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Environmental Law: Law, Land Use, and Groundwater Recharge

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Environmental Law

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Every day, around the world, billions of people rely on water pumped from wells. They do so because groundwater is an extraordinarily useful resource. It is available over broad areas; even in landscapes where surface water streams are few and far between, many people can access groundwater simply by drilling a well.[2] Because the subsurface filters out some contaminants, groundwater is often cleaner than surface water.[3] And because groundwater usually flows slowly and evaporates minimally,[4] groundwater storage can often last much longer than surface-water storage; groundwater therefore can remain available even during extended droughts. These benefits extend to ecological systems, too: because groundwater tends to be cleaner, cooler, and more steadily available than surface runoff, it plays a crucial role in sustaining many rivers, streams, wetlands, and lakes.[5]

Despite its value, groundwater is often ignored, misunderstood, or taken for granted, and inattention often goes hand in hand with unsustainable exploitation.[6] Groundwater supplies in the United States and around the world are being depleted, in some places with alarming speed.[7] That depletion is

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[1] Excerpted and adapted from Dave Owen, *Law, Land Use, and Groundwater Recharge*, 73 STAN. L. REV. 1163 (2021).

[2] *See* Mark Giordano, *Global Groundwater? Issues and Solutions*, 34 ANN. REV. ENV'T & RES. 153, 155 (2009).

[3] *Id.*

[4] *Id*; Peter Dillon & Muhammad Arshad, *Managed Aquifer Recharge in Integrated Water Resource Management*, *in* INTEGRATED GROUNDWATER MANAGEMENT: CONCEPTS, APPROACHES AND CHALLENGES 435, 445 (Anthony J. Jakeman et al. eds. 2016) (describing surface-water evaporation as high as 35% to 45%).

[5] *See* Derek Eamus et al., *Groundwater Dependent Ecosystems: Classification, Identification Techniques and Threats*, *in* INTEGRATED GROUNDWATER MANAGEMENT, *supra* note 4, at 313, 317–18.

[6] *See* Dave Owen, *Taking Groundwater*, 91 WASH. U. L. REV. 253, 255 (2013).

[7] *See* Matthew Rodell et al., *Emerging Trends in Global Freshwater Availability*, 557 NATURE 651, 655 (2018); Steven M. Gorelick &

already leading to shortages, which are likely to spread and intensify as a growing global population uses more water and as climate change accelerates water stress.[8] The human and environmental costs of these crises can be immense.[9] Yet even as groundwater resources come under growing strain, many people are eyeing groundwater as an increasingly important source of future supply.[10] Their reasons are straightforward: the world's growing population must get water from somewhere, and in a warming world, with more droughts and less water precipitating as snow, surface water cannot meet the demand in many places, particularly during warmer and dryer seasons.[11]

Some combination of property rights and regulatory governance is a standard response to these challenges, and consequently, groundwater pumping is governed by common-law water rights, legislation, and administrative regulations.[12] But before groundwater is available to pump, it needs to get into the ground, which happens through a process known as groundwater recharge. Recharge is a natural, gravity-driven process, but human activities affect groundwater recharge in a variety of ways. Over much of the earth's land surface, humans determine what vegetation grows, and increasing the amount of water consumed by plants typically means reducing infiltration deeper into the

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Chunmiao Zheng, *Global Change and the Groundwater Management Challenge*, 51 WATER RES. RSCH. 3031, 3031 (2015); James S. Famiglietti, *The Global Groundwater Crisis*, 4 NATURE CLIMATE CHANGE 945, 946 (2014).

[8] *See* Blanca E. Jiménez Cisneros & Taikan Oki, *Freshwater Resources*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY; PART A: GLOBAL AND SECTORAL ASPECTS 229, 241 (Christopher B. Field et al. eds. 2014).

[9] *See* Owen, *supra* note 6, at 305 n.319 (citing sources describing how groundwater shortages contribute to human conflicts, including the civil war in Syria).

[10] *See* Richard G. Taylor et al., *Ground Water and Climate Change*, 3 NATURE CLIMATE CHANGE 322, 324 (2013) (describing projected increases in demand for groundwater).

[11] *See* Timothy R. Green et al., *Beneath the Surface of Global Change: Impacts of Climate Change on Groundwater*, 405 J. HYDROLOGY 532, 539–40 (2011).

[12] *See* Owen, *supra* note 6, at 266–71 (describing groundwater law).

ground.[13] Roads, buildings, and other impervious surfaces often inhibit recharge.[14] Water diversion for irrigation can deprive one area of recharge while saturating another.[15] Our often-antiquated systems for delivering water can leak into the ground.[16] Flood-control measures limit recharge into areas adjacent to rivers and streams.[17] All these manipulations are at least partly the products of property rights, planning processes, permits, subsidies, and other regulatory decisionmaking, but rarely with the effects of law on groundwater recharge in mind.[18]

This chapter explores how U.S. laws can handle these intersections of land use and groundwater recharge. Existing legal arrangements span a hodge-podge of doctrines.[19] Many of those doctrines affect recharge without any underlying plan or design, and none seems matched for an era in which water managers increasingly call for carefully planned uses of groundwater.

A robust legal regime for managing groundwater recharge should address land development, which is one of the most

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[13] *See* Vildan Sahin & Michael J. Hall, *The Effects of Afforestation and Deforestation on Water Yields*, 178 J. HYDROLOGY 293, 303–04 (1996) (finding that increasing forest cover generally reduces water yields); *cf.* Bernt Matheussen et al., *Effects of Land Cover Change on Streamflow in the Interior Columbia River Basin (USA and Canada)*, 14 HYDROLOGICAL PROCESSES 867, 868 (2000) ("Removal of forest cover is known to increase streamflow as a result of reduced evapotranspiration and to increase peak flows as a result of higher water tables.").

[14] *See* Emily S. Bernhardt & Margaret A. Palmer, *Restoring Streams in an Urbanizing World*, 52 FRESHWATER BIOLOGY 738, 739–40 (2007).

[15] *See* Bridget R. Scanlon et al., *Impact of Land Use and Land Cover Change on Groundwater Recharge and Quality in the Southwestern US*, 11 GLOB. CHANGE BIOLOGY 1577, 1586 (2005)).

[16] David Schaper, *As Infrastructure Crumbles, Trillions of Gallons of Water Lost*, NPR (Oct. 29, 2014).

[17] *See* Jeffrey J. Opperman et al., *Sustainable Floodplains Through Large-Scale Reconnection to Rivers*, 326 SCI. 1487, 1488 (2009).

[18] *See* Barton H. Thompson, Jr., *Beyond Connections: Pursuing Multidimensional Conjunctive Management*, 47 IDAHO L. REV. 273, 301 (2011) ("States also historically ignored the important connection between land use and land cover, on the one hand, and groundwater recharge and quality, on the other.").

[19] Laws protecting groundwater from recharged pollution, including RCRA and CERCLA, are more extensive than laws governing the amount of groundwater supply.

common ways humans affect groundwater recharge. Existing land-use law, however, is largely inadequate. Old common-law doctrines, including the "common enemy rule," allow landowners to ignore changes to groundwater recharge.[20] A few newer legal requirements do directly address recharge, either by limiting the ability of development to increase surface-water runoff or by protecting streams and wetlands—which often function as recharge zones—from being filled. But these requirements affect only small portions of the American landscape, and the scope of stream and wetland protections is currently under attack.[21]

Because groundwater recharge often occurs in the floodplains of rivers, groundwater-recharge laws should preserve rivers' connections with their floodplains. Longstanding U.S. policy, however, has been to do exactly the opposite. For decades, the Army Corps and other federal, state, and local agencies have focused on keeping floodwaters out of floodplains.[22] They have built thousands of dams, often partly for the purpose of limiting downstream flooding.[23] Governmental and nongovernmental actors also have built thousands of miles of levees, again to isolate rivers from their floodplains.[24] Development—often facilitated by local zoning laws and federal flood insurance—can spring up behind those levees, further limiting the option of allowing rivers beyond their banks.[25] All these flood mitigations tend to occur with little or no discussion of—let alone legal response to—their effects on

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[20] *See* ANTHONY DAN TARLOCK & JASON ANTHONY ROBISON, LAW OF WATER RIGHTS AND RESOURCES § 3:12 (2020).

[21] *See* Dave Owen, *Little Streams and Legal Transformations*, 2017 UTAH L. REV. 1.

[22] *See generally* A. Dan Tarlock, *United States Flood Control Policy: The Incomplete Transition from the Illusion of Total Protection to Risk Management*, 23 DUKE ENV'T L. & POL'Y F. 151 (2012).

[23] Dave Owen & Colin Apse, *Trading Dams*, 48 U.C. DAVIS L. REV. 1043, 1052–53 (2015).

[24] *See* Kara Scheel et al., *Understanding the Large-Scale Influence of Levees on Floodplain Connectivity Using a Hydrogeomorphic Approach*, 55 J. AM. WATER RES. ASS'N 413, 414 (2019); U.S. Army Corps of Eng'rs, *Levees of the Nation*, NAT'L LEVEE DATABASE, https://perma.cc/EP8V-Y7QN (archived Mar. 11, 2021).

[25] *See* Jessica Ludy & G. Matt Kondolf, *Flood Risk Perception in Lands ''Protected'' by 100-Year Levees*, 61 NAT. HAZARDS 829, 830–32 (2012).

groundwater recharge. The upshot is that there are flood-prone regions where people must worry simultaneously about having too much water above the ground and not enough below.[26]

In many other areas, humans affect groundwater recharge by managing forests, rangelands, and farms. Because much precipitation falls on, and is transpired by, forests and agricultural lands,[27] management of those lands can have important—and sometimes problematic—effects on groundwater recharge.[28] With limited exceptions, however, existing law ignores these effects. In the United States, as in other countries, forestry law is concerned primarily with timber production, erosion control, biodiversity protection, and, more recently, carbon sequestration—but rarely groundwater recharge. Similarly, agricultural law addresses groundwater effects, if at all, primarily as the incidental consequences of laws focused on other matters.

A final key area for groundwater-recharge regulation involves "managed aquifer recharge" (MAR), which refers to using empty aquifer space to store water from some other source. Typically, the source is surface water,[29] though some MAR projects rely on groundwater from other aquifers or on treated municipal wastewater.[30] Legal regimes for MAR projects, though still

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26 *See, e.g.*, Bob Rehak, *How Montgomery County Could Keep Sinking*, HOUS. CHRON. (Nov. 5, 2018); ADRIAN MCINNIS ET AL., WATER INST. OF THE GULF, STATE OF THE SCIENCE TO SUPPORT LONG-TERM WATER RESOURCE PLANNING 65 (2020); Steve Hardy, *Baton Rouge Water Company Says Industry Needs to Stop Drawing Water from Aquifer*, ADVOCATE (July 1, 2017).

27 *See* Ronald L. Hanson, *Evapotranspiration and Droughts*, *in* NATIONAL WATER SUMMARY 1988–89—HYDROLOGIC EVENTS AND FLOODS AND DROUGHTS 99, 99 (Richard W. Paulson et al. eds. 1991).

28 *See, e.g.*, Shixiong Cao et al., *Greening China Naturally*, 40 AMBIO 828, 829 (2011) (describing the problematic and unanticipated water-supply impacts of China's afforestation policies).

29 *E.g.*, *Aquifer Storage & Recovery*, SAN ANTONIO WATER SYS., https://perma.cc/L97F-PVNQ (last updated Mar. 11, 2021) (describing a program to store excess Edwards Aquifer water in another aquifer).

30 *E.g.*, *What Is SWIFT?*, HRSD, https://perma.cc/49NE-9UDR (archived Apr. 20, 2021) (describing the Hampton Roads Sanitary District's Sustainable Water Initiative for Tomorrow (SWIFT), which uses recharge of treated wastewater to combat saltwater intrusion in a coastal Virginia aquifer).

emerging, are generally more specific and intentional than legal regimes for addressing land-use impacts on groundwater recharge. But many MAR projects are modest in scale, at least compared to overall volumes of groundwater storage and use.[31] The vast majority of the world's groundwater recharge occurs outside of MAR projects, and most groundwater users cannot take advantage of a MAR project.[32] While the law of MAR projects is likely to be increasingly important for groundwater management, robust groundwater-recharge legal regimes must go beyond MAR projects.

Effective legal regimes for groundwater recharge would need to address three questions. The first question is whether more regulation of groundwater recharge makes sense at all. In some places, the answer to that question will be yes; in others, additional regulation will be more trouble than it is worth. The second question is what sort of ethic should undergird a system of groundwater-recharge law. Any system of natural-resource regulation (or nonregulation) reflects judgments, often implicit, about appropriate relationships with the natural world and with each other. The judgments underlying existing legal regimes are mostly laissez-faire; a more communitarian ethic would provide a foundation for better long-term outcomes. The third question is what regulatory instruments a more robust system of groundwater-recharge law should employ. Possibilities include property-based regimes, informational regulation, planning,

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[31] *See, e.g.*, Res. Conservation Dist. of Santa Cruz Cnty. et al., *Recharge Net Metering (ReNeM) in the Pajaro Valley* 2 (2017), https://perma.cc/R47H-8ZQQ (noting the program's goal to "generate ~1000 ac-ft/yr in total of infiltration benefit").

[32] One comparison illustrates this disparity. The Kern Water Bank, which is one of California's few large-scale MAR projects, received approximately 2.5 million acre-feet of water for recharge between 1995 and 2017, for an annual average of just under 109,000 acre-feet. *See* Michael Kiparsky et al., *Groundwater Recharge for a Regional Water Bank: Kern Water Bank, Kern County, California*, 5 CASE STUD. ENV'T, no. 1, at 4 (2021). That is a large amount of water, but in the Tulare Lake Basin—the California region in which the Kern Water Bank is located—average groundwater use is approximately 6.185 million acre-feet per year, according to California Department of Water Resources statistics. *See California's Groundwater*, MAVEN'S NOTEBOOK, at fig. 2-8 (updated Apr. 1, 2020), https://perma.cc/WF9B-BNTP.

performance standards, prohibitions, and financial incentives. But the most promising are mechanisms that use impact fees to encourage better groundwater management and to create pools of money to support selective governmental interventions.

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