California, and how GWMPs fit with other elements of this framework, including various types of water plans, special district legislation, and environmental impact reporting legislation. It describes key characteristics of groundwater management in California—both in terms of management gaps as well as successes—based on an expanded collection of 70 GWMPs and special district legislation. It diagnoses, throughout, key obstacles to improved regional groundwater management. It makes the following key findings.

Goals of groundwater management in California

California's basin-scale goal for groundwater management is to restrain groundwater pumping to the "safe yield" of the aquifer. This goal does not consider ecological impacts or impacts on surface waters that can occur even under safe yield conditions, nor restoring depleted basins that are nonetheless "in balance". Although this goal does not formally and directly apply in the absence of basin adjudications, which are rare, it heavily influences GWMPs. Unfortunately, it does not align with modern Californian water policy, which embraces a vision of water sustainability that includes wider environmental and social considerations.

Legislation for statutory water management plans

Legislation and grant funding conditions for urban water management plans, integrated regional water management plans, and agricultural water management plans involve much more rigorous requirements than do those for GWMPs. This is notably the case in relation to encouraging a plan to evaluate and use a portfolio of strategies and values—particularly when it comes to demand management as well as supply augmentation, and including environmental elements, such as acknowledging environmental water needs. Other important areas in which GWMP provisions lag are in requiring plans to be reviewed; ensuring broad public involvement; and disseminating information about the plan and data to the public. Although in theory, GWMPs must be implemented, no established reporting structures support the enforcement of this obligation.

At present, the different plan types are largely uncoordinated, leading to unnecessary duplication and complexity. There is significant scope to reduce duplication and inefficiency for water agencies, and improve groundwater management, by harmonizing requirements for GWMPs with the other plan types, requiring data sharing, and encouraging agencies to combine plans where possible.

Groundwater management plans in practice

The quality and content of GWMPs varies throughout the state. The best GWMPs excel in four key areas, which, if more widespread, would likely result in improved regional groundwater management. These areas are: (1) accepting an active groundwater management role; (2) adopting a broad vision and goals for groundwater management; (3) seriously considering a range of groundwater management tools—a "portfolio of strategies"—and transparently evaluating these tools and how they contribute to achieving specified goals; and (4) collecting, analyzing and reporting groundwater information.

Legislation for special districts

Legislation establishing special districts reflects markedly different decision-making structures than those that apply to general agencies, with board members often appointed, rather than elected. Special district legislation also contains clearer and stronger powers to control groundwater pumping directly and through pumping fees. While more research would be necessary to determine the effect of appointing versus electing boards, it seems likely that providing more certain and stronger powers to agencies beyond special districts could contribute to improved regional groundwater management.

CEQA and groundwater

The Californian Environmental Quality Act (CEQA) affects groundwater management by requiring environmental impact reporting for projects, which have the possibility of having a significant impact on the environment. Relevant groundwater projects include groundwater storage projects, transfer projects, and the installation of groundwater production wells or monitoring wells. Whether a project may have a significant impact depends on local agency interpretations, is subjective, and even projects with such an impact may go ahead if the agency determines that economic and social goals outweigh these impacts. CEQA requirements go some way towards addressing the weakness of GWMP provisions in relation to environmental aspects of groundwater management. However, they do not allow for proactive, long-term planning, do not cover all types of projects, and provide little guidance on how to consider whether a groundwater impact is significant.

Obstacles to improving regional groundwater management

California has the outlines of an effective legislative framework for regional groundwater management, but there are many gaps to fill and obstacles to remove to improve management. Most fundamentally, California lacks a cohesive, modern vision for groundwater management at the basin scale, and also at the level of individual groundwater rights. At the basin scale, California's legal goal for groundwater management focuses narrowly on direct groundwater supply for human uses—"safe yield"—and there is no well-accepted alternative. Modern water policy, by contrast, increasingly dictates that environmental goals are "co-equal" to water supply reliability. At the individual rights scale, the constitutional prohibition on wasting water is too vague to be workable in practice. At the project scale, the concept of a "significant" environmental impact under CEQA in relation to groundwater pumping is unclear.

Alongside the lack of a coherent legal and policy vision for groundwater management, many agencies do not consider groundwater management—particularly management of private extraction within their territory—to be part of their core mission. Accordingly, in some areas, characterizing the

actions of water agencies that relate to groundwater as “management” would be overly generous. Some GWMPs only recite arrangements currently in place, lack any implementation plan, and consider using only a very narrow part of the full toolbox of available demand-side and supply-side management measures, and their benefits and costs. Local electoral systems for directors of general agencies, requirements to hold special elections prior to imposing groundwater charges, and landholder-focused processes for GWMPs, all hamper the ability of agencies to use demand management measures, like pumping controls and fees, in groundwater management. Legal uncertainty over their powers and related fear of litigation also discourage agencies from using such measures. Groundwater recharge and banking projects are probably under-utilized tools and may be causing harm, because they are not supported by a legal framework that gives certainty to participants about their rights, and prevents adverse impacts on third parties and the environment.

Finally, raw groundwater data are often imperfect, information on groundwater management is difficult to access, and there is a complete lack of groundwater information that is targeted to policy makers or to the public by being presented in its social, economic and environmental context.

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Glossary

AWMP	Agricultural water management plan, made under the Agricultural Water Management Planning Act, CWC §§ 10800-10855
Bulletin 118	*California's Groundwater: Bulletin 118 (Update 2003)*, the DWR's guide to groundwater resources and management in the state
California Water Plan	*California Water Plan Update 2009: Integrated Water Management* (DWR Bulletin 160-09)
CASGEM	California Statewide Groundwater Elevation Monitoring program, established under Senate Bill 6 (7th Extraordinary Session) in 2009
CEQA	Californian Environmental Quality Act, California Public Resources Code § 21000 *et seq*.
CWC	California Water Code
DWR	California Department of Water Resources
general agency	Any one of the 20 or so types of independent local water agencies, for which the California Water Code provides, which are the most numerous agencies that manage groundwater in the state
GWMP	Groundwater Management Plan, made under the Ground Water Management Act, CWC §§ 10750-10767
IRWMP	Integrated Regional Water Management Plan, made under the Integrated Regional Water Management Planning Act of 2002, CWC §§ 10530-10550
IRWMP Guidelines	*Proposition 50, Chapter 8 - Integrated Regional Water Management Grant Program Guidelines: Proposal Solicitation Packages Round 2*, June 2007
LGA Guidelines	DWR, *Draft Guidelines and Proposal Solicitation Package: Local Groundwater Assistance Grant Program*, November 2009
special district	A local government agency given special powers by its own individual legislation to manage groundwater (NB: this definition may differ from that used in Bulletin 118, which is not explicit)
UWMP	Urban Water Management Plan, made under the Urban Water Management Planning Act, CWC §§ 10610-10657

1. Introduction

Commissioned by the Natural Resources Defense Council, this report builds upon a 2011 working paper entitled *Uncommon Innovation: Developments in Groundwater Management Planning in California*, written by Rebecca Nelson and published by Water in the West, a joint initiative of the Stanford Woods Institute for the Environment and the Bill Lane Center for the American West at Stanford University. That publication presented promising and innovative approaches to local groundwater management, by analyzing a collection of groundwater management plans (GWMPs) prepared under the California Water Code.

This report goes further. It provides an overview of laws and policies that relate to groundwater management in California, and how GWMPs fit with other elements of this framework, including various types of water plans, special district legislation, and environmental impact reporting legislation. It describes key characteristics of groundwater management in California—both in terms of management gaps as well as successes—based on an expanded collection of 70 GWMPs and special district legislation. It diagnoses, throughout, key obstacles to improved regional groundwater management. This report first describes the key agencies involved in groundwater management and key goals of Californian groundwater management, from a legal and policy perspective (Parts 2 and 3). Parts 4 to 7 then set out and analyze the present legal and policy structure for local and regional groundwater management in California, the key elements of which are:

(a) water management plans: Part 4 sets out and contrasts legal and policy provisions for GWMPs, integrated regional water management plans (IRWMPs), urban water management plans (UWMPs), agricultural water management plans (AWMPs), and others. Part 5 discusses how these provisions translate into management plans in practice, with reference to examples of GWMPs, which are the dominant water planning mechanism for groundwater;

(b) legislation that establishes special districts for managing groundwater: Part 6 discusses key aspects of this legislation with reference to the contrasting legal arrangements for establishing general agencies, which are the most numerous agencies managing groundwater in California; and

(c) legislation that establishes Californian environmental impact reporting requirements: Part 7 discusses these requirements and how they affect local and regional groundwater management.

Throughout Parts 2 to 7, the report notes legal and policy gaps and obstacles that stand in the way of improving groundwater management in California. For the reader's convenience, these are indicated by this symbol: 

Finally—a cautionary note. The main basis of this report is documentary information in the form of a set of 70 GWMPs, which are a subset of all GWMPs, which themselves reflect only a subset—and probably a self-censored subset, at that—of the views of all agencies managing groundwater in California. These documents have served to indicate both obstacles and also potential solutions to improving groundwater management, based on

the apparent frequency of an obstacle arising and drivers for water agency action. This dataset is enormously valuable, but also necessarily incomplete. As such, further empirical research using interviews is desirable to confirm water agency views of key obstacles, and drivers for action.

2. Local agencies managing groundwater in California

The key protagonists and subjects of this report are local agencies, which fall into two broad types: "general agencies" and special districts. The California Water Code provides for the establishment of 20 types of general agencies that may have powers related to groundwater management, deriving from the legislation that provides for them to be established.[1] In addition to powers granted to them by their constitutive legislation, they may obtain additional groundwater management powers if they adopt a groundwater management plan ("GWMP") (see Part 4.2). Such agencies include California water districts, county water districts, irrigation districts, reclamation districts, water conservation districts, water replenishment districts, water storage districts, and waterworks districts. There are over 2,200 general agencies in California,[2] in contrast to only 17 special districts. Accordingly, general agencies are the primary types of agencies that manage groundwater in California. They are involved in groundwater management because they supply groundwater to users, or supply surface water to users who also use groundwater, or they may wish to protect the resource from overpumping by landowners within their service area because they plan to use groundwater in the future.

"Special districts" have special groundwater management powers in certain areas of the state. Generally, these areas suffer from groundwater depletion or anticipated depletion, or seawater intrusion. In contrast to special districts, general agencies are not established by individual pieces of legislation that are tailored to local conditions; rather, they may be established anywhere in the state. Special districts may also adopt GWMPs. Outside special districts, agencies are not obliged to manage groundwater, nor is any agency held accountable for poor groundwater management, since management activities, such as formulating and implementing GWMPs, are voluntary.

3. Goals of groundwater management in California

Legal and policy goals for groundwater management set the background for, and facilitate an assessment of, groundwater planning efforts. A lack of clear and consistent goals is an important obstacle to improved groundwater management, and one which appears as a recurring theme in this report. It is introduced here because it pervades all the major legal and policy arrangements for groundwater management in California.

Californian groundwater management rests on legal goals that are, in two major respects, vague, narrow, and inconsistent with modern water policy goals. First, at the basin scale, law limits groundwater withdrawals narrowly, by seeking to balance withdrawals with recharge. This contrasts with the broader modern water policy vision that also considers

[1] California Department of Water Resources, "California's Groundwater: Bulletin 118 (Update 2003)," (Sacramento, California: Department of Water Resources, 2003), 34.
[2] California State Controller, *Special Districts Annual Report 2007-2008*, 58th ed. (Sacramento, California: California State Controller, 2010), 1061.

impacts on surface waters, ecosystems, and communities. The dominance of this narrow view hinders the achievement of healthy basin conditions and improved regional groundwater management. Second, at the level of individual groundwater rights, concepts of beneficial use and waste are vague, and fail to restrain unreasonable uses in practice. Agencies are unlikely to restrain higher than reasonable individual uses without more concrete guidance as to what constitutes waste, allowing such uses cumulatively to deplete aquifers.

3.1 A basin-scale goal for groundwater management

Water law limits total basin extraction to the volume that ensures "safe yield" conditions, where annual withdrawals will not gradually lower groundwater levels, being approximately the rate of recharge.[3] It does not consider ecological impacts or impacts on surface waters that can occur even under safe yield conditions, nor restoring depleted basins that are nonetheless "in balance". Unlike legal rules for surface water allocation, which take account of environmental uses through the public trust doctrine, for example, the current legal vision for groundwater allocation ignores ecological dependence on groundwater.[4] It can also reward groundwater depletion (and correspondingly increased surface water and ecological impacts), since lower groundwater levels can increase the inflow of groundwater from connected aquifers, increasing the safe yield, and therefore the volume of water available to users, while maintaining water levels.[5]

By contrast, state water policy embraces a vision of water sustainability that is more nuanced than a "discharge = recharge" calculation. In particular, the California Water Plan confirms that environmental considerations and ecosystem stewardship are vital to water management.[6] Bulletin 118, the Department of Water Resources (DWR) guide to groundwater resources and management in the state, states that overdraft occurs when continuing current water management practices would probably result in significant adverse overdraft-related impact upon environmental, social or economic conditions at a local, regional, or state level.[7] In addition, major recent water legislation—the 2009 legislative package—was driven in significant part by the declining health of aquatic ecosystems. There is also industry support—as demonstrated by the Association of California Water Agencies (ACWA), at least in principle—for recognizing environmental aspects of groundwater management. ACWA's 2011 Groundwater Framework states that "the ideal groundwater management plan … satisfies the needs of both the environment and the economy while ensuring the continued health of the basin."[8]

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[3] Burr v. Maclay Rancho Water Co., 154 Cal. 428, 98 P. 260 (1908); City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199, 123 Cal. Rptr. 1, 537 P.2d 1250 (1975).

[4] See below, note **Error! Bookmark not defined.**.

[5] Stoddard & Associates, "Groundwater Management Plan for the Southern Agencies in the Delta-Mendota Canal Service Area (Prepared for the San Luis & Delta-Mendota Water Authority)," (1996), 27, 35 ("lowering the groundwater levels increases sustainable yield, since subsurface inflow is induced by pumping in the confined zone which counteracts the water extracted").

[6] California Department of Water Resources, "1 California Water Plan Update 2009: Integrated Water Management (Department of Water Resources Bulletin 160-09)," (2010), 2-13, 2-14. See also below, note **Error! Bookmark not defined.**.

[7] California Department of Water Resources, Bulletin 118, above note 1, 98.

[8] Association of California Water Agencies, "Sustainability from the Ground Up: Groundwater Management in California - a Framework," (2011).p. 25.

The narrowness of the goal of safe yield is important because it defines Californian groundwater management, even though basin adjudications, which would apply the concept formally, are rare. The goal finds its way into GWMPs (see Parts 4.2 and 5), and special districts that restrict groundwater extractions do so with reference to safe yield levels of extraction.[9]

Provisions for other types of water plans—integrated regional water management plans, urban water management plans, and agricultural water management plans—embrace a vision of water management that is much broader than safe yield. They mention, for example, environmental stewardship and environmental water needs. The wider goal evident in water policy is unfortunately absent from GWMP provisions.

The constitutive legislation of general agencies in California supports (or at least, does not challenge) the outdated, narrow groundwater management goal of safe yield, rather than embracing a modern vision focused on sustainability, which considers demand management and the broader impacts of water supply. Few local water agencies have specific legislative mandates to address groundwater problems; none has an express legislative mandate to consider the broader effects of groundwater depletion, beyond water supply concerns. This is despite the fact that water management planning provisions are peppered with legislative findings about the severity of groundwater problems.[10] Management planning tools have been grafted on to old, established institutions, which have legislative mandates that do not match the demands of contemporary water policy. As this report later argues with respect to GWMPs, agencies that now "manage" groundwater under GWMPs often retain that old focus and mindset.[11]

Outside water allocation and management laws and policies, CEQA (see Part 7) encourages a wider vision of groundwater management. But this applies in limited circumstances, for example, where a public agency is involved, and the impacts of a project are "significant"—a term, the meaning of which can vary greatly. Nor is this vision helpful to restoring depleted groundwater basins (or deciding whether such a goal is desirable in particular local circumstances); it only prevents conditions becoming "significantly" worse.

A more modern legal vision for basin-scale groundwater management would align with current water policy, and its goals of managing extraction, encompassing considerations of community, ecological and surface water impacts.

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[9] For example, the Fox Canyon GMA's legislation defines overdraft as "the condition of the groundwater basin or aquifer where the average annual amount of water extracted exceeds the average annual supply of water to a basin or aquifer", and "safe yield" as "the condition of a groundwater basin when the total average annual groundwater extractions are equal to, or less than, the total average annual groundwater recharge, either naturally or artificially": CWC App. §§ 121-318, 331.

[10] E.g., CWC §§ 12926(b), 13701(c).

[11] See, e.g. Kern-Tulare Water District and Rag Gulch Water District, "Groundwater Management Plan," (2006), 3; Westlands Water District, *Who We Are*, http://www.westlandswater.org/wwd/aboutwwd/aboutwwd.asp?title=Who%20We%20Are&cwide=1280 (last accessed August 20, 2011); Shafter-Wasco Irrigation District, "Groundwater Management Program," (1993), 2.

3.2 An individual-level goal for groundwater management

The California Constitution advances an individual-scale goal for groundwater management that limits an individual's water rights to "reasonable beneficial use" and does not permit the user to waste water.[12] However, these terms are unclear and difficult to operationalize in the absence of detailed definitions, which have not been promulgated.

While recent legislation for agricultural conservation contains detailed and mandatory conservation elements,[13] which might seem to address this problem, it seems that these requirements apply only to water that is provided by an agricultural water supplier, rather than water than is self-supplied from individual pumpers' wells.[14] If this is indeed the case, then large individual groundwater pumpers remain almost entirely untouched by the recent wave of water conservation requirements for agency-supplied water. Fundamentally, in the absence of widespread basin adjudications, individual groundwater pumpers are not subject to clear or meaningful restraints on, or held responsible for the effects of, their groundwater use.

4. Legislation for water management plans

In the absence of widespread groundwater adjudications, or a permitting scheme for groundwater allocations, water management plans are the key vehicles for managing groundwater at the local and regional levels in California.[15] The California Water Code ("CWC") provides for local agencies of different kinds to make four key types of water management plans, which are relevant to groundwater:

(a) integrated regional water management plans (IRWMPs);

(b) urban water management plans (UWMPs);

(c) groundwater management plans (GWMPs); and

(d) agricultural water management plans (AWMPs).

These plans generally operate at different spatial scales: UWMPs and AWMPs may only be adopted by one agency; a GWMP may be adopted by one or multiple agencies; and an IRWMP may only be adopted by multiple agencies (a "regional water management group").

Under state law, each of these types of plans must meet certain enumerated requirements. An agency must meet basic requirements in order to adopt the plan; additional requirements apply for the agency to be eligible to receive state funding for water projects. These requirements relate to substantive as well as procedural matters. Common substantive matters include: using a portfolio of management strategies (that is, looking beyond a traditional focus on supply augmentation as a universally desirable strategy);

[12] California Constitution, Art. X, §2; Barstow v Mojave Water Agency, 23 Cal. 4th 1224 (2000).
[13] For an expanded discussion of this legislation, see Part 4.4, below.
[14] For example, nearly all references to efficiency requirements refer to water "delivered": CWC § 10608.48.
[15] It is important to note that the notion of using these water management plans to "manage" groundwater at the local or regional level falls short of defining or determining any rights to pump groundwater—water management planning legislation explicitly provides so. See, e.g., CWC § 10549 (in relation to IRWMPs).

recognizing the full hydrological context in which groundwater exists (that is, connections with surface water and ecological dependence on groundwater); measures directed towards ensuring the plan is implemented; and using measurable objectives. Procedural matters include: whether or not a plan is mandatory; opportunities for public involvement; and data dissemination. Parts 4.1 to 4.6 discuss these elements in relation to each plan type. Part 4.7 and Table 1 compare provisions for IRWMPs, GWMPs, UWMPs and AWMPs, and show that the GWMP provisions are significantly less robust than the others. Part 4.8 describes how the plans interact, and suggests how this interaction could be better streamlined.

4.1 Integrated Regional Water Management Plans

The Integrated Regional Water Management Planning Act of 2002[16] establishes the state's framework for encouraging local agencies to coordinate to manage water supplies, water quality, and flood protection. It provides for "regional water management groups"[17] to prepare and adopt IRWMPs. The public, and a broad range of enumerated local agencies and stakeholders, must be given an opportunity to participate in developing and implementing an IRWMP.[18] IRWMPs may, but need not, incorporate other types of water plans, including UWMPs and GWMPs.[19] Unlike GWMPs, IRWMPs do not form the basis of any special agency powers, and the IRWMP Guidelines themselves contemplate GWMPs continuing to be the key method of managing groundwater in the state.[20]

Though it deals with water generally, the IRWMP Act addresses groundwater management specifically by providing for IRWMPs to include strategies to increase water supplies through storage and conjunctive water management, as well as groundwater management strategies as a way to "improve resource stewardship".[21] Each plan must also identify "any significant threats to groundwater resources from overdrafting" and protect groundwater resources from contamination.[22]

Agencies are encouraged to use a broad range of water management strategies, beyond just increasing water supplies. IWRMPs may include projects or programs that aim to reduce water demand, increase water supplies, improve operational efficiency and reliability, improve water quality, improve resource stewardship and improve flood management.[23]

The IRWMP Act recognizes environmental water needs and the desirability of facilitating "environmental stewardship" in the legislative findings;[24] by including programs to improve resource stewardship, which includes ecological aspects;[25] by requiring IRWMPs to protect, restore and improve the "stewardship of aquatic, riparian, and watershed resources within the region";[26] and by specifically requiring that environmental stewardship organizations be given an opportunity to participate in developing and implementing the

[16] CWC §§ 10530-10550.
[17] CWC § 10539.
[18] CWC §10541(g).
[19] CWC § 10540(b).
[20] IRWMP Guidelines, 10.
[21] CWC §§ 10537(b)(1), (e).
[22] CWC § 10540(c)(4), (6).
[23] CWC §10537.
[24] CWC §10531(a), (d).
[25] CWC § 10537(e).
[26] CWC § 10540(c)(5).

plan.[27] Proposition 84, which provides funding for IRWMPs, applies to projects that "assist local public agencies to meet the long term water needs of the state including … the protection of … the environment".[28]

Agencies are not required to report on IRWMPs in a general sense. However, reporting is a condition of receiving state funds: grant recipients must prepare a "Project Assessment and Evaluation Plan", setting out how they will report on the achievements of the project, including the goals, indicators, measurement tools and targets used to do so.[29] They must also submit quarterly reports during the term of a Proposition 84 grant.[30]

4.2 Groundwater Management Plans

The Ground Water Management Act[31] establishes the state's framework for local groundwater management planning, in basins with significant groundwater yields, which are not adjudicated.[32] It permits a local agency, which includes a special district or a group of agencies, to adopt and implement a GWMP for all or part of the agency's service area.[33]

Adopting a GWMP involves taking formal procedural steps, including making specific resolutions, issuing public notices and conducting public hearings.[34] If landowners, who represent more than 50 percent of the assessed value of the land within the local agency, protest against the GWMP, the local agency may not adopt it.[35] Among the plans discussed in this report, this focus on landowners is unique to GWMPs, and there is no provision requiring (or requiring the agency to encourage) broad public participation, unlike for IRWMPs and UWMPs.[36]

A GWMP may cover 12 enumerated matters. The quantity-related matters are: mitigating conditions of overdraft, replenishing extracted groundwater, monitoring groundwater, facilitating conjunctive use operations, and constructing and operating groundwater recharge, conservation, water recycling, and extraction projects.[37] Quality-related matters are: controlling saline water intrusion; identifying wellhead protection areas and recharge areas; regulating the migration of contaminated groundwater; administering a well abandonment and well destruction program; identifying well construction policies; constructing and operating groundwater contamination cleanup projects; and reviewing land use plans and coordinating with land use agencies to assess activities which create a reasonable risk of groundwater contamination.[38]

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[27] CWC § 10541(g)(8).
[28] California Public Resources Code § 75026.
[29] IRWMP Guidelines, p. 35.
[30] Proposal Solicitation Package: Integrated Regional Water Management, Proposition 84 – Round 1 (August 2010), 15 http://www.water.ca.gov/irwm/docs/PlanningGrants/Prop84_Round1/Final_PLANNING%20PSP_072010.pdf last accessed August 25, 2011.
[31] CWC §§ 10750-10767.
[32] CWC §§ 10750(a), 10750.2, 10752(b).
[33] CWC §§ 10752(g), 10753(a), 10755.2.
[34] CWC §§ 10753.2-10753.6.
[35] CWC § 10753.6.
[36] For a discussion contrasting this with arrangements that apply to special districts, see below, Part 6.2(b).
[37] CWC § 10753.8.
[38] CWC § 10753.8.

The following components are required to qualify as a GWMP and receive state funding: "monitoring and management of groundwater levels, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin."[39] However, as described below in Part 5.2(d), there is insufficient high-quality data and information available and accessible in relation to many of these issues, to facilitate adopting meaningful management strategies for them. This is particularly the case in relation to groundwater-surface water interaction.

An agency "shall adopt rules and regulations to implement and enforce" a GWMP,[40] and it is theoretically necessary to implement the GWMP to receive state funding for groundwater projects,[41] and comply with contractual funding provisions. However, there is no requirement for an implementation plan, and in the absence of one, it would be difficult to enforce the generally nebulous nature of many GWMPs, or otherwise hold an agency accountable for implementing it.

A GWMP must, as a prerequisite for state funding, include "basin management objectives".[42] However, there is no requirement for the plan to contain actions that relate to the objectives.

When a local agency adopts a GWMP, it gains special powers. It may limit or suspend groundwater extractions, provided it "has determined through study and investigation that groundwater replenishment programs or other alternative sources of water supply have proved insufficient or infeasible to lessen the demand for groundwater".[43] It may also impose "equitable fees and assessments for groundwater management based on the amount of groundwater extracted", provided a majority of voters endorses this, and may exercise the power of a water replenishment district to collect fees and assessments for groundwater management.[44] GWMPs have further legal effect in relation to surface water transfers: under the CWC, a person may only transfer surface water and replace that water with groundwater if the groundwater use is consistent with a GWMP adopted for the affected area.[45] Accordingly, in addition to a dominant focus on the basin scale, a GWMP can also affect the exercise of individual groundwater rights, in the context of a transfer of surface water.

Once it adopts a GWMP, the local agency must submit a copy of the plan to the DWR (which must, in turn, make the plan public), as a requirement of the state funding projects under the GWMP.[46] DWR presently maintains a database of GWMPs on its Integrated Water Resources Information System (IWRIS, available at

[39] CWC § 10753.7(a)(1).
[40] CWC § 10753.9(a).
[41] CWC § 10753.7(a)(1).
[42] CWC § 10753.7(a).
[43] CWC § 10753.9.
[44] CWC §§ 10754.2, 10754.3.
[45] CWC § 1745.10. Where no GWMP applies, replacing transferred surface water with groundwater is permitted if "the water supplier from whose service area the water is to be transferred … determines that the transfer will not create, or contribute to, conditions of long-term overdraft in the affected groundwater basin." *Ibid*.
[46] CWC § 10753.7(b)(2).

http://app1.iwris.water.ca.gov/iwris/index.asp). However, this is not sufficient to ensure that the public has full and easy access to information about groundwater management in California. Not all agencies that manage groundwater have adopted GWMPs, and not all agencies that adopt GWMPs provide them to the state, since agencies that do not request state funding do not need to submit them to the state. Not all GWMPs received by the state are electronic, making public access to them very difficult, and not all electronic GWMPs, which are made by agencies that receive state funding, appear on the IWRIS database. The IWRIS database appears not to be kept up-to-date, and some entries are duplicated or redundant, which can be confusing.[47] The IWRIS database does not contain any rules and regulations, which local agencies are obliged to adopt to implement their GWMPs. It appears that agencies rarely do adopt such rules and regulations, based on the very few that were provided during the process of collecting GWMPs. The main exceptions to this are counties that adopt ordinances containing or closely related to their GWMPs.[48] It is not clear whether IWRIS, or some other DWR system, will be used to offer public access to GWMPs in the future.

GWMPs are subject to few information reporting requirements. The DWR recommends that agencies produce periodic reports on the implementation of GWMPs, but itself acknowledges that historically there has been little such documentation.[49] Searches of agency websites suggest that few agencies post such reports, though there are notable exceptions to this.[50]

Information reporting is mandatory, however, as part of state funding arrangements. Agencies that receive money from the Local Groundwater Assistance Fund, which funds the preparation and implementation of GWMPs, must have a process in place "that informs groundwater users, stakeholders, and the general public about the project to be funded with the proposed grant and disseminates relevant reports and data".[51] However, there is no set format for doing this; informational mailings, presumably to a much smaller audience than would be able to access a website, may suffice to meet these requirements.[52] Agencies must also give DWR quarterly progress reports on funded projects.[53] Contractually, funded agencies must agree that all data and reports produced under a grant "shall be in the public domain", but the contract does not specify a mechanism for making this information public.[54] I have been unable easily to locate any relevant progress reports online for agencies that received LGA grants during 2009-2010. After the term of the funding agreement, no reporting requirements apply; the agency is not required to update or review its GWMP.

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[47] As one example, the database contains various groundwater management plans made by the Kings River Conservation District in the 1990s, but does not include its 2005 plan, which I consider to be particularly innovative, by Central Valley standards. The database also contains many old plans, which have been superseded by plans that are also in the database, without noting that this is the case.

[48] See, e.g. Glenn County, "Ordinance No. 1115: Ordinance Amending the County Code, Adding Chapter 20.03, Groundwater Management " (2000); Butte County, "Municipal Code Chapter 33a: Groundwater Management," (2009).

[49] California Department of Water Resources, Bulletin 118, above note 1, 61-62.

[50] See below, Part 5.2(d) for a discussion of agencies that do this well.

[51] LGA Guidelines, p.21.

[52] LGA Guidelines, p.21.

[53] 2010 Grant Agreement Template for Local Groundwater Assistance, available at http://www.water.ca.gov/lgagrant/docs/lgaTemplate-030110.pdf, § 16 (last accessed August 25, 2011).

[54] Ibid., § D26.

4.3 Urban Water Management Plans

The Urban Water Management Planning Act[55] establishes the state's framework for encouraging local agencies to pursue the efficient use of water for urban supply purposes by mandating that "urban water suppliers" prepare, adopt, implement, and keep up-to-date, UWMPs.[56] Like IRWMPs, UWMPs are subject to public notice and participation requirements.[57] UWMPs must be submitted to DWR, the California State Library, and any city or county within which the supplier provides water;[58] they must also be made available for public review by the supplier and DWR.[59] DWR must, in turn, identify "exemplary" elements of UWMPs and distribute this information to suppliers and to the Legislature.[60]

Though it covers urban water generally, the UWMP Act also specifically addresses groundwater management by envisioning "effective water management strategies" as including groundwater storage projects.[61] If groundwater is an existing or planned water source covered by an UWMP, the UWMP must include a copy of any GWMP adopted by the supplier, and information as to the amount and location of groundwater the supplier pumps and projects to pump.[62] Importantly, it also requires urban agencies to take a long-term view of resource conditions, by providing information as to whether the basin will become overdrafted if present management conditions continue, and steps taken to eliminate the long-term overdraft condition.[63] In addition, a city or county must make a "water supply assessment" for a development project subject to CEQA, and if the supply for the project supply includes groundwater, the assessment must contain information from the UWMP and an analysis of the sufficiency of groundwater from the relevant basin.[64] If supplies are insufficient, the city or county must include plans for acquiring additional water supplies.[65]

The UWMP provisions encourage agencies to use a broad range of water management strategies, beyond just increasing water supplies. Indeed, the Act focuses on demand management, specifying 14 different demand management strategies.[66] It also explicitly requires plans to minimize the need to import water from other regions.[67] The plan must evaluate strategies based on both economic *and noneconomic* factors, and identify total benefits and total costs associated with each one, and include methods for evaluating the effectiveness of their planned strategies.[68] Implementation schedules and timelines are also required.[69] Of all the water plans evaluated here, these requirements are the most rigorous and comprehensive, and seem likely to uncover optimal management strategies.

[55] CWC §§ 10610-10657.
[56] CWC §§ 10610.4, 10620, 10631.5, 10643. These entities must prepare an UWMP within one year of becoming an urban water supplier; they must also update it at least every five years: CWC §§ 10620(b), 10621.
[57] CWC § 10642.
[58] CWC § 10644(a).
[59] CWC § 10645.
[60] CWC § 10644(b), (c).
[61] CWC §§ 10610.2(a)(6), 10633(d).
[62] CWC § 10631(b).
[63] CWC § 10631(b).
[64] CWC § 10910.
[65] CWC § 10911.
[66] CWC §§ 10611.5, 10631(f).
[67] CWC § 10620(f).
[68] CWC § 10631(f)(3), (g).
[69] CWC § 10631(f), (h).

The UWMP Act reflects environmental considerations by requiring a supplier to evaluate a list of possible demand management options with reference to noneconomic factors, which include environmental factors.[70] It also calls for establishing "an independent technical panel to provide information and recommendations to the [DWR] and the Legislature on new demand management measures, technologies, and approaches", where the panel must include one or two representatives from environmental organizations.[71] It also recognizes environmental water uses such as wildlife habitat enhancement and wetlands.[72]

Though urban water retailers need not report on UWMPs in a general sense, they must make standard-form progress reports on reaching their 20% water use reduction targets, which were mandated in 2009 legislation.[73] Member agencies of the California Urban Water Conservation Council are deemed to comply with reporting requirements if they provide the annual reports required by the "Memorandum of Understanding Regarding Urban Water Conservation in California."[74] DWR may also receive information about the implementation of UWMPs (and specifically, the implementation of water demand management measures) through annual reports submitted by an agency as evidence that it is implementing its UWMP, which is a condition of grant funding.[75]

DWR has recently developed an online submittal tool for agencies to submit their UWMPs and water data. It intends to make the resulting aggregated database public, to allow analysis by both the public and the state.[76]

4.4 Agricultural water management plans

Under the Agricultural Water Management Planning Act,[77] an agency that supplies water for agricultural purposes must prepare and adopt an AWMP on a five-yearly basis.[78] Agricultural water suppliers[79] must notify and may consult with cities and counties in preparing an AWMP, and with the public.[80] Suppliers must also implement their plan, to the extent that water conservation programs or practices are locally cost effective.[81] They must provide their plan to seven listed groups of entities, and plans must be available online.[82]

AWMPs focus on water conservation. Among other things, they must contain: a description of the local groundwater supply, water uses (including environmental uses and groundwater recharge), water efficiency information, a water budget, and the effects of

[70] CWC § 10631(f)(3).
[71] CWC § 10631.7.
[72] CWC § 10633(d).
[73] CWC §§ 10608.16, 10608.40.
[74] CWC § 10631(j).
[75] CWC § 10631.5(e).
[76] See DWR Online Submittal Tool (DOST) For Urban Water Management Plan Data, http://www.water.ca.gov/urbanwatermanagement/dost/, last accessed August 25, 2011.
[77] CWC §§ 10820-10845.
[78] CWC § 10820.
[79] An "agricultural water supplier" is a public or private entity that supplies 2,000 acre-feet or more of surface water annually for agricultural purposes or serving 2,000 or more acres of agricultural land: CWC § 531.
[80] CWC §§ 10821, 10841.
[81] CWC § 10825. Agricultural water suppliers that provide water to less than 25,000 acres must only implement requirements of the AWMP Act if "sufficient funding has specifically been provided … for these purposes": CWC § 10853.
[82] CWC §§ 10843, 10844.

climate change on future water supplies.[83] A central part of an AWMP is water use efficiency information.[84] 2009 amendments to the CWC require agricultural water suppliers to measure water deliveries, adopt a volume-based pricing structure, and implement a menu of other requirements, if they are locally cost-effective, including: increasing groundwater recharge through pricing structures, facilitating use of recycled water, increasing conjunctive use of surface water and groundwater, and facilitating or promoting customer pump testing.[85] The implementation of these measures must be reported in AWMPs, along with estimates of improvements in water use efficiency.[86]

Similar to UWMPs, member agencies of the Agricultural Water Management Council, which submit AWMPs to that Council in accordance with the "Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California", are deemed to comply with requirements relating to water demand management measures.[87] Other plans, like UWMPs or IRWMPs, may fulfill the AWMP requirements if they have the necessary contents.[88] As is the case for UWMPs, from 2010, DWR must identify “outstanding elements” of adopted AWMPs, and provide this information to other agricultural water suppliers and the Legislature every five years.[89]

4.5 Other types of water plans

Additional types of water plans further complicate the groundwater management scene in California.[90] Key types are listed briefly here, for completeness.

(a) *Regional water quality control plans*, commonly referred to as “basin plans”: Regional water quality control boards prepare these plans, which set out water quality objectives, beneficial uses of water, and a program for achieving these objectives. The State Water Resources Control Board approves basin plans, which are then binding on state offices, departments and boards.[91]

(b) *City and county general plans*: these plans set out development policies, which must include seven mandated elements. A water resources element is voluntary, rather than mandatory.[92]

(c) *Stormwater resource plans* under the Stormwater Resource Planning Act of 2009: these plans may be made by cities, counties or special districts. They must be

[83] CWC § 10826.
[84] CWC §§ 10608.48, 10826(e).
[85] CWC § 10608.48(c).
[86] CWC § 10608.48(d).
[87] CWC § 10827. Similar arrangements apply in relation to water conservation plans submitted to the Bureau of Reclamation: CWC § 10828.
[88] CWC § 10829.
[89] CWC § 10845. But note that this section contains the undesirable and unusual constraint that it does not authorize the department to critique individual plans; and does not contain the technical panel provisions that apply to UWMPs.
[90] Note that this section does not include project-specific plans, such as water supply assessments under CWC §§ 10910-10915.
[91] CWC §§ 13240-13248.
[92] California Government Code § 65350ff. An example of a relevant general plan policy is Policy PF-C.3 “Reduce the demand on county’s groundwater resources and encourage the use of surface water”: GEI Consultants, "Consolidated Irrigation District Groundwater Management Plan," (2009), 16.

consistent with IRWMPs, and must include eight specified elements. These elements include design criteria for increasing groundwater supplies by infiltration, projects to reestablish natural infiltration systems, opportunities to augment local water supplies through groundwater recharge or other storage, and ordinances or other mechanisms necessary to ensure effective implementation.[93]

Based on the relatively few mentions of these plans in GWMPs, there appears to be little integration of these plans with GWMPs, though in the case of stormwater resource plans, this is likely because they are relatively recent innovations (2009).

4.6 Comparing water management plan requirements

Compared to UWMPs, IRWMPs, and AWMPs, requirements for GWMPs lag substantially. The weakness of GWMP requirements contributes to (or at least, does not alleviate) significant obstacles to improved regional groundwater management. The evidence of these obstacles is discussed more fully in the balance of this report, but is briefly referenced here, because their existence is strikingly consistent with legal and policy gaps in the GWMP provisions.

(a) The voluntary nature of GWMPs, the lack of a legislative mandate to report on their implementation, or to review them or keep them up-to-date, perpetuates and likely contributes to the perception in some agencies that they need not actively manage groundwater in their district (see further, Part 5.2(a)).

(b) The lack of a requirement to consider a range of groundwater values, beyond supply for human uses—notably, the failure to include ecosystem values of groundwater—perpetuates a narrow vision of groundwater management, which ignores key groundwater problems. The goal of the GWMP requirement to include a "component" relating to monitoring and managing "changes in surface flows and surface quality that … are caused by groundwater pumping in the basin" is unclear, and falls short of requiring management of the impacts of groundwater pumping on surface water (see further, Part 5.2(b)).

(c) The lack of a requirement to consider demand management, or to evaluate a portfolio of strategies, contributes to the incomplete management "toolbox" of many agencies, which has a comparatively lower chance of optimally improving regional groundwater management (see further, Part 5.2(c)).

(d) The weak information requirements for GWMPs lag behind the standardized, structured approach of other plan types, which include setting targets, specifying measurement methods, submitting or publishing quarterly reports, and using standardized online data submittal tools (see further, Part 5.2(d)).

Table 1, below, summarizes and compares the key characteristics of each plan type discussed above.

[93] CWC §§ 10560-10564.

Table 1: Summary and comparison of state provisions for key water plans

Topic of provisions[94]	IRWMPs	GWMPs	UWMPs	AWMPs[95]
Substantive requirements				
Specifically address groundwater issues	☑ §§ 10537(b)(1), (e), 10540(c)(4), (6); IRWMP Guidelines	☑	☑ §§ 10610.2(a)(6) , 10631(b)	☑ § 10826(b)(2) (b)(5)(E)
Use a portfolio of management strategies	☑ §§ 10531(c), 10537	☒ (restrictions on mandating demand management)	☑ §§ 10611.5, 10615, 10631(f)	☑ § 10608.48
Recognize environmental water needs / environmental stewardship	☑ §§ 10531(a), 10534, 10540(c)(5)	☒	☑ §§ 10631(f)(3), 10631.7, 10633(d)	☑ § 10826(b)(5)(B)
Include a plan to implement or implement and finance	☑ (for state funding: § 10541(e)(8), IRWMP Guidelines)	☒	☑ §§ 10631(f)(2), (h), 10631.5(a)(3) (for state funding)	☑ §§ 10842
Implement the plan	☒ (agency explicitly not required to fund) § 10540(d)	☒ (but must adopt rules & regs to implement a plan; must implement to receive funding) §§ 10753.7; 10753.9	☑ (generally, and also for state funding §§ 10631.5, 10643	☑ (some to the extent "locally cost effective") §§ 10608.48(b), (c), 10825, 10842
Use measurable objectives / measure performance, effectiveness, and/or costs and benefits	☑ § 10541(e)(4), (7) § 75026(a) Public Resources Code (funding requirement)	☒ (funding requires unspecified "management objectives", dealing with unspecified subject matters) § 10753.7(a)(1)	☑ § 10631(f)(3), (g)	☑ § 10608.48(d)

[94] Unless otherwise specified, provisions cited in this table are provisions of the CWC.

[95] This column sets out requirements relating to AWMPs, combined with related requirements to implement efficient management practices, which are related to AWMPs, and set out in CWC §§ 10608.48ff.

Topic of provisions[94]	IRWMPs	GWMPs	UWMPs	AWMPs[95]
Procedural requirements				
Adopt a plan (i.e. mandatory)	☒	☒ (explicitly no requirement to adopt) § 10750.4	☑ (for "urban water suppliers") § 10620	☑ (for large "agricultural water suppliers") §§ 10820, 10853
Public consultation	☑ § 10543	☑ §§ 10753.2-10753.6	☑ § 10642	☑ § 10841
Use/encourage a broad public process to develop the plan	☑ (for state funding) § 10541(e)(12), (g), (h)	☒ (but must issue statement on how public may participate: § 10753.4(b))	☑ § 10642	☒
Review and update the plan	☑ (for state funding) § 10541(i)	☒ (but DWR suggests this: Bulletin 118 p.231)	☑ §§ 10621, 10640	☑ § 10820
Make the plan publicly accessible	☑ (for Prop. 84 funding)	☑ (for state funding, must provide the plan to DWR, which must make it public) § 10753.7(b)(2)	☑ (both agency and DWR must make the plan public) § 10645	☑ (must be online) § 10844
Make data resulting from implementing the plan publicly accessible	☑ (for state funding) IRWMP Guidelines p.15	☑ (for state funding under Local Groundwater Assistance Fund) LGA Guidelines p.21	☑ (in relation to water use targets) §§ 10608.40, 10608.42, 10608.52	☑ (in relation to water use efficiency) §§ 10608.48, 10608.52
Report on plan implementation	☑ (for state funding under Local Groundwater Assistance Fund, also § 10541(e)(12))	☑ (for state funding under Local Groundwater Assistance Fund) See contract template	As above.	As above.

It might be tempting to assume that in such a tangle of water management planning arrangements, other plans would compensate for these weaknesses in GWMPs. Unfortunately, this is not the case. IRWMPs, UWMPs and AWMPs do variously require agencies that pump groundwater to implement these respective plans, manage demand, and consider the environment. But UWMPs and AWMPs focus on groundwater pumping by agencies, which, judging from the information in GWMPs, is relatively uncommon compared to pumping by private entities within the territory of agencies. IRWMPs do not enable agencies to use important individual-scale tools like controlling pumping or imposing fees.

4.7 Reconciling key water management plans

California's myriad water planning provisions make for a complicated water planning scene, laid over a complex and crowded institutional scene. This scene is unnecessarily complex because the plans interact in various ways, the precise nature of which varies from place to place. For example, the relationship between a GWMP and an IRWMP varies and even inverts across the state. While an IRWMP may legally include a GWMP,[96] in practice, we see the following models:

(a) Minimal integration: A GWMP may adopt only certain elements of IRWMPs, such as goals, or data, but generally not explicitly demonstrate a high degree of integration in terms of joint projects, data sharing, etc,[97] or mention the IRWMP only in passing.[98]

(b) GWMP = IRWMP model: the GWMP may be prepared so that it meets the requirements of both the GWMP Act and the IRWMP Act.[99]

(c) GWMP→ IRWMP model: the GWMP is seen as the higher-level document. It may outline projects to be coordinated within the larger IRWMP effort, and list IRWMP projects, or the development of an IRWMP, as a GWMP "action".[100]

(d) IRWMP→ GWMP model: the GWMP is seen as the lower-level document. It incorporates an IWRMP "by reference", and cross-references its provisions where relevant. The IWRMP is seen as supporting the preparation of GWMPs by individual districts, including by providing general guidelines for the formulation of projects at the local level. The GWMP adopts goals that go beyond, but are consistent with, those of the IWRMP, and implements the IWRMP at the local level, responding to unique district circumstances.[101]

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[96] See above, note 19, and accompanying text.
[97] See, e.g., GEI Consultants, "Consolidated Irrigation District Groundwater Management Plan," (2009) 21, 64 (adopting objectives from the Upper Kings IRWMP and adopting guidelines for an Integrated Regional Conjunctive Use Program); Water Resources & Information Management Engineering Inc (prepared for the Calaveras County Water District), "Groundwater Management Plan 2007 Update," (2007), 5-1 (noting that the GWMP was prepared with the goals of the IRWMP in mind).
[98] See, e.g., Provost & Pritchard (for Kings County Water District), "Groundwater Management Plan: Final Draft," (1993, as revised 2011), 28, 31.
[99] See, e.g., Stanislaus & Tuolumne Rivers Groundwater Basin Association, "Integrated Regional Groundwater Management Plan for the Modesto Subbasin," (2005).
[100] See, e.g., Tulare Irrigation District, "Groundwater Management Plan," (2010), 28, attachment 14; Delano-Earlimart Irrigation District, "Groundwater Management Plan," (2007), 16.
[101] See, e.g., GEI Consultants, above note 97, 7-8, 64.

UWMPs are generally less integrated with GWMPs, and less frequently mentioned in them, than are IRWMPs. Indeed, GWMPs often note or imply that there is insufficient coordination between the UWMPs and/or general plans of cities, and GWMP efforts.[102] Some GWMPs reference UWMPs to ensure that the two are not inconsistent, and use data from UWMPs in preparing GWMPs;[103] urban water retailers with UWMPs and GWMPs sometimes incorporate data and actions from UWMPs as GWMP actions.[104]

In addition to the complexity of how different plans interact, even at the level of GWMPs alone, there are different scales of operation and interaction. Some GWMPs operate at a regional level, whereas others address purely local issues.[105] Overlapping GWMPs, for example in the Kings River area, result in special arrangements for resolving conflicts.[106]

The variation in how these plans work together (or don't) is likely to cause inefficiency and duplication, wasting resources that could be better used to address groundwater problems, rather than creating synergy and an integrated approach. For example, where they are made by different agencies, valuable connections can be made between UWMPs and GWMPs through mechanisms for groundwater agencies to comment on proposed land developments and EIRs, for example by using maps of potential impacts on groundwater quality and recharge;[107] and using urban population and water demand forecasts in groundwater planning.[108]

Streamlining these plans is not straightforward, since it would be difficult to combine these myriad water plans within California's present institutional structure, in which many agencies have different narrow roles in overlapping areas. For example, the detailed operational water management provisions of individual UWMPs are not relevant at the larger geographic scale of an IRWMP.

[102] See below, note 138 and accompanying text.
[103] See, e.g., N.E. San Joaquin County Groundwater Banking Authority, "Eastern San Joaquin Groundwater Basin Groundwater Management Plan " (2004); Water Resources & Information Management Engineering Inc, above note 97, 2-25.
[104] See, e.g., Luhdorff and Scalmanini Consulting Engineers Inc (prepared for Diablo Water District), "Groundwater Management Plan for AB 3030," (2007), 42.
[105] Provost & Pritchard (for Kings County Water District), above note 98 ("This GMP focuses on groundwater issues unique to KCWD and its surrounding area, while the [Kaweah Delta Water Conservation District GWMP] focuses on regional groundwater issues.")
[106] Ibid., 60 (describing overlaps between the Kings County Water District, Alta Irrigation District, and Consolidated Irrigation District, all of which have their own GWMPs).
[107] See, e.g., Santa Clara Valley Water District, "Santa Clara Valley Water District Groundwater Management Plan," (2001), 53.
[108] See, e.g., Sonoma County Water Agency, "Sonoma Valley Groundwater Management Plan," (2007), 2-3, 2-36.

5. Groundwater management plans in practice: characteristics and state funding

This section describes the general performance, and outstanding examples, of GWMPs in relation to four key characteristics: (1) accepting an active groundwater management role; (2) adopting a broad vision of groundwater management; (3) seriously considering a range of groundwater management tools—that is, a well-equipped groundwater management toolbox, or a "portfolio of strategies"—and transparently evaluating these tools and how they contribute to achieving specified goals; and (4) groundwater information and reporting. Implementing these characteristics more widely would represent a significant opportunity to improve regional groundwater management and address key obstacles to improved management.

5.1 Variation in GWMPs

At the outset of any discussion of GWMPs in practice, it must be noted that they vary significantly in terms of date, length, complexity, and the extent to which they are directed to implementation. Plans at one extreme of these dimensions, for example, date from the early 1990s, contain only seven pages, describe groundwater monitoring as the only management activity, and contain no implementation plans, but are merely descriptive. At the other extreme are plans which are mere months old, contain over 400 pages, include many approaches to controlling groundwater problems, and have detailed implementation timetables stretching decades into the future. In general, more recent plans tend towards greater length, complexity and apparent inclination toward implementation.

5.2 Key characteristics of GWMPs

(a) Accepting an active groundwater management role

As described in Part 2, Californian water agencies generally lack a groundwater management mandate. It is therefore unsurprising that many local water agencies, with which management responsibility rests by default, do not consider that their role includes managing groundwater—particularly non-agency groundwater extraction in their territory. District staff members tend to emphasize the private nature of groundwater rights, rather than the public ownership of the resource itself. Anecdotally, some district staff of even agencies that have GWMPs reveal that they feel uncomfortable with the term "manage", because it seems to entail a threat to private groundwater rights. This sentiment emerges in GWMPs. GWMPs often explicitly defer to the rights of landowners to pump groundwater without interference from the district and sometimes actions, which plans describe, are phrased as "typical" actions that would be taken to respond to a problem, rather than actions to which the plan adopter commits.[109] A reluctance to accept an active groundwater management role is also evident in the fact that GWMPs relatively rarely match actions to basin management objectives.[110] This permits some plans to contain such central objectives

[109] See, e.g., Stoddard & Associates, above note 5, 29-30 (setting out a plan for responding to the adverse water quality impacts of groundwater pumping as elements which a program would "typically" include to protect beneficial uses).

[110] For an example of where this does occur, see Calaveras County's GWMP explicitly links sections of the GWMP to the achievement of its BMOs: Water Resources & Information Management Engineering Inc, above note 97, 3-3.

as to "maintain or improve groundwater levels in the district", while saying nothing about how any actions will contribute to achieving it.[111]

A significant number of GWMPs appear to have been adopted by agencies mainly for the purpose of safeguarding local control. Indeed, many GWMPs explicitly state that a key purpose of adopting the plan is to retain local control and avoid State intervention.[112] While some of these plans are almost certainly bona fide efforts to address groundwater problems, others contain no action items and are plans in name only. The latter merely "formalize" current management practices in order to consolidate local control over groundwater vis-à-vis the state.[113]

Some agencies strongly accept an active groundwater management role, and this is evident in their GWMPs, which include detailed implementation plans,[114] and strongly adopt the characteristics discussed in the remainder of this Part.

(b) Adopting a broad goal for groundwater management

Though it is relatively rare, some GWMPs adopt a goal for groundwater management that is broad in two senses—by containing objectives that include, but extend beyond solely human uses of groundwater and concepts of safe yield, and by appreciating the broader environmental context in which groundwater occurs. Such GWMPs do this by including ecological objectives, as well as objectives relating to human uses; others by recognizing interactions between surface water and groundwater, between groundwater quantity and quality, and between land use and groundwater. This section discusses these overlapping elements in turn.

GWMPs commonly frame their objectives solely with human use of groundwater in mind,[115] guided by the concept of "safe yield", which does not account for non-human uses of groundwater. GWMPs often refer to safe yield or "sustainable yield" as a goal, a trigger for management action, or a crucial matter for investigation—presumably on account of also being one or both of the former.[116] Some GWMPs cite the broad, policy-derived definition of

[111] Kern-Tulare Water District and Rag Gulch Water District, above note 11, 19.
[112] See, e.g., AMEC Geomatrix Inc, "Merced Groundwater Basin Groundwater Management Plan Update: Merced County, Ca," (2008), 43 (stating that "[b]ecause of the enactment of State legislation, it is now clear to the Parties that local management of water resources is desirable in order that local control be maintained over such resources"); Kings River Conservation District, "Lower Kings Basin Groundwater Management Plan Update," (2005), 3-2 (stating that an objective of the plan is to "[m]aintain local control of the groundwater basin by developing agreements and institutional arrangements that promote responsible management groundwater resources…"); Turlock Groundwater Basin Association, "Turlock Groundwater Basin Groundwater Management Plan," (2008), C-4.
[113] See, e.g. Rosedale-Rio Bravo Water Storage District, "Groundwater Management Plan," (1997), 2; North Kern Water Storage District and Rosedale Range Improvement District, "Organization of Existing Groundwater Management Programs under California Water Code Sections 10750 Et Seq. (AB-255)," (1993), 1.
[114] Butte County, "Butte County Groundwater Management Plan," (2005), pp. 3-1 to 3-22; Fox Canyon Groundwater Mgmt. Agency, United Water Conservation District, and Calleguas Municipal Water District, "2007 Update to the Fox Canyon Groundwater Management Agency Groundwater Management Plan," (2007), 82-85.
[115] See, e.g., Stoddard & Associates, above note 5, 4-5 ("Optimizing groundwater use is the basic goal of groundwater management", with groundwater uses described as agricultural, municipal and industrial uses).
[116] See, e.g., Orange Cove Irrigation District, Tri-Valley Water District, and Hills Valley Irrigation District, "Groundwater Management Plan" (2006), 2, 25; Fresno Irrigation District et al., "Fresno Area Regional

critical overdraft, and describe undesirable results as deteriorating water quality, depleting groundwater reserves, uneconomic pumping lifts, conflicts over water rights, and depleting stream flow.[117] Other GWMPs refer to a narrow concept of discharge being equivalent to recharge. Yet others aim to maintain groundwater levels at some other level, for example, "high enough to provide emergency reserves adequate for the worst credible drought";[118] or to keep groundwater storage above a historical low.[119] Objectives are often expressed with reference to the "long term", which is usually undefined,[120] with a small minority expressing a specific planning horizon.[121]

Ecological elements, if they appear, are generally limited to a term in an equation representing the quantity of groundwater consumed by phreatophytes.[122] An exception to this general situation is the Elsinore Valley Municipal Water District GWMP, which seeks to "ensure a reliable, high-quality, cost-efficient groundwater supply for the users of the Elsinore Basin in an environmentally responsible manner".[123] Reminiscent of the UWMP provisions, it assesses alternative management strategies with reference to, among other criteria, environmental impacts, including habitat impacts, increased energy usage, and water quality degradation, and uses a heavy weighting for this criterion.[124]

Other GWMPs seek to actively provide ecological benefits. Groundwater recharge and banking projects are a prominent part of the vast majority of GWMPs surveyed for this report. A small number of GWMPs envision the possibility of achieving multiple benefits with these projects—specifically, increasing water reliability while enhancing the environment, particularly for wildlife.[125] For example, the large-scale Groundwater Recharge Project in eastern San Joaquin County also provides seasonal or permanent habitat for migratory birds,[126] and the Consolidated Irrigation District plans to use "environmental features" and "ecosystem values" developed by an environmental stakeholders work group in designing recharge projects.[127]

While a great number of GWMPs refer to "conjunctive use" of surface water and groundwater, this does not necessarily entail recognizing the connection between these two sources—an oversight that can result in pumping damaging surface water rights and

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Groundwater Management Plan" (2006), 8-3; N.E. San Joaquin County Groundwater Banking Authority, above note 103, 108; Stoddard & Associates, above note 5, 27.

[117] E.g. Stoddard & Associates, above note 5, 33; Provost & Pritchard, above note 98, 21; Tulare Irrigation District, above, note 100, 12, 18.

[118] Jones & Stokes (for Zone 7 Water Agency), "Groundwater Management Plan for Livermore-Amador Valley Groundwater Basin," (2005), 4-1.

[119] Ibid., 4-33.

[120] See, e.g., Water Resources & Information Management Engineering Inc, above note 97, 3-2 ("To protect and maintain a suitable, reliable, high-quality groundwater supply in the planning area for the long-term use of the groundwater resource.")

[121] For example, 17 years is used by the Elsinore Valley Municipal Water District: Elsinore Valley Municipal Water District, "Elsinore Basin Groundwater Management Plan: Final Draft Report," (2003), ES-1.

[122] See, e.g., NBW Lowry (prepared for the San Juan Basin Authority and The Metropolitan Water District of Southern California), "San Juan Basin Groundwater Management and Facility Plan," (1994), 3-8.

[123] Elsinore Valley Municipal Water District, above note 122, 1-6.

[124] Ibid., 7-6, 7-11, 7-18, 7-19. This approach is reminiscent of the requirement of UWMPs to evaluate strategies using both economic and non-economic factors: see note 68 and accompanying text.

[125] Provost & Pritchard, above note 98, 55.

[126] See http://www.farmingtonprogram.org/ (last accessed August 24, 2011).

[127] GEI Consultants, above note 97, 101.

ecological assets. Rather, the term commonly only describes a strategy of seeking to maximize consumptive water use by preferentially using the most available or cheapest source. However, the interaction between surface water and groundwater arises in several, more meaningful, ways in GWMPs, more consistent with the spirit of the GWMP provisions.[128] Some GWMPs adopt as an objective, minimizing the effects of groundwater pumping on surface water flows and quality, and the effects of changes to surface water flows and quality on groundwater levels and quality.[129] Some describe surface water-groundwater connections as part of the hydrogeologic characteristics of the area. While this is commonly done at a conceptual level, in a few cases, it includes quantifying surface water contributions to groundwater and vice versa, including by using integrated surface water-groundwater models.[130] Others monitor surface water flows and quality, in areas in which it is connected to groundwater;[131] and monitor developments that affect surface waters, which are connected to managed groundwater, because of potential effects on groundwater quantity and quality.[132]

In addition to integrating surface water and groundwater considerations, the best GWMPs explicitly recognize connections between groundwater quantity and quality, by:

(i) Adopting an objective relating to the effects of groundwater pumping on surface water quality;[133]

(ii) Acknowledging that groundwater pumping can cause poor quality groundwater to migrate and degrade the quality of other groundwater;[134]

(iii) Undertaking groundwater modeling to "allocate pumping periods to individual wells based on well water quality",[135] or to evaluate water quality changes that result from different pumping scenarios,[136] or to determine the agency's performance against an objective of non-degradation of water quality, and determine whether it needs to carry out control measures, such as increasing recharge or pumping, to achieve the objective;[137]

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[128] See above, note 39 and accompanying text.
[129] See, e.g., Lake County Watershed Protection District, "Lake County Groundwater Management Plan," (2006), 1-3; Luhdorff and Scalmanini Consulting Engineers Inc, above note 104, 27 (adopting as a regional basin management objective, "Preservation of Interrelated Surface Water and Groundwater Resources", being "the non-degradation of surface water flows or quality as a result of groundwater management practices"). Notably, though, these objectives sometimes seem unconnected to any substantive management actions to work towards achieving them: See, e.g. Lake County Watershed Protection District, above note 130.
[130] For exceptions to this statement, see: Robertson-Bryan Inc, "Southeast Sacramento County Agricultural Water Authority Groundwater Management Plan," (2002), 18-19; Stoddard & Associates, above note 5, 7 (quantifying seepage from canals and creeks as an aggregate source of recharge, rather than by reach); Winzler & Kelly above note 131, 12.
[131] Robertson-Bryan Inc, above note 131, 19-20; Jones & Stokes, above note 119, 1-5.
[132] Robertson-Bryan Inc, above note 131, 6 (in relation to the Cosumnes River).
[133] See above, footnote 129.
[134] See the GWMP of the San Luis and Delta-Mendota Canal Water Authority for a comprehensive discussion of this process: Stoddard & Associates, above note 5, 28-30. For further examples, see also Winzler & Kelly, above note 131, 7.
[135] Stoddard & Associates, above note 5, 9.
[136] Winzler & Kelly, above note 131, 20.
[137] Jones & Stokes, above note 119, 4-30. This model is part of a plan to comply with the requirements of a water recycling permit approved by the Regional Water Quality Control Board. Ibid, 5-1.

Agencies have expressed concerns that decisions about land and water are disconnected.[138] Some GWMPs embrace a vision of groundwater management that also extends to recognizing water-land connections. The Zone 7 Water Agency reviews land use plans at the city and county level for their impacts on water quantity and quality; [139] monitors land use using annual aerial photography, interviews with landowners, and field observations, to determine changes that may impact groundwater, and uses this information to compile a monthly land use change report, which is then used for coordination with land use planning agencies.[140] Similarly, the Elsinore Basin GWMP uses groundwater models, which simulate the effects of different management strategies, with future land use projections from general plans.[141] The Consolidated Irrigation District takes another approach, deriving from the requirements of land use planning and environmental laws. Local government laws require cities, which annex land, to demonstrate that water supplies will be available for projected needs, and CEQA requires that significant impacts of development on groundwater be mitigated.[142] The Consolidated Irrigation District's GWMP aims to "serve as a regional water supply assessment for purposes [sic] of evaluating proposed development", when it is adopted by cities and developed plans and funding strategies for mitigating impacts using recharge programs.[143] At the county level, another approach is for an ordinance to require a groundwater impact analysis before the county issues a development permit, proving that sufficient water supplies are available, and to receive comments from local water agencies as to water availability.[144]

(c) Using a well-equipped groundwater management toolbox

The best GWMPs seriously consider a range of groundwater management tools, and select tools based on a comprehensive and transparent evaluation of costs and benefits. For example, the Elsinore Valley Municipal Water District GWMP sets out baseline conditions, identifies a series of management strategies for mitigating overdraft, evaluates four alternative strategies using a groundwater model and applying 11 clearly specified criteria, and presents an implementation plan for the recommended alternative.[145] The baseline condition scenarios evaluate likely conditions if current management continues until 2020, and account for increasing demand. The alternatives canvassed involve both supply augmentation and demand management.[146]

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[138] Agencies have noted that UWMPs and cities' General Plans "do not recognize overdraft or the limitation of the groundwater source, nor do they define how cities will mitigate water supply impacts of new development". See, e.g., GEI Consultants, above note 97, ES-6, 16.
[139] Jones & Stokes, above note 119, 1-11.
[140] Ibid., 4-25.
[141] Elsinore Valley Municipal Water District, above note 122, 4-11.
[142] GEI Consultants, above note 97, 18-19.
[143] Ibid., 22, 71, App.A.
[144] Water Resources & Information Management Engineering Inc, above note 97, 4-8.
[145] An unfortunate shortcoming of the GWMP is that it is largely expressed in terms of recommendations to the District's Board of directors—presumably in the form it was received from the consulting engineers who prepared it—rather than an accepted plan of action.
[146] The alternatives considered were dual purpose injection-extraction wells, surface spreading, in-lieu recharge and water conservation, and a combination of strategies. The following criteria were used: ability to reduce overdraft, expected cost, environmental impacts, risk, legal and regulatory implementation, public acceptability, funding, reliability, water quality, flexibility and ease of implementation. Elsinore Valley Municipal Water District, above note 122, ES-9, ES-13.

Unfortunately, GWMPs rarely exhibit consideration of the full toolbox of groundwater management measures available to an agency, and their benefits and costs, providing little assurance that the selected management strategies will be optimal. This is particularly the case in relation to demand management measures. Sometimes the mission statements of agencies entrenches a supply-side orientation that then prevents them considering certain groundwater management tools.[147] Other agencies reject mandatory approaches on principle,[148] outright dismissing potent strategies that the law expressly grants them.

Agencies managing groundwater, regardless of whether they manage overdrafted areas, should be thinking more broadly than supply-side measures. While importing water can be effective in some places, climate change and environmental claims may reduce the availability and reliability of surface water sources. State policy may also interfere, in light of the new state "guiding principle" of increasing regional self-sufficiency by depending less on long-term imports of water from other hydrologic regions.[149] A bill passed by the California Legislature but vetoed by the Governor would have required IRWMPs to demonstrate how they reduce future dependence on the Sacramento-San Joaquin Delta.[150] The best GWMPs account for the fact that relying on imported water involves some risk.[151] Physical measures are also expensive, and ongoing state subsidies far from certain.[152] They also do not correct underlying problems, such as agricultural trends towards higher water-use crops or double- or triple-cropping, which lead to increasing demand and potential future problems.[153] Planning water management strategies and instituting robust measures takes time and stakeholder acceptance—waiting until water supplies are threatened or groundwater problems become established before even considering these measures, or when they should be triggered, risks later political interference and being unable to use them in a timely fashion when the need arises.[154]

No GWMP reviewed for this report quantifies or significantly explores the benefits of managing demand to halt depletion (for example, quantifying the economic benefits of avoiding degradation of water quality). Rather, they consider and quantify only the costs of taking action such as mandatory conservation, generally without considering ways to avoid or minimize these costs. Such matters may be complicated, but standard ways of monetizing environmental benefits, for example, are used in the area of urban water conservation.[155] Agencies commonly justify dismissing the possibility of regulating groundwater extraction with reference to the "severe" economic effects of doing so, without any supporting evidence

[147] For example, Westlands Water District's mission statement focuses on water supply and acquiring additional water sources to meet landowners' needs: Westlands Water District, above note 11.
[148] Westlands Water District, "Groundwater Management Plan," (1996), 15; Tulare Irrigation District, above, note 100, 44; Orange Cove Irrigation District et al., above note 117, 34; Delano-Earlimart Irrigation District, above note 100, 29; Provost & Pritchard, above note 98, 47.
[149] California Department of Water Resources, Bulletin 160, above note 5, 2-13.
[150] SB 834, enrolled on September 2, 2011, would have amended § 10540 to this end.
[151] Elsinore Valley Municipal Water District, above note 122, ES-15.
[152] Ellen Hanak et al., "Managing California's Water: From Conflict to Reconciliation," (San Francisco, California, USA: Public Policy Institute of California, 2011).
[153] Tulare Irrigation District, above, note 100, 18; Provost & Pritchard, above note 98, 46.
[154] Charles Jonathan Nevill, "Managing Cumulative Impacts: Groundwater Reform in the Murray-Darling Basin, Australia," *Water Resources Management* 23(2009): 2628.
[155] See, e.g., California Urban Water Conservation Council, Environmental Benefits of Urban Water Conservation: Spreadsheet Model Operating Instructions, April 3, 2007, available at http://www.cuwcc.org/WorkArea/showcontent.aspx?id=2682, last accessed August 28, 2011.

quantifying these effects, how economic effects would change with the level of regulation, or how the initial economic costs of regulation would balance against longer-term costs of overdraft.[156] Some agencies acknowledge that overpumping could lead to the decline of local agriculture;[157] some have found that continuing current management strategies costs more, overall, than strategies involving demand management.[158] Given that GWMPs frequently seek to achieve good groundwater management at "least cost",[159] the overwhelming failure of these plans rationally to calculate the costs of available alternatives is incongruous.

In contrast to the rarity with which GWMPs include demand management measures, intentional groundwater recharge projects using spreading basins or injection wells are reasonably common GWMP tools. This is particularly the case in the San Joaquin and Tulare Lake areas, where overdraft creates a great deal of potential storage space, and almost all GWMPs contain an intentional groundwater recharge element or a groundwater banking component (i.e. buying rights to groundwater recharged in another area). The state also encourages groundwater recharge,[160] and will expend at least $230 million on groundwater recharge and banking projects.[161]

Groundwater recharge and groundwater banking can provide important benefits in terms of water supply reliability, water quality, and ecological conditions. Water agencies cite benefits such as dealing with a variable surface supply, but a constant irrigation demand;[162] mitigating overdraft conditions and their attendant problems;[163] blending contaminated and un-contaminated groundwater to improve groundwater quality;[164] making water available to lands that are ineligible to receive project water directly,[165] and providing wildlife habitat.[166]

Groundwater recharge and banking have the potential to significantly improve regional groundwater management through these benefits. Unlike other western states such as Oregon, Arizona and New Mexico, California lacks a legal framework that would protect the rights of water storers and protect third parties and the environment from potential adverse impacts. Such a framework would best ensure that benefits eventuate, and adverse impacts are avoided. The absence of such a framework is likely to lead to under-investment in recharge projects due to uncertain rights, and also unwitting acceptance of damage to

[156] See, e.g., Kaweah Delta Water Conservation District, "Groundwater Management Plan," (2006), 49.
[157] For example, Semitropic WSD notes that if it is "not able to maintain water levels at economically viable pumping lifts at all locations in the Management Area, then the existing agricultural uses would cease in those locations." Semitropic Water Storage District, *Groundwater Management Plan Volume 1* (2003), 29.
[158] Elsinore Valley Municipal Water District, above note 122, ES-15.
[159] See, e.g., Shafter-Wasco Irrigation District, above note 11, 3; Semitropic Water Storage District, above note 158, 3; North Kern Water Storage District and Rosedale Range Improvement District, above note 114, 1.
[160] See, e.g., CWC § 10608.4(c)(4) (requiring agricultural water suppliers to implement efficient management practices, including (if the measures are locally cost effective and technically feasible) incentive pricing structures to promote groundwater recharge and conjunctive use of groundwater).
[161] Proposition 13 provided the $1.97 billion water bond of 2000, $200 million of which was for a Groundwater Storage Program, and $30 million of which was for a Groundwater Recharge Program. CWC § 79560-79565; Brown & Caldwell, "Grant Funding Opportunities for California Water Utilities, Irrigation Districts, and Sanitation Districts," (2004), 1.
[162] Arvin-Edison Water Storage District, "Groundwater Management Plan," (2003), 4.
[163] Semitropic Water Storage District, above note 158, 17.
[164] Delano-Earlimart Irrigation District, above note 100, 26.
[165] Ibid., 28.
[166] See notes 125 to 127 and accompanying text.

third parties, the long-term security of the groundwater resource, as well as connected surface waters and ecosystems.[167] GWMPs explicitly identify significant legal uncertainties as constraints to developing groundwater recharge projects to their full potential.[168] Stakeholders in some areas of the Central Valley have successfully halted groundwater banking projects due to a lack of public involvement that could be remedied by appropriate statutory or policy guidelines.[169] While it appears that some contractual arrangements for groundwater banking include some relevant elements,[170] negotiating these matters "from scratch" is likely to result in inefficiencies. Further, public benefit issues are unlikely to be included in contractual negotiations, and contracts cannot bind third parties. By jeopardizing the outcomes of these projects, the lack of a legal framework for groundwater banking also jeopardizes the effectiveness of state funds used to support them.

The present litigation surrounding the Kern Water Bank suggests that California is already suffering from the lack of a legal framework for groundwater banking. Among other things, Rosedale-Rio Bravo alleges that rapid withdrawals of water stored in the Kern Water Bank (stated differently—a lack of controls over the rate at which "banked" water is recovered) "has and will potentially substantially and significantly affect" groundwater levels, the amount of groundwater available and recoverable, the cost of recovery, the quality of groundwater available, historic hydraulic gradients, and have long-term adverse impacts on the environment of the region.[171] Local conflicts have also occurred in the Kings River area over allegations from well owners that recharge operations have negatively affected them.[172]

(d) Collecting and reporting information about groundwater conditions and management

Raw groundwater data: availability, quality and access issues

Insufficient groundwater data is a widely recognized problem in California. The California Water Plan formally recognizes that the State lacks information about almost every technical aspect of groundwater.[173] Many GWMPs agree, stating that agencies need improved groundwater monitoring systems,[174] and noting that a lack of data makes adopting concrete, quantitative management goals impossible.[175] GWMPs suggest that the availability

[167] For a useful and comprehensive list of the potential adverse impacts of groundwater banks, see Ella Foley-Gannon, "Institutional Arrangements for Conjunctive Water Management in California and Analysis of Legal Reform Alternatives," *Hastings W.-N.W. J. Env. L. & Pol'y* 14(2008).
[168] For a relatively comprehensive list, see GEI Consultants, above note 97, 60.
[169] See, e.g., Gregory A. Thomas, *Designing Successful Groundwater Banking Programs in the Central Valley: Lessons from Experience* (2001), 66.
[170] See, e.g., Delano-Earlimart Irrigation District, above note 100, 31 (leaving a portion of the banked water in the aquifer as payment).
[171] Petition for Writ of Mandate and Complaint for Injunctive and Declaratory Relief, Rosedale-Rio Bravo Water Storage District and Buena Vista Water Storage District v. California DWR, Kern Water Bank and Others, Case No. 270635-KCT, Superior Court of the State of California, County of Kern, June 9, 2010, pp. 5-6, available at http://www.c-win.org/webfm_send/118 (last accessed August 24, 2011).
[172] Provost & Pritchard, above note 98, 60.
[173] California Department of Water Resources, Bulletin 160, above note 5, 6-6, 6-7.
[174] See, e.g. Yuba County Water Agency, "Groundwater Management Plan," (2005), 53; N.E. San Joaquin County Groundwater Banking Authority, above note 103, 71; Stanislaus & Tuolumne Rivers Groundwater Basin Association, above note 99, 107.
[175] See, e.g. Lake County Watershed Protection District, above note 130, 3-2 ("Because of the limited monitoring of groundwater levels, quality and land subsidence in Lake County, stakeholders chose to develop qualitative [rather than quantitative] BMOs."); Water Resources & Information Management

of groundwater quantity and quality data varies widely: some data are quite limited spatially (both in surface and vertical extents), and some basins are not monitored at all;[176] generally speaking, more data is available for areas near cities than for agricultural areas.[177] The areas of least data availability are: surface water-groundwater interaction, which is both a quantity and quality issue;[178] groundwater pumping, which is crucial for constructing a groundwater model to guide and assess the impact of management decisions;[179] and ecological resources dependent on groundwater.[180]

The availability of groundwater elevation data is likely to increase greatly, given the roll-out of the California Statewide Groundwater Elevation Monitoring (CASGEM) program established in 2009. Under this program, local agencies will monitor and report groundwater elevations to the DWR, and the resulting data will be publicly available.[181] By contrast, groundwater quality information is sometimes only available from private parties or because local drinking water suppliers must monitor it, and is generally much less commonly available for agricultural areas.[182] Districts that are heavily involved in groundwater banking are, understandably, more concerned with groundwater quality than is generally the case for other agricultural areas.[183] Similarly, districts that rely solely or predominantly on groundwater display significant concern about groundwater quality.[184] Some local agencies have successfully collected data from private well owners who volunteer to provide it;[185] and converted wells, which would otherwise be abandoned, into monitoring wells.[186]

Relatively few GWMPs comment specifically on the quality of the available data.[187] Requiring or recommending that plans include metadata would facilitate assessing them more thoroughly. From the information provided in the available GWMPs, it seems that a significant proportion of wells used for monitoring are likely to provide data of sub-optimal

Engineering Inc, above note 97, 3-3 (“Due to the lack of adequate and reliable groundwater data in the Plan Area, general qualitative BMOs are more appropriate at this time.)

[176] See, e.g. Lake County Watershed Protection District, above note 130, 3-2.

[177] GEI Consultants, above note 97, 76.

[178] See, e.g. Stanislaus & Tuolumne Rivers Groundwater Basin Association, above note 99, 58; City of Roseville et al., "Western Placer County Groundwater Management Plan."; City of Tracy, "Tracy Regional Groundwater Management Plan," (2007), 5.

[179] See, e.g. Sonoma County Water Agency, above note 108, 2-43; City of San Diego Water Dep't, "San Pasqual Groundwater Management Plan," (2007), 2-44.

[180] For an exception, see the description of biological resources in City of San Diego Water Dep't, above note 180, 2-3.

[181] DWR information on CASGEM is available at http://www.water.ca.gov/groundwater/casgem/ (last accessed August 26, 2011). The DWR will take a secondary role in undertaking monitoring, where local agencies do not undertake this task.

[182] See, e.g., Grant A. Kreinberg, "South San Joaquin Irrigation District Groundwater Management Plan," (1994), 2-3; Turlock Groundwater Basin Association, above note 113, 39; Castaic Lake Water Agency, “Groundwater Management Plan: Santa Clara River Valley Groundwater Basin, East Subbasin” (2003), 12; Delano-Earlimart Irrigation District, above note 100, 19; Stoddard & Associates, above note 5, 12; Provost & Pritchard, above note 98, 36.

[183] See, e.g. Semitropic Water Storage District, above note 158.

[184] See, e.g. Robertson-Bryan Inc, above note 131.

[185] See, e.g. Soquel Creek Water District and Central Water District, "Groundwater Management Plan - 2007: Soquel-Aptos Area," (2007), 81.

[186] Robertson-Bryan Inc, above note 131, 22; Provost & Pritchard, above note 98, 36 (contemplating a partnership with the county to inform the district of permits to abandon wells, to alert the district to the possibility of converting the well).

[187] For an example of a plan which does this well, see Sonoma County Water Agency, above note 108, 2-42.

quality. For example, data are frequently not continuous,[188] some wells have long screened intervals and do not provide depth-specific information;[189] data collection can be relatively infrequent, for example annually or semi-annually[190] (with a minority of monitoring done on a continuous or monthly basis);[191] production wells are often used to measure groundwater levels, which is problematic due to the influence of pumping on levels;[192] and different agencies collect data in inconsistent ways, causing problems with sharing and aggregating data from different agencies, and determining trends over time.[193] Some agencies adopt "standard operating procedures", which cover collecting samples, devices used, data recorded, etc, to ensure uniform data collection among agencies.[194]

Data *access* is arguably the greatest institutional problem affecting groundwater data in California—and the problem, the solution to which would provide great value for money spent, given the relatively low cost of making public existing data collection efforts, compared to sinking new wells. Data are often widely dispersed among agencies and available in multiple formats, both hard copy and different digital formats, which "complicate capture, comparison, and evaluation".[195] Water quality constituents are referred to using different naming conventions (for example, different species of nitrate), which makes aggregation and evaluation difficult.[196]

Despite these difficulties, promising examples exist of aggregating regional data to improve access. The Yolo County Flood Control and Water Conservation District focuses its GWMP on developing a regional-scale centralized water database, which uses historical and continuing data from multiple agencies and also private well owners, covers both groundwater levels and quality, and also integrates surface water and groundwater (though it notes that this last aspect needs expansion). The database is used to develop extraction estimates, complete a water budget, consider recharge areas for protection, and evaluate long-term trends in groundwater levels and quality.[197] The process of collecting data and setting up structures for coordination led to the discovery of previously unknown monitoring efforts with a long history.[198]

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[188] GEI Consultants, above note 97, 76; Sacramento County Water Agency, "Central Sacramento County Groundwater Management Plan," (2006), 3-11; Water Resources & Information Management Engineering Inc, above note 97, 2-10.
[189] Sonoma County Water Agency, above note 108, 2-43.
[190] See, e.g., City of San Diego Water Dep't, above note 180, 3-25; Westlands Water District, above note 149, 15. *Cf* two-monthly data collection: Carpinteria Valley Water District, "Groundwater Management Plan," (1996), 4.
[191] E.g. Jones & Stokes, above note 119, 1-9.
[192] See, e.g. Stanislaus & Tuolumne Rivers Groundwater Basin Association, above note 99, 84; Davids Engineering Inc., "Dunnigan Water District Groundwater Management Plan," (2007), 42; Brown & Caldwell, "Alpine County Groundwater Management Plan," (2007), 43.
[193] Yolo County Flood Control and Water Conservation District, "Groundwater Management Plan," (2006), App1 p.17.
[194] Jones & Stokes, above note 119, App.C; Provost & Pritchard, above note 98, App.E.
[195] See, e.g., GEI Consultants, above note 97, 76; Sacramento Groundwater Authority, "Sacramento Groundwater Authority Groundwater Management Plan," (2008), 45; Yolo County Flood Control and Water Conservation District, above note 194, App.1, p.76.
[196] Yolo County Flood Control and Water Conservation District, above note 194, App.1, p.77.
[197] Ibid., App.1, pp. 64-5.
[198] Ibid., App.1, p. 76.

Collecting better raw groundwater data has been a focus of state groundwater funding. From 2000 to 2008, the majority of state grants disbursed through DWR's $38.5 million Local Groundwater Assistance program have supported projects aimed at increasing groundwater monitoring, measurement, and modeling. Projects with components relating to monitoring and measurement received $23.9 million; those with components relating to groundwater modeling received $8.8 million (with some overlap between these two categories). Generally speaking, GWMPs suggest that agencies view these state grants as a crucial component of the resources available for groundwater management,[199] though there are isolated examples of local bodies turning down state grants in order to avoid sharing data with state agencies.[200]

Unfortunately, discussions with groundwater managers and GWMPs and DWR grant descriptions suggest that state grants for groundwater data collection and modeling may not be producing data that can readily influence groundwater management. In other words, state funding is probably not improving regional groundwater management to the extent that it should be, for the following reasons:

(i) The vast majority of state funds for groundwater data collection are directed towards monitoring groundwater elevation or quality, and very few support collecting data on groundwater *use*, which is necessary to construct an accurate water balance, or contextualized information about groundwater. Agencies use a variety of approaches to collecting data on groundwater use. A small minority contemplate metering all private groundwater use in the district;[201] others meter only "significant" wells, with production from smaller wells inferred from power records or land use data;[202] while others dismiss the possibility of metering private wells on principle.[203]

(ii) State funds are expended to install monitoring wells, but agencies may lack the ongoing resources to collect data from the wells,[204] resulting in long gaps in the data, or only short periods of collection, or insufficiently frequent data to be useful for demonstrating trends over time.

(iii) Agencies may lack the resources to analyze the data they collect, whether or not by way of a groundwater model.

[199] See, e.g., Delano-Earlimart Irrigation District, above note 100, 40; GEI Consultants, above note 97, 61, 66; Lake County Watershed Protection District, above note 130, 4-1; Provost & Pritchard, above note 98, 1. Indeed, sometimes local funding is seen as a "secondary" source of funding for implementing GWMPs: Turlock Groundwater Basin Association, above note 113, 7, 72. In addition to specific mentions of the importance of state funding, this is evident in the fact that most contemporary GWMPs follow precisely the structure recommended by DWR, which DWR also uses to assess grant applications. This is set out in Bulletin 118, Appendix C.

[200] See, e.g., David Smith, "Scott Valley Groundwater Committee Members Chosen," *Siskiyou Daily News (Yreka, CA)*, February 7, 2011.

[201] Westlands Water District, above note 149, 29.

[202] Jones & Stokes, above note 119, 4-26.

[203] Provost & Pritchard, above note 98, 61.

[204] See, e.g. GEI Consultants, above note 97, 76.

(iv) Although agencies must provide to the state groundwater data collected with state funds,[205] they need not provide it in a standardized electronic format, which results in inefficient double-handling on the part of the state, before it becomes publicly available.[206]

(v) State grants to develop groundwater models sometimes result in consultants building proprietary models, which then require agencies to pay the consultants to keep them up-to-date; these models sometimes simply remain unused because they become out of date or are too complicated for agencies to use.

Policy-relevant groundwater information: contextualized information on groundwater conditions, information on GWMPs, and GWMP implementation

Information for improved groundwater management extends beyond a need for good raw data, to information that is easy to use for policy making at the local, regional and state levels. As described here, California lacks a system for producing such information, leaving local agencies to shoulder the task. GWMPs provide an as-yet unused vehicle for planning the collection and presentation of such information.

To paraphrase a federal administrator, there is little point in producing more data to enable people to make bad decisions more accurately:[207] information should be focused on policy needs, management decision-making and public accountability. Policy-relevant groundwater information includes, at a basic level, information on how groundwater is managed, including GWMPs; ideally, information should be contextualized: it should cover groundwater conditions and groundwater management in way that integrates these with ecological, economic and social data. In other words, it should explain the ecological, economic, and social consequences of current and projected future groundwater conditions. Indeed, the California Water Plan states that to meet escalating and increasingly complex water problems, the State needs "integrated information on water quality, environmental objectives, economic performance, social equity objectives, and surface water and groundwater interaction".[208]

Generating and presenting such contextualized information goes against the historical grain of traditional water agencies; even with conscious effort at the federal level, for example, it has proven difficult.[209] There is, as yet, no effort to provide such information at the Californian state level. Bulletin 118's policy-targeted information on groundwater conditions, designating "critically overdrafted" basins, dates back to 1980, and no funding

[205] CWC § 10795.19.
[206] DWR makes this information available at http://www.water.ca.gov/waterdatalibrary/. Significant numbers of wells display long gaps in data.
[207] Personal communication from Roger Pulwarty, at the W. Governors' Ass'n, W. States Water Council & W. States State Federal Agency Support Team, *National Integrated Drought Information System and Climate Services Workshop for the Western United States*, in San Francisco, Cal., (April 1, 2010).
[208] California Department of Water Resources, Bulletin 160, above note 5, 6-6, 6-7.'
[209] See generally Susan Hanna, et al., "Integrating Social Science into NOAA Planning, Evaluation and Decision-Making: A Review of the Implementation to Date and Recommendations for Improving Effectiveness - Report of the Social Science Working Group to the NOAA Science Advisory Board" (2009), http://www.sab.noaa.gov/Reports/2009/SAB_SSWG_Report_FINALtoNOAA_041609.pdf.

has been available since then to update this information.[210] As a result, the public, the State, and sometimes also local agencies, have a very incomplete picture of the gravity of local groundwater problems and the consequences of over-extraction, and no information at all in terms of integrated social science information that would guide policy making. Though Senate Bill 7X 6 of 2009 renews DWR's obligation to undertake groundwater investigations sufficient to determine areas of critical overdraft,[211] this binary determination (whether an area is in critical overdraft or not) constitutes only the most rudimentary policy-relevant analysis. The bill unfortunately imposes no obligation on the State or any other actor to convert groundwater data into information that is more meaningful to non-experts, or connected to a broader economic, social or environmental context—goals of the State's own water policy.

More basic, policy-relevant information is also lacking. There is no simple, centralized, reliable way to access GWMPs or reports on their implementation. Nor is summary information available on best practices in groundwater management planning, unlike for UWMPs and AWMPs. Bulletin 118 is the best source of information on the general state of groundwater management, but it gives only examples of management around the state, rather than a comprehensive view. It is now almost 10 years out of date.

As noted in Part 3, agencies are not uniformly required to report how they implement GWMPs, though they are encouraged to do so, and theoretically must do so under contracts for state groundwater grants. Such information is, in fact, difficult to find. Some districts only provide information to water users in the district, rather than to the public as a whole;[212] or only provide groundwater reports to the public upon request, rather than posting them on a website.[213] Nonetheless, promising instances exist. The Zone 7 Water Agency produces a series of groundwater condition reports, and an annual groundwater program design report.[214] The Scotts Valley Water District produces a comprehensive annual report[215] on the implementation of its 1994 GWMP. The report includes an assessment of groundwater conditions (both quality and levels), groundwater management actions, pumping, its groundwater model and the resulting water budget, and descriptions of connections with the district's UWMP, and the applicable IRWMP. Butte County takes this one step further, explicitly assessing changing groundwater conditions against basin management objectives.[216]

[210] California Department of Water Resources, Bulletin 118, above note 1, 15, 98.
[211] CWC § 12924.
[212] Westlands Water District, above note 149, 29.
[213] See, e.g., Provost & Pritchard, above note 98, 32.
[214] The groundwater reports are: a monthly report on groundwater levels, a quarterly municipal groundwater quality report, a semi-annual groundwater level report, an annual monitoring report: Jones & Stokes, above note 119, 4-13.
[215] See, e.g., Kennedy/Jenks Consultants (prepared for Scotts Valley Water District), "Annual Report: 2010 Water Year - Scotts Valley Water District Groundwater Management Program," (2011).
[216] Butte County, Basin Management Objectives (BMO), see http://www.buttecounty.net/Water%20and%20Resource%20Conservation/BMO.aspx (last accessed October 1, 2011).

6. Legislation establishing special water districts

Special district acts were passed between 1933 (Orange County Water District) and 1995 (Surprise Valley Groundwater Basin District), creating agencies with special groundwater management powers. They were established in an ad-hoc way, in response to local demand, particularly where locals feared groundwater exports from the local area,[217] rather than through a coordinated State effort to identify basins in trouble or at risk.[218] Bulletin 118 lists 13 special districts, established by 12 acts.[219] A review of Californian legislation reveals an additional four acts establishing four unique agencies, which are outside adjudicated basins, and which have the same types of groundwater management powers as those listed by Bulletin 118.[220] Special districts are concentrated in the coastal and eastern border areas of California (see Appendix 2), responding primarily to concerns about seawater intrusion and out-of-basin groundwater exports, respectively.

While special districts have had some success in dealing with local groundwater problems, establishing them requires political will that is rarely forthcoming.[221] Nonetheless, special district legislation illuminates mechanisms for addressing obstacles to improved regional groundwater management that could be used more generally. Notable mechanisms are powers to control groundwater problems by controlling pumping and imposing fees; and decision-making structures, which influence when those powers will be used.

6.1 Powers of special districts to control groundwater depletion

Special districts have a range of powers to manage groundwater. For example, they may control pumping in situations of actual or threatened overdraft, limit groundwater exports from the local basin, require well spacing to minimize well interference, undertake supply augmentation activities, and impose fees relating to groundwater extraction.

Compared to general agencies, special districts have stronger and clearer powers to control both new and existing pumping directly, impose conservation measures, and impose fees on pumping. A majority of special districts have either a general power to limit groundwater pumping, or the power to prohibit the drilling of new wells in the district. Special districts control existing groundwater pumping by directly regulating existing wells, and imposing charges on groundwater extraction. The Fox Canyon Groundwater Management Agency (“GMA”) provides an example of strong powers to limit existing and new groundwater pumping, and impose fees, which the agency has used to establish a comprehensive groundwater management ordinance. These powers and ordinance provide a promising model for controlling groundwater pumping in other overdrafted areas.

[217] For example, the Mono County Tri-Valley Groundwater Management District Act of 1989 was passed to “create a locally controlled water district for the purpose of preserving the waters of the basins” in response to “pressures to export groundwater from the basins to other areas of the state”, even though “it is not certain what adverse effects would result [from groundwater export]”: CWC App. § 128-102.
[218] Gregory S. Weber, "Twenty Years of Local Groundwater Export Legislation in California: Lessons from a Patchwork Quilt," *Natural Resources Journal* 34, no. 3 (1994).
[219] CWC §§ 10700 et seq.; CWC App. 40, 60, 100, 118, 119, 121, 124, 128, 129, 131, 135.
[220] CWC App. 61, 70, 103, 137.
[221] David A. Sandino, "California's Groundwater Management since the Governor's Commission Review: The Consolidation of Local Control," *McGeorge Law Review* 36 (2005).

(a) Controlling new groundwater pumping: the Fox Canyon GMA approach

The board of the Fox Canyon Groundwater Management Agency may mandate conservation practices and measures if it:

> determines after a noticed public hearing, and consideration of any relevant investigations, studies, and evidence that groundwater management activities are necessary in order to improve or protect the quantity or quality of groundwater supplies within a groundwater basin or aquifer …[222]

Following this process also permits the board to:

> Control groundwater extractions by regulating, limiting, or suspending extractions from extraction facilities, the construction of new extraction facilities, the enlarging of existing extraction facilities, and the reactivation of abandoned extraction facilities…[223]

The board has exercised these powers by requiring a groundwater pumper to obtain a permit from the Agency before initiating any new or increased use of groundwater in certain areas of its territory.[224] The permitting provisions are strong, detailed, and administratively pragmatic. Among other things, they:

(i) are administered by requiring an applicant for a permit under the Ventura County Water Well Ordinance to include further information on that form, rather than instituting an additional separate permit process;[225]

(ii) require that the permit applicant identify the proposed location, purpose and quantity of water use, and the potential impacts of the proposed water use on the water balance of the relevant basin;[226]

(iii) require that the Agency *only* grant the permit if "the proposed groundwater use will result in no net detriment to the [basins]"—a condition which is defined to mean, among other things, no degradation in water quality and no diminution of recharge;[227] and

(iv) allow the Agency to impose conditions on the permit, including a limited term, and in the case of a proposed agricultural water use, require "the installation of irrigation systems that employ irrigation best management practices consistent with then current industry standards".[228]

Similarly, the Ojai Basin Groundwater Management Agency "may control groundwater extractions by regulating, limiting, or suspending extractions from extraction facilities, the

[222] CWC App. §121-701.
[223] CWC App. §121-701.
[224] Fox Canyon GMA, *Ordinance 8.1: An Ordinance to Adopt the Fox Canyon Groundwater Management Agency Code*, adopted July 27, 2005, amended July 28, 2010, § 4.2.1.1.
[225] Ibid., § 4.2.1.2.
[226] Ibid., §§ 4.2.1.2.1-4.2.1.2.7.
[227] Ibid., § 4.2.1.3.
[228] Ibid., §§ 4.2.1.4.1, 4.2.4.1.3.

construction of new extraction facilities, the enlarging of existing facilities, and the reactivation of abandoned or inactive extraction facilities."[229]

(b) Controlling existing groundwater pumping: the Fox Canyon GMA approach

As set out above, the Fox Canyon GMA's legislation allows it to regulate, limit or suspend existing groundwater extractions. A similar power is granted to some other special districts.[230] Fox Canyon GMA exercises this power with the goal of eliminating overdraft and establishing "safe yield conditions".[231] It requires groundwater pumps to be registered,[232] and uses a scheme for reducing the amount of groundwater that each pumper may extract. This scheme is specifically authorized by its legislation,[233] and put into practice using an agency ordinance. The Executive Officer establishes an "operator's extraction allocation" for each extraction facility (i.e. pump), based on:[234]

(i) the historical level of extraction, which is reduced by an increasing percentage as time passes, for example, the historical allocation is reduced to 85% of the historical level of extraction between 2000 and 2004, and to 80% of the historical level of extraction between 2005 and 2009, etc.; or

(ii) a "baseline allocation" of one acre-foot per year for properties with no or very low historical groundwater extraction; or

(iii) an "efficiency" allocation, which can be granted if the applicant can demonstrate that agricultural water is at least 80% efficient, with reference to a certain formula.

A flexible definition of efficiency, using location-specific factors, applies to calculating allowable groundwater extraction.[235] This system combines equitable considerations (by recognizing past use), allowing a certain level of further development (under the baseline allocation), and allowing efficient but intensive uses (through the efficiency allocation). In reducing existing groundwater extractions, the legislation states that its purpose is not "to determine or allocate water right entitlements."[236]

Other special district legislation uses different schemes for reducing existing groundwater use. For example, the Honey Lake Valley GMD legislation provides for in-basin

[229] CWC App. §131-706.
[230] E.g. Honey Lake Valley GMD: CWC App. § 129-702(c) ("powers include the right to regulate, limit, or suspend extractions from extraction facilities, the construction of new extraction facilities, the enlarging of existing facilities, or the reactivation of abandoned extraction facilities.")
[231] This goal is expressed in Fox Canyon GMA, *Ordinance 8.1*, above note 224, §§ 4.1.1, 5.1.
[232] Fox Canyon GMA, *Ordinance 8.1*, above note 224, § 4.3.
[233] CWC App. §§121-1101 (permits establishment of operator's extraction allocation and extraction surcharges).
[234] Fox Canyon GMA, *Ordinance 8.1*, above note 224, §§ 5.2-5.7.
[235] It uses an irrigation efficiency formula that takes into account reference evapotranspiration, a crop factor, rainfall, and the amount of water required to avoid salt build-up, based on irrigation water quality: Fox Canyon GMA, *Ordinance 8.1*, above note 224, §§ 5.6.1.2.2, 5.6.1.2.4. This information is readily available on DWR's California Irrigation Management System (www.cimis.water.ca.gov/).
[236] Fox Canyon GMA, *Ordinance 8.1*, above note 224, § 5.1. The legislation empowering Fox Canyon GMA to use extraction allocations and extraction surcharges (see above at Part 6.1(b)) is accompanied by a legislative finding that these measures are necessary to eliminate overdraft and bring the basins into safe yield conditions. CWC App. §121-1102.

pumping to be reduced if limiting exports is insufficient to "eliminate existing or threatened conditions of overdraft"; limiting in-basin extractions is to be guided primarily by the number of irrigable acres a user owns, and further factors, such as inefficient use, reasonable need, water conservation activities, and "any other factors" required to achieve equity.[237]

The Ojai Basin GMA may, more generally, "require conservation practices and measures".[238] Equivalent provisions apply to the Honey Lake Valley GMD, Willow Creek Valley GMD, Sierra Valley GMD and Long Valley GMD.[239]

Other special districts have specific legislative powers to prevent waste of groundwater, either in those general terms,[240] or through litigation.[241] Such provisions present a promising way of reducing groundwater drawdown, because they have the potential to flesh out the constitutional prohibition against wasting water in a way that is tailored and relevant for the local area. The difficulty with such provisions tends to be in then clearly defining what constitutes waste, or reasonable conservation practices.

The Pajaro Valley Water Management Agency has adopted an ordinance which sets out "mandatory restrictions on water waste" in the areas of irrigation and urban uses. However, while the urban uses tend to be expressed fairly clearly (for example, prohibiting the use of hoses for construction activities, unless they are equipped with shutoff nozzles), the irrigation prohibition is not. It merely says that:

> No person shall use, suffer, or permit the use of water for agricultural or landscape irrigation in a manner or to an extent which permits water to run to waste, allows unreasonable evaporation loss, leads to unreasonable deep percolation loss, or causes substantial soil erosion.[242]

Precisely what constitutes "unreasonable evaporation", "unreasonable deep percolation loss" or "substantial soil erosion" are not defined. The Fox Canyon GMA's concept of efficiency could be useful here.

In addition to controlling existing groundwater pumping directly, many special districts may control existing pumping indirectly, by charging groundwater pumping fees. The Fox Canyon GMA charges groundwater pumpers within its territory a base groundwater extraction charge,[243] and also extraction surcharges, which are specifically designed to "discourage extraction of groundwater in excess of the approved allocation when that extraction will adversely affect achieving safe yield of any basin within the Agency."[244]

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[237] CWC App. § 129-709.
[238] CWC App. § 131-702(a).
[239] CWC App. § 129-702(b); CWC App. § 135-702(b); CWC App. § 119-702(d).
[240] See, e.g., Monterey Peninsula Water Management District: CWC App. § 118-328(i).
[241] See, e.g., Santa Clara Valley Water District: CWC App. § 60-5(5).
[242] Pajaro Valley Water Management District, *Ordinance 92-1: An Ordinance Establishing Regulations Prohibiting Water Waste*, § 6(B).
[243] Fox Canyon GMA, *Ordinance 8.1*, above note 224, § 2.4.
[244] Fox Canyon GMA, *Ordinance 8.1*, above note 224, § 5.8.3. This is in contrast to groundwater charges applied by some other special districts (notably Orange County and Santa Clara Valley Water Districts), which are not expressly designed to discourage groundwater pumping, but are intended to pay for water replenishment activities.

(c) Obstacles to using powers to control new and existing pumping

In addition to general agencies' philosophical obstacles to considering directly controlling groundwater pumping, the sparse and unclear nature of the relevant GWMP provision makes fear of litigation a further obstacle. The detailed special district legislation for regulating existing and new pumping, identified above, presents a potential reform path.

GWMPs reveal that agencies have received legal advice that suggests that they may not have the power to limit or suspend groundwater extractions, without the consent of a groundwater pumper, regardless of the wording of the GWMP Act (though no reasons are given).[245] Other agencies consider that they have no legal authority to implement mandatory conservation measures, even though they recite the GWMP Act provisions that empower agencies with GWMPs to adopt rules and regulations to implement and enforce the GWMP.[246]

A significant procedural barrier exists to both special districts and general agencies using their respective powers to impose pumping fees: the requirements to hold special elections to do so. Under California's Constitution (Proposition 218), agencies must prove that they comply with certain substantive and procedural requirements before imposing or increasing certain fees and charges.[247] California courts have recently found that groundwater pumping fees constitute fees or charges imposed "as an incident of property ownership". As such, it appears they must comply with Proposition 218, even if the Water Code, which includes the GWMP Act, or a special district act, authorizes an agency to charge the fees.[248]

Accordingly, in order to impose or increase groundwater fees, an agency will most likely need to: mail information about the charge to the owner of every affected parcel of land; hold a hearing at least 45 days after the mailing; reject the proposed charge if a majority of property owners present a written protest; hold an election on the charge, and gain the approval of a 2/3 supermajority of the electors residing in the affected area, or a majority vote of property owners affected.[249] Courts have declared increases in groundwater fees imposed by the Water Replenishment District of Southern California and the Pajaro Valley Water Management District, which did not meet these requirements, invalid. These extensive procedural requirements run counter to the intentions of special district acts, in particular. These acts frequently permit districts to adopt ordinances (including ordinances to impose fees and control extractions) simply by a majority vote of the board,[250] rather than explicitly requiring an election on the issue. Proposition 218, as interpreted by recent court cases, represents a significant cost burden, and provides for significant political interference,

[245] See, e.g., Borrego Water District, "Borrego Water District Groundwater Management Plan " (2002), 13 (citing advice provided by the District's legal counsel).
[246] Winzler & Kelly above note 131, 6, 16 (Humboldt Bay Municipal Water District is a groundwater wholesaler).
[247] Proposition 218, Articles XIII C and D of the California Constitution.
[248] Pajaro Valley Water Management District v. Amrhein (2007) 150 Cal.App.4th 1364; City of Cerritos, et al. v. Water Replenishment District of Southern California (Superior Court of Los Angeles County, Case No. BS128136, decided April 25, 2011).
[249] California Constitution, Art. XIII D, §§ 3(a), 6.
[250] E.g. CWC App. §121-403 (relating to Fox Canyon GMA).

for agencies that attempt to use groundwater fees—a key tool in the regional groundwater management toolbox.

In addition, GWMPs reveal that agencies perceive uncertainty in the GWMP Act powers regarding setting fees.[251] These concerns include the precise meaning of an "equitable fee", the identities of the voters eligible to vote at an election to fix a fee (for example, all registered district voters, or all residents of a groundwater basin), and whether a fee can be imposed if the district does not use it to purchase replenishment water.[252]

As a result of these obstacles, most groundwater managers in California will likely continue to use only half of the available groundwater management "toolbox"—those supply-side measures which, typically, are legally and locally politically uncontroversial.

6.2 Decision-making by special districts

Structures for agency decision-making are critical to groundwater management—an agency may have wide-ranging discretionary powers to control groundwater pumping, for example, but a decision-making structure biased towards groundwater-intensive uses may mean that these powers are never considered, much less used. Special district legislation suggests mechanisms for avoiding such bias.

The directors of both general agencies and special districts are generally required to be local residents or landowners. Interestingly, key differences between these two types of agencies exist in relation to how directors are selected, with much special district legislation using mechanisms that encourage agency boards to take a long-term and balanced approach to groundwater management. In addition, special district legislation provides a precedent for enabling citizens to enforce legislative mandates to manage groundwater.

(a) Electing versus appointing directors

Directors of general agencies are typically elected; this is the case for irrigation districts and water districts, for example.[253] By contrast, boards of directors of special districts are often appointed, in whole or in part. Of the 17 special districts, two have boards composed of directors, each of which is appointed by local government entities and/or water providers.[254] A further seven have boards on which some directors are appointed in this way.[255] For example, cities appoint directors representing three of Orange County Water District's 10 divisions;[256] and the directors of the Ojai Basin Groundwater Management

[251] See above, note 44 and accompanying text.
[252] Borrego Water District, above note 246, 14. Other districts interpret that the normal election rules applicable to the district govern the seeing of fees for replenishment assessments: Provost & Pritchard, above note 98, 7.
[253] CWC §§ 21551, 35028.
[254] These are: Fox Canyon Groundwater Management Agency, and Ojai Basin Groundwater Management Agency.
[255] These are: Honey Lake Valley Groundwater Management District, Monterey Peninsula Water Management District, Mono County Tri-Valley Groundwater Management District, Orange County Water District, Pajaro Valley Water Management Agency, Santa Clara Valley Water District, and Castaic Lake Water Agency.
[256] CWC App. § 40-12.

Agency are appointed by the Ojai City Council, the Ojai Water Conservation District, and various local water providers.[257]

This difference in methods of selecting directors of general agencies and those of special districts is striking. One possible advantage of the special district approach is that it may encourage a focus on the longer-term interests of the district and a broad vision of groundwater management, relatively less constrained by short-term political fallout. Whether this advantage takes effect depends on the power and philosophies of different elector groups and potential appointing bodies, relative to each other, in a particular local setting.

(b) Qualifications of electors

Many general agency acts weight electors' votes by the value or size of their landholding.[258] This privileges the management preferences of large landholders, and likely over-represents groundwater-intensive agricultural interests in water decision-making: elected directors would face a significant electoral disadvantage if they acted to control groundwater problems in a way that might constrain short-term agricultural profits, for example, using demand management. Only one special district act explicitly provides for a similar arrangement,[259] though some require that a small number of directors represent agricultural interests.[260] A one person-one vote system that is most commonly used by special districts encourages boards to make groundwater management decisions that are more balanced, looking beyond solely agricultural considerations.

(c) Public enforcement of legislative mandates relating to groundwater

Though it is certainly uncommon, at least one special district act explicitly allows a citizen suit if the agency refuses to carry out a legislative mandate in relation to groundwater management. Under the Castaic Lake Water Agency's legislation:

> If the agency fails to commence the preparation of a groundwater management plan … or fails to complete a groundwater management plan … any interested party may seek a writ of mandamus to compel the agency to prepare a groundwater management plan…[261]

Though it appears that this provision has never been used, but it provides a useful precedent for the idea of citizen suits in the groundwater context.[262]

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[257] CWC App. §131-401.
[258] For example, for California water districts, each voter has one vote for each dollar's worth of land to which he or she holds title: CWC § 35003. The situation is similar for reclamation districts and water storage districts: CWC §§ 41001, 50704.
[259] Each elector of the Willow Creek Valley Groundwater Management District has one vote per acre of land owned and irrigated by groundwater: CWC App. §135-402.
[260] For example, appointed members of the Pajaro Valley Water Management Agency must derive at least 51 per cent of their income from agriculture; three of Mono County Tri-Valley Groundwater Management District's seven-member board must own district land equipped with pumping facilities capable of pumping at least 100 gallons per minute (e.g. CWC App. §§124-402, 128-401(a)(3)).
[261] CWC App. § 103-15.1(e)(4).
[262] On the flipside, citizen challenges to groundwater management strategies have, though, occurred by way of voter initiatives. For example, when the North San Joaquin Water Conservation District passed a 2007 resolution imposing groundwater charges "to begin correcting the critical groundwater overdraft", in accordance with its statutory power to do so as a Water Conservation District, district voters adopted a

7. Groundwater and the Californian Environmental Quality Act

In the absence of a broad legal vision for groundwater management expressed through water law, the Californian Environmental Quality Act (CEQA)[263] is the main way in which environmental considerations apply to groundwater management. However, CEQA requirements are not adequate to implement a broad, modern vision of groundwater management.

CEQA requires a public agency, which will undertake any non-exempt "governmental activity that may have as its ultimate consequence a physical change in the environment", to determine whether there is a possibility that the project may have a significant impact on the environment. If a project may have a significant impact, it must either be revised to avoid or mitigate those impacts (a "mitigated negative declaration" ensues), or be subject to an Environmental Impact Report ("EIR"). At the time of considering these issues in relation to certain land development projects, a water agency or city or county must make findings relating to available water supplies, and incorporate groundwater information, including information from the UWMP, if the supply includes groundwater.[264]

In addition to the role of an EIR in informing the public, a public agency must consider an EIR before it approves or disapproves of a project. The agency may not approve or carry out a project with significant effects that cannot be mitigated or avoided, unless it finds that specific overriding economic, legal, social, technological, or other benefits of the project outweigh the significant effects on the environment (a "statement of overriding consideration").

A brief review of CEQA documents[265] relating to projects that involve groundwater pumping reveal numerous groundwater storage projects;[266] numerous groundwater transfer projects;[267] the installation of groundwater production wells by agencies;[268] the installation of groundwater monitoring wells by agencies;[269] groundwater ordinances;[270] and groundwater plans.[271] Other activities relevant to groundwater management may be exempt from CEQA

measure to repeal the charge: N. San Joaquin Water Conservation Dist. v. Howard Jarvis Taxpayers Ass'n, 2010 Cal. App. Unpub. LEXIS 7197 (Cal. App. 3d Dist. Sept. 9, 2010).

[263] Public Resources Code § 21000 *et seq*.

[264] CWC § 10910-10915; see above, text accompanying footnotes 64 and 65. Recall that if the urban water supplier has adopted a GWMP, this must be included in its UWMP: see note 61 and accompanying text.

[265] This review was based on a "groundwater" keyword search of records on the CEQAnet Database of the State Clearinghouse within the Office of Planning and Research (available at http://www.ceqanet.ca.gov/default.htm). The database contains documents from 1990 onwards.

[266] E.g., Stockton East Water District's Farmington Groundwater Recharge Program; James Irrigation District's Groundwater Recharge Basin; Fresno Irrigation District's Groundwater Recharge Basin; and Alta Irrigation District's Traver Groundwater Recharge and Banking Project.

[267] E.g., the San Joaquin River Exchange Contractors Water Authority's 25-Year Groundwater Pumping/Water Transfer Project; and Westlands Water District's Agreement for Wheeling Central Valley Project Water to Semitropic Water District.

[268] E.g., Fresno Irrigation District's Sunnyside Groundwater Extraction Project.

[269] E.g., monitoring wells installed by the Kaweah Delta Water Conservation District.

[270] E.g., San Joaquin County's Groundwater Extraction and Exportation Ordinance.

[271] E.g., Patterson Irrigation District's Groundwater Monitoring Plan of 2010; and Eastside Water District's 2008 Turlock Basin GWMP. It is unclear why these were submitted, since CEQA does not apply to the preparation and adoption of planning tools, which are not "projects" (CWC §§ 10652; CEQA Guideline §§ 15262, 15306). However, activities funded under Proposition 50 (which include groundwater recharge and management projects) must comply with CEQA: IRWMP Guidelines p.12.

requirements. For example, increasing groundwater pumping charges for certain reasons is exempt from CEQA.[272] Most of these projects were determined to have no significant environmental impact. Some were subject to mitigated negative declarations.[273] Some were subject to a statement of overriding considerations.[274]

The CEQA Guidelines help agencies determine whether a project may have significant impacts. For example, Part IX (Hydrology and water quality) of the CEQA Environmental Checklist Form asks whether the project would:

> Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

In practice, making this determination involves a "judgment call", and "CEQA retains substantive flexibility not just in how localities may choose to balance environmental, economic and social goals, but also in how environmental standards should be applied in any given case."[275] This flexibility makes CEQA requirements an unreliable way to infuse environmental considerations into groundwater management.

The CEQA Guidelines urge agencies formally to pre-specify activities that they will consider significant, by adopting "thresholds of significance".[276] Based on DWR information, it appears that of the few agencies that have formally adopted thresholds of significance, none has adopted one that relates specifically to groundwater pumping. A model threshold of significance could usefully guide agencies in considering groundwater impacts and increase CEQA's power to consistently lead to environmental protections in groundwater management.

[272] Cal Pub Resources Code § 21080(b)(8); Great Oaks Water Co. v. Santa Clara Valley Water Dist., 170 Cal. App. 4th 956 (Cal. App. 6th Dist. 2009) (affirming that Santa Clara Valley Water District's increasing groundwater pumping charges, for the purpose of its operating and capital budget for existing parts of its system, did not require it to undertake a CEQA review).
[273] E.g., Eastern Municipal Water District's production well project; and Alta Irrigation District's Traver Groundwater Recharge and Banking Project.
[274] E.g., West Kern Water District Groundwater Banking Project; Kern Delta Water District Groundwater Banking In-Lieu Water Supply Project; East Bay Municipal Water District's Bayside Groundwater Project.
[275] Elisa Barbour and Michael Teitz, "CEQA Reform: Issues and Options," in *Occasional Papers* (San Francisco, California: Public Policy Institute of California, 2005), 5.
[276] That is, an "identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant":14 Cal. Code Reg. § 15064.7(a).

8. Conclusion

California has the outlines of an effective legislative framework for regional groundwater management, but there are many gaps to fill and obstacles to remove to improve management. Most fundamentally, California lacks a cohesive, modern vision for groundwater management at the basin scale, and also at the level of individual groundwater rights. At the basin scale, California's legal goal for groundwater management focuses narrowly on direct groundwater supply for human uses—"safe yield"—and there is no well-accepted alternative. Modern water policy, by contrast, increasingly dictates that environmental goals are "co-equal" to water supply reliability. At the individual rights scale, the constitutional prohibition on wasting water is vague in practice and may not provide comprehensive guidance. At the project scale, the concept of a "significant" environmental impact under CEQA in relation to groundwater pumping is unclear.

Alongside the lack of a coherent legal and policy vision for groundwater management, many agencies do not consider groundwater management—particularly management of private extraction within their territory—to be part of their core mission. Accordingly, in some areas, characterizing the actions of water agencies that relate to groundwater as "management" would be overly generous. Some GWMPs only recite arrangements currently in place, lack any implementation plan, and consider using only a very narrow part of the full toolbox of available demand-side and supply-side management measures, and their benefits and costs. This reflects gaps in the state's legal framework for GWMPs, which lags significantly behind the requirements that apply to IRWMPs, AWMPs, and UWMPs. Local electoral systems for directors of general agencies, requirements to hold special elections prior to imposing groundwater charges, and landholder-focused processes for GWMPs, also hamper the ability of agencies to use demand management measures, like pumping controls and fees, in groundwater management. Legal uncertainty over their powers and related fear of litigation further discourage agencies from using such measures. Groundwater recharge and banking projects are probably under-utilized tools and may be causing harm, because they are not supported by a legal framework that gives certainty to participants about their rights, and prevents adverse impacts on third parties and the environment.

Finally, raw groundwater data are often imperfect, information on groundwater management is difficult to access, and there is a complete lack of groundwater information that is targeted to policy makers or to the public by being presented in its social, economic and environmental context.

This catalog of obstacles undeniably presents a significant challenge. California's frameworks for IRWMPs, AWMPs and UWMPs, and special district arrangements, can provide important inspiration for dealing with these obstacles on the road to improving regional groundwater management in California.

Appendix 1: Groundwater management plans reviewed for this report

For brevity, the 70 GWMPs reviewed for this report are listed by setting out the name of the principal agency and the year of the plan.

Alameda County Water District (2001)
Alta Irrigation District (1994)
Arvin-Edison Water Storage District (2003)
Borrego Water District (2002)
Calaveras County Water District (2007)
Carpinteria Valley Water District (1996)
Castaic Lake Water Agency (2003)
Chowchilla Water District – Red Top Resource Conservation District Joint Powers Authority (1997)
City of Roseville (2007)
City of San Diego (2007)
City of Tracy (2007)
Consolidated Irrigation District (2009)
County of Alpine
County of Butte
County of Glenn
Delano-Earlimart Irrigation District (2007)
Diablo Water District (2007)
El Camino Irrigation District (1995)
Elsinore Valley Municipal Water District (Final Draft Report, 2003)
Fresno Irrigation District (2006)
Glenn-Colusa Irrigation District (1995)
Humboldt Bay Municipal Water District (2006)
Indian Wells Valley Cooperative Groundwater Management Group (2006)
Kaweah Delta Water Conservation District (2006)
Kern-Tulare Water District (2006)
Kings County Water District (Draft, 2011)
Kings River Conservation District (2005)
Lake County Flood Control and Water Conservation District (1999)
Lake County Watershed Protection District (2006)
Madera Irrigation District (2000)
Maine Prairie Water District (1997)
Mendocino City Community Services District (undated)
Merced Area Groundwater Pool Interests (2008)
Northeastern San Joaquin County Groundwater Banking Authority (2004)
North Kern Water Storage District (1993)
North San Joaquin Water Conservation District (1995)
Ojai Basin Groundwater Management Agency (2007)
Orange County Water District (2009)
Orange Cove Irrigation District (2006)
Pajaro Valley Water Management Agency (2002)
Reclamation District 108 (2008)
Reclamation District 2068 (2005)
Rosedale-Rio Bravo Water Storage District (1997)
Sacramento County Water Agency (2006)
Sacramento Groundwater Authority (2008)
San Benito County Water District (1998)
San Juan Basin Authority and Metropolitan Water District of Southern California (1994)
San Luis and Delta-Mendota Water Authority (1996)
Santa Clara Valley Water District (2001)
Semitropic Water Storage District (2003)
Shafter-Wasco Irrigation District (1993)
Shasta County Water Agency (2007)
Sonoma County Water Agency (2007)
Soquel Creek Water District (2007)
South San Joaquin Irrigation District (1994)
Southeast Sacramento County Agricultural Water Authority (2002)
Squaw Valley Public Service District (2007)
Stanislaus and Tuolumne Rivers Groundwater Basin Association (2005)
Sutter Extension Water District (1995)
Thermalito Water and Sewer District (undated)
Tulare Irrigation District (2010)
Tulare Lake Basin Water Storage District (1997)
Turlock Irrigation District (2008)
Twentynine Palms Water District (2008)
West Kern Water District (1997)
Western Canal Water District (2006)
Westlands Water District (1996)
Yolo County Flood Control and Water Conservation District (2006)
Yuba County Water Agency (2005)
Zone 7 Water Agency (2005)

Appendix 2: Locations of special districts

Hydrologic Region (HR)		District and date act passed
North Coast HR		Mendocino City Community Services District (1987)
Sacramento River HR		Sacramento County Water Agency (1952)
North Lahontan HR		Honey Lake Valley Groundwater Management District ("GMD") (1989)
		Willow Creek Valley GMD (1993)
		Long Valley GMD (1980)
		Sierra Valley GMD (1980)
		Surprise Valley GMD (1995)
San Francisco Bay HR		Santa Clara Valley Water District (1951)
Central Coast HR		Monterey Peninsula Water Management District (1977)
		Pajaro Valley Water Management Agency (1984)
		San Benito County Water District (1953)
South Lahontan HR		Mono County Tri-Valley GMD (1989)
South Coast HR		Fox Canyon Groundwater Management Agency (1982)
		Ojai Basin Groundwater Management Agency (1991)
		Orange County Water District (1933)
		Castaic Lake Water Agency (1962)
Colorado River HR		Desert Water Agency (1961)

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