DROUGHTS, FLOODS, AND SCARCITY ON A CLIMATE-DISRUPTED PLANET: UNDERSTANDING THE LEGAL CHALLENGES AND OPPORTUNITIES FOR GROUNDWATER SUSTAINABILITY

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I. INTRODUCTION

Since humans could dig rudimentary wells to reach water where surface supplies were scarce, groundwater has been critical to human needs. Invented in 1937, the high-speed centrifugal (turbine) pump made it possible for large-scale access to groundwater that could go beyond individual domestic needs.[1] After World War II, the dissemination of this pumping technology facilitated widespread irrigated agriculture. Groundwater use soared in the United States and other parts of the world.[2] Now with increasing temperatures and precipitation uncertainties in our climate-disrupted world, humans are relying even more on groundwater to adapt and maintain access to water.

Legal issues shaping access to water, water quality, underground storage of water supplies, walling off saline intrusion in coastal aquifers, property damage due to land sinking when aquifers are depleted, increased flooding in areas of compacted aquifers, and related impacts on food production, abound around the world. Groundwater legal issues can range from the very local, involving a small aquifer contained within a single political boundary, to the multinational, involving large aquifers that cross multiple political boundaries. Yet, the socio-political-economic impacts of laws that fail to stop unsustainable groundwater depletion can be global. One may not readily associate the mass human migrations and dislocations from Yemen, Syria, and Jordan with groundwater, but some experts assert extreme water scarcity in the world's most water-stressed aquifer is linked with crisis, war, and human migrations.[3]

This article aims to provide an introduction to groundwater hydrology followed by a comprehensive, yet succinct, overview of groundwater laws in the United States, and some of the emerging efforts to manage ground and surface waters together. The article then analyzes—and adds a measure of hope—for future sustainable management with the example of California's nascent approach. California, the most populous state in the United States, uses the most groundwater in the country.[4] It is also prone to drought and lacks local water sources sufficient for its

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1 Noah Silber-Coats & Susanna Eden, *Arizona Water Banking, Recharge, and Recovery*, ARROYO (U. Ariz. Water Resource Res. Ctr.) 2017, at 2.

2 *Id.*; *see also* Jane Braxton Little, *The Ogallala Aquifer: Saving a Vital US. Water Source*, SCI. AM. (March 1, 2009), https://www.scientificamerican.com/article/the-ogallala-aquifer/; Laura Parker, *What You Need to Know About the World's Water Wars*, NAT'L GEOGRAPHIC (July 14, 2016), https://news.nationalgeographic.com/2016/07/world-aquifers-water-wars/.

3 Parker, *supra* note 2.

4 *Groundwater Use in the United States*, U.S. GEOLOGICAL SURVEY (June 17, 2018), http://water.usgs.gov/watuse/wugw.html.

population and robust, water-dependent agricultural production. Additionally, in 2017, the Ninth Circuit affirmed the reserved groundwater rights of a tribal government in *Agua Caliente Band of Cahuilla Indians v. Coachella Valley*.[5] But with more than one hundred federally recognized tribes in California,[6] this decision may have far reaching impacts. This combination of factors make California's potential success worth monitoring, as it will be all the more relevant to other parts of the world experiencing wicked water management complexities.

As used in this article, sustainability in groundwater management means permitting the withdrawal and use of groundwater to the extent it can be replenished within a reasonable time and will not result in land subsidence, lowering of groundwater levels, significant reduction in groundwater storage, seawater intrusion, degraded water quality, and depletions in interconnected surface water.[7] By understanding the various legal approaches in the United States and in California more specifically, readers should take away the importance of sustainable management of water resources—ground and surface—as a unified whole. A global comparison of groundwater laws is beyond the scope of this article. Yet, by understanding the various legal tools used in the United States, one can critique and compare water management in other jurisdictions throughout the world.

II. HYDROLOGY 101: GROUNDWATER—SUPPLY AND DEMAND IN THE UNITED STATES

Different jurisdictions have developed varying legal approaches for ground and surface waters, partly due to differing levels of scientific knowledge. While surface water law is covered by two common law doctrines, riparian and prior appropriation, groundwater is covered by five doctrines: capture, American reasonable use, correlative rights, the Restatement (Second) of Torts, and prior appropriation.[8] Groundwater law, like surface water law, is further complicated because very few jurisdictions apply any one of these doctrines in a uniform way; there may be localized hybrid common law approaches, or, increasingly, new public

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[5] 849 F.3d 1262, 1265–66 (2017).

[6] MASS. CTR. FOR NATIVE AM. AWARENESS, LIST OF FEDERALLY RECOGNIZED TRIBES BY STATE 2–4, http://www.mcnaa.org/uploads/1/2/6/5/12656184/list_of_federally_recognized_tribes_by_state.pdf (last visited Nov. 11, 2018).

[7] This definition mirrors the one employed by California's Sustainable Groundwater Management Act. CAL. WATER CODE §10721 (2016).

[8] *Water Law: An Overview*, NAT'L AGRIC. L. CTR., http://nationalaglawcenter.org/overview/water-law/ (last visited Aug. 19, 2018).

law frameworks set out in statutes and regulations.[9] Nonetheless, a basic understanding of hydrogeology and its terminology is critical to understanding this area of law.

A. Terminology and Basic Model of Water Systems

Precipitation flows along land, with a portion going into surface waterbodies and some seeping into the ground. The "unsaturated zone" describes the subsurface layer where water initially soaks into the ground and is accessible to plants as moisture. The water that keeps moving downward through empty spaces or cracks in the soil, sand, or rocks eventually reaches a layer of rock that is relatively impermeable. In short summary, "[t]he water then fills the empty spaces and cracks above that layer. The top of the water in the soil, sand, or rocks is called the 'water table' and the water that fills the empty spaces and cracks is called 'groundwater'" when it is found in this "saturated zone."[10]

Groundwater sources are aquifers—geologic formations, or parts thereof, that contain sufficient saturated permeable material to yield significant quantities of water to springs and wells. Aquifers are usually composed of permeable gravel, sand, sandstone, or fractured rock such as limestone. The presence of shale or clay restricts the flow of groundwater. There are unconfined and confined aquifers: an unconfined aquifer has an upper surface that is a freely fluctuating water table, readily influenced by precipitation, while a confined aquifer is found between two layers of relatively impermeable rock or clay. The water in a confined aquifer is under pressure and, in order to reach it, people need to drill through the confining layer. A confined aquifer recharges on a geologic time-scale of thousands or millions of years, much like a nonrenewable resource.[11]

Although the laws related to ground and surface waters historically have been disconnected, ground and surface waters are almost always hydrologically connected.[12] Groundwater in a gaining stream supplies

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9 *Id.*

10 U.S. GEOLOGICAL SURVEY, OPEN FILE REPORT 93–642, WHAT IS GROUND WATER? (April, 2001), *available at* https://pubs.usgs.gov/of/1993/ofr93-643/.

11 *Ground Water Glossary*, U.S. GEOLOGICAL SURVEY (Jan. 10, 2013), https://pubs.usgs.gov/gip/gw/glossary.html; *Chapter 7: Aquifers and Springs*, TEX. AQUATIC SCI. (2013), https://texasaquaticscience.org/aquifers-springs-aquatic-science-texas/.

12 This disconnected view is changing as more states turn to conjunctive management of surface and ground waters. The U.S. Supreme Court approved a settlement of an interstate compact dispute between Kansas and Nebraska that included modeling to track the interaction between ground and surface water. Final Report of the Special Master with Certificate of Adoption of RRCA Groundwater Model, Kansas v. Nebraska, 538 U.S. 720 (Sept. 17, 2003) (No. 126, Orig.).

base flow to rivers and streams.[13] In fact, groundwater is the source of almost 40% of the stream flow in the United States.[14] Conversely, some surface waters supply a flow of water to groundwater, and this is called a losing stream.[15] Some waterbodies may be losing streams in one area and gaining streams in another.[16] Further, withdrawing water from shallow aquifers near a surface water can reduce the surface water supply.[17]

B. Physical Impacts of Groundwater Supply and Demand

Groundwater use in the United States was fairly modest until after World War II, when a combination of federal policies focusing on rural electrification and agricultural production, along with new technologies to pump water and use it for irrigation, spurred greater reliance on groundwater.[18] According to the U.S. Geological Survey ("USGS"), at present, "[m]ore than 50 percent of the people in the United States, including almost everyone who lives in rural areas, use groundwater for drinking and other household uses."[19] In addition to household uses, people pump groundwater for industrial, agricultural, and municipal uses. People have satisfied their water demands by drilling more deeply into aquifers with more powerful pumps and high capacity wells.[20]

Pumping groundwater forms a cone of depression at the base of the well. If the cone of depression captures groundwater that would have been available for a neighboring well, this results in well interference.[21] If well interference impacts a large group of wells, there may be a

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13 *Rivers Contain Groundwater*, U.S. GEOLOGICAL SURVEY (Dec. 2, 2016), https://water.usgs.gov/edu/rivers-contain-groundwater.html.

14 DAVID W. MOODY ET AL., U.S. GEOLOGICAL SURVEY, WATER-SUPPLY PAPER 2325, NATIONAL WATER SUMMARY 1986: HYDROLOGIC EVENTS AND GROUND-WATER QUALITY 3 (1988).

15 *Rivers Contain Groundwater*, *supra* note 13.

16 *Id.*

17 *Groundwater Depletion*, U.S. GEOLOGICAL SURVEY (Dec. 9, 2016), https://water.usgs.gov/edu/gwdepletion.html.

18 *See generally Water Use in the United States: Trends, 1950–2015*, U.S. GEOLOGICAL SURVEY (June 17, 2018), https://water.usgs.gov/watuse/wutrends.html; *see also* JOSHUA LEWIS & EDSON SEVERNINI, IZA INSTITUTE OF LABOR ECONOMICS, IZA DP NO. 11243, SHORT- AND LONG-RUN IMPACTS OF RURAL ELECTRIFICATION: EVIDENCE FROM THE HISTORICAL ROLLOUT OF THE U.S. POWER GRID 1 (Dec. 2017).

19 WHAT IS GROUND WATER?, *supra* note 10.

20 *See, e.g.*, Ryan Sabalow et al., *California Famers Say 'No Apologies,' As Well Drilling Hits Record Levels*, THE TRIBUNE (Sept. 26, 2016), https://www.sanluisobispo.com/news/state/california/article104251276.html (explaining the incentives California farmers have to drill deeper with powerful pumps in order to extract groundwater).

21 *Aquifers and Groundwater*, U.S. GEOLOGICAL SURVEY, https://water.usgs.gov/edu/earthgwaquifer.html (last visited Nov. 6, 2018).

regional decline in groundwater, which raises larger socio-economic and legal issues.

Groundwater reductions due to pumping from an unconfined aquifer can be offset by groundwater recharge from precipitation, surface waters, excess irrigation water, or leaky pipes or canals that lose water and allow it to seep down into the groundwater.[22] Recharge may also be facilitated by well injection or by spreading water on land to prompt percolation into the ground.[23] During dry periods and droughts, recharge decreases, and if people continue to pump groundwater during these times, there will be an overdraft and the water table will fall further below the land surface.[24] Depending on the depth of wells, they may go dry. The decline may be temporary or permanent, and, without water filling the space under the Earth, the land may subside.[25]

Land subsidence is a gradual settling or sudden sinking of the Earth's surface that occurs due to a variety of factors including lowering the water table. In the United States, more than 17,000 square miles in forty-five states are experiencing subsidence.[26] Major population centers throughout the world, from Mexico City to Beijing, are also experiencing subsidence.[27] USGS explains, "[t]he compaction of unconsolidated aquifer systems that can accompany excessive groundwater pumping is by far the single largest cause of subsidence."[28] Sometimes subsidence is associated with groundwater mining because the groundwater withdrawal is unlikely to be replenished within a reasonable amount of time. This largely non-recoverable reduction in pore volume reduces the total storage capacity of the aquifer system.[29]

Since subsidence permanently reduces storage space, it also increases flood risks, as has been demonstrated in San Jose, California, and the Houston-Galveston area of Texas, among other places.[30] This risk became

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22 *See Artificial Groundwater Recharge,* U.S. GEOLOGICAL SURVEY (Dec. 18, 2017), https://water.usgs.gov/ogw/artificial_recharge.html; A confined aquifer may not readily recharge, so withdrawals from it make this type of aquifer a nonrenewable resource. BARTON THOMPSON ET AL., LEGAL CONTROL OF WATER RESOURCES 450 (5th ed. 2012).

23 *Artificial Groundwater Recharge, supra* note 22.

24 *Groundwater Depletion,* U.S. GEOLOGICAL SURVEY (Dec. 9, 2016), https://water.usgs.gov/edu/gwdepletion.html.

25 *See* U.S. GEOLOGICAL SURVEY, FACT SHEET-165-00, LAND SUBSIDENCE IN THE UNITED STATES (Dec. 2000).

26 *Id*.

27 Parker, *supra* note 2.

28 *See* LAND SUBSIDENCE IN THE UNITED STATES, *supra* note 25 ("Three distinct processes account for most of the water-related subsidence—compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.").

29 *Id*.

30 *Id*.

reality in August 2017 when Hurricane Harvey hit Houston, bringing unprecedented amounts of rainfall and flooding.[31] The parts of Houston with high subsidence appear to have had the worst flooding.[32]

Subsidence is often incremental and therefore hard to notice, but in some places it is quite dramatic. In 2000, for example, the land surface in the San Joaquin Valley, California, was nearly thirty feet (9.1 meters) lower in some locations than it was seventy-five years earlier.[33] During California's most recent drought, people extracted so much groundwater that the land surface in some places dropped almost two inches (five centimeters) per month.[34] In addition to permanent loss of groundwater storage capacity and increased flooding risk, lowering the land surface causes structural problems to buildings, roads, and other infrastructure.[35] In Florida, an unsuspecting man disappeared into a sinkhole that, without warning, formed under his bedroom floor, which collapsed into the twenty foot-by-twenty foot hole.[36] Thus, in addition to impacting water availability, failure to manage groundwater resources sustainably can result in significant socio-economic costs related to property insecurities, from flooding to infrastructure damage, as well as individual costs to private property owners and loss of life.

C. Groundwater Availability and Use

On a global scale, there is much more groundwater than fresh (non-saline), unfrozen surface water. Of all the unfrozen freshwater in the Earth's hydrosphere, about ninety-five percent is groundwater.[37] Because this water supply is generally more stable and less dependent on precipitation, it will be an even more critical resource as the world responds to changes in precipitation due to climate disruption.

However, groundwater is also susceptible to contamination. Just as precipitation moves down through permeable materials into groundwater,

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31 *See New NASA Maps Show Flooding Changes in Aftermath of Hurricane Harvey*, NASA (Sept. 13, 2017), https://www.nasa.gov/feature/goddard/2017/harvey-atlantic-ocean.

32 Ralph Vartabedian, *For Years, Engineers Have Warned that Houston Was a Flood Disaster in the Making. Why Didn't Somebody Do Something?*, L.A. TIMES (Aug. 29, 2017), http://www.latimes.com/nation/la-na-harvey-engineering-20170828-story.html.

33 LAND SUBSIDENCE IN THE UNITED STATES, *supra* note 25.

34 Michael Kiparsky & Holly Doremus, *How to Create Effective Groundwater Agencies*, NEWS DEEPLY (June 8, 2016), https://www.newsdeeply.com/water/community/2016/06/08/how-to-create-effective-groundwater-agencies.

35 Jaskaran Gill, *Groundwater Managed: California Takes Its First Step towards Groundwater Sustainability*, 25 SAN JOAQUIN AGRIC. L. REV. 17, 23–24 (2016).

36 *Florida Man Swallowed by Sinkhole Under Bedroom Feared Dead*, THE GUARDIAN (Mar. 1, 2013), https://www.theguardian.com/world/2013/mar/01/man-disappears-sinkhole-florida.

37 RALPH HEATH, U.S. GEOLOGICAL SURVEY, WATER-SUPPLY PAPER NO. 2220, BASIC GROUND-WATER HYDROLOGY 1 (2005).

so too do pollutants. Seepage from landfills, septic systems, leaking sewage pipes, underground fuel tanks, fertilizers or pesticides, and other chemicals, can reach and pollute groundwater. Generally slow to respond to human interventions, groundwater needs long-term management of quality in order to mitigate the potential effects of pollution.[38]

Yet, groundwater supply is prone to being mismanaged and depleted at an unsustainable rate, in part because of the common pool nature of groundwater with multiple users who can neither easily exclude others nor see the impact of their choices. As defined by Elinor Ostrom, a Nobel Prize winning economist, a common pool resource is "a natural or man-made resource from which it is difficult to exclude or limit users once the resource is provided" by nature or produced by humans.[39] A common pool resource is prone to depletion when one's use of the resource makes it unavailable for another person's use. When a common pool resource has a high value, but weak legal or institutional constraints, users have strong incentives to take as much as they can and deplete the overall supply available for future users.[40] Hence, groundwater is a classic common pool resource—prone to depletion, and in need of strong legal or institutional constraints to manage competing uses.

The USGS' most recent data reports that in 2015 five states alone withdrew fifty-four percent of U.S. groundwater.[41] These states include California (twenty-one percent of U.S. total withdrawals), Arkansas (eleven percent), Texas (nine percent), Nebraska (seven percent), and Idaho (six percent).[42] Additionally, more than two-thirds of fresh groundwater withdrawals in the United States in 2005 were used for irrigation.[43] While use of water for irrigation in 2010 decreased nine percent from 2005, there is substantial room for greater reductions by switching to more efficient irrigation systems.[44] In 2015, "the majority of total U.S. irrigation withdrawals (eighty-one percent) and irrigated acres (seventy-four percent) were in the seventeen conterminous Western

38 WHAT IS GROUNDWATER?, *supra* note 10.

39 Elinor Ostrom, *Coping with Tragedies of the Commons*, ANNU. REV. POL. SCI. 493, 497 (1999).

40 *Id.* at 498.

41 A withdrawal of water includes all units of water extracted from a supply source. By contrast, water consumption is the amount of withdrawn water used and not returned to the original supply source. *Water Use Terminology*, U.S. GEOLOGICAL SURVEY (June 2018), https://water.usgs.gov/watuse/wuglossary.html.

42 *Groundwater Use, supra* note 4.

43 JOAN F. KENNY ET AL., U.S. GEOLOGICAL SURVEY, CIRCULAR 1344, ESTIMATED USE OF WATER IN THE UNITED STATES IN 2005 tbl. 4A (2009).

44 *Irrigation Use in the United States*, U.S. GEOLOGICAL SURVEY (June 19, 2018), http://water.usgs.gov/watuse/wuir.html.

States."[45] Groundwater was the primary source of irrigation water in California, Kansas, Oklahoma, Nebraska, Texas, and South Dakota.[46]

Parts of all of these states are pumping from the High Plains regional aquifer, which contains the Ogallala aquifer and underlies 175,000 square miles in eight states (Kansas, Oklahoma, Nebraska, Texas, South Dakota, New Mexico, Wyoming, and Colorado).[47] As the nation's largest aquifer, the High Plains regional aquifer is unconfined, but recharges slowly from rain and snowmelt at an average rate of about three inches per year. Meanwhile, some areas of the aquifer's water table are dropping by two feet per year.[48] In 2016, USGS published regional measurements of groundwater decline in the High Plains aquifer from pre-development in 1950 to 2015, showing total recoverable water in storage down by over 250 million acre-feet, with the part of the aquifer under Texas down by over 150 million acre-feet.[49] An acre-foot is a term commonly used in hydrology and water law—it refers to the volume of water that covers one acre of surface area to the depth of one foot.[50] Based on water supply planners' estimates, 250 million acre-feet would satisfy the average needs of 500 million households.[51]

Continued declines in the High Plains aquifer makes the region more vulnerable economically, underscoring the need for regional groundwater management and conservation. Perhaps less apparent, however, is that these water management and agricultural policy decisions have a national and global impact. The Ogallala Aquifer irrigates one-sixth of the world's grain production.[52] Therefore, if these states fail to sustainably manage the Ogallala, it could impact hunger problems globally.

III. U.S. LEGAL FRAMEWORK

Groundwater management and control is divided across the United States, with different roles for the federal, tribal, state, and local

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45 *Id.*

46 *Id.*

47 Press Release, U.S. Geological Survey, High Plains Aquifer Groundwater Levels Continue to Decline (June 2017), https://www.usgs.gov/news/usgs-high-plains-aquifer-groundwater-levels-continue-decline.

48 Jeremy Frankel, *Crisis on the High Plains: The Loss of America's Largest Aquifer—The Ogallala*, U. DENV. WATER L. REV. BLOG (May 17, 2018), http://duwaterlawreview.com/crisis-on-the-high-plains-the-loss-of-americas-largest-aquifer-the-ogallala/.

49 High Plains Aquifer Groundwater Levels Continue to Decline, *supra* note 47.

50 *Water Science Glossary of Terms*, U.S. GEOLOGICAL SURVEY (April 2017), https://water.usgs.gov/edu/dictionary.html.

51 R. WASKOM & M. NEIBAUER, COLO. ST. U. EXTENSION, FACT SHEET NO. 9.952, WATER CONSERVATION IN AND AROUND THE HOME 1 (Oct. 2014), *available at* http://extension.colostate.edu/docs/pubs/consumer/09952.pdf.

52 Frankel, *supra* note 48.

governments. As the primary source of authority is derived from state law, this section first discusses state common law approaches and then explains the federal and tribal authorities.

A. State Role, the Public Nature of Groundwater, and Five Common Law Doctrines for Private Use

A majority of states view groundwater as a public resource in which private rights are usufructuary, meaning the groundwater pumper has the right to use but not own water.[53] For instance, the Nebraska Supreme Court has declared that "[g]round water is owned by the public, and the only right held by an overlying landowner is in the use of the ground water."[54] Despite this longstanding view, Texas provides an outlier example,[55] and the "ownership" of groundwater is currently involved in an interstate dispute pending before the U.S. Supreme Court.[56]

Private rights to use groundwater depend on state law. There are five legal doctrines applicable to groundwater, though many states do not adhere to a pure form of any one doctrine. Several courts have applied a hybrid of the common law doctrines, and some state statutes establish permit systems that modify or hybridize the common law. Additionally, some permit systems may only apply to specific parts of a state, leaving the common law in place for the rest. With those caveats in mind, the five legal doctrines are known as capture, reasonable use, correlative rights, restatement torts, and prior appropriation.

1. Capture, Absolute Ownership, Absolute Dominion, or English Rule (Rights Based on Land Ownership)

While sometimes referred to interchangeably as the English Rule, capture, absolute ownership, or dominion, these names can have different

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53 *E.g.*, City of Barstow v. Mojave Water Agency, 23 Cal. 4th 1224, 1237 (2000); Cent. & W. Basin Water Replenishment Dist. v. S. Cal. Water Co., 109 Cal. App. 4th 891, 905 (Cal. Ct. App. 2003) ("[T]here is no private ownership of groundwater"). Most courts agree that overlying landowners do not have a constitutionally protected right in groundwater beneath their property *in situ. See, e.g*., Village of Tequesta v. Jupiter Inlet Corp., 371 So.2d 663, 671 (Fla. 1979). In general, the property concept that a landowner owns to the center of the Earth does not apply to groundwater. John Sprankling, *Owning to the Center of the Earth*, 55 UCLA L. REV. 979, 1005 (2008). *But see*, Edwards Aquifer Authority v. Day, 369 S.W.3d 814, 831–32 (Tex. 2012).

54 In re Application U-2, 413 N.W.2d 290, 298 (Neb. 1987).

55 *Edwards Aquifer Authority*, 369 S.W.3d at 831–32.

56 Mississippi claims that Memphis, Tennessee is pumping groundwater so heavily that a cone of depression is altering the regional groundwater flow. Mississippi claims "ownership" of the groundwater and has requested $615 million in compensation from Tennessee. Christine Klein, *Owning Groundwater: The Example of Mississippi v. Tennessee,* 35 VA. ENVT'L L.J. 474 (2017).

connotations.[57] For example, the title of "absolute ownership" is a misnomer given that the groundwater user owns nothing absolutely. This is essentially a no-liability rule of pumping, where the biggest pump with the deepest well gets to use the water.

As the oldest and most simplistic groundwater doctrine, capture reflects the historically scant scientific understanding of the natural resource. Essentially, because groundwater was seen as mysterious and almost magical in its properties,[58] the law allowed a landowner to pump groundwater without any limit on quantity or place of use. The only limit on this absolute dominion was a malicious pumping exception.[59] This was the majority approach in the United States in the nineteenth century, which, given the ignorance about hydrology at the time, was probably the only viable approach.[60] The one outlier was New Hampshire, which in the late nineteenth century broke from the pack with a decision that spoke of the "reasonable" use of water.[61]

Today, Texas, Maine, and perhaps Indiana, are the only states that continue to apply this doctrine.[62] This doctrine fits uncomfortably with modern groundwater disputes over scarce resources. For example, in the 1999 decision, *Sipriano v. Great Spring Waters of America*, [63] the Texas Supreme Court applied the common law rule of no liability under the capture doctrine, and then expressly encouraged the legislature to regulate the conflicts between neighboring wells.[64] The legislature took up the charge, and private landowners challenged that legislation on multiple grounds. In one of those challenges—*Edwards Aquifer Authority v. Day*—the Texas Supreme Court held that land ownership includes groundwater in place.[65] The court treated this case as an issue of first impression, recognizing that "while the rule of capture does not entail ownership of groundwater in place, neither does it preclude such ownership."[66] In response to arguments that such ownership conflicts with the rule of capture, the court borrowed from the law of oil and gas

57 Joseph W. Dellapenna, *A Primer on Groundwater Law*, 49 IDAHO L. REV. 265, 269 (2013) (citing Greenleaf v. Francis, 35 Mass. 117, 122 (1836)).

58 Frazier v. Brown, 12 Ohio St. 294, 311 (1861).

59 Dellapenna, *supra* note 57, at 273 (citing Greenleaf v. Francis, 35 Mass. 117, 122 (1836)).

60 *Id.* at 271.

61 Bassett v. Salisbury Mfg. Co., 43 N.H. 569, 577–79 (1862).

62 Acton v. Blundell, 152 Eng. Rep. 1223 (Ex. Cham. 1843); Houston & T.C. Railway v. East, 81 S.W. 279 (Tex. 1904); Sipriano v. Great Spring Waters of America, 1 S.W.3d 75 (Tex. 1999); Maddocks v. Giles, 728 A.2d 150 (Me. 1999); Wiggins v. Brazil Clay & Coal Co., 452 N.E.2d 958 (Ind. 1983); Dellapenna, *supra* note 57, at 269–74.

63 1 S.W.3d 75 (Tex. 1999).

64 *Id.* at 79.

65 Edwards Aquifer Authority v. Day, 369 S.W.3d 814 (Tex. 2012).

66 *Id.* at 828.

regarding ownership in place and held this applied to groundwater as well.[67] Once the court established ownership of groundwater, it further held that the right cannot be taken for public use without just compensation under the Texas Constitution.[68] Under some circumstances, therefore, Texas' groundwater regulation could affect a compensable taking of property.[69] On this case's record, however, the court was unable to determine whether a compensable taking occurred and reversed summary judgment against the takings claim, leaving that significant issue for a future date.[70]

2. Reasonable Use or American Rule (Rights Based on Land Ownership)

First adopted in New Hampshire in 1862, the "reasonable use" or "American rule" is the second oldest groundwater doctrine.[71] The doctrine proffers that, based on land ownership, people have the right to pump groundwater for any reasonable use on the overlying land. This rule prohibits off-tract uses of water as per se unreasonable.[72] Courts have generally upheld any use on-tract as reasonable, even if it depletes the aquifer and interferes with a neighbor's reasonable on-tract use.[73]

In practice, the doctrine tends to favor farmers and other rural residents against cities seeking to sink high-capacity wells and use the water off-tract.[74] It also provides an enforceable way to limit pumping to on-tract use, and this means less depletion of a shared common pool resource. Such measured use is especially important with groundwater when each pumper does not know the available supply. The on-tract requirement also promotes aquifer recharge as water use on-tract will more likely return to the aquifer of origin.

3. Correlative Rights (Rights Based on Land Ownership)

Neither the rule of capture nor the reasonable use doctrine was a good fit for the growing state of California. Therefore, in the early 1900s, the California Supreme Court charted a new course in its common law.[75]

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67 *Id.* at 831–32.
68 *Id.* at 833, 838.
69 *Id.*
70 *Id.* at 843.
71 Bassett v. Salisbury Mfg. Co., 43 N.H. 569, 577–79 (1862).
72 *Id.*
73 WILLIAM B. STOEBUCK & DALE A. WHITMAN, HORNBOOK OF THE LAW OF PROPERTY 428–29 (3d ed. 2000).
74 Martin v. City of Linden, 667 So.2d 732 (Ala. 1995) (ruling against city with saltwater contaminated groundwater that sought to sink wells outside the city and use the water off-tract).
75 Katz v. Walkinshaw, 70 P. 663 (Cal. 1902), *reh'g granted* 74 P. 766 (Cal. 1903).

Similar to reasonable use, correlative rights to groundwater are established by land ownership over an aquifer, which convey the private right to pump water to be reasonably used on the overlying land. As water law expert, Professor Dellapenna has observed, this principal differs from reasonable use because, with correlative rights, "there is no room for judicial adjustment of shares to reflect a judge's appraisal of what is the most reasonable use of the groundwater."[76]

The California Supreme Court first articulated the doctrine of correlative rights in 1902 in *Katz v. Walkinshaw*.[77] As formulated through the common law of California since that decision, the doctrine of correlative rights allows landowners to use an amount of groundwater proportional to their land ownership. Unlike reasonable use, landowners can use groundwater off-tract, but only if there is surplus. Surplus water exists when recharge exceeds current withdrawals of groundwater. When there is a surplus, the off-tract users' rights are established under the prior appropriation doctrine. Conversely, whenever there is not enough groundwater for the landowners pumping water and using it on the land overlying the aquifer, those who are using the water off-tract face reductions first, in order of priority. If more reductions are needed, pumpers using the water on-tract are to share in reductions so each is allowed to use a "fair and just proportion" of the supply, a proportion based on acres owned over the aquifer.[78]

In addition to California, proportional sharing via correlative rights also exists in Nebraska and Oklahoma.[79] For example, the Nebraska Supreme Court has held that if a landowner must deepen a well due to heavy pumping by another overlying owner, the one causing the need for a deeper well is liable to compensate the other.[80]

4. Restatement (Second) of Torts (Rights Based on Land Ownership or Contract with Landowner)

Stated as a liability rule, the Restatement (Second) of Torts also informs water allocation between users. According to the Restatement (Second) of Torts § 858:

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[76] Dellapenna, *supra* note 57, at 278.

[77] 70 P. 663 (Cal. 1902), *reh'g granted* 74 P. 766 (Cal. 1903).

[78] Katz v. Walkinshaw, 74 P. 766, 772 (Cal. 1903); Burr v. Maclay Rancho Water Co., 98 P. 260 (Cal. 1908); Hudson v. Dailey, 105 P. 748, 753 (Cal. 1909); Tehachapi-Cummings County Water Dist. v. Armstrong, 49 Cal. App. 3d 992 (Cal. Ct. App. 1975).

[79] Dellapenna, *supra* note 57, at 284; Beatrice Gas Co. v. Thomas, 59 N.W. 925, 928–29 (Neb. 1894); Prather v. Eisenmann, 261 N.W.2d 766, 771 (Neb. 1978) (interpreting statute amidst backdrop of correlative rights' proportional sharing); Canada v. Shawnee, 64 P.2d 694 (Okla. 1936).

[80] *Prather*, 261 N.W.2d at 771–72.

(1) a proprietor of land or his grantee who withdraws ground water from the land and uses it for a beneficial purpose is not subject to liability for interference with the use of water by another, unless

(a) the withdrawal of ground water unreasonably causes harm to a proprietor of neighboring land through lowering the water table or reducing artesian pressure,

(b) the withdrawal of ground water exceeds the proprietor's reasonable share of the annual supply or total store of ground water, or

(c) the withdrawal of the ground water has a direct and substantial effect upon a watercourse or lake and unreasonably causes harm to a person entitled to the use of its water.[81]

The last factor of the Restatement (Second) approach is significant, as it may nudge towards conjunctive management of ground and surface water supplies to prevent liability. Also noteworthy, and unlike reasonable use and correlative rights, the Restatement (Second) does not distinguish based on use of water on-tract or off-tract.[82] One of this Restatement's comments notes that it "permits the sale of ground water . . . ."[83] This could allow a groundwater use right to be sold to someone for use in another basin, off-tract.

In order to determine liability, the principles of surface water reasonable use apply to groundwater.[84] Some refer to the Restatement (Second) approach as the same as reasonable use.[85] This article distinguishes reasonable use as those jurisdictions that developed the doctrine prior to and without regard to incorporating the concepts in the Restatement (Second), which was completed in 1977. While the doctrines are closely related and both are relational, the Restatement (Second)

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81 RESTATEMENT (SECOND) OF TORTS § 858 (1979).

82 The Midwestern states of Ohio, Michigan, and Wisconsin apply this common law doctrine. Cline v. American Aggregates Corp., 474 N.E.2d 324 (Ohio 1984); State v. Michels Pipeline Constr., Inc., 217 N.W.2d 339, 345 (Wis. 1974); Maerz v. United States Steel Corp., 323 N.W.2d 524 (Mich. Ct. App. 1982); *but see* Michigan Citizens for Water Conservation v. Nestle Waters N. America, Inc., 709 N.W.2d 174, 200–02 (Mich. Ct. App. 2005) (applying reasonable use balancing test instead of §858). Indiana, Maine and Texas have rejected it. JOSEPH W. DELLAPENNA, LEGAL CLASSIFICATIONS, *in* 2 Waters and Water Rights §19.05(b)(2) (Amy K. Kelley ed., 3d ed. LexisNexis/Matthew Bender 2011). Nebraska applied the Restatement in a case where groundwater pumpers were alleged to have reduced streamflow, but held there was no showing the pumpers had "unreasonably caused harm." Spear T Ranch v. Knaub, 691 N.W.2d 116, 132 (Neb. 2005).

83 RESTATEMENT (SECOND) OF TORTS § 858 cmt. b (1979).

84 *See id.* (referring to principles in §§ 850–857). Riparian landowners' "Reasonable use" of surface water means that the riparian landowner may use the water on the riparian tract without interfering with another downstream riparian landowner's reasonable use. Courts determine "reasonableness" based on comparing proposed use with others' uses, and typically "natural" uses, "such as water for drinking, watering livestock, or watering a garden" are reasonable. *Water Law: An Overview*, *supra* note 8.

85 Dellapenna, *supra* note 57, at 313–19.

approach requires courts to perform a balancing analysis of utility against harm of competing uses, allows off-tract uses, and acknowledges hydrologic connection between ground and surface water.[86]

5. Prior Appropriation (Rights Based on First-in-Time Use)

Similar to the surface water doctrine of the same name, groundwater prior appropriation awards water rights to the first actors to access groundwater and put it to beneficial use.[87] First adopted by Idaho in 1915, many western states have applied prior appropriation or a version thereof to groundwater, as these states already had for surface water use.[88]

Unlike the other groundwater doctrines, prior appropriation is not based on land ownership. The water rights are to a specific point of withdrawal, a specific place of use, and an exact quantity. [89] Significantly, such rights can be lost through non-use.[90] The water rights generally can be transferred to another user if it does not harm others' water rights; however, state rules vary widely regarding transfers in a water market.[91]

A thorny issue that arises in a prior appropriation jurisdiction is whether a senior appropriator with a shallow well can force a junior to stop pumping water from a deeper well, and whether the junior is required to pay for the senior to install a deeper well.[92] Other issues include whether a senior can stop a junior from pumping if the aquifer is being "mined," meaning the pumped water exceeds the recharge rate. The Idaho Supreme Court has concluded that a provision of its state statutes prohibit "ground water mining."[93] In a conflict between an appropriator of ground and an appropriator of surface water, however, the Colorado Supreme Court determined the prior right of the groundwater user did not guarantee the maintenance of historic water table.[94] Yet, this case does not reveal who would win in a conflict between two groundwater appropriators where the senior claims a guarantee of the historic water table.

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86 RESTATEMENT (SECOND) OF TORTS § 858A (1979).

87 *See, e.g.*, Bower v. Moorman, 147 P. 496 (Idaho 1915).

88 *Id.* In Colorado, "designated groundwaters" are subject to appropriation, but this does not include non-tributary groundwater. COLO. REV. STAT. § 37-90-102(1)-(2) (2018). In City of Colo. Springs v. Bender, 366 P.2d 552, 556 (Colo. 1961), the court held the senior's well must be reasonably adequate in light of economics and historical use.

89 Dellapenna, *supra* note 57, at 298.

90 *Id.*

91 Dellapenna, *supra* note 57, at 307–13.

92 Current Creek Irr. Co. v. Andrews, 344 P.2d 528 (Utah 1959) (holding junior appropriator liable to senior); Parker v. Wallentine, 650 P.2d 648 (Idaho 1982) (holding junior appropriator liable to senior).

93 Baker v. Ore-Ida Foods, Inc., 513 P.2d 627, 637 (Idaho 1973).

94 Gallegos v. Colo. Ground Water Comm'n, 147 P.3d 20, 27 (Colo. 2006).

The use of appropriative rights can minimize problems of uncertainty regarding amounts of water to which one has a right. These systems, however, provide little protection for the public interest in groundwater or a way to balance the relative importance of particular uses when there is a shortage. In other words, when there is not enough water for all water users, the social value of the use is irrelevant to the determination of appropriative rights beyond the determination of whether the use is "beneficial."

B. Federal and Tribal Governmental Roles

While the states are traditionally the primary jurisdictions to determine groundwater law, the federal and tribal governments also impact demand and management. The federal role in groundwater management has been fractured and indirect. Federal law has promoted various uses of groundwater through such tools as federal crop and biofuel subsidies that encourage agriculture dependent on groundwater for irrigation in arid areas (i.e., growing corn over the Ogallala aquifer).[95] While one would not categorize this as water law, it significantly shapes water demands.

Furthermore, since the federal government owns about one-third of the land in the United States, it can assert control over groundwater as land managers.[96] Not surprisingly, the federal government has "reserved" rights to water, including groundwater, for its federal lands.[97] Similarly, the federal government may assert federal law reserved rights claims on behalf of tribes to groundwater.[98] As discussed below, tribal governments also assert these claims directly.[99]

Reserved water rights arise from the federal government asserting water rights needed to protect the primary purpose for which the federal government reserved the land in the first place. Thus, the federal government has substantial power to protect the primary purposes of its reservation of land, including the authority to protect endangered species from harm by groundwater pumping. In *Cappaert v. United States*,[100] the Supreme Court issued its first decision on whether the federal doctrine of implied reservation of water rights applied to groundwater. The Court held that the federal government had a reserved right to groundwater such

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95 Little, *supra* note 2.

96 David Johnson & Pratheek Rebala, *Here's Where the Federal Government Owns the Most Land,"* TIME (Jan. 5, 2016), http://time.com/4167983/federal-government-land-oregon/.

97 Cappaert v. United States, 426 U.S. 128 (1976).

98 Winters v. United States, 207 U.S. 564 (1908).

99 Agua Caliente Band of Cahuilla Indians v. Coachella Valley, 849 F.3d 1262, 1265–66 (9th Cir. 2017).

100 426 U.S. 128 (1976).

that it could enjoin a private landowner from pumping groundwater that lowered the water level in Devil's Hole—a cavernous pool in nearby Death Valley National Monument—to a level that prevented an endangered fish species from spawning.[101] The federal reserved right to underground waters appurtenant to Devil's Hole was key to maintaining a level of water in the pool necessary to sustain its scientific value, thus furthering the 1952 Presidential Proclamation establishing Devil's Hole as a national monument.[102]

More specifically, the Court in *Cappaert* reasoned that the American Antiquities Preservation Act authorized the President to reserve water in Devil's Hole, "since such [a] pool and its rare inhabitants are 'objects of historic or scientific interest' within the meaning of the Act. P. 2071."[103] Also, the 1952 Presidential Proclamation expressed an intention to reserve unappropriated water, and thus the court granted a remedy of limiting pumping to a water level in Devil's Hole that preserved its purpose of protecting the fish habitat.[104] As a matter of federal law, the Court found that the United States could protect its reserved water from subsequent diversion by others, whether the diversion is of surface water or groundwater.[105] The federal reserved right in unappropriated water "vests on the date of the reservation and is superior to the rights of future appropriators."[106] Further, because the federal Desert Land Act was inapplicable, the Court determined that reserved water rights are "not governed by state law but derives from the federal purpose of the reservation."[107] While state courts may adjudicate federal water rights, federal courts also have jurisdiction to determine the water rights of the United States.[108] Although the McCarran Amendment waives sovereign immunity of the federal government in state court general water rights adjudications, the Supreme Court rejected the argument that this is a substantive statute, requiring the United States to "perfect its water rights in the state forum like all other land owners."[109]

Nonetheless, while federal reserved rights are powerful, they only apply to federally reserved lands in certain circumstances. There are no national, proactive, or comprehensive approaches to groundwater

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101 *Id.*
102 *Id.* at 131, 139–41.
103 *Id.* at 129.
104 *Id.*
105 *Id.*
106 *Id.* at 138.
107 *Id.* at 145–46.
108 *Id.*
109 *Id.*; *see also The McCarran Amendment*, U.S. DEP'T OF JUST. (May 12, 2015), https://www.justice.gov/enrd/mccarran-amendment.

management. Instead, beyond protecting specific federal interests and policies, the federal role has largely been used to rescue states that have failed to sustainably manage their water supply. Often, the federal government has financed and provided those states with surface water projects (e.g., extensive dam, reservoir, and conveyance systems) to supplement water supplies.[110]

In a variation on this rescue theme, the federal government simultaneously stimulated Arizona's groundwater management. The Central Arizona Project was designed to bring Colorado River water from near the border between California and Arizona over several hundred miles and up several hundred feet in elevation to be distributed across Arizona, all the way down to Tucson, Arizona.[111] The federal authorizing legislation for the Project prohibited the Secretary of the Interior from delivering water to any part of Arizona that lacked adequate groundwater control measures.[112] This spurred Arizona to enact the 1980 Groundwater Management Act.[113] That law is now seen as historic for Arizona. Among other things, it required new development in "actively managed areas," where most of the population lives, to prove they had enough water to sustain residents for at least 100 years. Since the passage of the law, Arizona's population and economy have grown tremendously, but it uses three percent less water now than it did sixty years ago.[114]

Despite this successful example of providing a federal nudge to state law without preempting it, Congress has not created similar legislation for any other water projects. For instance, given the importance of the Ogallala aquifer to the United States and to the global grain supply, it is noteworthy that the federal government's approach, encapsulated in the "Ogallala Aquifer Initiative," remains largely voluntary and based on economic incentives to individual water users.[115] Through the Ogallala Initiative, the U.S. Department of Agriculture's Natural Resources Conservation Service ("NRCS") describes its role as providing "agricultural producers with technical and financial assistance to

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110 *E.g.*, *Central Valley Project*, U.S. BUREAU OF RECLAMATION (Dec. 12, 2017), https://www.usbr.gov/mp/cvp/; *Colorado River Storage Project*, U.S. BUREAU OF RECLAMATION (Nov. 13, 2018), https://www.usbr.gov/uc/rm/crsp/index.html.

111 *System Map*, CENT. ARIZ. PROJECT, https://www.cap-az.com/about-us/system-map (last visited Nov.11, 2018).

112 THOMPSON, *supra* note 22, at 571; 43 U.S.C. §1524(c) (2004).

113 THOMPSON, *supra* note 22, at 571; 43 U.S.C. §1524(c) (2004).

114 *Arizona's Historic Groundwater Management Act of 1980*, ARIZ. WATER FACTS (Dec. 1, 2016), http://www.arizonawaterfacts.com/news/arizonas-historic-groundwater-management-act-1980.

115 *Ogallala Aquifer Initiative*, U.S. DEPT. OF AGRIC., NAT. RES. CONSERVATION SERV., https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/initiatives/?cid=stelprdb1048809 (last visited July 22, 2018).

implement a variety of conservation practices, including improving irrigation efficiency, managing nutrients, implementing prescribed grazing and other conservation systems."[116] This is essentially the same approach NRCS uses generally with farmers across the country,[117] so this non-regulatory initiative does not reflect the urgent need to manage the Ogallala aquifer to stop the current race to the bottom.

Additionally, federally recognized tribes are sovereign governments with jurisdiction over their lands. Along with their land, they may possess federally reserved water rights to make the land habitable. Any attempt by the state to regulate a tribe's use of groundwater would have to take into account tribal regulatory jurisdiction and the federal nature of the reserved rights.[118]

The Supreme Court's *Winters v. United States* decision is the touchstone for defining the nature and scope of tribal reserved water rights.[119] Tribal reservations were intended to provide tribes with natural resources and means of subsistence, for which water is a necessity.[120] Under the *Winters* doctrine, the "priority date" of federally reserved rights is the creation date of the reservation. Since the tribes' rights were federally reserved, they are paramount and not subject to state law requirements of use or forfeiture.[121] Over time, courts have wrestled with the quantification method of *Winters* rights and the determination of the "primary purposes" for which the reservations were established.[122]

The Supreme Court has not declared outright that the *Winters* doctrine applies to groundwater, but the federal circuit courts and states that have addressed this issue have found reserved rights in groundwater, with Wyoming being an exception.[123] The most recent decision concerning this

116 *Id.*

117 Melissa K. Scanlan, *Adaptive Trading: Experimenting with Unlikely Partners,* 62 KAN. L. REV. 971, 980–82 (2014).

118 Stephen Quesenberry et al., *Tribal Strategies for Protecting and Preserving Groundwater*, 41 WM. MITCHELL L. REV. 431, 447 (2015).

119 Winters v. United States, 207 U.S. 564 (1908).

120 Judith Royster, *Indian Tribal Rights to Groundwater*, 15 KAN. J.L. & PUB. POL'Y 489, 497 (2006).

121 *Winters,* 207 U.S. at 576–77. For a full discussion of the *Winters* case background, *see* THE FUTURE OF INDIAN AND FEDERAL RESERVED WATER RIGHTS: THE WINTERS CENTENNIAL (Barbara Cosens & Judith V. Rosyter eds., 2012).

122 Arizona v. California, 373 U.S. 546, 600 (1963); United States v. New Mexico, 438 U.S. 696, 702 (1978); United States v. Adair, 723 F.2d 1394, 1408–09 (9th Cir. 1983); Colville Confederated Tribes v. Walton, 647 F.2d 42, 47 (9th Cir. 1981).

123 In re Gen. Adjudication of All Rights to Use Water in Big Horn River Sys., 753 P.2d 76, 99 (Wyo. 1988), *aff'd sub nom*., Wyoming v. United States, 492 U.S. 406 (1989) (finding no reserved right); In re Gen. Adjudication of All Rights to Use Water in the Gila River Sys. & Source, 989 P.2d 739, 745 (Ariz. 1999) (finding reserved right in groundwater); COHEN'S HANDBOOK OF FEDERAL INDIAN LAW §19.03[2][b] (Nell Jessup Newton ed., 2012) (showing that a majority

issue, *Agua Caliente Band of Cahuilla Indians v. Coachella Valley*, from the Ninth Circuit, addressed this issue in a way that will impact the future implementation of California's sustainable groundwater law. According to attorneys for the Agua Caliente Band of Cahuilla Indians,

> Although many courts, both federal and state, have recognized that federally reserved water rights apply to groundwater as well as to surface water, this was a significant opinion as it clearly and decisively applied the doctrine of *U.S. v. Winters*, an early case establishing the reserved water rights of Indian tribes, to groundwater.[124]

To elaborate, the Agua Caliente Band of Cahuilla Indians filed suit in 2013 seeking confirmation and quantification of tribal groundwater rights under the *Winters* doctrine. The Agua Caliente Band of Cahuilla Indians' use of the Coachella Valley predates California statehood. By two executive orders in 1876 and 1877, the President created the Tribe's reservation on 31,396 acres, which is now dotted by several cities within Riverside County, including Palm Springs, Cathedral City, and Rancho Mirage. This area is in a very arid part of Southern California, which receives only three to six inches of rain per year.[125] Because of the desert conditions and lack of surface water, most of the water used in the Coachella Valley is from an aquifer supplying groundwater.[126] Despite deliveries of water from the Colorado River and the California Water Project used to recharge the basin, the water level of this aquifer has been declining since the 1980s.[127] Instead of pumping groundwater from its reservation, the Tribe has had to purchase water from the water agencies sued in this case.[128]

The Ninth Circuit affirmed the California district court's partial summary judgment, which ruled in favor of the tribe and against two California water agencies in the first phase of the litigation.[129] In reaching its holding, the court applied the *Winters* doctrine, which "only reserves water to the extent it is necessary to accomplish the purpose of the reservation, and it only reserves water if it is appurtenant to the withdrawn

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of courts find reserved right in groundwater); Agua Caliente Band of Cahuilla Indians v. Coachella Valley, 849 F.3d 1262, 1265–66 (2017) (finding reserved right in groundwater).

124 Steven Moore & Heather Whiteman Runs Him, Agua Caliente v. Coachella Valley Water District, et al., NATIVE AM. RIGHTS FUND, https://www.narf.org/cases/agua-caliente-v-coachella/ (last visited July 22, 2018).

125 *Coachella Valley*, 849 F.3d at 1265–66.

126 *Id.* at 1266.

127 *Id.*

128 *Id.* at 1266–67.

129 *Id.* at 1265.

land."[130] The court rejected the California water utilities argument that the 1978 Supreme Court decision, in *United States v. New Mexico*,[131] limits federal reserved water rights to situations where water use is a primary purpose of the reservation. The water agencies asserted that water is impliedly reserved only if other sources of water then available cannot meet the reservation's water demands.[132] Instead, the Ninth Circuit reframed the question as "whether the purpose underlying the reservation envisions water use."[133]

To answer this, the court looked at the original executive orders establishing the reservation, which "declared that the land was to be set aside for 'the permanent use and occupancy of the Mission Indians' or, more generally, for 'Indian purposes.'"[134] The court went on to reason, "[w]ithout water, the underlying purpose—to establish a home and support an agrarian society—would be entirely defeated."[135] Thus, the court held that the United States impliedly reserved appurtenant water sources when it created the Tribe's reservation in California's arid Coachella Valley.[136] Further, that reservation to appurtenant water must include groundwater where, as is the case here, surface water is minimal or lacking for most of the year.[137]

To summarize, federal reserved water rights may preempt state water rights and tribes are entitled to use groundwater even if they have not historically done so. The Supreme Court's *New Mexico* decision does not consider whether water is currently needed to sustain a reservation, but whether water use was necessary for the reservation's purpose when it was created.[138] The decision in *Agua Caliente Band of Cahuilla Indians* has national implications; tribes with unresolved water rights issues will likely closely analyze how this could impact their access to groundwater and negotiating power in water disputes.

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130 *Id.* at 1268.

131 438 U.S. 696 (1978).

132 *Coachella Valley*, 849 F.3d at 1265–66. *United States v. New Mexico* involved the Gila National Forest, and the Congressional purpose of that reservation was "to conserve the water flows, and to furnish a continuous supply of timber for the people." *Id.* at 1269–70.

133 *Id.* at 1269.

134 *Id.* at 1270.

135 *Id.* at 1270.

136 *Id.* at 1265; *see also id.* at 1270.

137 *Id.* at 1271.

138 *Id.* at 1271–1272.

IV. GROUNDWATER MANAGEMENT

A. Permit Systems

While federal and tribal governments can have a significant impact on groundwater demands and management, the states have been the governmental entities with primary responsibility for groundwater law.[139] While the five groundwater doctrinal approaches described above provide after-the-fact remedies in groundwater disputes that rise to the level of litigation in court, they do not generate forward-looking comprehensive approaches to managing common pool groundwater resources, much less conjunctive management of interconnected surface and ground waters. States' police powers allow them to regulate groundwater using permit systems.[140] Some states also hold groundwater in trust and have an articulated public trust doctrine that gives them not just the power, but also the trustee duty to regulate.[141]

Permit systems tend to fall into three categories: well construction permits, reporting requirements, and water rights permits. In many states, a prerequisite to drilling a well is obtaining a construction permit that specifies the use and amount of water to be withdrawn, a legal description of the well location and type, and a description of the geology.[142] Well drillers must be licensed, and the construction permit is a way of registering the existence of wells and their maximum design capacity in a fashion that involves basic information gathering, though it is not uniformly gathered.[143] Even though California uses more groundwater than any other state, it resisted registering wells until 1955, and then only required registration of high capacity wells in four counties in Southern California.[144] California now has additional statewide reporting requirements, as discussed more fully below, but lagged behind other states, even those with plentiful water.[145]

In contrast, the U.S. states and Canadian provinces in the relatively water-rich area surrounding the Great Lakes provide a model for

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139 *E.g.*, CAL. WATER CODE div. 6, pt. 2.74 (2016).

140 *Id.*

141 Vermont Groundwater Withdrawal Permit, VT. STAT. ANN. tit. 10, § 1418(i) (2018) (affirming public trust in groundwater but limiting practical impact of regulation to very limited situations); Conservancy Lake Beulah Mgmt. Dist. v. State Dep't of Natural Res., 799 N.W.2d 73, 83 (Wis. 2011) (limiting trusteeship to situations when groundwater is connected to navigable waters).

142 DAVID GETCHES, WATER LAW IN A NUTSHELL 241 (5th Ed. 2015).

143 *Id.*

144 Zachary Smith, *Rewriting California Groundwater Law: Past Attempts and Prerequisites of Hydrology*, 20 CAL. W.L. REV. 223, 276–84 (1967).

145 CAL. WATER CODE § 10735.2(c)(3) (2016).

extensive and unified reporting requirements on groundwater and surface water usage for a multi-jurisdictional region.[146] The Great Lakes states and Canadian provinces agreed to establish a uniform protocol for gathering and sharing water use data when they entered into the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement and the Great Lakes-St. Lawrence River Basin Water Resources Compact in 2008.[147] The involved states and provinces agreed to submit data annually into this regional water use database.[148] These registration and reporting requirements allow for basic information gathering, which these jurisdictions see as a necessary precursor to active adaptive management of the entire Great Lakes Basin.[149] As such, they require reporting of withdrawals, consumptive use, diversion out of the basin, and diversion return flow back into the basin.[150]

Finally, water rights permits may be required before groundwater is legally withdrawn and used. Some states use a version of regulated riparianism that may apply to ground and surface waters, while some require permits only for groundwater or only for surface water.[151] Groundwater use permit factors vary among states. Some common aspects addressed by the permit systems are protecting existing pumpers, making policy choices about whether to allow groundwater mining and at what rate, determining if certain wells are grandfathered, creating a process for identifying critical areas where groundwater supplies are in danger of overdraft, and including water conservation objectives.[152] While some states allow groundwater mining to the detriment of future generations,[153] others identify critical areas where groundwater pumping will be prohibited or severely limited due to overdraft.[154]

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146 Resolution No. 9, Adoption of Water Use Reporting Protocols, Great Lakes–St. Lawrence River Basin Water Resources Council (Dec. 8, 2009).

147 *Id.* Attach. A, 1.

148 *Id.* Attach. A, 5.

149 Interstate Compact Regarding Water Resources in the Great Lakes–St. Lawrence River Basin, Pub. L. No. 110-342, 122 Stat. 3739 (2008).

150 Resolution No. 9, *supra* note 146, Attach. A, 5–6.

151 *Water Law: An Overview*, *supra* note 8 ("Each state that uses a form of regulated riparianism has a central state agency with the control to say who may use the water, how much they can use, and when they can use it. Regulated riparianism departs from common law riparianism by looking at the projected use before any water is ever actually used. The state will use the same reasonable use criterion as with the common law but determine beforehand if the new use is reasonable.").

152 *See, e.g.*, N.M. STAT. ANN. § 72-12-3 (1978).

153 Oklahoma allows 100% depletion within 20 years. OKLA. STAT. tit. 82, § 1020.5(b) (2018).

154 *See, e.g.*, IDAHO CODE ANN. § 42-226 *et seq.* (2018); Baker v. Ore-Ida Foods, Inc., 513 P.2d 627, 636 (Idaho 1973).

B. Conjunctive Management

In 1968, Congress established a seven-person National Water Commission that produced a 1973 report with recommendations for water policy.[155] Despite the National Water Commission's call for integration of ground and surface water management, most jurisdictions have not addressed this issue.[156] Conjunctive use is not a legal doctrine, but rather a water management tool that acknowledges the interconnection of ground and surface water and then coordinates these uses through a unified permit system.[157] One example of how such an integrated system is used is aquifer storage, where excess surface water is stored in an aquifer for later use during droughts.

State permit systems can facilitate or impede conjunctive management of waters. For example, Florida encourages conjunctive management in its state statutory definition of "waters of the state" as:

> [A]ny and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state.[158]

Florida Statute § 373 creates a regulatory program that includes all of these "waters of the state" with a state water plan, permits for consumptive uses, well permits, and management and storage of surface waters, among other aspects.[159]

In comparison, California, New Mexico, Colorado, Utah, Washington, and Texas regulate groundwater sources in parts of their states affected by or affecting surface flow as part of the surface water permit system.[160] Additionally, as part of its groundwater permit system, the Wisconsin Department of Natural Resources must regulate the impact of pumping on surface navigable waters, but there is an ongoing controversy regarding the agency's jurisdiction.[161]

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155 NAT'L WATER COMM'N, WATER POLICIES FOR THE FUTURE (1973).

156 *See id.* at 233.

157 *Conjunctive Use*, WATER EDUC. FOUND. (Nov. 3, 2015), https://www.watereducation.org/aquapedia/conjunctive-use.

158 FLA. STAT. ANN. § 373.019(22) (2016).

159 *Id.* § 373 *et seq*.

160 CAL. WATER CODE § 1200 (2018); COLO. REV. STAT. ANN. § 37-92-102(1)(a) (2018); UTAH CODE ANN. § 73-3-1 (2018); WASH. REV. CODE ANN. § 90.03.010 (2018); Templeton v. Pecos Valley Artesian Conservancy Dist., 332 P.2d 465, 470 (N.M. 1958); Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 822 (Tex. 2012).

161 Based on the public trust doctrine, the Wisconsin Supreme Court ordered the Wisconsin Department of Natural Resources ("DNR") to consider impacts on navigable waters when issuing high capacity well permits to groundwater users. Conservancy Lake Beulah Mgmt. Dist. v. State

1. Water Pollution

What about conjunctive management of ground and surface waters when it comes to water pollution? While not conjunctive management per se, a recent decision from the Fourth Circuit applying the Clean Water Act ("CWA")[162] hinges on the hydrologic connection between surface and ground water.[163] With the spate of discoveries of perfluorinated compounds discharged into groundwater and their adverse health effects, these decisions may inform the ability to use the CWA to control later discharges to surface waters.[164]

In *Upstate Forever, et al. v. Kinder Morgan Energy Partners, et al.*, the primary issue the Fourth Circuit considered was "whether an indirect discharge of a pollutant through ground water, which has a direct hydrological connection to navigable waters, can support a theory of liability under the CWA."[165] The court held that it does.[166] Kinder Morgan's underground gasoline pipeline broke and spilled gasoline into soil and groundwater. From the site of the spill, the plaintiffs alleged that the contaminated groundwater flowed into nearby navigable waters in the Savannah River watershed, and was continuing to do so even after the pipeline was repaired.[167] The court reasoned that though an indirect discharge (one to groundwater) would involve a "delay between the time

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Dep't of Nat. Res., 335 Wis.2d 47, 72–73 (Wis. 2011). However, in 2016, the Wisconsin Attorney General wrote a formal opinion that the case is no longer controlling due to WIS. STAT. §§ 227.10(2m) to .11(2)(a) (2018), which require the DNR to have explicit authority granted by a statute or rule to impose a permit condition. Wis. Att'y Gen. Op. 01-16, 2016 Wisc. AG LEXIS 1, ¶ 33 (2016). However, in *Clean Wisconsin, Inc. v. DNR*, a Wisconsin circuit judge followed the Wisconsin Supreme Court on the matter, but that decision is currently on appeal. Lee Berquist, *Judge Throws Out Well Permits While Ordering Wisconsin DNR to Consider Impacts of Heavy Water Use*, MILWAUKEE J. SENTINEL (Oct. 12, 2017), https://www.jsonline.com/story/news/politics/2017/10/11/dane-county-judge-throws-out-persm-rules-dnr-must-consider-impacts-heavy-water-use-throws-out-permit/756025001/. The groundwater and surface water problems continued in Wisconsin. Brett Walton, *Wisconsin Towns Face Groundwater Crisis Alone*, CIRCLE OF BLUE (Feb. 14, 2017), https://www.circleofblue.org/2017/water-management/wisconsin-towns-face-groundwater-crisis-alone/. As of December 2018, the *Clean Wisconsin, Inc. v. DNR* case is still pending resolution in the Court of Appeals. *See Clean Wisconsin, Inc. v. DNR*, 2018AP000059 (Wis. Ct. App. filed Jan. 5, 2018).

162 33 U.S.C. § 1251, *et seq.* (2012) (explaining this law "establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters."). The EPA and delegated states implement it largely through permits on pollution discharges. *Summary of the Clean Water Act*, EPA (March 29, 2018), https://www.epa.gov/laws-regulations/summary-clean-water-act.

163 Upstate Forever v. Kinder Morgan Energy Partners, L.P., 887 F.3d 637, 646 (4th Cir. 2018).

164 Analies Dyjak, *3M Pays Minnesota $850M for Decades of Water Contamination*, HYDROVIV (Feb. 26, 2018), https://www.hydroviv.com/blogs/water-smarts/update-3m-contaminates-minnesota-ground-water.

165 *Upstate Forever*, 887 F.3d at 646.

166 *Id.* at 652.

167 *Id.* at 648.

at which pollution leaves the point source and the time at which it is added to navigable waters,"[168] the CWA still created liability for such indirect discharges.[169] In reaching this conclusion, the court noted it was consistent with a recent Ninth Circuit decision that "likewise rejected the theory that the CWA creates liability for discharges 'only . . . where the point source itself directly feeds into the navigable water—e.g., via a pipe or a ditch.'"[170]

The application of the requirements of the CWA is contingent on a showing of direct hydrologic connection between the groundwater into which a point source discharged a pollutant and the navigable surface water.[171] The court in *Upstate Forever* noted that the Environmental Protection Agency requires permits under the CWA for discharges of pollutants to groundwater where a direct hydrologic connection to surface water exists.[172] In explaining how such connections are determined, the court noted that "[t]he assessment of the directness of a hydrological connection is a 'factual inquiry,' in which 'time and distance' are relevant, as well as factors such as 'geology, flow, and slope.'"[173] Therefore, while pollutant discharges into groundwater itself are not regulated by the CWA, discharges into groundwater with a direct hydrological connection to surface navigable waters are regulated under certain circumstances.[174] This recognizes that groundwater has the potential to act as a "conduit" for pollutants from point sources to navigable surface water, thus triggering the need for a permit under the CWA. However, it leaves groundwater vulnerable to contamination by not extending the pollution protections of the CWA to groundwater for groundwater's sake.

2. *Aquifer Storage and Recovery*

An example of conjunctive management is the storage of surface waters in underground aquifers for later withdrawal. Water storage in surface water reservoirs, primarily in the West, has been more of the norm than underground storage,[175] but that may need to change in a climate-

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168 *Id.*

169 *Id.* at 651–52.

170 *Id.* at 650 (citing Haw. Wildlife Fund v. Cty. of Maui, 886 F.3d 737, 748 (9th Cir. 2018)).

171 *Id.* at 651.

172 *Id.*

173 *Id.* (quoting National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, 66 Fed. Reg. 2960, 3017 (proposed Jan. 12, 2001)).

174 *Id.* at 652.

175 A. DAN TARLOCK ET AL., WATER RESOURCE MANAGEMENT 22 (Robert C. Clark et al. eds., 7th ed. 2014).

disrupted era of increasing temperatures and droughts. Currently there are 2,654 reservoirs and controlled natural lakes with capacities of 5,000 acre-feet or more in the United States, and over two-thirds of this capacity is in the West.[176] Dams and reservoirs on the Colorado River can store four years of the river's typical annual flow.[177]

Aquifer storage is less common than surface reservoir storage, but well managed aquifer recharge projects tend to cost less and have fewer negative environmental effects than reservoirs. One of the legal issues complicating aquifer storage is determining ownership of the pore space under one's land. If multiple, overlying landowners own pore space, assuming there are typically multiple landowners over an aquifer, one landowner could be in a position to prevent a storage project from going forward absent his or her consent. Courts in several western jurisdictions have generally ruled against the overlying landowner's claim of trespassing or taking of property when another person or government entity uses the pore space under the land to store water.[178]

Another legal issue concerns whether a person storing water in an aquifer, typically not an overlying landowner, has a right to extract that water and to prevent other overlying landowners from pumping it.[179] For example, the Nebraska Supreme Court has held that although an overlying landowner has the right to use groundwater, he or she does not possess an ownership right in that water since "Nebraska's groundwater is itself publicly owned."[180] Since there was no evidence of harm to the land or diminishment of enjoyment of the property in this case, the court held against the overlying landowner and in favor of the use of the pore space for incidental water storage due to seepage from a 600-mile surface canal for irrigation.[181]

Similarly, the Colorado Supreme Court has held that the "water-bearing capacity of natural formations [does not] belong to a landowner as a stick in [its] property rights bundle."[182] Likewise, the California Appeals Court held that unused storage space in an aquifer is a public resource, and by state statute the water replenishment district has the right

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176 *Id.*

177 *Id.* at 25.

178 *Id.*

179 *Id.*

180 In Re Application U-2, 413 N.W.2d 290, 298 (Neb. 1987) (citing Nebraska *ex rel*. Douglas v. Sporhase, 305 N.W.2d 614 (Neb. 1981), *rev'd on other grounds*, Sporhase v. Nebraska *ex rel.* Douglas, 458 U.S. 941 (1982)).

181 *Id.* at 299*; see also* THOMPSON, *supra* note 22, at 557–60.

182 Bd. of Comm'rs v. Park Cty. Sportsmen's Ranch, LLP., 45 P.3d 693 (Colo. 2002).

to manage that water.[183] The court further held that the right to pump groundwater does not carry with it a proportional right to use the storage capacity in the aquifer.[184]

The Supreme Court of Washington also held against an overlying landowner who claimed a right to water incidentally stored in the aquifer after it percolated down from the Columbia Basin Project, a federal surface water reclamation project.[185] The court upheld the U.S. Bureau of Reclamation's ownership claim on imported project water artificially stored in the aquifer, finding that it was factually and legally possible to divide by volume and separately permit naturally occurring and imported groundwater.[186]

Regarding water recovery, states can control groundwater recharge and recovery through legislation requiring permits for both types of activities. Arizona, for example, has extensive and complex legislation on this topic, starting with the Groundwater Management Act of 1980, which Congress catalyzed.[187] Subsequently, Arizona filled in the gaps with additional groundwater amendments and legislation, as well as legislation establishing the Central Arizona Groundwater Replenishment District and the Arizona Water Banking Authority.[188]

It is difficult to generalize about the jurisdictions because the approach to groundwater regulation is so varied across the states. A way to begin to assess the variety of approaches is to focus on key factors that appear to promote the sustainable management of water. These factors include whether the systems:

- create a body of scientific data to inform higher quality management of the shared resource;
- draw jurisdictions with regards to aquifer and basin rather than political boundaries;
- can be used to induce groundwater users to vary the rate of pumping;
- set objectives to maintain or achieve sustainable water tables;
- maximize the return of the pumped water to the aquifer or watershed of origin to keep water in a recycling natural system;
- manage surface and ground water as an integrated whole; and
- set standards for both quantity and quality.

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183 Cent. & W. Basin Water Replenishment Dist. v. S. Cal. Water Co., 135 Cal. Rptr. 2d 486, 503–05 (Cal. Ct. App. 2003).

184 *Id.*

185 Jensen v. Dept. of Ecology, 102 Wash.2d 109 (1984).

186 *Id.*; *see also* THOMPSON, *supra* note 22, at 564–65.

187 *See supra* notes 111–12 and accompanying text.

188 Silber-Coats, *supra* note 1, at 3–5, 7–10.

While there are currently no U.S. jurisdictions that integrate all of these factors, California's recently enacted groundwater legislation incorporates many of them.

V. A SUSTAINABLE GROUNDWATER FUTURE? THE CALIFORNIA EXAMPLE

As a study of extremes, California presents unique water management problems, which, if overcome, could serve as a model of hope for other jurisdictions facing similarly extreme water challenges. California has the largest population, biggest economy, and uses the most groundwater of any state in the country.[189] Yet, at the turn of the century, it had only adjudicated water use rights in sixteen of its four hundred and fifty groundwater basins. The State also had a dearth of groundwater data and lacked statewide comprehensive groundwater legislation, much less integrated conjunctive management of all waters.[190] In 2014, however, spurred by intense drought, the State embarked on a new course to tackle its numerous water management problems.[191] Thus, if California can establish and implement a sustainable approach to water management, it will provide a model for other jurisdictions that face scarcity, weather extremes, and population pressures.

Groundwater, sometimes referred to as a "saving's account" for the state, provides about one-third to half of California's water supply.[192] Increasingly severe periods of drought in California, however, made groundwater an even more valuable asset and highlighted the need to manage groundwater more aggressively on a statewide basis.[193] California applies the common law correlative rights doctrine to groundwater, and a mix of riparian and appropriative rights to surface waters.[194] California has not, however, implemented a statewide regulatory system of conjunctive management. Thus, when the last drought spurred tighter restrictions on surface waters, people began

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189 *Groundwater Use in the United States*, *supra* note 4; Jonathan Cooper, *California Now World's 5th Largest Economy, Surpassing UK*, USA TODAY (May 5, 2018), https://www.usatoday.com/story/news/nation-now/2018/05/05/california-now-worlds-5th-largest-economy-beating-out-uk/583508002/; Press Release, U.S. Census Bureau, Florida Passes New York to Become the Nation's Third Most Populous State (Dec. 23, 2014), https://www.census.gov/newsroom/press-releases/2014/cb14-232.html.

190 THOMPSON, *supra* note 22, at 585.

191 CAL. WATER CODE § 10727.2 (2015).

192 Michael Kiparsky & Holly Doremus, *How to Create Effective Groundwater Agencies*, WATER DEEPLY (June 8, 2016), https://www.newsdeeply.com/water/community/2016/06/08/how-to-create-effective-groundwater-agencies.

193 *Id.*

194 *E.g.*, Katz v. Walkinshaw, 70 P. 663 (Cal. 1902), *reh'g granted* 74 P. 766 (Cal. 1903); Burr v. Maclay Rancho Water Co., 98 P. 260 (Cal. 1908); Hudson v. Dailey, 105 P. 748, 753 (Cal. 1909).

pumping more groundwater because it was less regulated.[195] During this drought, people pumped so much groundwater that the land surface collapsed almost two inches (five centimeters) per month in some places.[196] These pressures helped spur the 2014 enactment of California's Sustainable Groundwater Management Act ("SGMA").[197] In order to better appreciate the significance of this new law, some common law context and descriptions of prior efforts to manage California water are provided.

California's doctrine of correlative common law rights to groundwater means that whenever there is not enough groundwater for the landowners pumping water and using it on the land overlying the aquifer, those who are using the water off the land from which it is pumped face reductions first, in order of priority.[198] The rights of pumpers using water on-tract can be asserted at any time. These rights are based on land ownership, and the use must be "reasonable and beneficial" per Article 10, Section 2 of the California Constitution.[199] These landowners are entitled to a "fair and just proportion" of the supply before any uses off-tract.[200] Enforcing this common law regime requires after-the-fact litigation instead of a prevention-oriented management system.

Southern California, and Los Angeles in particular, has long dealt with populations that exceeded their local water supplies. In fact, planners and politicians built this region on imported water from the Owens Valley, Mono Lake, and even the Colorado River.[201] Despite these massive water imports, by the middle of the twentieth century, Southern California's aquifers were declining and in coastal areas saline intrusion was already advancing.[202]

Given the population increase in Southern California, the largest users of groundwater were cities, and since city boundaries were not drawn based on aquifers, the common law correlative rights concept of giving priority to using water on-tract was strained.[203] In 1949, the California Supreme Court broke from the traditional application of correlative rights

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195 Sabalow et al., *supra* note 20.

196 *Id.*

197 Alf W. Brandt, *California Adopts Sustainable Groundwater Management*, 46 No. 4 ABA Trends 9 (2015).

198 *See supra* Part III.A.3.

199 Burr v. Maclay Rancho Water Co., 154 Cal. 428 (1908).

200 Katz v. Walkinshaw, 141 Cal. 116 (1902), *reh'g granted* 141 Cal. 116, 74 P. 766 (1903); Tehachapi-Cummings County Water Dist. v. Armstrong, 49 Cal.App.3d 992 (Cal. Ct. App. 1975).

201 Madeline Ostrander, *LA Imports Nearly 85% of its Water*, YES! MAGAZINE (Jan. 5, 2015), https://www.yesmagazine.org/issues/cities-are-now/los-angeles-imports-nearly-85-percent-of-its-water.

202 *Id.*

203 THOMPSON, *supra* note 22, at 576.

when it approved a settlement of a groundwater adjudication involving Pasadena that proportionally reduced the amount of water by all pumpers regardless of use on or off the overlying land.[204]

After many years of court-approved settlements of groundwater adjudications in Southern California that did not use the off-tract distinction, in 2000 the California Supreme Court rejected a settlement in the Mojave Basin that similarly drew no distinction between on-tract and off-tract uses in *City of Barstow v. Mojave Water Agency*.[205] The court reasoned that rejecting this aspect of correlative rights short-changed the landowners who used water on the overlying land.[206] This court emphasis on correlative rights was a wakeup call for California. Relying on a common law approach to groundwater management in the country's most populous state, where water systems are engineered more than provided by nature, was fraught with uncertainties that made urban and business planning less secure.

Why, in the year 2000, was the City of Barstow litigating a common law claim rather than a claim based on a statewide groundwater management law? Astounding as it may seem in a state so reliant on groundwater to support its massive economy and population, no statewide legislation applied to this situation. To put this in perspective, one needs to understand California's prior efforts to legislate groundwater management. In 1955, the California Legislature enacted the Water Recordation Act, which focused on the simple act of recording withdrawals. However, the law only required pumpers of twenty-five acre-feet or more annually in certain cities in Southern California to record and report their groundwater withdrawals.[207] This provided a base of information from which the basins could negotiate to address overdraft and salt water intrusion. Six basins in particular adjudicated settlements that imposed enforceable controls on groundwater pumping and relied heavily on more expensive imported water supplies.[208]

Despite the intensive litigation and negotiation over southern California's ground and surface water, there has been little groundwater management in the rest of the state. There has also been a lack of uniformity in approach with many basins not managed at all, and others

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204 Pasadena v. City of Alhambra, 33 Cal.2d 908 (1949) (this decision was based on applying a theory of mutual prescription, which was later limited by state statute to not apply to municipalities or utilities).

205 5 P.3d 853 (Cal. 2000).

206 *Id.* at 868.

207 THOMPSON, *supra* note 22, at 578.

208 *Id.*

managed by a patchwork of adjudication, by special management districts, or by county ordinance.[209]

California law authorizes local agencies to establish groundwater management programs and plans.[210] In 2002, the legislature required these plans to include objectives and monitoring in order to qualify for state funds. At a 2003 check-in-point, the counties had plans, though many had not implemented them and were only focused on limiting exports of water.[211] The use of counties for this purpose is also problematic because they are not necessarily planning for an entire aquifer since their planning boundaries are limited to municipal lines.[212]

In the decade that followed *City of Barstow*, drought and more intensive use of groundwater in California demanded the creation of a new statewide legislative approach to groundwater management. As regulations governing surface water became stricter due to drought, farmers began to dig wells to access groundwater for farming because of the lack of regulatory controls.[213] In 2009, the state passed California State Senate Bill X7-6, which required local agencies to monitor every basin in the state.[214] Compliance with this law led local agencies to collect data on the location and quantity of groundwater supplies.[215] This data collection further illuminated the need for better management of groundwater.[216]

Better data, extended drought, and chronic over-pumping in the Central Valley aquifer in particular, pushed the state government to action, with Governor Brown declaring a drought emergency in 2014.[217] The Governor convened a working group of stakeholders, which led to his signing into law a three-bill legislative package known as the Sustainable Groundwater Management Act ("SGMA") on September 16, 2014.[218]

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209 *Id*. at 585.

210 *Id.*

211 *Id.*

212 *Id.* at 586–87.

213 Gill, *supra* note 35, at 22.

214 John Perona, *A Dry Century in California: Climate Change, Groundwater, and a Science-Based Approach for Preserving the Unseen Commons*, 45 ENVTL. L. 641, 647 (2015).

215 *Id.* at 648.

216 *Id.*

217 "In 2015, California entered its fourth year of drought—the driest period in 163 years of recorded rainfall history. Scientists estimate that the snowpack in the Sierra Nevada Mountains, which typically accounts for one-third of California's water supply, has now reached its lowest point in more than 500 years." Belynda Reck, *Sea Changes: Amid California's Severe Drought, the Sustainable Groundwater Management Act and New Restrictions on Water Use are Being Implemented,* 39 L.A. LAW. no. 2 16, 17 (2016).

218 Brandt, *supra* note 197, at 9.

The SGMA was the first legislation in California to regulate groundwater on a statewide basis and included a state backstop if local agencies failed to implement the law. The SGMA mandates that local groundwater agencies, called Groundwater Sustainability Agencies ("GSAs"), manage groundwater to mitigate over-draft and prevent future harm.[219] The SGMA further authorizes and requires the GSAs to collect information, create a plan, regulate groundwater extraction, and enforce limits on pumping to maintain sustainability.[220]

The SGMA defines sustainability as the maintenance of groundwater aquifers in a manner that will not cause "undesirable results."[221] Undesirable results are quite broad and include the following: the continued lowering of groundwater levels, significant reduction in groundwater storage, seawater intrusion, degraded water quality, land subsidence and depletions in interconnected surface water.[222] Furthermore, the first step in this management is for the California Department of Water Resources to give each water basin one of three designations: high, medium, or low priority.[223] For high or medium priority basins, the GSAs must be established by July 1, 2017.[224]

The California Department of Water Resources complied with the new law by identifying 127 high and medium priority groundwater basins, which it adjusted downward to 109 basins in 2018.[225] From there, the local GSAs manage high or medium priority basins. If no local GSA assumes the responsibility or if the local GSA's groundwater sustainability plan is deficient, the State Water Resources Control Board has the power to put the GSA on "probation" and issue an interim plan.[226]

The SGMA lays out a timeline for when management goals must be met.[227] The California Department of Water Resources established emergency regulations in 2016, and it was required to produce best

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219 CAL. WATER CODE § 10727.2 (2015).

220 *Id.* § 10725.4.

221 *Id.* § 10721.

222 *Id*.

223 Philip Womble & Richard Griffin, *Two Interactions Between California's Sustainable Groundwater Management Act and the Public Trust Doctrine*, 18 U. DENV. WATER L. REV. 472, 473 (2015).

224 *Groundwater Sustainability Agencies,* CAL. DEPT. WATER RES., https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainable-Agencies (last visited Dec. 4, 2018).

225 CAL. DEPT. WATER RES., DRAFT, 2018 SGMA BASIN PRIORITIZATION PROCESS AND RESULTS 2, 5 (May 2018).

226 CAL. WATER CODE § 10735.2(a) (2015).

227 *Id.* § 10733.2; *Groundwater Sustainability Plans,* CAL. DEPT. WATER RES. (April 18, 2018), https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans.

groundwater management practices by 2017.[228] Any Agencies located in water basins that are "subject to critical conditions of overdraft," which is a subcategory of high and medium priority basins, need to have a management plan in place that is consistent with the regulations by 2020.[229] The SGMA further gives other high and medium priority basins until 2022 to have their plans prepared.[230]

Despite state level direction in the SGMA and state oversight of the GSAs, the GSAs still have broad authority to manage groundwater supplies,[231] and the SGMA specifically preserves local authority over groundwater.[232] If a high-or-medium priority basin is not within the management area of an GSA, the county within which that unmanaged area lies will be presumed to be the GSA for that area.[233] Finally, the SGMA provides another hook by authorizing the GSA to impose fees on pumpers for overuse of groundwater.[234]

The SGMA put California in league with all of its western neighbors with statewide groundwater management already in place.[235] Success will be measured over time as the State and GSAs implement the law. California will need to address a wide variety of implementation issues from the most basic—requiring all users to meter and register their wells—to the more complex—accounting for tribal reserved water rights.[236] Some California water experts urge that the design of the GSAs is also crucial and highlight several factors that should be managed by state oversight. Professor Michael Kiparsky and Professor Holly Doremus, for example, assert that the GSAs will need sophisticated technical abilities to understand and manage water complexities, adequate funding, the legal ability and political will to impose restrictions on pumping, and the ability to skillfully engage a broad array of stakeholders and not succumb to narrow interests.[237]

Importantly, as to incorporating tribal reserved water rights in the planning, the SGMA does not explicitly account for tribal reserved water

228 CAL. WATER CODE § 10733.2(d) (2015); *Groundwater Sustainability Plans*, *supra* note 227.

229 CAL. WATER CODE § 10720.7(a)(1) (2015).

230 *Id*. §10720.7(a)(2).

231 Justin Anthony Brown, *Uncertainty Below: A Deeper Look into California's Groundwater Law*, 39 ENVIRONS ENVTL. L. & POL'Y J. 45, 67–68 (2015).

232 CAL. WATER CODE § 10724(a) (2015).

233 *Id*.

234 *Id*. § 10730.2; Lindsay Pace, *The Reasonability of California Groundwater Policies in Light of Drought*, 43 HASTINGS CONST. L. Q. 163, 181 (2015). While this is not a mandatory duty, it still provides the agencies some power to enforce the SGMA.

235 Brandt, *supra* note 197, at 9.

236 Gill, *supra* note 35, at 36–37 ("The GSAs will be unable to monitor groundwater levels without knowing where the wells are and how much water the groundwater wells are extracting.").

237 Kiparsky & Doremus, *supra* note 192.

rights. Quantifying these rights to groundwater will be a necessary piece of the sustainable management of California's groundwater:

> By asserting a federally reserved *Winters* doctrine right to groundwater, tribes will be claiming a right (1) with a priority based on the date the overlying reservation lands were reserved, (2) that cannot be forfeited or lost for non-use, and (3) that in periods of scarcity can effectively preempt the exercise of rights of other overlying landowners and water appropriators under state law.[238]

In Phase I of the litigation in *Agua Caliente Band of Cahuilla Indians v. Coachella Valley*, the Ninth Circuit held that the Tribe had a reserved right to groundwater and that a "reserved right in unappropriated water . . . vests on the date of the reservation and is superior to the rights of future appropriators."[239] Still outstanding, the Court noted that, "[p]hase II will address whether the Tribe beneficially owns the 'pore space' of the groundwater basin underlying the Agua Caliente Reservation and whether a tribal right to groundwater includes the right to receive water of a certain quality . . . [and] Phase III will attempt to quantify any identified groundwater rights."[240] In a basin that is already overused and declining, this could have a strong ripple effect on readjusting all of the existing urban and agricultural users in the Coachella Valley. When all is decided, the local Agency charged with groundwater management for the Coachella Valley under the SGMA will need to account for these reserved water rights. With over one hundred federally recognized tribes within its boundaries, California may need to make a statewide assessment of the potential impacts of this decision on water supplies and rights.[241]

Going back to the factors previously set out for evaluating a strong regulatory approach to water management, one can see almost every factor present in the SGMA, as it:

- creates a body of scientific data to inform higher quality management of the shared resource (the SGMA authorizes and requires the GSAs to collect data);[242]
- draws jurisdictions with regards to aquifer and basin rather than political boundaries (the SGMA uses groundwater basins,

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238 Quesenberry et al., *supra* note 118, at 545.
239 849 F.3d 1262, 1272 (2017).
240 *Id.* at 1267.
241 MASS. CTR. FOR NATIVE AM. AWARENESS, *supra* note 6, at 6.
242 CAL. WATER CODE § 10725.4 (2015).

designated as high, medium, or low priority, and empowers local Agencies to manage the basins);[243]

- can be used to induce groundwater users to vary the rate of pumping (the SGMA empowers GSAs to set use rates and impose fees on pumpers for overuse of groundwater);[244]
- sets objectives to maintain or achieve sustainable water tables (the SGMA sets sustainability objectives and defines it in part as avoiding "undesirable results");[245]
- maximizes the return of the pumped water to the aquifer or watershed of origin to keep water in a recycling natural system (it is unclear whether the SGMA requires this);
- manages surface and ground water as an integrated whole (the SGMA, to some extent, employs conjunctive management by defining "undesirable results" as depletions in interconnected surface water);[246] and
- sets standards for both water quantity and water quality (the SGMA sets quantity standards and, to some extent, allows for the setting of quality standards by defining "undesirable results" as degraded water quality).[247]

If California continues to aggressively implement its new law, it has the potential to serve as a model for other jurisdictions that similarly face wicked water management conflicts.

VI. CONCLUSION

As temperatures soar and drought-prone areas get even drier, people turn to groundwater as a lifeline. However, extracting groundwater at rates that draw down aquifers faster than they can be replenished by precipitation and snowmelt leads to land subsidence, increased flooding when rains eventually come, the need for deeper wells, more energy-demanding pumps to reach deeper water, and an unstable future.[248] Yemen, Syria, and Jordan contain the most water-stressed aquifer in the world, and extreme water scarcity in this region is associated with crisis, war, and human migrations.[249]

243 *Groundwater Sustainability Agencies*, *supra* note 224.
244 CAL. WATER CODE § 10730.2 (2015); *see* Pace, *supra* note 234, at 181. While this is not a mandatory duty, it still provides the agencies some power to enforce the Act.
245 CAL. WATER CODE § 10721(v).
246 *Id*. § 10721(x)(6).
247 *Id*. § 10721(x)(4).
248 Parker, *supra* note 2.
249 *Id*.

With so much riding on sustainable groundwater management, it is important to understand the laws that guide its management. The legal approach to groundwater management in the United States has been fragmented due to a reliance on state laws, each of which reflect varying degrees of scientific understanding of hydrology.[250] While individuals are focused on specific "rights" to withdraw water, there is a need for an overarching holistic management of the entire common pool resource as an integrated system where ground and surface waters, and the quality and quantity of these waters, are viewed together. The geographic scope of the aquifer (i.e., whether it crosses political boundaries) should inform the appropriate management scale. For smaller aquifers, a local agency with technical expertise and state standards could be sufficient; for an aquifer that crosses state boundaries, a compact or other interstate agreement among the interested states and approved by Congress is more appropriate.

Groundwater management, ideally conjunctive with surface water, starts with extensive and uniform data collection and leads into a regulatory system where an agency has the funding, legal authority, expertise, and political will to set limits for the good of the whole. To this end, the data collection system that the Great Lakes Compact and Agreement established for the Great Lakes states and Canadian provinces is a good example of jurisdictions coordinating their efforts to build the scientific data needed for thoughtful management decisions that can adapt to changing conditions.[251] This management system provides a regional, bi-national approach that delegates authority to state and provincial level agencies. Further, California's SGMA sets state level standards, but delegates authority to the level of groundwater basin for management decisions.[252] The approach involves incentives and penalties and allows local Agencies to limit groundwater pumping in certain circumstances with a focus on meeting a goal of sustainability, as defined by law.[253] While California's new groundwater law is in the early stages of implementation, it holds hope for the most populated and biggest groundwater user in the United States to get a handle on managing water resources to provide for a water-sustainable future. It may even provide a model for other complex jurisdictions facing groundwater challenges.

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250 *See supra* Part III.A.
251 *See supra* notes 146–50 and accompanying text.
252 *See supra* notes 219–24 and accompanying text.
253 *See supra* notes 231–34 and accompanying text.