Aquifer Recharge

MANAGED AQUIFER RECHARGE

AN OVERVIEW OF LAWS AFFECTING AQUIFER RECHARGE IN SEVERAL WESTERN STATES

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Editors' Note: Groundwater v. Ground Water
While there is, as yet, no uniformity in usage within or among the states "groundwater" is expressed as a single word throughout this article, except within quoted text where it originally appeared as "ground water."

INTRODUCTION

Given the ever-increasing demand for finite water resources in the western United States, the effective functioning of our aquifers continues to be of the utmost importance. Numerous western aquifers currently suffer from moderate to severe overdraft, with groundwater withdrawal outpacing replenishment, while many other aquifers are on their way towards one-hundred percent depletion. This unsustainable situation will continue unless something is done to stop the overdraft of groundwater. As aquifer depletion becomes more problematic, a continued effort to stabilize aquifers and promote the managed recharge of aquifers will be crucial to the economic and social health of the western United States.

Some efforts are already underway. In a number of western states, both public and private entities are working to stabilize aquifers through various methods, including managed aquifer recharge. One recent example comes from Idaho, where earlier this year the Idaho Legislature passed House Bill 547, which dedicates $5 million annually in state Cigarette Tax revenue to be used by the Idaho Water Resource Board for statewide aquifer stabilization. In California, the Legislature recently voted to place a $7.545 billion bond before the voters to, among other things, promote aquifer recharge. In addition,as this issue of *The Water Report* goes to press, a three-bill legislative package addressing groundwater sustainability is awaiting Governor Brown's signature.

This article briefly summarizes of the technical aspects of aquifer recharge and then lays out background information on laws affecting groundwater management approaches in California, Colorado, Arizona, and Idaho to illustrate some of the similarities and differences amongst these western states.

TECHNICAL ASPECTS

Hydrogeology

Aquifer Diversity

A geologic formation from which groundwater can be pumped for domestic, municipal, or agricultural uses is known as an aquifer. Oftentimes, aquifers are separated from one another by a geological formation that permits little or no water to flow between them. These geological formations can be either less permeable than the aquifer (an "aquitard") or entirely impermeable (an "aquiclude"). Describing the diversity of aquifers, the United States Geological Survey (USGS) states that, "an aquifer may be only a few or tens of feet thick to hundreds of feet thick. It may lie a few feet below the land surface to thousands of feet below…[and] may underlie thousands of square miles to just a few acres." *Ground Water,* USGS (1999) at: http://pubs.usgs.gov/gip/gw/how_b.html.

Confined & Unconfined

There are two major types of aquifers: unconfined and confined. An unconfined aquifer has no overlying aquitard or aquiclude, the absence of which allows water to percolate directly into the aquifer from the surface. A confined aquifer, on the other hand, is sandwiched between an aquitard above and an aquiclude or aquitard (e.g., bedrock) below. Oftentimes, a confined aquifer is pressurized such that drilling a borehole into it will cause the water in the aquifer to rise above the water table level and even, at times, rise above the surface without the aid of a pump. This type of borehole creates an artesian well. However, when groundwater is not confined under pressure, "it is described as being under water-table conditions. Water-table aquifers generally are recharged locally, and water tables in shallow aquifers may fluctuate up and down directly in unison with precipitation and stream flow."*Id*.

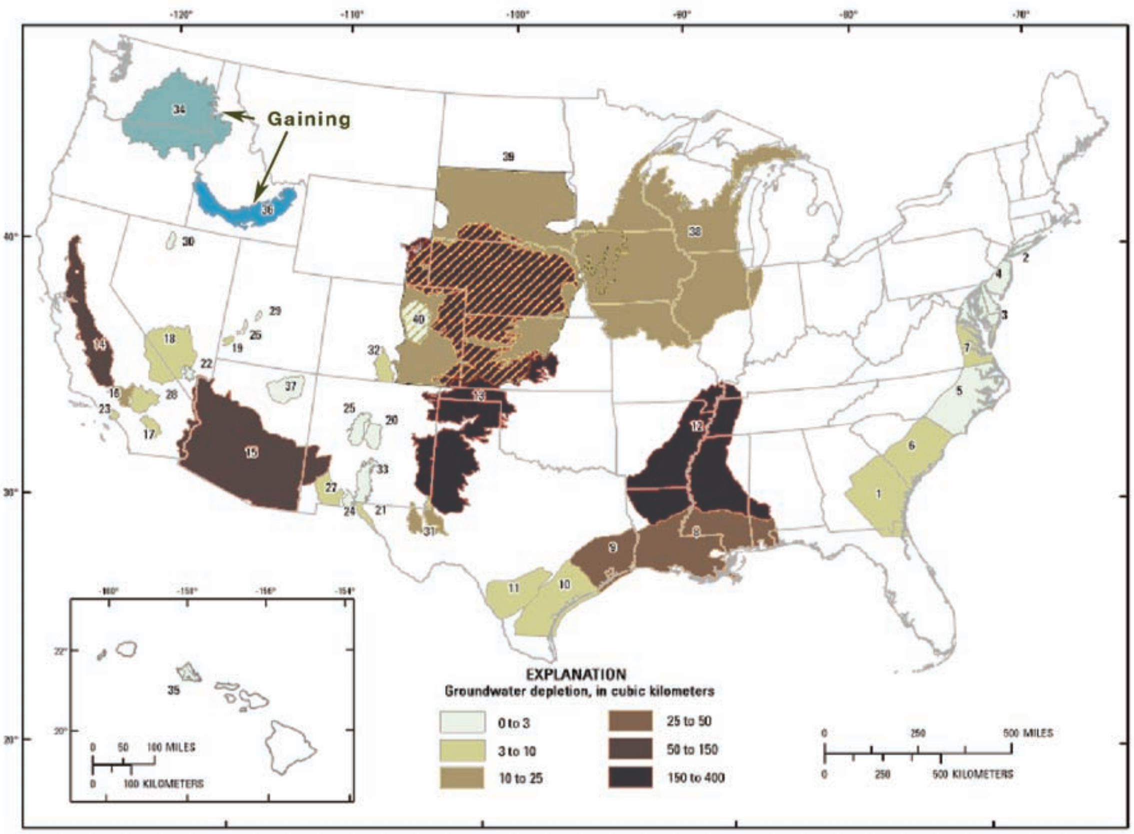
Aquifer Depletion & Recharge

Increasing Groundwater Use

Groundwater use has been increasing for agricultural, drinking, and industrial supplies across the western US, due in large part to the increasing population demand. In addition, the development of a new type of groundwater pump in the 1950's combined with the availability of cheap rural electricity led many irrigators to begin using groundwater instead of surface water. Many irrigators preferred groundwater because there was seemingly never a shortage of supply which was available even if it did not rain all year. As a result of this increased groundwater pumping, many aquifers have been dwindling at an alarming rate. The amount of water that may be extracted from an aquifer without causing depletion is primarily dependent upon the amount of groundwater recharge to that aquifer.

Aquifer Recharge

Figure 1
US Groundwater Depletion



Map of the United States (excluding Alaska) showing cumulative groundwater depletion, 1900 through 2008, in 40 assessed aquifer systems or subareas. Colors are hatched in the Dakota aquifer (area 39) where the aquifer overlaps with other aquifers having different values of depletion.

Managed Aquifer Recharge

Recharge Purposes

In order to thwart the depletion of aquifers, many public and private entities have used a technique known as managed aquifer recharge. Managed aquifer recharge refers to the "the movement of water via man-made systems from the surface of the earth to underground water-bearing strata where it may be stored for future use." *See Aquifer Recharge and Aquifer Storage and Recovery Wells,* EPA (1999), page 2. According to the US Environmental Protection Agency (EPA), "[managed aquifer] recharge may be conducted for ground water resource management, water storage and recovery, prevention of salt water intrusion into fresh water aquifers, and subsidence control, among other purposes... ." *Id*. at 2-3.

It is important to note that, to ensure the active and proficient operation of a managed aquifer recharge project, a detailed and comprehensive hydrogeologic study must be conducted before selecting the site and method of recharge.

Necessary Considerations

NECESSARY MANAGED AQUIFER RECHARGE CONSIDERATIONS, INCLUDE:

- locations of geologic and hydraulic boundaries
- ground transmissivity (permeability multiplied by saturated thickness)
- depth to the aquifer
- lithology (rock characteristics)
- storage capacity
- porosity
- hydraulic conductivity (ease of fluid movement)
- availability of land
- surrounding land use and topography
- quality and quantity of water to be recharged
- economic and legal aspects governing recharge
- level of public acceptance
- natural inflow and outflow of water to the aquifer

While often difficult to ascertain, the exact amount of recharge actually received by the aquifer is the most important figure required for management of groundwater resources.

Three Methods

In general, managed aquifer recharge utilizes one of three different methods:1) surface spreading; 2) smaller infiltration pits/basins; or 3) injection wells.

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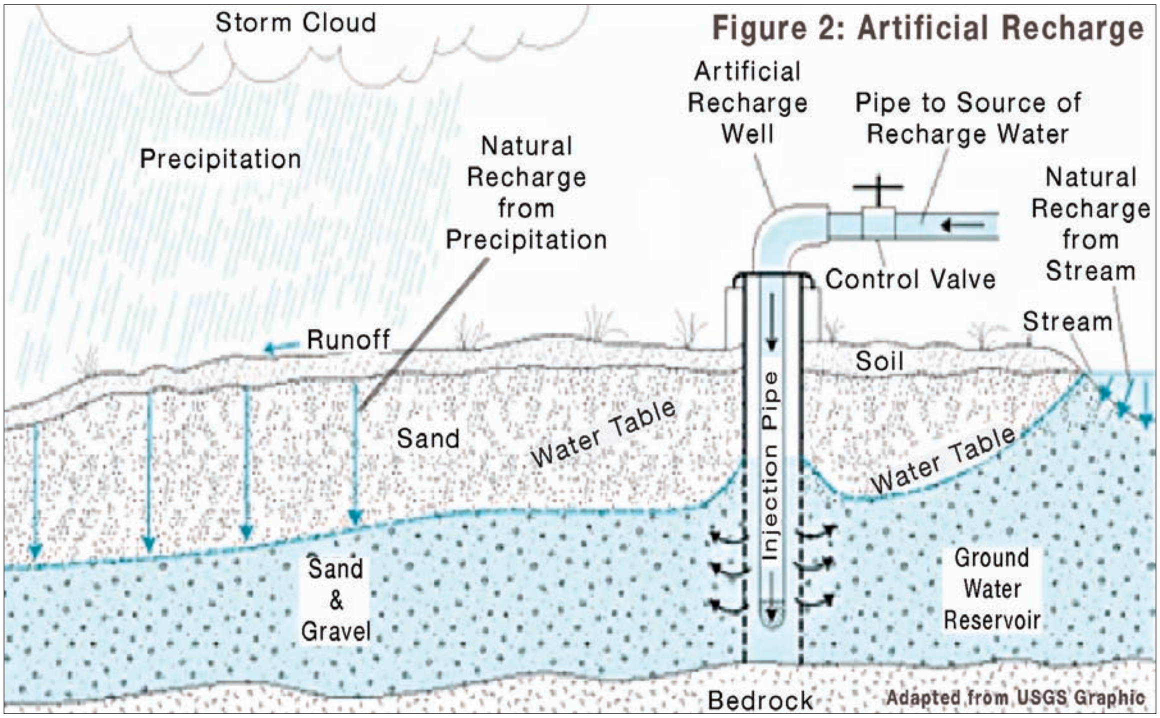
Surface Spreading

Surface spreading is intentionally spreading water over a permeable strata of soil that will allow water to percolate down to the unconfined aquifer below. The majority of existing large-scale artificial recharge operations use surface spreading, which typically employs infiltration basins to enhance the natural percolation of water into the subsurface. This method's effectiveness relies on factors such as the climate, the acreage available, hydrogeology of the available land and the aquifer below, and whether the water is local or imported. With surface spreading, the larger the area of recharge and the longer the water has contact with the soil, the better the rate of recharge. Moreover, surface spreading generally has relatively low construction costs and is easy to operate and maintain.

Artificial Recharge



Infiltration Pits & Basins

While surface spreading and infiltration pits are very similar in concept, infiltration pits and basins are often used in areas where less acreage is available. These recharge systems are generally smaller than surface spreading systems and are commonly used to manage stormwater in municipalities and irrigation control in canal management. An infiltration basin does not normally have a structural outlet to discharge runoff from stormwater. Instead, outflow from an infiltration basin is through the surrounding soils. "*New Jersey Stormwater Best Management Practices Manual*," New Jersey Dept. of Environmental Protection, (April 2004). For this reason, infiltration pits and basins also serve a dual purpose of water quality management. Water pollutant removal may be achieved by the filtration of the runoff through the soil as well as biological and chemical activity within the soil. *Id*.

Injection Wells

Injection wells can be drilled to deliver water into an aquifer. "Injection wells are the selected method of artificial recharge in areas where the existence of impermeable strata between the surface and the aquifer makes recharge by surface infiltration impractical or in areas where land for surface spreading is limited." *Aquifer Recharge and Aquifer Storage, supra* at 3. Also referred to as "direct subsurface recharge," injection wells convey water directly into an aquifer and therefore the quality of the recharged water is of major concern. This is due in large part to the fact that injection wells put water into the aquifer without filtration and oxidation that occurs through the natural percolation of the water through the soil. Injection wells generally inject water directly into water supply aquifers and so, under EPA regulations, they are considered Class V injection wells. These wells are subject to regulation for groundwater quality by EPA or EPA-authorized state agencies with regulations as least as stringent as federal standards (Underground Injection Control). *See* 40 CFR 146.5(e)(6).

ASR Wells

There are different types of injection wells. In the last 30 years, **a**quifer **s**torage **r**ecovery (ASR) wells have increased in usage. ASR wells are used to not only recharge the water into the aquifer, but also to retrieve the recharged water from the same well. In other words, the well has a dual-purpose: recharge and recovery. Generally, ASR wells are expensive and prone to clogging by suspended solids, biological activity, or chemical impurities. *Artificial Recharge of Groundwater, supra.* For these reasons, ASR wells are more expensive to construct and maintain and thus used less often for managed aquifer recharge.

GROUNDWATER LAWS: A FOUR STATES COMPARISON

Aquifer Recharge

A number of different legislative approaches have arisen to address groundwater management. Each state's approach reflects that state's unique history and geology and each has unique strengths and weaknesses. A brief examination of approaches in California, Colorado, Arizona, and Idaho will help illuminate a number of the similarities and differences across the western states. This examination includes: a history of groundwater laws in each state; current groundwater laws and administration; water quality legislation; and the differing hydrogeology of each state.

Idaho

Snake River Basin

Idaho encompasses five major drainage basins. The majority of the State's population lives in the largest of these basins, the Snake River Basin. The Snake River Basin also provides most of the irrigation water for the vast agricultural infrastructure Idaho boasts. While the amount of land devoted to agriculture has declined over the years, irrigation remains the largest single user of both surface and groundwater in Idaho. *Estimated Use of Water in the United States in 2005*, USGS Circular 1344 (2009). A few areas, notably Butte and Camas Counties, have suffered significant groundwater level declines — ranging from one foot to fifty feet. *Groundwater Management in the West*, Ashley and Smith (1999), page 102.

Applicable Idaho Law

As with the other state's of the American West, water usage in Idaho is administered under the "first in time, first in right" principle of western water law's Prior Appropriation Doctrine. Idaho's version of this Doctrine is well developed, as reflected in Idaho's constitution, statues, administrative code, and case law.

Unique Aquifer

This examination of Idaho law will focus largely on the Snake River Plain Aquifer and its nearly finished adjudication of water rights. The Eastern Snake Plain Aquifer (ESPA) has unique characteristics with regard to groundwater recharge. ESPA's size is comparable to Lake Erie. It is one of the largest and most productive aquifers in the world. Recharge into the ESPA is "predominantly from infiltration of applied irrigation water, infiltration of stream flow, and ground-water inflow from adjoining mountain drainage basins. Some recharge may be from direct infiltration of precipitation, however the hot, arid climate of the Plain make this a minimal contribution." Digital Geology of Idaho at: http://geology.isu.edu/Digital_Geology_Idaho/Module15/mod15.htm.

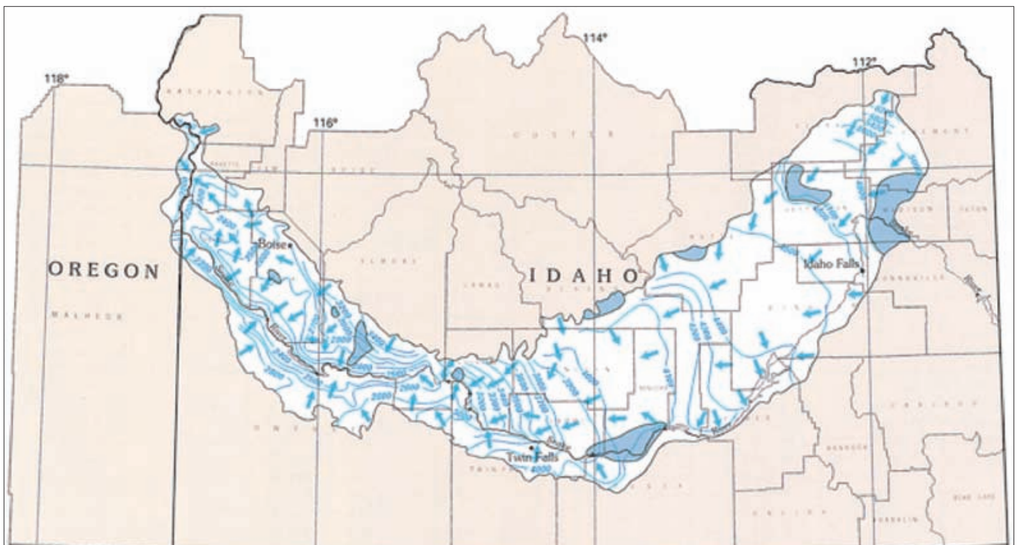


Figure 3: Snake River Plain Aquifer

Sprinkler Irrigation

The change from flood irrigation to sprinklers throughout the mid-1900's created increased efficiency in the use of water. However, expanded irrigated acreage and other changes to agricultural practices also led to a decrease in the irrigated water that is returned to the aquifer. (The US Supreme Court recently discussed some of the problems arising from the increased efficiency of sprinkler irrigation in *Montana v. Wyoming*, 131 S.Ct. 1765 (2011)).

Drinking Water Source

ESPA water is also the sole source of drinking water for nearly three hundred thousand Idaho residents, gaining it a "sole source aquifer" designation from EPA. Carlquist, *supra* at 147. Groundwater pumping has increased due to an ever-increasing population and the corresponding increase of overall water demand. Fortunately for Idahoans, this increased usage has resulted in an approximate decrease in overall aquifer storage of only 3%. Digital Geology, *supra*.

Aquifer Recharge

The ESPA is an unconfined aquifer that has a strong hydrological connection with the Snake River and its many tributaries. Generally, the aquifer, as well as the river above, flows in a southwestern direction. In the upper 150 meters of the aquifer elevation, the storage capacity has been estimated at 200 million acre-feet to 300 million acre-feet. *Id*. Ultimately, the ESPA culminates at two main areas of natural discharge: 1) springs along the Snake River near American Falls Reservoir, which discharge at about 2600 cubic feet per second (cfs); and 2) Thousand Springs, west of Twin Falls, where the collective discharge is about 5200 cfs.

Well Permits

As is true in many western states, domestic wells have been exempted from the permit process. All other appropriations require a water right permit and license and are defined by source quantity, date of priority, point of diversion, purpose of use, season of use, and place of use. Idaho Code Ann. § 42-1411. Groundwater is defined as all water under the surface of the ground, whatever the geological structure in which it is standing or moving. Idaho Code Ann. § 42-230(a).

"Two River" Concept

Idaho water policy on the Snake River has long centered on the notion that there is a "two-river" concept. Beginning in 1986, the Idaho Code has stated that "for the purpose of the determination and administration of rights to the use of the water of the Snake River or its tributaries downstream from Milner Dam, no portion of the water of the Snake River or surface or groundwater tributary to the Snake River upstream from Milner Dam shall be considered." Idaho Code Ann. § 42-203B(2). This effectively splits the Snake River into two different sections in which the administration of one does not affect the other. As a practical matter, water users downstream from Milner Dam are precluded from making "calls" for priority regulation of water above Milner, even if they have senior priority rights. Tuthill, David. *Conjunctive Management in Idaho*, *The Water Report* #108, page 2 (Feb. 15, 2013).

Conjunctive Use Administration

Starting in 1951, the Idaho Legislature determined that groundwater was subject to the Doctrine of Prior Appropriation under the Ground Water Act. Idaho Code Ann. § 42-229. The 1951 Act is significant because it stated that "while the doctrine of 'first in time is first in right' is recognized, a reasonable exercise of this right *shall not block full economic development of underground water resources*." Idaho Code Ann. § 42-226 (emphasis added). The Idaho Supreme Court thoroughly interpreted the Ground Water Act in *Baker v. Ore-Ida Foods, Inc*., 95 Idaho 575, 513 P.2d 627 (1973). *Baker* was the first Idaho Supreme Court analysis of the Ground Water Act as it related to the removal of groundwater in excess of the aquifer's recharge rate. *Baker* held that the Ground Water Act seeks to promote "full economic development" of Idaho's groundwater resources and used the phrase "reasonable pumping levels" — therefore, senior appropriators are "not necessarily entitled to maintenance of historic pumping levels."

"Reasonable" Pumping Levels

> A senior appropriator is only entitled to be protected to the extent of the "reasonable ground water pumping levels" as established by the IDWA. I.C. § 42-226. A senior appropriator is not absolutely protected in either his historic water level or his historic means of diversion. Our Ground Water Act contemplates that in some situations senior appropriators may have to accept some modification of their rights in order to achieve the goal of full economic development.

Id. at 635.

Aquifer Mining Forbidden

Baker also held that the Ground Water Act "forbids mining of an aquifer." *Id*. Thus, the Ground Water Act provided that "ground water usage must be administered to protect both affected senior-priority rights — i.e., both ground and surface water — and to avoid mining of the source aquifer (use existing recharge)." Tuthill, *supra* at 3.

Groundwater Regulation

Idaho water, surface and ground alike, is administered by the Idaho Department of Water Resources (IDWR) pursuant to Idaho Code §42-604. Within IDWR is the Water Resources Board (Board), which is responsible for implementing a comprehensive state water plan for conservation, development, management, and optimum use of all unappropriated water resources and waterways in the public interest subject to legislative approval. Idaho Code Ann. § 42-1734A. Board members are appointed by the governor to serve four-year terms. Moreover, they have specifically mandated functions and responsibilities that are outside the IDWR (*see* www.idwr.idaho.gov/waterboard). While the Director of IDWR (Director) has direction and control of the distribution of all Idaho waters, the actual distribution is accomplished by watermasters who act under the supervision of the Director. Tuthill, *supra* at 2. Historically, watermasters were only in charge of surface water but in 2002 and 2003 the Director obtained authorization from the Snake River Basin Adjudication District Court to exercise authority over groundwater. *Id*. Since this initial authorization, the Director has established water districts across Eastern Idaho with watermasters responsible for distributing water from the ESPA.

Conjunctive Use Rules

In response to pressure for more administrative action, the Director promulgated Rules for Conjunctive Management of Surface and Ground Water Resources (CM Rules) in 1994. *See* Idaho Admin. Code 37.03.11.001-.999 (2014). The CM Rules provide procedures that govern IDWR's response to a delivery call "made by the holder of a senior-priority surface or ground water right against the holder

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Material Injury

Mitigation Plans

Stored Water Mitigation

Injury Prevention

Agency Discretion

Beneficial Use

Water Quality Regulation

of junior-priority ground water right in an area having a common ground water supply." Idaho Admin. Code 37.03.11.001 (2014). The CM Rules also integrate the administration and use of all surface and groundwater in a manner consistent with the traditional state policies of reasonable use. Idaho Admin. Code 37.03.11.020(03) (2014). The CM Rules provide numerous factors that must be considered to determine whether a senior priority user has actually suffered a material injury from the pumping of a junior-priority groundwater user. *See* Conjunctive Management Rule 42 for the list of factors at: http://adminrules.idaho.gov/rules/current/37/0311.pdf.

While the priority system in Idaho is absolute, the CM Rules make it clear that priority can only be asserted if there is injury to a senior appropriator. "The CM Rules state that the seniors' actual needs and uses, rather than the diversion rate or volume stated on their licenses or decrees, will determine the extent to which they may obtain priority administration against junior ground water users." Jeffrey C. Fereday & Michael C. Creamer, *The Maximum Use Doctrine and Its Relevance to Water Rights Administration in Idaho's Lower Boise River Basin*, 47 Idaho L. Rev. 67, 75 (2010). Also, the CM Rules allow for a mitigation plan, which is very similar to "augmentation" in Colorado (*see* below). Idaho defines a mitigation plan as a "document submitted by the holder(s) of a junior-priority ground water right and approved by the Director as provided in Rule 043 that identifies actions and measures to prevent, or compensate holders of senior-priority water rights for, material injury caused by the diversion and use of water by the holders of junior-priority ground water rights within an area having a common ground water supply." Idaho Admin. Proc. Code 37.03.11.010.15, located at: http://adminrules.idaho.gov/rules/current/37/0311.pdf.

A recent example of the mitigation plan process in Idaho involves a plan submitted by Idaho Ground Water Appropriators, Inc. (IGWA) . The plan generally proposed "supplying water stored in Snake River reservoirs to the Surface Water Coalition" to mitigate for the impact of groundwater pumping on surface water users. *See* "*Order Approving Mitigation Plan*" (*In the Matter of the Idaho Ground Water Appropriators, Inc.'s Mitigation Plan in Response to the Surface Water Coalition's Water Delivery Call*). Although a number of the IGWA's specific conditions were rejected by the Director, the plan itself was approved. The Director took a methodical approach applying the expressly enumerated factors in CM Rule 43.03, regarding what a proposed mitigation plan entails and how to determine whether the plan will prevent injury to senior rights. The Director took issue with IGWA's proposal to supply the mitigation water *after* irrigation season is over. The Director allowed IGWA to rent storage water or acquire an option to rent water *prior* to irrigation season. Overall, this Order supports the over-arching policy goal of full economic development of the state's water resources by increasing the overall beneficial use of the water throughout the state.

The Idaho Supreme Court affords the Director significant discretion when applying the CM rules. For example, in *American Falls Reservoir Dist. No. 2 v. IDWR*, 143 Idaho 862, 154 P.3d 433 (2007), the Court held that the CM Rules are constitutional on their face and that an as-applied challenge was premature prior to the exhaustion of all administrative remedies. The Court found that "somewhere between the absolute right to use a decreed water right and an obligation not to waste it and to protect the public's interest in this valuable commodity, lies an area for the exercise of discretion by the Director." *Id*. at 451. Further, as recently as 2011, the Court again sided with a Director's curtailment decision stating that the Director's use of the "best available science" was within his discretion and within the "legal standards applicable" and an "exercise of reason." *Clear Springs Foods, Inc. v. Spackman*, 252 P.3d 71, 98 (Idaho 2011).

Managed Aquifer Recharge in Idaho

In regard to managed aquifer recharge, the Idaho Legislature has declared that the appropriation and underground storage of water for purposes of groundwater recharge is a beneficial purpose. Idaho Code Ann. § 42-234. This allows IDWR to issue permits for managed aquifer recharge. The Legislature also specified that incidental recharge cannot be used as the basis for a claim of a separate or expanded water right. *Id*. Also, the Legislature gave the Idaho Water Resource Board authority to approve all groundwater recharge projects that exceeded 10,000 acre-feet on an average annual basis. Tuthill, *supra* at 3. In 1997 the Legislature enacted a pilot aquifer recharge program for four counties: Jerome, Lincoln, Gooding and Twin Falls counties. Idaho Code Ann. § 42-4201. As noted above, in 2014 the Legislature passed House Bill 547, directing five million dollars annually from Cigarette Tax revenue to be used for statewide aquifer stabilization.

Water quality in Idaho is regulated by the Idaho Department of Environmental Quality (IDEQ). IDEQ's rulemaking body — the Board of Environmental Quality — created the Ground Water Quality Rules. *See* IDAPA 58.11.01.000. These Rules give IDEQ the power to categorize Idaho aquifers based on: vulnerability of the groundwater; existing and future beneficial uses of the groundwater; existing water quality; and social and economic considerations. IDAPA 58.01.11.150.02. An aquifer can be designated a sensitive, general, or other resource. Sensitive aquifers require the strongest level. Injection wells are regulated by IDWR but recharge through surface spreading is IDEQ's responsibility. When surface waters are put into a surface spreading project with the intent to recharge the underlying aquifer, no permit is

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Wastewater Recharge

"Tax" Crediting

required. *See* www.deq.idaho.gov/water-quality/ground-water/monitoring/managed-recharge.aspx. There is, however, authorization for the IDEQ to monitor groundwater quality under the Wastewater Rules if surface waters are land applied. IDAPA 58.01.16.600. These monitoring plans must include water quality sampling, frequency, and reporting to the IDEQ. *See* www.deq.idaho.gov/water-quality/ground-water/monitoring/managed-recharge.aspx. If the water being used to recharge is wastewater, a DEQ permit is required. IDAPA 58.01.17. Lastly, Idaho also has rules governing drinking water quality that would come into play if managed aquifer activities impact drinking water supplies. IDAPA 58.01.0; *see* http://adminrules.idaho.gov/rules/current/58/0108.pdf .

Overall, Idaho is relatively new to the managed aquifer recharge scene. Idaho does, however, seem to have most of the necessary legislative "pieces" in place. To complete the managed aquifer recharge puzzle, Idaho may need to establish a way to credit any private effort at managed aquifer recharge for the water recharged, minus some unrecoverable amount. Also, Idaho needs to consider whether they want to "tax" crediting of recharged water for the long-term goal of aquifer stabilization, by requiring that a portion of the recharged water be left in the aquifer for aquifer stabilization. Arizona has enacted such a "tax" as part of its program for groundwater recharge credits (see below). As Idaho becomes one of the first states to finish a massive aquifer-wide adjudication (Snake River Basin Adjudication), it seems poised to move on to the daunting challenge of aquifer stabilization in the Eastern Snake River Aquifer.

Colorado

Applicable Colorado Law

"Pure Appropriation" State

While most of early Colorado water law dealt with surface water, over the past half-century Colorado has developed a complex statutory framework to administer its groundwater resources. Indeed, it has been referred to as the "pure appropriation" state because of its free transferability of water rights, integration of surface and groundwater, and active water market/water transfer environment. The Colorado Supreme Court has also proclaimed the maximum utilization of the waters of the state a constitutional water law doctrine. *Fellhauer v. People*, 447 P.2d 986, 994-95 (Colo. 1968).

1965 Act

"Mining" Addressed

In 1965, the Colorado Legislature passed the 1965 Colorado Ground Water Management Act (1965 Act), which was the first major Colorado statute to deal exclusively with groundwater. The 1965 Act focused on areas where the main source of supply was groundwater rather than surface water in order to address the problem of groundwater "mining." The statutory provisions for "designated ground water basins" created designated areas managed by local districts, subject to the jurisdiction of the Ground Water Commission. Colorado Ground Water Management Act of 1965, ch. 319, § 148-18-1, 1965 Colo. Sess. Laws 1246, 1246; codified at Colo. Rev. Stat. §§ 37-90-101 to -143 (1997).

Designated Groundwater Areas

Notably, the 1965 Act provided a procedure for establishing designated groundwater areas within the state. Currently, groundwater may be subject to designation if: 1) groundwater, in its natural course, would not be available to and required for the fulfillment of decreed surface rights; or 2) the groundwater is in an area not adjacent to a continuously flowing natural stream and groundwater withdrawals in that area have constituted the principal source of water for at least 15 years prior to the date of the first hearing on designating that basin. Interestingly, designated groundwater basins are essentially legal-political boundaries and do not always correspond with the hydrologic boundaries of the aquifer. Patrick and Archer (1994) at 143; Colo. Rev. Stat. Ann. § 37-90-103 (2014). According to the Ground Water Commission, designated basins are generally areas in the eastern plains with "very little surface water where users rely primarily on ground water as their source of water supply." *See* http://water.state.co.us/groundwater/CGWC/Pages/default.aspx.

Management Districts

Once a basin is designated, resident tax-paying electors have the option to petition the Ground Water Commission to conduct an election on whether to form a groundwater management district, which is a quasi-municipal corporation akin to a water and sanitation district. These districts have the power to tax, regulate, research, and administer the designated groundwater. Currently, there are eight designated basins, with thirteen Ground Water Management Districts within those basins. *See* http://water.state.co.us/groundwater/CGWC/Pages/ManagementDistricts.aspx.

"Tributary" & "Non-Tributary" Distinction

Colorado also distinguishes between tributary and non-tributary groundwater basins. Groundwater is tributary to surface water if its withdrawal would "within one hundred years, deplete the flow of a natural stream…at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal." Colo. Rev. Stat. Ann. § 37-90-103 (2014). All other non-designated groundwater is considered non-tributary, except the Denver Basin which is an exception to the exception. *See Synopsis of Colorado Water Law*, Colorado Division of Water Resources (2011). If there is not a sufficient scientific or factual understanding of groundwater to meet the tributary definition, Colorado presumes that all groundwater is tributary to surface water. However, water users who believe otherwise may rebut this presumption. *See Synopsis of Colorado Water Law*, for further explanations regarding the myriad terms of art in Colorado water law.

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Denver Basin

The Denver Basin Aquifer System is a complicated story beyond the scope of this article. Briefly, the Denver Basin is composed of deep groundwater located within the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers. Groundwater from these four bedrock aquifers is allocated to overlying landowners at a rate of one percent per year, assuming a one-hundred year life of the aquifer. *See Citizen's Guide to Colorado Water Law*, Colorado Foundation for Water Education (2004), page 11. For those interested in a more detailed breakdown of the unique complexities of the Denver Basin aquifer system, please see http://water.state.co.us/groundwater/GWAdmin/DenverBasin/Pages/DenverBasin.aspx.

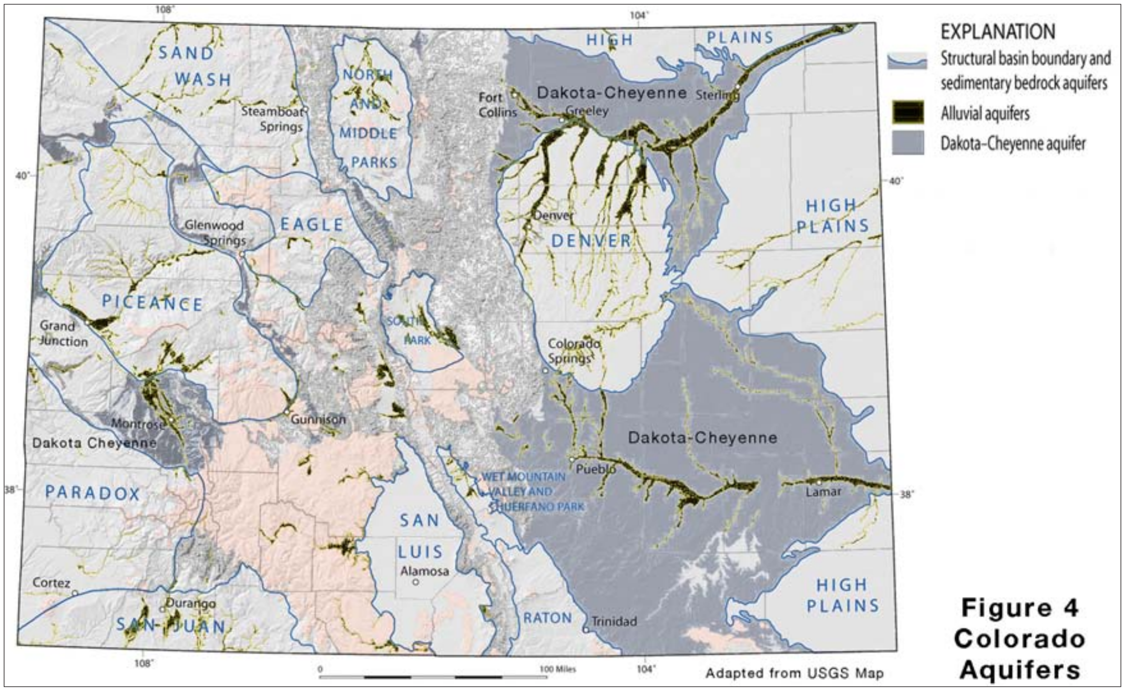


Figure 4 Colorado Aquifers

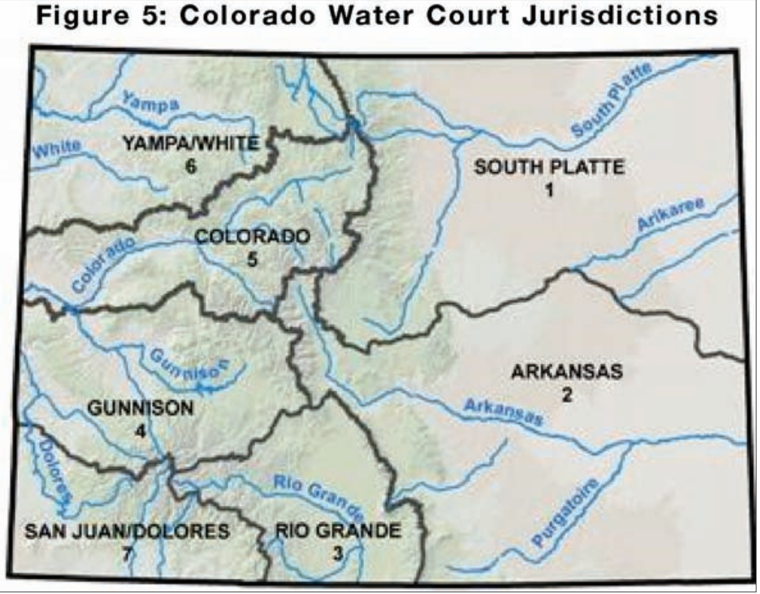
Water Courts

In contrast to most western states that use a water right permit system, Colorado courts play a central role in the administration of Colorado groundwater. Water courts "have jurisdiction over all water right decree applications for surface water, tributary groundwater, nontributary [groundwater], Denver Basin groundwater outside of designated groundwater basins, and geothermal resources." The water courts also have jurisdiction to review cases where the state engineers refused to enforce a call placed on junior users. *Citizen's Guide*, *supra* at 12. Any appeal of a water court decision goes directly to the Colorado Supreme Court. *Id*. Currently, there are seven different water courts across Colorado that were created based upon the drainage patterns of the rivers in Colorado. Water Courts, Colorado Judicial Branch website at: www.courts.state.co.us/Courts/Water/Index.cfm.

Commission

Meanwhile, for designated groundwater basins, the Colorado Ground Water Commission is the regulatory and permitting agency. It manages and controls the groundwater resources in designated basins. The Commission has the authority to hold rulemaking and court hearings. Commission decisions on cases by the Commission are then subject to judicial review by the District Court for the county where the water right is located. *See* the Commission's website at: www.water.state.co.us/cgwc.

Figure 5: Colorado Water Court Jurisdictions



Similar to many other western states, Colorado requires well owners, who make out-of-priority diversions that interfere with senior users, to substitute their depletions with an approved substitute supply or augmentation plan. Substitution plans are short-term plans that are approved by the State Engineer and usually take place within the course of yearly administration. An augmentation plan, on the other hand, is a court-approved plan, which is designed to protect existing water rights by replacing water used in a new project. The augmentation plan must be approved by the water court prior to the new water use. *See Guide to Colorado Well Permits, Water Rights, and Water Administration, Sept. 2012* (Citizen's Guide), pages 12-13 at: http://water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf. It is important that the replacement water meet the needs of the senior water

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Augmentation Plan

rights holders at the time, place, quantity, and quality that they would otherwise enjoy absent the out-of-priority diversions. Citizen's Guide, *supra* at 16. An augmentation plan must identify the structures, diversions, beneficial uses, timing, and amount of depletion to be replaced, along with how and when the replacement water will be supplied and how the augmentation plan will be operated. *Id*.

Water Market

Colorado treats water rights as real property rights and thus allows water rights to be conveyed by deed. As a real property right, the water right is another "stick in the bundle," that may be severed from the land, and bought and sold. Carolyn F. Burr et. al., *Water: The Fuel for Colorado Energy*, 15 U. Denver Water L. Rev. 275, 280 (2012). This has created a well-developed market for water rights in Colorado. This is good news for junior appropriators because it allows them to acquire sufficient water rights for new developments, even in an over-appropriated basin. However, the cost of purchasing the rights, changing them through the water court application process, and dealing with the local regulatory agency can be quite high, and at times impracticable. *Id*. at 280.

Water Quality Policy

In regard to water quality, the Colorado Water Quality Control Act states that it is the policy of Colorado to: "conserve state waters and to protect, maintain, and improve, where necessary and reasonable, the quality thereof for public water supplies, for protection and propagation of wildlife and aquatic life, for domestic, agricultural, industrial and recreational uses, and for other beneficial uses, taking into consideration the requirements of such uses;...[and] to provide for the prevention, abatement, and control of new or existing water pollution... ." C.R.S. §25-8-102. This Act also created the Water Quality Control Commission, which is charged with maintaining a comprehensive and effective program for prevention, control, and abatement of water pollution and to ensure the conveyance of safe drinking water by public water systems. The complete text of the Colorado Water Quality Control Act is available at: www.colorado.gov/pacific/sites/default/files/T1_WQCC_Colorado-Water-Quality-Control-Act_2013.pdf.

Managed Aquifer Recharge in Colorado

Augmentation Recharge

Colorado currently has numerous decreed augmentation plans that use managed aquifer recharge as a court-approved substitute supply. For example, in the South Platte River basin, mutual ditch companies, irrigation districts, farmers, and other entities have developed managed aquifer recharge projects to replace water that is taken out-of-priority by well pumping. These projects involve the use of unlined irrigation ditches and surface spreading ponds that are filled during times of excess to recharge the groundwater aquifers that slowly feed back to the South Platte River. Citizen's Guide, *supra* at 16. Often the recharge locations are specifically situated and managed in such a way that the bulk of the recharged water often returns to the river during the peak demand times, thus allowing out-of-priority wells to continue pumping when otherwise they would have been shut down. William Blomquist, Tanya Heikkila & Edella Schlager, *Institutions and Conjunctive Water Management Among Three Western States*, 41 Nat. Resources J. 653, 679 (2001). These different entities receive credits for the water recharged and, furthermore, any water in excess of what is needed to cover the out-of-priority well pumping may be transferred and sold. *Id*. This market approach allows individual water rights holders to engage in managed aquifer recharge with the expectation that they will receive the full benefits. Moreover, allowing the buying and selling of these recharge credits helps utilize all of the water of the state, both surface and ground, in accordance with the constitutional mandate of maximum utilization.

Recharge Credits

While Colorado's water court system is complex, it incorporates a surprising amount of flexibility and continues to adapt to the state's ever-increasing water demands.

California

Groundwater Regulation Lacking

California is dependent upon a massive and intricate system of state and federal waterworks that store and transport water for use throughout the state. California leads the US in groundwater pumping, taking eleven billion gallons of water from the ground each day — which is more than 13% of total US groundwater extraction. Most of the groundwater withdrawals are used for irrigation and domestic supply. Peculiarly, California is one of only two western states that do not have state-level groundwater regulation, with Texas being the other. John Hedges, *Currents in California Water Law: The Push to Integrate Groundwater and Surface Water Management Through the Courts*, 14 U. Denver Water L. Rev. 375, 377 (2011).

Applicable California Law

Surface Water v. Groundwater

Uniquely, California differentiates between "surface water" — which for water rights purposes includes both surface streams and subterranean streams — and percolating groundwater. Ruth Langridge, *Confronting Drought: Water Supply Planning and the Establishment of A Strategic Groundwater Reserve*, 12 U. Denver Water L. Rev. 295, 303 (2009). Surface waters are subject to state-level permitting and regulation under the riparian and appropriative doctrines while groundwater — defined as "percolating groundwater" — is not subject to permitting by any state agency. Hedges, *supra* at 380. Consequently, the regulation of California's percolating groundwater has been left largely to local governments and the courts. Cal. Water Code Ann. § 1200 (2014).

Aquifer Recharge

"Reasonable & Beneficial Use"

California's constitution, however, does proclaim that "the water resources of the State be put to *beneficial use* to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the *reasonable and beneficial use* thereof in the interest of the people and for the public welfare." Cal. Const. art. X, § 2 (emphasis added). This "reasonable and beneficial standard" overlies all local regulations. The California Supreme Court held that this requirement applied to all water in the state, including groundwater, in *Joslin v. Marin Mun. Water Dist.,* 429 P. 2d 889, 893 (Cal. 1967).

Public Trust Doctrine

The California Supreme Court has also declared that all water rights are merely usufructory and thus only confer the right to use the water, not the actual private ownership of the water. *Nat'l Audubon Soc'y v. Superior Court of Alpine County*, 658 P.2d 709, 724 (Cal. 1983). In that same case, the Court applied the Public Trust Doctrine and proclaimed that "the state has an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible." *Id.* at 728. Thus, while California generally confers the power to regulate groundwater to local governments, it retains authority under the Public Trust Doctrine and the constitutional requirement of "reasonable and beneficial use" to regulate some groundwater pumping. An example of the curtailment of groundwater pumping is pumping that may adversely affect surface instream benefits, i.e, fish populations and riparian values. Landridge, *supra* at 313.

Correlative Rights

With regard to percolating groundwater, California follows a dual system of rules. The statutory differentiation arises based on who is using the water — i.e., whether it be the overlying landowner or an exporter. California was the first state to adopt a system of "correlative" rights with regard to groundwater for overlying landowners. Joseph W. Delapenna, *Quantitative Groundwater Law,* 4 Waters and Water Rights § 21.03 (Robert E. Beck & Amy K. Kelley, eds., 3rd ed. 2010). This doctrine gives owners of land overlying a groundwater basin equal rights to the groundwater. This is, of course, subject to California's "reasonable and beneficial" use requirement and therefore requires all owners to cut back their use in times of shortage. Hedges, *supra* at 380. During drought years, overlying landowners must share in the shortages equally as no correlative right is greater than another. Any use of groundwater on land that does not overly the source, however, is subject to appropriative priority rights, and groundwater exporters must yield to overlying users during water shortages. *Id*. In other words, groundwater exporters follow the appropriative doctrine of "first in time, first in right" and are limited to water that overlying landowners do not need. During times of shortage, correlative rights are more valuable than an appropriative right because the shortage is, at most, shared with other landowners, while the appropriative right of an exporter can be curtailed in full.

Groundwater Exporters

Conserved Water

To incentivize the use or sale of conserved water, California's Water Code allows conserved water to be transferred and its purpose of use, place or use, and point of diversion changed, just like any other water right. *Id*. "Water, or the right to the use of water, the use of which has ceased or been reduced as the result of water conservation efforts as described in subdivision (a), may be sold, leased, exchanged, or otherwise transferred pursuant to any provision of law relating to the transfer of water or water rights, including, but not limited to, provisions of law governing any change in point of diversion, place of use, and purpose of use due to the transfer." Cal. Water Code §1011(b).

Temporary Changes

In order to make water supply more responsive to demand across the state, California set deadlines for its State Water Resource Control Board for temporary water right changes, i.e. those that last for one year or less. Under this statute, the State Water Resource Control Board must review petitions within ten days of receiving them and make a final decision whether the change would harm another user within 35 days. Cal. Water Code §1726. This accelerated process has made for a more responsive usage of water and has aided the state in water short years.

Conveyance Facilities

California also protects against third parties delaying transfer of water rights. In a 1986 statute, the legislature prohibited state, regional, or local agencies from denying the transfer of water through conveyance facilities that have unused capacity, so long as fair compensation is paid for that use. Cal. Water Code Ann. § 1810. This legislation has resulted in the number of buyers and sellers with access to one another to dramatically increase as conveyance methods that were once "off the market" are now available to be used in water transfers. This allows water transfers to occur over much greater distances, between numerous differing parties, while guaranteeing the maximum viable usage of the water resource infrastructure.

Local Management

Adding to the complexity of California groundwater is the fact that city and county governments manage the vast majority of the basins and the regulations vary across the state. California is considered the "great exception" in the western US because it has continued to promote local management of aquifers. Currently, approximately twenty-eight out of fifty-six counties, overlying the majority of California's groundwater resources, have enacted some kind of groundwater regulation. Hedges, *supra* at 381.

California courts have also recognized the concept that local control of groundwater is clearly California law. In *Baldwin v. County of Tehama* 36 Cal. Rptr. 2d 886, 888 (Cal. App. 3d Dist. 1994),

Aquifer Recharge

State v. Local Control

a landowner in Tehama claimed that a county ordinance that regulated the pumping practices and uses of groundwater was preempted by "provisions of the [State] Water Code and uncodified statutes concerning water use." The question before the court was whether a county is precluded from the regulation of groundwater because state law has preempted the field. The court held that state law, "while regulating aspects of groundwater, does not wholly preclude county regulation" and that local governments may regulate groundwater through their inherent police power. *Id*. Similar to the ordinance at controversy in *Tehama*, the majority of local ordinances in California focus on efforts to discourage, or altogether preclude, groundwater export to outside users. *An Overview of California Groundwater Law & Management*, 2011 Water Quality Coordinating Committee, Prof. Richard Frank (2011) at: www.waterboards.ca.gov/board_reference/2011fall/frank_wqcc_gw2011.pdf.

Regulatory Complexity

The complexity of groundwater regulation throughout California has led to efforts for comprehensive statewide legislation concerning California's groundwater resource. A comprehensive and consistent reporting of the exact amounts of groundwater extraction, coupled with local agency regulation subject to statewide standards set by the State Water Resource Control Board (SWRCB), is needed to reduce groundwater contamination, overdraft, and saltwater intrusion, according to Professor Richard Frank. *Id*. California has been taking small steps in statewide administration of groundwater monitoring. For example, in 2009 the Legislature amended the state Water Code and created a monitoring program to track trends in groundwater elevations and groundwater quality in California's groundwater basins. It was the intent of the Legislature to establish a groundwater monitoring program that included significant cooperation with local groundwater monitoring entities to provide the information to the public. *See* www.water.ca.gov/groundwater/casgem/.

Managed Aquifer Recharge in California

Recharge "Beneficial"

California considers managed aquifer recharge a "beneficial use" so long as the water is subsequently recovered and put to the beneficial use for which it was being stored. Cal. Water Code §1242. Users are given ten years to pump the stored water for use but a different deadline may be allowed if applied for under the storage permit. Adam Schempp, *Western Water in the 21st Century: Policies and Programs That Stretch Supplies in A Prior Appropriation World*, 40 Envtl. L. Rep. News & Analysis 10394, 10404 (2010).

Local Control

While the groundwater monitoring program mentioned above is a step towards statewide administration of groundwater, local control over groundwater is not likely to disappear anytime soon. In fact, California recently provided financial incentives to local agencies for the acquisition and construction of groundwater recharge facilities. More than $120 million was awarded in grants and loans to local agencies in the first two years of the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act of 2000 (Proposition 13). Cal. Water Code §§ 79161, 79171. The Local Groundwater Management Assistance Act of 2000 provided more than $15 million to local agencies for seventy-one different groundwater projects. Cal. Water Code §10795. In the 2013-14 regular session, the California Legislature passed AB 1739, which deals directly with groundwater basin management across the state.

Pending Sustainability Legislation

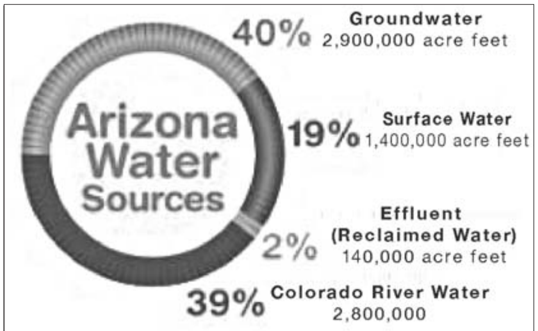
AB 1739 requires a "sustainable groundwater management plan to be adopted…for each high or medium priority groundwater basin by any [local] groundwater management." This bill requires all local agencies to meet certain requirements in order to "achieve sustainable groundwater management in the ground water basin within 20 years of the implantation of the plan." *See* www.leginfo.ca.gov/pub/13-14/bill/asm/ab_1701-1750/ab_1739_bill_20140422_amended_asm_v98.pdf. As noted above, the three-bill package which includes AB 1739 is awaiting Governor Brown's signature (see sidebar, below).

Overall, California has one of the most complex and unique approaches to managing and administering groundwater in the western US. Its combination of correlative and appropriative rights creates complexity that even experts constantly aim to decipher. In order to promote continuity and stability across the state, many people are calling for a legislative takeover of all groundwater management. While a statewide annexation of groundwater management is unlikely to occur in the near future, California continues to remain a very active participant in managed groundwater recharge and an example of how local entities can help, as well as hinder, managed aquifer recharge.

Pending California Groundwater Legislation

A three bill package that would significantly change groundwater management in California passed the California Legislature on August 29 and has been sent to Governor Jerry Brown for his signature. SB 1168 (Pavley), AB 1739 (Dickison), and SB 1319 (Pavley) are the three bills awaiting signature. The bills would initiate groundwater sustainability planning and programs for California's most critical basins. The bill package would create a framework for local and regional groundwater management — providing for the creation of local and regional groundwater sustainability agencies throughout the state. The bills focus on high priority basins which are in the most critical overdraft.

For info:
Bills available at: www.legislature.ca.gov/the_state_legislature/bill_information/bill_information.html



Arizona

Throughout the 1900's groundwater pumping became exceedingly prevalent across Arizona, resulting in the overdraft of aquifers across the state. While increased groundwater pumping was not exclusive to Arizona, its unique arid climate and increasing population made groundwater usage more extensive than some other western states. In fact, in some basins the amount of water pumped from aquifers exceeded its natural recharge by a factor of three or more. *Layperson's Guide to Arizona Water*, Water Education Foundation & Arizona Water Resources Research Center (2007), page 13. Over time, the need for regulated management and statewide control has grown.

Aquifer Recharge

Applicable Arizona Law

Statewide groundwater administration has been occurring in Arizona for decades. Arizona water law has its roots in the Prior Appropriation Doctrine and the judicially decreed "beneficial use" doctrine.

"Reasonable" Use

> Until the enactment of the Arizona Groundwater Management Act of 1980, landowners were at liberty to freely pump groundwater from above land that was being put to a "beneficial use." The Groundwater Management Act was a monumental occurrence in the history of Arizona water law, preserving certain rights of active users before its enactment and placing restrictions and use limitations for new groundwater users…Groundwater pumping is now governed by the reasonable use doctrine, which permits overlying landowners to obtain as much groundwater as can be "reasonably" used for the land. This subsequently relieves these landowners from liability when another user's supply is diminished as a result of such pumping. Unfortunately, the lacking oversight and determination of what constitutes "reasonable," as an always ambiguous term in the law, contributes significantly to the depletion of water resources.

Allison Evans, *The Groundwater/Surface Water Dilemma in Arizona: A Look Back and A Look Ahead Towards Conjunctive Management Reform*, 3 Phoenix L. Rev. 269, 278 (2010) (footnotes omitted).

1980 Act (Code)

Years of work by various entities, led to the 1980 Arizona Groundwater Management Act. *Id*. The 1980 Act, commonly referred to as the Arizona Groundwater Management Code (Code), significantly changed groundwater law in Arizona and laid the foundation for managing Arizona's water resource in a clear, logical, and coherent way. It is still considered one of the most innovative and effective strategies for managing groundwater in the US. In fact, the Ford Foundation recognized the Code as one of the "10 most innovative programs in state and local government."

Policy Goals

The three goals of the Arizona Groundwater Management Code were to:

1) control severe overdraft occurring in many parts of the state
2) provide a means to allocate the state's limited groundwater resources to most effectively meet changing needs
3) augment Arizona's groundwater through water supply development

"AMAs"

In order to achieve these lofty goals, the Code established a number of significant provisions. Initially, the Code created the Arizona Department of Water Resources (ADWR), which is in charge of administering the Code statewide. Kenneth A. Hodson & Maxine Becker, *The Constitutionality of Intrastate Ground Water Management: Arizona-A Case Study*, 49 Ariz. L. Rev. 385, 390 (2007). Additionally, the Code designated many overdrafted basins as Active Management Areas (AMAs). With almost eighty-five percent of Arizona's population residing within one of the five different AMAs, most of Arizona's population had their water rights significantly affected by the Code. *Layperson's Guide*, *supra*.

"Safe-Yield"

Having an area designated an AMA imposes significant restrictions and regulation on the use of groundwater within those areas. Ariz. Rev. Stat. Ann. §§ 45-561 to -578 (2014). Among other provisions, the Code requires ADWR to adopt and enforce management plans that are designed to implement rigorous conservation efforts for each AMA. These plans are to help the AMAs reach a "safe-yield" by 2025. Hodson, *supra* at 392. "Safe-yield" is defined in the Code as "a groundwater management goal which attempts to achieve and thereafter maintain a long-term balance between the amount of groundwater withdrawn in an [AMA] and the annual amount of natural and artificial recharge in the [AMA]." A.R.S. § 45-561(12). Essentially, the Code required conservation by agricultural, industrial, and municipal users in AMAs and a reduction in overdraft of the aquifer. *Layperson's Guide*, *supra*.

100 Year Supply Assurance

The Code provides that, under the Assured Water Supply Program, a proposed development must verify that it has secured enough water, of sufficient quality, to meet the needs of the new residents for 100 years. In the exact words of the Code, the water must be "physically, continuously and legally available for one-hundred years." On top of that, the Assured Water Supply Program also requires developers to show

Aquifer Recharge

the financial capability to construct the necessary water systems for such a supply. Patrick & Archer (1994) at 139. While these requirements have created an impediment for some developers, the program has, indeed, created an assured water supply for the Arizona people.

Outside AMAs

Outside of AMAs, Arizona's groundwater management is far less regulated, even being described as minimal. The only material restriction outside of AMAs, provided by the Code, is the restriction on transportation of groundwater between different sub-basins. Hodson, *supra* at 394. In general, groundwater may be pumped and withdrawn but only if used reasonably and for a beneficial purpose, similar to surface water. Evans, *supra* at 279. A lack of regulatory uniformity clearly exists between the AMAs and rural areas, which adds uncertainty to numerous statewide water transactions. This often leads to increased legal fees due to the complexity of many intrastate transactions.

Water Quality Discharge Permits

With regard to water quality, the Arizona Department of Environmental Quality requires any person who discharges or who owns or operates a facility that "discharges" to obtain an aquifer protection permit from the agency's Director. The list of "discharge" facilities include underground water storage facilities, injection wells, and surface impoundments. Ariz. Rev. Stat. Ann. § 49-241 (2014). There are some exemptions listed under Arizona Statute §49-250.

Specific Groundwater Recharge Statutes

Recharge Credits

Arizona created its first groundwater recharge statutes in 1986 with the passage of the Underground Water Storage, Savings and Replenishment Program (UWSP), Act effective April 25, 1994, 1994 Ariz. Sess. Laws, ch. 291, § 32 (codified at Ariz. Rev. Stat. Ann. §§ 45-801.04 to -898.01). The main goal of the UWSP was to create a "flexible and effective regulatory program for underground storage." Ariz. Rev. Stat. Ann. § 45-801.01. This occurred through the creation of "long-term storage credits" that must be stored for more than a year and may be recovered in the future to be used for number of reasons, including "establishing an assured water supply or fulfilling replenishment obligations." *See* Ariz. Rev. Stat. Ann. § 45-853.01.

Source Water Character

Recharged water maintains the legal character of the original source water. Stored water is usually eligible for long-term storage credits when: 1) the water cannot reasonably be used directly; 2) the water was not recovered on an annual basis; and 3) the water would not have been naturally recharged within an AMA. Ariz. Rev. Stat. Ann. § 45-852.01(B). Recharged water also maintains the legal character of the original source water, regardless of where it is recovered or how it is used. Thus, if Central Arizona Project (CAP) water is stored, no matter where recovery occurs the water is considered to be CAP water when recovered and it may be used in any way that CAP water could be used. Ariz. Rev. Stat. Ann. § 45-832.01(A).

CAP Recharge Projects

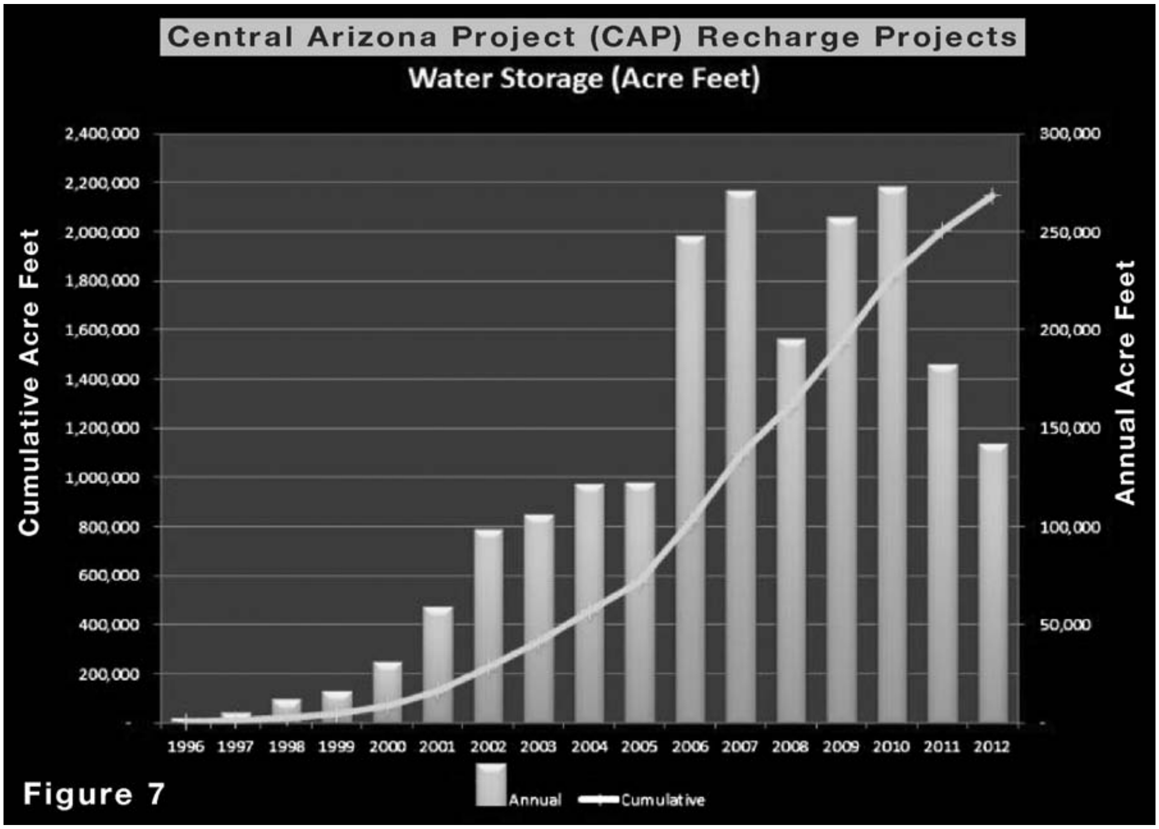


Figure 7

Aquifer Recharge

"Cut" Tax

Under certain permitted recharge activities, the UWSP requires that a percentage of the recharge water be made non-recoverable, as a "general benefit" to the aquifer. This is commonly referred to as a "cut" and can be conceptualized as a tax for the general welfare of the aquifer. Currently, the cut to the aquifer required for long-term storage credits is five percent. Also, cuts do not apply to water that is stored and recovered annually, but is only required for long-term storage credits. A.R.S. § 45-852.01; *see* Recharge Credits and Accounting (ADWR) at: www.azwater.gov/azdwr/WaterManagement/Recharge/RechargeCreditsandAccounting.htm; and Water Management, Basic Terminology at: www.azwater.gov/AzDWR/WaterManagement/Recharge/BasicRechargeTerminology.htm.

Alternative "Cuts" Proposed

There are, however, proposals to modify the percentage of the cut. These proposals are being analyzed by ADWR.

Under these proposals, cut percentages could be determined relative to:

- the distance from the recharge facility
- boundaries of the groundwater savings facilities
- whether the water was recovered from a different sub basin
- whether the recharged water would "uniquely benefit" the aquifer

See ADWR Enhanced Aquifer Management (Alternative Cuts to the Aquifer) Proposal at: *www.azwater.gov/azdwr/WaterManagement/AMAs/EnhancedAquiferManagementStakeholderGroup.htm*

Managed Aquifer Recharge in Arizona

Colorado River Water

Large-scale artificial recharge projects, formed by both public and private entities, have been used in Arizona for decades to recharge groundwater across the state. On the public level, Arizona created a number of statewide agencies to, in large part, use all of its water guaranteed under the Colorado River Compact, as apportioned by Congress. (*See Arizona v. California*, 376 U.S. 340 (1963) for a detailed breakdown of the interstate apportionment of the Colorado River). For example, the Arizona Water Banking Authority (AWBA) was created because Arizona was not using all of its original allocation of the Colorado River. *See* Ariz. Rev. Stat. Ann. § 45-2401. The AWBA pays the delivery and storage costs to bring excess Colorado River water to recharge and storage facilities operated by municipalities, water companies, and other entities, which recharge the water for long-term storage. Hodson, *supra* at 393. These differing entities are given long-term storage credits for the water they recharge and are allowed to use them on the open water market. Underground Water Storage, Savings and Replenishment Program Act effective April 25, 1994, 1994 Ariz. Sess. Laws, ch. 291, § 32 (codified at Ariz. Rev. Stat. Ann. §§ 45-801.04 to -898.01). The AWBA also contracts with the States of Nevada and California to store some of their apportionments of the Colorado River. Hodson, *supra*. The water utilized by the AWBA comes for use of the Central Arizona Project (CAP). CAP has also created a number of different recharge project across the state.

Recharge Projects

Storage Privatization

On the private side, numerous companies have brokered multi-million dollar water deals throughout Arizona. Some market consultants predict that Arizona will see more water privatization in the future. *See* Verde River Basin Partnership's website at: http://vrbp.org/uncategorized/trading-water/. Companies such as Vidler Water Company (Vidler) have been integrating themselves into Arizona's water system for years. Vidler was the first private company to reach an agreement with the AWBA for underground storage. Vidler has a recharge facility outside Phoenix that can store up to a one million acre-feet of CAP water. *Id*. According to their website, Vidler has stored approximately 250,000 acre-feet of water in that facility. Add this to the approximately 157,000 acre-feet stored in five sites in Phoenix and Vidler clearly has a large water supply as its disposal. Given the increasing demand for water in Arizona, the value of their stored water is also increasing as time goes by. Vidler is a good example of a profitable company that also works in close connection with numerous public entities, such as AWBA and CAP, to provide much needed water across Arizona.

Aquifer Recharge Leader

Arizona is leading the western US in managed aquifer recharge in many different aspects. Due in large part to the unique conditions of its population growth and minimal precipitation, it was imperative for Arizona's future to utilize most of its apportionment of the Colorado River. Therefore, in order to not let any water be lost, Arizona incentivizes public and private entities to recharge water across the state through a stable and reliable set of statutory guidelines. Using aquifers for storage has allowed continued growth throughout Arizona, even with the stringent 100-year supply requirement. As noted above, Arizona has numerous examples of successfully managed aquifer recharge projects, in both the public and private sectors. *See* ADWR summary at: www.azwater.gov/AzDWR/WaterManagement/Recharge/documents/2013LTSASummary_08.7.2014.pdf. Arizona also continues to discuss and improve their groundwater management system through mandated management plans. Other western states would do well to undertake a detailed examination of Arizona groundwater recharge laws.

Aquifer Recharge

CONCLUSION

The complexities of the technical aspects of groundwater and groundwater recharge have led to different approaches in the western states, in addition to each state's development of the law as it relates to groundwater use. Comparing the four states to one another, in addition to looking at approaches utilized by one's own state, is instructive as we move toward sustainable and reasonable use of the groundwater resources we all rely on.

Building on the background information presented in this article, a future issue of *The Water Report* will examine the legal aspects of groundwater recharge in the western United States and how practitioners deal with the legal requirements. A third article will then discuss utilizing public/private partnerships for groundwater recharge projects and their potential for implementation.

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