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Assessing Institutional Ability to Support Adaptive, Integrated Water Resources Management

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Christina Hoffman* and Sandra Zellmer**

Assessing Institutional Ability to Support Adaptive, Integrated Water Resources Management

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I. INTRODUCTION

Institutions that embrace flexibility, as well as the ability to cope with change, will be essential in managing the water resource challenges that face our country. However, existing institutions—formal and informal rules, laws, organizational entities, and norms of behavior[1]—designed to manage water resources as they existed in the past are often ill-equipped to address the challenges of today.[2] In many ways, resource management institutions in the United States and throughout the world have become "prisoners of history" which embody past rather than present, much less future, knowledge and necessity.[3] Western water law, in particular, emerged as an institution at a time when water resources were seemingly ample, supplies were not fully allocated, and early territorial and state governments had limited administrative capabilities.[4] Since then, domestic and agricultural demands have grown and, in many areas, outpaced available supplies, causing adverse consequences for the social-ecological system.[5] Accordingly, the National Research Council declared that the "research agenda for the 21st century should give priority to developing new legal arrangements governing diversions and consumptive

1. *See* DEREK ARMITAGE ET AL., ADAPTIVE CO-MANAGEMENT: COLLABORATION, LEARNING, AND MULTI-LEVEL GOVERNANCE 329 (2007) (providing a broad definition of "institution").
2. DAVID M. GILLIAN & THOMAS C. BROWN, INSTREAM FLOW PROTECTION: SEEKING A BALANCE IN WESTERN WATER USE (1997); Marios Sophocleous, *Review: Ground Water Management Practices, Challenges, and Innovations in the High Plains Aquifer, USA—Lessons, and Recommended Actions*, 18 HYDROGEOLOGY J. 559, 572 (2010).
3. Stephen R. Dovers & Adnan A. Hezri, *Institutions and Policy Processes: The Means to the Ends of Adaptation*, 1 WILEY INTERDISCIPLINARY REVIEWS: CLIMATE CHANGE 212, 223 (2010). For a detailed historical assessment of western water law as a deeply entrenched "Lord of Yesterday," see CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST (1992).
4. NAT'L RESEARCH COUNCIL, ENVISIONING THE AGENDA FOR WATER RESOURCES RESEARCH IN THE TWENTY-FIRST CENTURY (2001).
5. Maja Schlüter & Claudia Pahl-Wostl, *Mechanisms of Resilience in Common-Pool Resource Management Systems: An Agent-Based Model of Water Use in a River Basin*, 12 ECOLOGY & SOC'Y [1] (2007).

use that emphasize flexibility and facilitate the management of water scarcity."[6]

Once thought to be the solution to our water needs, dams, canals, and other forms of large-scale infrastructure are being challenged by more frequently occurring weather extremes and other naturogenic forces.[7] Limitations on the ability to control extremes by technical means,[8] combined with the need to deal with conflicting values,[9] uncertainty, and changing environmental conditions, are stimulating more adaptive approaches in water resources management.[10] Within the United States, each of the major federal resource management agencies has committed to employ adaptive management, albeit to varying degrees.[11] Yet implementation of adaptive management has been spotty, in part because the agencies are constrained by foundational legal frameworks established to promote certainty and stability,[12] and in part because of the inherent inertia of existing government institutions.[13]

If adaptive, integrated management of surface and groundwater resources is indeed a way forward in managing complex water resource systems, can water resource institutions embrace flexibility and adaptation while maintaining the stability associated with existing legal frameworks and investment-backed expectations? Such a balance will require resource managers to identify and understand the problems faced by the social-ecologically linked system and to calibrate their strategies to address those problems, while ensuring ac-

6. *See* NAT'L RESEARCH COUNCIL, *supra* note 4, at 33.
7. MARC REISNER, CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER (1993); Christine A. Klein, *On Dams and Democracy,* 78 OR. L. REV. 641 (1999).
8. Claudia Pahl-Wostl, *Transitions Towards Adaptive Management of Water Facing Climate and Global Change*, 21 WATER RESOURCES MGMT. 49, 51 (2007).
9. Conflicting values and priorities are well exemplified in the scenario used by Marios Sophocleous: "for flood control a reservoir should be empty, for water supply it should be full, and for recreation the level should remain constant." Marios Sophocleous, *Water Resources of Kansas—A Comprehensive Outline*, *in* PERSPECTIVES ON SUSTAINABLE DEVELOPMENT OF WATER RESOURCES IN KANSAS 3, 50 (1998).
10. ADAPTIVE GOVERNANCE AND WATER CONFLICT: NEW INSTITUTIONS FOR COLLABORATIVE PLANNING (John T. Scholz & Bruce Stiftel eds., 2005); Robin Kundis Craig, *Adapting Water Law to Public Necessity: Reframing Climate Change Adaptation as Emergency Response and Preparedness*, 11 VT. J. ENVTL. L. 709, 746 (2010).
11. J. B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L REV. 424, 443 (2010); Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: An Adaptive Approach to Federal Land Management*, 87 NEB. L. REV. 833 (2009).
12. Ruhl & Fischman, *supra* note 11, at 451, 470, 483; Sandra Zellmer & Lance Gunderson, *Why Resilience May Not Always be a Good Thing: Lessons in Ecosystem Restoration,* 87 NEB. L. REV. 893, 918–19 (2009).
13. David H. Getches, *Water Reform: Ideas Whose Time Has Come*, 90 WATER RESOURCES UPDATE 36, 38 (1993).

countability and enforceability, promoting focused learning that seeks and takes advantage of feedback loops, and securing sufficient funding for present and future actions.[14]

In states lacking a coordinated and integrated management system for surface and groundwater resources, efforts to more adaptively manage water resources can be administratively and legally challenging. While there are a handful of western states that integrated surface and groundwater resources into a single management system prior to the advent of extensive groundwater development,[15] the majority of western states are still struggling with the inherent challenges of managing water resources that are governed by disparate legal and administrative frameworks.[16] Maintaining a single, integrated system is logical,[17] both because the diversion and use of either type of water can impact the availability of the other[18] and because legal systems that manage hydrologically connected systems similarly are better able to deal with surface water and groundwater interaction problems than legal systems that treat the resources differently.[19] Even in areas with limited hydrologically connected water resources, integrated management can lead to a more optimum level of sustainable water use at a lower cost than if the supplies are managed separately.[20] In addition to reduced efficiency, failure to integrate surface and groundwater management can impact the larger social-ecological system through declines in river flows and impairment of the surrounding ecosystem.[21]

At a time when many, if not all, western states are under pressure to redefine how water resources are managed,[22] this Article provides insight into how one state—Nebraska—has attempted to modify the water management institutions within its borders to implement more integrated management approaches that embrace flexibility and

14. *See infra* notes 166–69.
15. *See* Barbara Tellman, *Why Has Integrated Management Succeeded in Some States but Not in Others?*, 106 WATER RESOURCES UPDATE 13 (1997).
16. *Id.*
17. Getches, *supra* note 13, at 39.
18. Douglas L. Grant, *The Complexities of Managing Hydrologically Connected Surface Water and Groundwater Under the Appropriation Doctrine*, 22 LAND & WATER L. REV. 63, 64 (1987).
19. *See* Sophocleous, *supra* note 2, at 572.
20. Grant, *supra* note 18, at 64 n.4; Getches, *supra* note 13, at 39.
21. *See* ELLEN HANAK ET AL., MANAGING CALIFORNIA'S WATER: FROM CONFLICT TO RECONCILIATION 192 (2011) (describing California's experience, where a failure to integrate surface and groundwater usage has caused reduced river flows and has lessened groundwater supplies, destroying riparian and wetland habitats).
22. Barbara Cosens, *Evolution of the Policies Surrounding Ground and Surface Water Management in the West*, 47 IDAHO L. REV. 1 (2010); *see* Dan Tarlock, *How Well Can Water Law Adapt to the Potential Stresses of Global Climate Change?*, 14 U. DENV. WATER L. REV. 1, 6–7 (2010) (listing six strategies that water managers are pursuing for climate change adaptation).

adaptability. Nebraska is a state that has extensive surface and groundwater development and different legal systems and management agencies for governing surface and groundwater resources. This late in the game, the state is unlikely to assimilate governance of surface and groundwater resources into a single, overarching legal system.[23] Instead, Nebraska has adopted a system that gives authority over groundwater resources to twenty-three local management districts, known as Natural Resources Districts (NRDs), while the state manages surface water resources. Recently, legislative revisions to the state's water code have required greater cooperation between the NRDs and the state.[24] We consider whether the hurdles posed by a system that was historically bifurcated between local and state authorities can be overcome through integrated management planning and coordination and, if so, whether such an approach can be used as a model for other western states under pressure to devise more holistic and adaptive approaches in managing water resources.

Part II introduces the physical and institutional context of water resources management by exploring state law governing water allocation and use within Nebraska, as well as federal laws applicable to water and water-dependent species throughout the nation. Part III discusses the principle of adaptive management and best practices for its use. Using these defining features, Part IV assesses the adaptive capacity of Nebraska's water institutions. It is followed in Part V by a comparative look at the efforts of other western states to implement adaptive, integrated water management, with a specific focus on Kansas and Colorado. The article closes with insights on adaptive, integrated management efforts within and beyond Nebraska.[25] While recent legislative efforts have moved Nebraska much closer to an adaptive, integrated framework of management, the system remains

23. Integrating groundwater users into the prior appropriation system at this point in time is not only politically doubtful but would likely create substantial inequities in how water is and can be used throughout the state. As noted by Professor Getches, "[m]ost western water is already tagged with water rights [under the prior appropriation system] that cannot be easily undone without major political upheaval and economic dislocation." Getches *supra* note 13, at 39–40. Further, modifications to water law can profoundly impact "equity, efficiency, and other goals, particularly in terms of how they affect the entitlements of existing users and potential access of new water users." Bryan Randolph Bruns & Ruth Meinzen-Dick, *Frameworks for Water Rights: An Overview of Institutional Options*, *in* WATER RIGHTS REFORM: LESSONS FOR INSTITUTIONAL DESIGN 3, 17 (Bryan Randolph Bruns et al. eds., 2005).

24. L.B. 962, 98th Leg., 2d Sess. (Neb. 2004).

25. Of course, adaptability in itself does not ensure success in meeting the diversity of potential management goals that need to be addressed (such as specific conservation objectives). However, building adaptive capacity is a necessity when it comes to developing strategies and innovative approaches by which to tackle specific management objectives, especially in the face of changing circumstances and uncertainties.

divided by separate authorities and separate legal doctrines for surface and groundwater. While it may not be a perfect model, it is a commendable advancement in achieving more adaptable water resource institutions and it is imperative that Nebraska and other western states continue to use the platform of integrated management planning to shape water management decisions into the future.

II. THE PHYSICAL AND INSTITUTIONAL CONTEXT OF NEBRASKA WATER RESOURCES MANAGEMENT

In many areas of the country, surface and groundwater resources are hydrologically connected but the institutions devised to govern the resources are distinctly different. In Nebraska, this dichotomy exists both in terms of the presiding legal systems and in the agencies charged with managing the resources. While legislative reforms have moved the state towards more comprehensive and integrated management, these efforts were not intended to overhaul the two systems—prior appropriation and "reasonable use"—long applied to Nebraska's surface and groundwater supplies, respectively. Taking a close look at the nature of the state's physical water resources, as well as the state and federal frameworks that guide water management, can provide valuable insight into the divergent ways in which surface and groundwater institutions developed and may suggest new ways to look at water institutions in the future.

A. Water Resources

Nebraska is considered a state rich in both ground and surface water resources. It is estimated that an average of 1.7 million acre feet of surface water flow into Nebraska and 8.9 million acre feet flow out of the state each year.[26] Three of the state's primary surface water resources are the Republican, Platte, and Niobrara Rivers. The Republican River originates in Colorado and Kansas, passes through Nebraska, and then returns to Kansas. Approximately 40 percent of the Republican's drainage basin lies in Nebraska, with the rest split between Kansas and Colorado. The Platte River forms in western Nebraska where the South Platte River (originating in Colorado) and North Platte River (originating in Wyoming) merge. The river is fed by snowmelt from the eastern Rocky Mountains and runs 310 miles through Nebraska before draining into the Missouri River on the Nebraska–Iowa border.[27] As for the Niobrara River, it enters western Nebraska from Wyoming and crosses the entire northern portion of

26. JAMES GOEKE, THE SIGNIFICANCE OF WATER TO NEBRASKA 32 (Univ. of Neb.-Lincoln, Office of Research & Econ. Dev. ed., 2009).

27. *Id.*; Noah D. Hall, *Interstate Water Compacts and Climate Change Adaptation*, 5 ENVTL. & ENERGY L. & POL'Y J. 237, 310 (2010).

the state. It, too, joins the Missouri River on the state's eastern border.[28]

Further, Nebraska has a wealth of groundwater resources found in the High Plains aquifer, the United States' largest underground water reserve. The High Plains aquifer, often referred to as the Ogallala aquifer,[29] extends from western Texas to South Dakota and underlies eight states. Approximately 37% of the aquifer's land area and 65% of the total aquifer volume resides within Nebraska.[30]

Most of the state's rivers and streams are hydrologically connected to groundwater reserves.[31] While surface water resources are considered to be renewable resources, groundwater resources are only recharged to the extent that aquifers are replenished by surface water runoff or percolation from precipitation.[32] Precipitation within Nebraska is highly variable. Mean annual precipitation can range from thirty-four inches in the southeast to only fifteen inches in western portions of the state.[33] The 100th meridian, long a symbol delineating the arid west from the water-rich east,[34] further illustrates this hydrologic variability, for the line passes directly through the center of the state.

In an effort to improve the reliability of surface water resources and deliver them to the farms and cities that need them, a plethora of dams and water diversions have been constructed across the land-

28. *Hydrogeomorphic Segments and Hydraulic Microhabitats of the Niobrara River, Nebraska*, U.S. GEOLOGICAL SURVEY, http://ne.water.usgs.gov/projects/niobgeomorph.html (last visited Oct. 22, 2012).

29. The High Plains aquifer includes various geologic formations; however, the Ogallala Formation is the principal water-bearing unit, covering seventy-seven percent of the aquifer. *See* PETER B. MCMAHON ET AL., U.S. GEOLOGICAL SURVEY, WATER-QUALITY ASSESSMENT OF THE HIGH PLAINS AQUIFER, 1999–2004, at 8 (2007).

30. MARY KELLY, PLATTE INST. FOR ECON. RESEARCH, NEBRASKA'S EVOLVING WATER LAW: OVERVIEW OF CHALLENGES AND OPPORTUNITIES 2 (2010).

31. *See* GOEKE, *supra* note 26, at 32 ("Ninety-seven percent of the flow of streams and rivers emanating from the Sand Hills—such as the Niobrara, Dismal, Calamus, Loup and Snake rivers—comes from groundwater. In other Nebraska streams, particularly in the eastern part of the state, surface water runoff contributes a bigger proportion of the streamflow.").

32. *See* Robert H. Abrams & Noah D. Hall, *Framing Water Policy In A Carbon Affected and Carbon Constrained Environment*, 50 NAT. RESOURCE J. 3, 11 (2010) (noting the Ogallala's "small rate of recharge"); *see also* V.L. MCGUIRE, U.S. GEOLOGICAL SURVEY, WATER LEVEL CHANGES IN THE HIGH PLAINS AQUIFER, PREDEVELOPMENT TO 2005 AND 2003 TO 2005, at 1 (2007), *available at* http://pubs.usgs.gov/sir/2006/5324/pdf/SIR20065324.pdf (explaining that precipitation is the primary form of recharge).

33. Carl Fricke & Darryll Pederson, *Ground-Water Resource Management in Nebraska*, 17 GROUND WATER 544, 545 (1979).

34. WALLACE STEGNER, BEYOND THE HUNDREDTH MERIDIAN: JOHN WESLEY POWELL AND THE SECOND OPENING OF THE WEST (1992).

scape,[35] especially along the Platte River and its tributaries where fifteen major dams and reservoirs, and a far greater number of water diversions and storage projects, are situated.[36] Most recently, a dramatic increase in infrastructure development can be seen in the expansion of groundwater wells and center pivot irrigation technology. Developed in the 1950s, this technology has exploded throughout the Great Plains, especially in Nebraska, where today there are well over 100,000 center pivot systems in operation.[37]

Irrigated agriculture, the backbone of Nebraska's economy,[38] is by far the largest user of both surface and groundwater in the state.[39] While surface water irrigation has remained near 1960 levels,[40] groundwater irrigated agriculture has dramatically increased and now accounts for over 93% of the state's groundwater withdrawals.[41] Within the state, groundwater withdrawals for irrigation have more than quadrupled from 1955 to 2005, increasing from about 850 to 7,310 million gallons per day.[42]

In addition to irrigated agriculture, significant portions of Nebraska's water resources are used for hydropower,[43] as well as for municipal water supplies,[44] industrial uses,[45] recreational uses,[46] and, to a limited extent, to protect threatened and endangered species in des-

35. For a description of the big-dam building era of the early to mid-twentieth century, and its societal and ecological implications, see REISNER, *supra* note 7.
36. DAVID M. FREEMAN, IMPLEMENTING THE ENDANGERED SPECIES ACT ON THE PLATTE BASIN WATER COMMONS 14 (2010); *see also* Platte River Whooping Crane Critical Habitat Trust v. Fed. Regulatory Energy Comm'n, 962 F.2d 27 (D.C. Cir. 1992) (assessing need for wildlife protective conditions in interim licenses to operate hydroelectric dams on the Platte River).
37. NEB. DEP'T OF NATURAL RES., CUMULATIVE TOTAL OF IRRIGATION WELLS REGISTERED IN NEBRASKA 1930–2010 (2011). For background, see Sandra Zellmer, *Boom and Bust on the Great Plains: Déjà vu All Over Again*, 41 CREIGHTON L. REV. 385 (2008).
38. *See* CHARLES LAMPHEAR, NEB. POLICY INST., THE IMPORTANCE OF AGRICULTURE AND AGRIBUSINESS TO NEBRASKA'S ECONOMY 2002, at 6 (2006) (reporting that, in 2002, agribusiness directly and indirectly contributed to 37% of the state's total gross output, 31% to total employment, and 33% to earned income, far exceeding any other industry in Nebraska).
39. *Water Use Trends in Nebraska*, U.S. GEOLOGICAL SURVEY, http://ne.water.usgs.gov/infodata/wateruse/waterusetrends.html (last modified December 17, 2010).
40. *Id.*
41. NEB. NATURAL RES. COMM'N, ESTIMATED WATER USE IN NEBRASKA, 1995, at viii (1998).
42. *See Water Use Trends in Nebraska*, *supra* note 39.
43. *See Water Use in Nebraska*, U.S. GEOLOGICAL SURVEY, http://ne.water.usgs.gov/wateruse.html (last modified July 29, 2011).
44. *See* Fricke & Pederson, *supra* note 33, at 545 ("Only two municipalities—Omaha and Crawford—draw their water supply from surface sources, and even Omaha supplements its surface-water supply with ground water. Except for Long Pine . . . all other cities, villages and towns . . . obtain their water supplies from wells.").
45. See *Water Use Trends in Nebraska*, *supra* note 39.

ignated stream segments through the use of instream flow water rights.[47] In many of the state's river basins, demand exceeds supply.[48]

B. The Institutional Framework

1. *Management of Surface Water Resources*

The doctrine of prior appropriation is the predominant legal system governing surface water use in the American West.[49] The doctrine originated during the gold-mining era of the mid-1800s.[50] Miners flocking to the arid West in hopes of wealth and prosperity relied on the large quantities of water they diverted from rivers and streams to fuel their mining operations.[51] In order to secure a water right, the miner had to take water from the river and put it to beneficial use. The use had to be continuous under this "use it or lose it" system and the person with the most seniority—"first in time, first in right"—had priority use of the water.[52]

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46. *See generally* STEVEN SHULTZ, NEB. GAME & PARKS COMM'N, ECONOMIC AND SOCIAL VALUES OF RECREATIONAL FLOATING ON THE NIOBRARA NATIONAL SCENIC RIVER (2009), *available at* http://watercenter.unl.edu/downloads/Papers/Niobrara_Report_May31.pdf.
47. *See* SANDRA ZELLMER, THE WATER CTR., INSTREAM FLOW LEGISLATION 1 (2006) ("Since the passage of its instream flow legislation in 1984, only 247 miles (2%) of Nebraska's 12,371 miles of streams and rivers have received some protection through instream flow appropriations (8 miles on Long Pine Creek and 239 miles on the Platte River)."). Instream flow rights were obtained for sections of the Central Platte River to keep a certain amount of water in the river, primarily to provide important habitat for Platte River species, including the endangered least tern, whooping crane, and pallid sturgeon and the threatened piping plover. Cent. Platte Natural Res. Dist. v. Wyoming, 245 Neb. 439, 451–61, 513 N.W.2d 847, 858–62 (1994).
48. For a map showing areas designated as either fully appropriated or overappropriated in Nebraska, see NEB. DEP'T OF NATURAL RES., FULLY APPROPRIATED AND OVERAPPROPRIATED SURFACE WATER IN NEBRASKA (2009), *available at* http://dnr.ne.gov/SurfaceWater/FullyOverAppropriatedAreaStatewide_0409.pdf. For definitions of the terms fully and over appropriated, see *infra* notes 89–90.
49. Sandra B. Zellmer & Jessica Harder, *Unbundling Property in Water*, 59 ALA. L. REV. 679, 695 (2008).
50. *See* WILKINSON, *supra* note 3, at 233–34.
51. *Id.* The evolution of prior appropriation is undoubtedly a more nuanced story, but its complexities are beyond the scope of this Article. *See* Zellmer & Harder, *supra* note 49, at 679 ("Although the oft-repeated story is that westerners simply followed the customs of the mining camps in the use and allocation of water, the underlying objectives were almost certainly more complex. Prior appropriation's roots are as likely to be found in the populist inclinations of farmers and homesteaders, who strongly resisted speculative investment by monopolistic land barons and railroad companies.").
52. Janet C. Neuman, *Beneficial Use, Waste, and Forfeiture: The Inefficient Search for Efficiency in Western Water Use*, 28 ENVTL. L. 919, 967 (1998).

Since 1895, Nebraska has had an administrative system overseeing the state's surface water resources based on the law of prior appropriation.[53] The prior appropriation doctrine continues to exist in much the same way as it did over a hundred years ago, but several important reforms have been adopted by the legislature in recent decades.[54]

Today, the Nebraska Department of Natural Resources (DNR) regulates all surface water related issues, including storage, irrigation, power, manufacturing, instream flows, and distribution of water resources in times of shortages.[55] In order to divert water for any of these purposes, water users are required to obtain a permit or water right from the state. In order to obtain a surface water right, there must be an available supply of unappropriated water.[56] If the requested water permit is located in a water short area, the permit process may include a formal hearing before the DNR, subject to review by the Nebraska Court of Appeals.[57]

In addition, the water must be applied to a "beneficial use."[58] While what constitutes "beneficial use" is somewhat subjective and can vary between states,[59] in Nebraska beneficial use includes water used for "domestic, municipal, agricultural, industrial, commercial, power production, subirrigation, fish and wildlife, ground water recharge, interstate compact, water quality maintenance, or recreational purposes."[60]

Once a surface water permit is obtained, priority of use is based on seniority.[61] Senior users receive their full appropriation, even if junior users must go without. However, when water is insufficient to meet all demands, there are preferences for certain priority uses.[62] Within Nebraska, domestic use has the highest preference, followed

53. Stephen D. Mossman, "*Whiskey is for Drinkin' but Water is for Fightin' About": A Firsthand Account of Nebraska's Integrated Management of Ground and Surface Water Debate and the Passage of L.B. 108,* 30 CREIGHTON L. REV. 67, 69 (1996). For an early version of this administrative system, see Arker's Law, 1895 Neb. Laws 244, 260 (substantially repealed but portions of the bill are presently codified at NEB. REV. STAT. §§ 46-203, -202, -204, -205, -215, -216, -217, -253 (Reissue 2010)).
54. WILKINSON, *supra* note 3, at 286; Neuman, *supra* note 52, at 967.
55. *Surface Water*, NEB. DEP'T OF NATURAL RES., http://www.dnr.ne.gov/docs/surface.html (last visited Oct. 22, 2012).
56. NEB. REV. STAT. § 46-234 (Reissue 2010).
57. *Id.*
58. NEB. CONST. art. XV, §§ 5–6.
59. *See* Neuman, *supra* note 52, at 922 ("Beneficial use is in fact a fairly elastic concept that freezes old customs, allows water users considerable flexibility in the amount and method of use, and leaves line drawing to the courts.").
60. NEB. REV. STAT. § 46-288 (Reissue 2010).
61. NEB. REV. STAT. § 46-204 (Reissue 2010).
62. Other western states have adopted similar preferences. *See* Robert E. Beck, *Use Preferences for Water*, 76 N.D. L. REV. 753, 767–68 (2000).

by agriculture, and then manufacturing.[63] To exercise a preference to the injury of a senior appropriator, the preferred user must provide just compensation.[64] Environmental or recreational uses are not listed within Nebraska's preference clause, effectively giving those uses low priority.

2. *Management of Groundwater Resources*

Groundwater resources within Nebraska are managed by twenty-three locally run NRDs. Created in 1969 with the passage of LB 1357, NRDs were the outcome of an effort to consolidate 154 special purpose districts then in existence throughout the state.[65] Prior to consolidation, these single-interest districts ranged in purpose from watershed planning boards to rural water districts to flood control districts, generating a complexity of authorities, overlapping functions, and boundaries.[66] As a result, coordination across sectors and between local and state agencies was awkward and inefficient.

Until the mid-1970s, Nebraska maintained a laissez-faire groundwater policy.[67] Few regulations were imposed on groundwater users, and they enjoyed relatively free and unrestricted access to the wealth of Nebraska's groundwater resources. Only if their use unreasonably interfered with use by other groundwater users would their use be restricted by judicial intervention.[68] However, during the 1960s and 1970s, Nebraska experienced a series of dry years. Around this time, center pivot groundwater irrigation systems were becoming more economical and were rising in popularity.[69] Many farmers invested in the development of groundwater resources to reduce their dependence on less reliable surface water resources, which vary depending on local

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63. NEB. REV. STAT. § 46-235.02(1)–(2) (Reissue 2010).

64. NEB. REV. STAT. § 46-204 (Reissue 2010); Keating v. Neb. Pub. Power Dist., 713 F. Supp. 2d 849, 852 (D. Neb. 2010), *aff'd*, 660 F.3d 1014 (8th Cir. 2011).

65. HAZEL M. JENKINS, NEB. DEP'T OF NATURAL RES., A HISTORY OF NEBRASKA'S NATURAL RESOURCES DISTRICTS 1 (Robert B. Hyer ed., 2009).

66. David Cash, *Innovative Natural Resource Management: Nebraska's Model for Linking Science and Decisionmaking*, ENVIRONMENT, Dec. 2003, at 8, 13.

67. Kurt Stephenson, *Groundwater Management in Nebraska*, 36 NAT. RESOURCES J. 761, 763 (1996); J. David Aiken, *Nebraska Groundwater Law and Administration*, 59 NEB. L. REV. 917, 923–24 (1980); Fricke & Pederson, *supra* note 33, at 545.

68. *See* Olson v. City of Wahoo, 124 Neb. 802, 811, 248 N.W. 304, 308 (1933) (adopting the American "reasonable use" rule of groundwater law with a "correlative" twist, which provides that, in the event of insufficient groundwater supply, each user is entitled to a reasonable proportion of the whole groundwater supply).

69. *See* ROBERT GLENNON, WATER FOLLIES: GROUNDWATER PUMPING AND THE FATE OF AMERICA'S FRESH WATER 26 (2002); WILKINSON, *supra* note 3, at 266.

precipitation, annual runoff from the Rockies, and availability after senior water rights are satisfied.[70]

Rapid growth and development of groundwater resources throughout the state, as well as concerns about groundwater level declines, led to the passage of the Groundwater Management Act (GWMA) of 1975.[71] This Act represented a first step towards addressing groundwater use on a more comprehensive basis.

Not surprisingly, the GWMA was controversial when it was first introduced because it instilled fear that the vast quantities of previously unregulated groundwater resources would be subject to stringent restrictions.[72] In its approach to groundwater allocation, however, the GWMA did not effectuate a major change in existing law, but rather simply codified the system of reasonable use and correlative rights that had already been adopted by Nebraska courts.[73] According to the GWMA, "every landowner shall be entitled to reasonable and beneficial use of the ground water underlying his or her land."[74] However, the landowner's right to use groundwater is "correlative . . . of other land owners when the ground water supply is insufficient for all users."[75] Essentially, this means that groundwater can be pumped freely as long as the use is deemed "reasonable and beneficial,"[76] and the water is used on overlying land (unless a transfer permit is obtained). Water is only shared when there is not enough water to go around. While the doctrines of reasonable use and correlative rights provide a great deal of freedom to the landowner, little protection is offered against impairment of neighbors and little power is held by the state to protect declining water tables.[77]

The administrative provisions of the GWMA were more remarkable in terms of making major changes in Nebraska water law. The GWMA gave NRDs the authority to petition to establish groundwater

70. From 1960 to 1970, the number of irrigation wells registered in Nebraska increased from approximately 23,000 to 70,000. As of December 8, 2010, the number of registered well in Nebraska stood at 107,017. *See* NEB. DEP'T OF NATURAL RES., *supra* note 37.

71. Nebraska Ground Water Management and Protection Act, NEB. REV. STAT. §§ 46-656 to -674.20 (Reissue 2010); *see* Fricke & Pederson, *supra* note 33, at 546 (discussing the history and passage of the Act).

72. *See* Fricke & Pederson, *supra* note 33, at 547.

73. *See* Olson v. City of Wahoo, 124 Neb. 802, 248 N.W. 304 (1933).

74. NEB. REV. STAT. § 46-702 (Reissue 2010).

75. *Id.*

76. For a list of designated beneficial uses of water within Nebraska, see *supra* note 60.

77. John C. Peck, *Groundwater Management in the High Plains Aquifer in the USA: Legal Problems and Innovations*, *in* 3 THE AGRICULTURAL GROUNDWATER REVOLUTION 296, 311 (M. Giordano & K.G. Villholth eds., 2007).

"management" or "control" areas within the state[78] as a means of protecting groundwater quantity or quality and preventing or resolving conflicts between users of hydrologically connected surface and groundwater resources.[79] To institute a groundwater control area, the locally elected NRD Board of Directors petitioned the Department of Water Resources (now the DNR) to hold a public hearing to determine whether a groundwater control area should be put in place. If established, the local NRD had broad authority over the groundwater control area (subject to approval by the Department of Water Resources), including responsibility to implement: (1) well spacing restrictions; (2) rotation of pumping wells; (3) limitations on groundwater pumping, including imposing moratoriums on drilling; and (4) other reasonable groundwater controls not listed in the Act.[80]

When restrictions were put in place by the Upper Republican NRD, a group of groundwater users brought a constitutional challenge to the GWMA. The Nebraska Supreme Court soundly rejected their plea: "[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. Furthermore, placing limitations upon withdrawals of ground water in times of shortage is a proper exercise of the State's police power."[81]

The NRD structure redefined natural resource management within the state by giving local agencies broad authority for a diversity of natural resource management responsibilities.[82] However, the

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78. The NRDs were created by the legislature in 1969 and came into being in 1972. Mossman, *supra* note 53, at 78; *see also* Fricke & Pederson, *supra* note 33, at 547 ("Th[e] fear [of regulation] was so strong that a provision giving the Department of Water Resources sole authority to establish ground-water controls areas was deleted from the Act by the Legislature, leaving the initiation of ground-water control procedures solely to individual NRD Boards.").

79. NEB. REV. STAT. § 46-712 (Reissue 2010).

80. Fricke & Pederson, *supra* note 33, at 547. Responsibility for implementing the Groundwater Management Act was held by the NRD Board of Directors. The supervisory role of the Department of Water Resources was merely to "prevent hasty or unreasonable action by an NRD and to initiate action when an NRD fails to act." *Id.* at 548.

81. Bamford v. Upper Republican Natural Res. Dist., 245 Neb. 299, 313, 512 N.W.2d 642, 652 (1994) (citation omitted).

82. *See* Mossman, *supra* note 53, at 99 ("Nebraska's natural resources districts . . . are still held up nationwide as a model for maintaining local control of natural resources decisions."); Warren Viessman Jr., *A Framework for Reshaping Water Management*, ENVIRONMENT, May 1990, at 14 ("the Nebraska Natural Resource Districts . . . are examples of effective regional institutions"). By statute, NRDs are directed

> to develop and execute, through the exercise of powers and authorities granted by law, plans, facilities, works, and programs relating to (1) erosion prevention and control, (2) prevention of damages from flood water and sediment, (3) flood prevention and control, (4) soil conservation, (5) water supply for any beneficial uses, (6) development, management, utilization, and conservation of ground water and surface water, (7) pollu-

GWMA did not go far enough. Neither the recently devised NRD system nor the GWMA itself encouraged integrated management of surface and groundwater resources within the state. Indeed, one of the main limitations of the GWMA was that it failed to encourage conjunctive use of surface and groundwater resources.[83]

3. *Toward Integrated Management: LB 962*

Despite the adoption of the GWMA, Nebraska's divided management system and a continually expanding number of water users with mounting demands fueled concerns about water conflicts throughout the state. The state recognized that there were "significant issues" relating to the laws governing surface and groundwater use and management and, in response, the Nebraska Unicameral passed LB 1003 in 2002 mandating the creation of a Water Policy Task Force.[84] The task force was appointed by the Governor and was charged with reviewing LB 108, which officially recognized the connection between surface and groundwater, to determine if any changes were necessary to "adequately address Nebraska's conjunctive use management issues," and to assess how inequities between surface and groundwater users should be addressed by the state.[85]

> tion control, (8) solid waste disposal and sanitary drainage, (9) drainage improvement and channel rectification, (10) development and management of fish and wildlife habitat, (11) development and management of recreational and park facilities, and (12) forestry and range management.

NEB. REV. STAT. § 2-3229 (Reissue 2007).

83. Fricke & Pederson, *supra* note 33, at 548. Conjunctive use refers to the coordinated management of surface and groundwater resources in a manner that produces greater and more sustained yields than if the system were managed in an uncoordinated fashion. Jack Coe, *Conjunctive Use—Advantages, Constraints, and Examples*, 3 J. IRRIGATION & DRAINAGE ENGINEERING 427, 427 (1990). However, "[n]o phrase has been more consistently misapplied and wrongfully maligned . . . . At its most basic, 'conjunctive' use means little more than the use of either ground or surface water . . . [but] not . . . regulation or management of those supplies of water." Mossman, *supra* note 53, at 67; *see* Frank J. Trelease, *Conjunctive Use of Groundwater and Surface Water*, 27 ROCKY MTN. MIN. L. INST. 1853, 1853 (1982) (noting that "[n]o one has formulated an all-inclusive definition" of conjunctive use).

84. L.B. 1003, 97th Leg., 1st Sess. (Neb. 2002). The task force was composed of stakeholders representing a wide variety of water interests across the state, including "irrigators from each of the state's 13 major river basins as well as representatives of natural resources districts, public power districts, municipalities, agricultural organizations, recreation users, environmental interests, the public at large, the Legislature's Natural Resources Committee, the Attorney General's Office and the Department of Natural Resources . . . ." *See* NEB. DEP'T OF NATURAL RES., LB962 IMPLEMENTATION 1 (2005), *available at* http://dnr.ne.gov/IWM/Newsletter/Newsletter_June05_Print.pdf.

85. L.B. 1003, 97th Leg., 1st Sess. (Neb. 2002).

As a result of this process, landmark legislation known as LB 962 was passed in 2004.[86] LB 962 adopted most of the Task Force's recommendations by establishing a system of integrated management planning and by requiring the state and local NRDs to work together in developing water management plans for water-scarce basins.[87] LB 962 gave the state DNR an enhanced role in the management of hydrologically connected groundwater resources, but it still left the lion's share of groundwater management authority to the NRDs.[88]

Through this legislation, the state DNR annually evaluates basins to determine whether the water resources within the system can sustain further development.[89] Basin evaluations consider both surface and groundwater supplies and uses when making a determination as to which basins are fully appropriated[90] or overappropriated.[91] If basins are given either of these designations, the local NRD and the DNR are required to engage in integrated management planning[92]

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86. 1996 Neb. Laws 46, 49.
87. *See* AM. BAR ASS'N, YEAR IN REVIEW 2004: ENVIRONMENT, ENERGY, AND RESOURCES LAW 301, 317 (2005) ("The 179-page bill implemented much of what a forty-nine member Water Policy Task Force had recommended. Absent, however, were two key provisions: establishment of a dedicated funding source to provide a steady source of revenue to pay for the costs of the new initiatives and full funding for the measures adopted.").
88. Douglas L. Grant, *Conjunctive Management of Hydrologically Connected Surface Water and Ground Water: The Problem of Sustainable Use*, 54 ROCKY MTN. MIN. L. INST. 14-1, 14-27 to 14-28 (2008).
89. NEB. REV. STAT. § 46-713(1) (Reissue 2010).
90. A river basin, subbasin, or reach is deemed fully appropriated if the DNR determines that

> then-current uses of hydrologically connected surface water and ground water in the river basin, subbasin, or reach cause or will in the reasonably foreseeable future cause (a) the surface water supply to be insufficient to sustain over the long term the beneficial or useful purposes for which existing natural-flow or storage appropriations were granted and the beneficial or useful purposes for which, at the time of approval, any existing instream appropriation was granted, (b) the streamflow to be insufficient to sustain over the long term the beneficial uses from wells constructed in aquifers dependent on recharge from the river or stream involved, or (c) reduction in the flow of a river or stream sufficient to cause noncompliance by Nebraska with an interstate compact or decree, other formal state contract or agreement, or applicable state or federal laws.

NEB. REV. STAT. § 46-713(3) (Reissue 2010).

91. A river basin is considered overappropriated, if on July16, 2004, the river basin is subject to an interstate cooperative agreement among three or more states and if, prior to this date, the state has declared a moratorium on issuance of new surface water appropriations and requested the NRDs to not issue well permits. NEB. REV. STAT. § 46-713(4)(a) (Reissue 2010).
92. Within fully appropriated and overappropriated basins, affected NRDs are required to work in conjunction with the state DNR to collectively develop an IMP. NEB. REV. STAT. § 46-715(1)(a) (Reissue 2010). Further, for a river basin designated as overappropriated, the affected NRDs and the DNR must jointly develop

with the goal of sustaining a balance between basin supplies and uses so that economic viability, as well as the social and environmental health, safety, and welfare of the affected area, can be maintained for both the near and long term.[93] For basins that have neither of these designations, NRDs still have the option of pursuing integrated management planning, although this course of action must be initiated and approved by the NRD Board of Directors.[94]

Under LB 962, when the DNR makes a preliminary determination that a river basin, subbasin, or reach has become fully appropriated, the DNR is required to place an immediate stay on the issuance of any new natural-flow, storage, or storage-use appropriations in the affected areas.[95] Additionally, upon official notice of the preliminary designation, the NRD must place a stay on the issuance of well construction permits in the geographic area determined to include hydrologically connected[96] surface and groundwater in the designated basin, subbasin or reach.[97] Further, if an overappropriated designation is made, any previously declared moratorium on the issuance of surface water appropriations must continue and a stay is to be placed on the issuance of new well construction permits. Stays remain in effect until (1) termination occurs following a formal hearing; (2) an integrated management plan (IMP) for the affected area has been adopted and put in place; (3) a reevaluation finds that the area is not fully appropriated or overappropriated; or (4) the stay expires.[98]

Currently, a moratorium is in place for all new surface water appropriations within the following Nebraska river basins and their associated subbasins: Republican; North Platte; South Platte; Platte above the mouth of the Loup River; White; and Hat Creek.[99] Enough petitions may be filed with the DNR to reconsider the moratorium des-

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a basin-wide plan for the area designated as overappropriated concurrently with each individual NRD IMP. NEB. REV. STAT. § 46-715(5)(a) (Reissue 2010).

93. NEB. REV. STAT. § 46-715(2)(a) (Reissue 2010).
94. NEB. REV. STAT. § 46-715(1)(b) (Reissue 2010).
95. NEB. REV. STAT. § 46-714 (Reissue 2010).
96. Hydrologically connected wells are defined as those which, if pumped "for 50 years will deplete the river or a base flow tributary thereof by at least 10% of the amount [of groundwater] pumped in that time." 547 NEB. ADMIN. CODE § 24-001.02 (2006).
97. NEB. REV. STAT. § 46-714 (Reissue 2010). For a map of areas determined to be hydrologically connected within Nebraska, see NEB. DEP'T OF NATURAL RES., GEOGRAPHIC AREAS DETERMINED TO HAVE SURFACE WATER HYDROLOGICALLY CONNECTED TO GROUND WATER FOR THE PURPOSE OF FULLY APPROPRIATED OR OVERAPPROPRIATED DESIGNATIONS 1 (2009), *available at* http://dnr.ne.gov/SurfaceWater/HydrologicallyConnectedAreaStatewide_0409.pdf.
98. NEB. REV. STAT. § 46-714 (Reissue 2010).
99. NEB. DEP'T OF NATURAL RES., ORDER DECLARING FORMAL MORATORIUMS (2004), *available at* http://dnr.ne.gov/SurfaceWater/FormalMoratorium_0804.pdf. The Order declares that the moratorium is in the public interest under NEB. CONST. art. XV, § 6 since

ignation for specific projects,[100] LB 962 has made easy access to water in the western two-thirds of the state a thing of the past.[101]

While both the state and local NRDs are involved in integrated management planning, ultimately NRDs, guided by their elected Board of Directors, have the legal authority to regulate groundwater activities and, as local entities, are the preferred regulators of activities that may contribute to groundwater depletion.[102] Meanwhile, the DNR remains the primary agency responsible for regulating surface water. In the event of a stalemate between the DNR and the NRD, either party may bring the dispute to the Governor who then can appoint an Interrelated Water Review Board to resolve the dispute.[103]

4. Federal Law

a. The Endangered Species Act

The federal Endangered Species Act (ESA) of 1973[104] has had substantial impacts on natural resources management across the nation, including water resource management in Nebraska.[105] Subsection 7(a)(2) of the Act requires each federal agency to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species.[106] Further, § 9 makes it unlawful for anyone to "take" a listed species, and this includes significantly modifying its habitat.[107] As Professor Getches observed, "[since] the construction, alteration, or

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> the public would not be well served by the continuance of granting permits where sufficient water is not available. This action would result in "paper water rights" that would cause additional costs to the taxpayer because of the costs of processing such applications, the costs of administering such applications, and the costs of canceling such appropriations in the future.

NEB. DEP'T OF NATURAL RES., *supra*, at 3. For a map depicting the areas where moratoriums and stays have been issued, see *Surface Water*, *supra* note 55.

100. NEB. REV. STAT. § 46-714(3) (Reissue 2010).
101. *See* GOEKE, *supra* note 26, at 33.
102. NEB. REV. STAT. § 46-702 (Reissue 2010).
103. NEB. REV. STAT. § 46-719 (Reissue 2010). To date, the Interrelated Water Review Board has never met.
104. 16 U.S.C. §§ 1531–1544 (2006).
105. *See* David H. Getches, *The Metamorphosis of Western Water Policy: Have Federal Laws and Local Decisions Eclipsed the States' Role?*, 20 STANFORD ENVTL. L.J. 3, 54 (2001) (describing several outside-the-box initiatives that have arisen out of fear of potential ESA enforcement on the Platte, Snake, Columbia, and Colorado Rivers and the California Bay–Delta).
106. 16 U.S.C. § 1536(a)(2) (2006).
107. 16 U.S.C. § 1538 (2006). "'Take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532(19) (2006). "Harm" includes habitat modification that injures a listed species. Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 692 (1995).

operation of virtually every major water facility, whether public or private, requires some kind of federal permit, and much of the undeveloped water in the West affects sensitive habitat, the ESA is often implicated."[108]

The role of the ESA in Nebraska water management is perhaps most vividly seen on the Central Platte River, where in 1984 Federal Energy Regulatory Commission (FERC) relicensing was required for continued operation of the Central Nebraska Public Power and Irrigation District's (CNPPID) hydroelectric project.[109] CNPPID generates irrigation water for approximately 223,000 acres of land surrounding the Platte River, in addition to producing electricity from hydropower.[110] During the relicensing process,[111] the U.S. Fish and Wildlife Service (FWS), the agency charged with implementing the ESA, found that CNPPID's water diversions and the resulting changes in land use throughout the Platte Basin posed potential jeopardy to the threatened piping plover and the endangered whooping crane, least tern, and pallid sturgeon.[112] The repercussions of these findings not only threatened CNPPID's operation but also extended beyond the state of Nebraska to Colorado and Wyoming, who also share in the use and benefits of Platte River water.

As a means to comply with ESA regulations and to improve the management of Platte River water resources, Nebraska, Colorado, Wyoming, and the FWS entered into a Cooperative Agreement in 1997.[113] The Cooperative Agreement was an important component of a settlement agreement that ultimately led to the relicensing of CNPPID's hydropower projects in 1998. Further, the Cooperative Agreement resulted in the establishment of the Platte River Recovery Implementation Program, an adaptive management initiative whose main charge is to aid in the recovery of the listed species. Platte River Program efforts include re-timing and improving river flows, which

108. Getches, *supra* note 104, at 53.

109. *See* 16 U.S.C. § 808 (2006).

110. For an overview of the relicensing process, see generally *A Brief History of the Central Nebraska Public Power and Irrigation District*, CENT. NEB. PUB. POWER & IRRIGATION DIST., http://www.cnppid.com/History_Central_P2.htm (last modified December 2, 2011).

111. *Id.*

112. Nebraska v. Rural Electrification Admin., 23 F.3d 1336, 1339 (8th Cir. 1994); Platte River Whooping Crane Critical Habitat Maint. Trust v. Fed. Energy Regulatory Comm'n, 962 F.2d 27, 31 (D.C. Cir. 1992); U.S. DEP'T OF THE INTERIOR, FISH & WILDLIFE SERV., BIOLOGICAL OPINION ON THE PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM 17 (2006).

113. U.S. DEP'T OF THE INTERIOR, COOPERATIVE AGREEMENT FOR PLATTE RIVER RESEARCH AND OTHER EFFORTS RELATING TO ENDANGERED SPECIES HABITATS ALONG THE CENTRAL PLATTE RIVER, NEBRASKA (1997).

entails obligations to provide 130,000 to 150,000 acre feet per year of water for ESA habitat (as determined by the FWS) by 2019.[114]

b. The Clean Water Act

Adopted in its current form in 1972, the federal Clean Water Act is aimed primarily at water quality rather than water quantity.[115] Indeed, the Act contains an explicit provision that strives to recognize state prerogatives over water quantity:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.[116]

The Act's requirements for preventing discharges of pollutants that undermine or defeat the designated uses of a surface water body, however, have sometimes necessitated instream flow protections to avoid concentrations of pollutants in the water column.[117] Clean Water Act permits have also been required for water transfers in some circumstances.[118] In addition, the Act's restrictions on dredge and fill activities can impede the development of water storage and delivery

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114. *Water Plan*, PLATTE RIVER RECOVERY AND IMPLEMENTATION PROGRAM, http://www.platteriverprogram.org/AboutPRRIP/Pages/WaterPlan.aspx (last visited Oct. 23, 2012).

115. 33 U.S.C. § 1251 (2006).

116. 33 U.S.C. § 1251(g); *see* Gregory J. Hobbs Jr. & Bennett W. Raley, *Water Rights Protection in Water Quality Law*, 60 U. COLO. L. REV. 841 (1989) (discussing federalism concerns raised by federal water quality regulation).

117. 33 U.S.C. §§ 1313, 1342 (2006); *see* Mary Jane Angelo, *Stumbling Toward Success: A Story of Adaptive Law and Ecological Resilience*, 87 NEB. L. REV. 950 (2009); *see also* PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700 (1994) (concluding that reductions in stream flows can result in water quality impairment in violation of the CWA); Application A-16642 v. 25 Corp., 236 Neb. 671, 678, 463 N.W.2d 591, 598 (1990) (citing NEB. REV. STAT. § 46-2,115(1) (Reissue 1988)) (upholding an instream flow appropriation for Long Pine Creek, a tributary of the Niobrara River, as being in the public interest, and citing "water quality maintenance" as a relevant factor).

118. *See, e.g.*, Catskill Mountains Chapter of Trout Unlimited, Inc. v. City of New York (*Catskills II*), 451 F.3d 77, 81 (2d Cir. 2006); Catskill Mountains Chapter of Trout Unlimited, Inc. v. City of New York (*Catskills I*), 273 F.3d 481, 491 (2d Cir. 2001); DuBois v. U.S. Dep't of Agric., 102 F.3d 1273, 1299 (1st Cir. 1996). *But see* Friends of the Everglades v. S. Fla. Water Mgmt. Dist., 570 F.3d 1210 (11th Cir. 2009) (upholding U.S. EPA regulation that transferring water via pumps and canals was not an "addition to navigable waters"); Miccosukee Tribe of Indians of Fla. v. S. Fla. Water Mgmt. Dist., 280 F.3d 1364 (11th Cir. 2002), *vacated sub nom.* 541 U.S. 95 (2004). For analysis, see Laura A. Schroeder & Kendall A. Woodcock, *Turbid Waters: The Interaction Between Interbasin Transfers and the Clean Water Act*, NEV. LAW., Jan. 2011, at 12.

infrastructure.[119] For example, the proposed Two Forks Dam on the South Platte River was shelved in 1990 when the U.S. Environmental Protection Agency exercised its veto authority under § 404 of the Clean Water Act due to the dam's potential for adverse environmental impacts.[120]

All of Nebraska's major water bodies include stream segments as well as lakes or reservoirs that are listed as water-quality impaired under the Clean Water Act.[121] The 2012 Nebraska Department of Environmental Quality Report reveals that, out of the 4,029 miles of streams assessed (55% of all stream miles within the state), 25% are water-quality impaired. Further, of the 140,054 acres of lakes and reservoirs that were assessed (94% of all lakes within the state), 72% are water-quality impaired.[122] Discharges into these waters, and perhaps even withdrawals from these waters, may be restricted by the Clean Water Act's requirements.[123]

c. *Interstate Compacts and Judicial Decrees*

Nebraska is a signatory to four interstate compacts and one judicial decree: the Upper Niobrara River Compact between Wyoming and Nebraska;[124] the South Platte River Compact between Colorado and Nebraska;[125] the Republican River Compact between Colorado, Nebraska, and Kansas;[126] the Big Blue River Compact between Kansas

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119. *See PUD No. 1 of Jefferson Cnty.*, 511 U.S. at 722–23 (holding that § 401 of the CWA could be utilized to restrict FERC's licensing authority under the Federal Power Act in order to protect water quality); *see also* Debra L. Donahue, *The Untapped Power of Clean Water Act Section 401,* 23 ECOLOGY L.Q. 201, 206 (1996) (discussing the implications of *PUD No. 1* and arguing that § 401 should apply to any federally permitted activity that may cause water pollution, regardless of whether the pollution is from a point or nonpoint source).
120. Final Determination Pursuant to Section 404(c) of the Clean Water Act Concerning the Two Forks Water Supply Impoundments in Jefferson and Douglas Counties, CO, 56 Fed. Reg. 76 (Jan. 2, 1991); *see* Daniel F. Luecke, *Two Forks: The Rise and Fall of a Dam,* 14 NAT. RESOURCES & ENV'T 24, 24 (1999) (discussing the Two Forks dispute and assessing "the institutional, economic and environmental issues arising in the context of large dam projects").
121. *See* NEB. DEP'T OF ENVTL. QUALITY, 2012 WATER QUALITY INTEGRATED REPORT 7 (2012), *available at* http://www.deq.state.ne.us/Publica.nsf/23e5e39594c064ee852564ae004fa010/7d8da25c1c1d0825862579f10054cfb0/$FILE/NE%202012%20WQ%20Integrated%20Report.pdf.
122. *Id.* at 8.
123. For an analysis of the CWA's provisions preventing degradation of high-quality waters, see Sandra B. Zellmer & Robert L. Glicksman, *Improving Water Quality Anti-Degradation Policies*, 4 GEO. WASH. J. ENERGY & ENVTL. L. 1 (2013).
124. Wyoming-Nebraska Compact on Upper Niobrara River, 1963 Neb. Laws 1063, *reprinted in* NEB. REV. STAT. app. § 1-112 (Reissue 2010).
125. South Platte River Compact, 1939 Neb. Laws 223, *reprinted in* NEB. REV. STAT. app. § 1-105 (Reissue 2010).
126. Republic River Compact, 1943 Neb. Laws 377, *reprinted in* NEB. REV. STAT. app. § 1-106 (Reissue 2010).

and Nebraska;[127] and the North Platte Decree between Colorado, Nebraska, and Wyoming.[128] These compacts and decrees dictate how water will be allocated between the states. Decrees like the North Platte decree are issued by the U.S. Supreme Court when litigation between the states over the equitable apportionment of transboundary water resources comes before it.[129] Compacts, by contrast, must be ratified by the state legislatures and by Congress, at which point they are enforceable under state and federal law.[130]

As pressures on water resources within the state continue to mount, the ability to meet interstate obligations has become ever more difficult.[131] Professor Noah Hall notes that while "water resources governed by interstate compacts have been relatively stable and unaffected by drastic changes in long-term weather patterns . . . climate change will force water managers to address new problems, including enormous changes in supply and demand."[132] Hall evaluates twenty-seven interstate water compacts with respect to their vulnerability to climate change impacts.[133] In his review of the four interstate compacts to which Nebraska is a party, the Big Blue River, the South Platte, and the Upper Niobrara are deemed inadequate due to their inability to allow for any significant adaptive management for changed conditions.[134]

The Republican River Compact fares scarcely better. It is deemed only somewhat adequate in its ability to address current and future water supply challenges and it fails to "offer enough proactive management to avoid future conflicts and uncertainties."[135] Disagreements over Republican River water use continue to provoke acrimonious litigation before the U.S. Supreme Court. In 1999, Kansas sued Nebraska, claiming that Nebraska was exceeding its compact allocation by allowing unregulated groundwater pumping in the Republican River Basin. This action eventually led to a settlement agreement that resulted in a moratorium on new large-capacity well drilling upstream of Guide Rock, Nebraska, increased regulation on existing wells, and a requirement for improved groundwater account-

127. Blue River Basin Compact, NEB. REV. STAT. app. § 1-115 (Reissue 2010).
128. Nebraska v. Wyoming, 325 U.S. 589, 665 (1945).
129. *Id.*
130. Cuyler v. Adams, 449 U.S. 433, 434 (1981).
131. Hall, *supra* note 28, at 243.
132. *Id.* at 240.
133. *Id.* at 263–65. Hall uses the following factors to evaluate interstate compacts' adaptability to climate change: (1) data collection and reporting; (2) geographic and hydrologic scope; (3) flexibility and adjustability of allocation; (4) water conservation; (5) ecosystem protection; (6) restrictions on transbasin diversions; (7) watershed governance institutions; and (8) duration, revision, and rescission. *Id.* at 241–42.
134. *Id.* at 295–318.
135. *Id.* at 304.

ing.[136] Recently, litigation has resurfaced before the Supreme Court over claims by Kansas that Nebraska violated the terms of the settlement agreement by overusing 78,960 acre feet of water from 2005 to 2006.[137] The Supreme Court has appointed a Special Master to hear the case.[138] Ultimately, Kansas is seeking the shutdown of 300,000 acres of groundwater irrigation in Nebraska.[139]

5. Water Management Moving Forward

State and federal laws as well as the various governing agencies continue to play a significant role in the development of Nebraska's water management system. While recent legislation such as LB 962 has made strides in better integrating management of interconnected surface and groundwater resources, clear challenges remain in maintaining an inherently divided institutional system. A recent Nebraska Supreme Court case, *Spear T Ranch, Inc. v Knaub*,[140] presents a judicial look at how groundwater and surface water disputes will be resolved in the future, given the disparate nature of Nebraska's water management framework.

Spear T Ranch was initiated by a claim that pumping by junior groundwater users was depleting senior surface water rights in the Pumpkin Creek drainage basin, resulting in the inability of the surface water user to use appropriated rights dating back to 1954 and 1956. Ultimately, the court found that then-existing law did not resolve such issues because surface water priorities did not apply to groundwater use.[141] Further, the court ruled that claims for conversion or trespass are not valid because surface water rights are a use right rather than a vested property right protected by those common law legal doctrines. Instead, the court embraced the *Restatement (Second) of Torts* § 858 in an attempt to balance the competing equities of groundwater and surface water appropriators.[142]

In order to prove a claim under the *Restatement*, the surface water appropriator must show that groundwater pumping has a "direct and substantial effect" on the river or stream which "unreasonably causes

136. *Republican River Settlement Documents*, NEB. DEP'T OF NATURAL RES., http://dnr.ne.gov/docs/RepSettlement.html (last visited Oct. 23, 2012).

137. *Republican River Case Back to Court,* MCCOOK DAILY GAZETTE, May 25, 2012, http://www.mccookgazette.com/story/1853501.html.

138. *Id.*

139. *Id.*; Russ Pankonin, *Trial Date Set for Second Kansas-Nebraska Water Suit*, IMPERIAL REPUBLICAN, May 31, 2012, http://www.imperialrepublican.com/index.php?option=com_content&view=article&id=4187:trial-date-set-for-second-kansas-nebraska-water-suit&catid=41:agbusiness&Itemid=53.

140. 269 Neb. 177, 691 N.W.2d 116 (2005).

141. *Id.* at 185, 691 N.W.2d at 126.

142. *Id.* at 194, 691 N.W.2d at 132.

harm" to the surface water user.[143] Reasonableness is decided on a case-by-case basis and considers an array of factors, including the purpose and suitability of the use; the economic and social value of the use; the extent and amount of harm the use causes; the practicality of avoiding harm or adjusting the quantity of water used; the protection of existing values of water uses, land, and investments; and whether justice requires the user causing harm to bear the loss.[144] While some cases may achieve equity between the parties, the *Restatement* approach not only adds uncertainty as to how each instance might be decided, but is also likely to be very fact- and time-intensive, as well as costly.[145] Furthermore, in its decision, the court recognized that the legislature would be better suited than the judiciary to resolve such conflicts on a broader scale. The court also noted that the newly adopted LB 962 does not solve preexisting conflicts or provide private redress for surface water users whose rights are impaired by groundwater pumpers.[146]

While LB 962 is limited in its ability to solve preexisting conflicts outside of the court system, new requirements for proactive, integrated management offer opportunities to head off future conflicts. In working together to develop IMPs, state and local water management agencies can begin to develop relationships, leverage resources, pursue more innovative management methodologies, and possibly even avoid or minimize conflicts between private users. The requirement of IMPs for fully appropriated and overappropriated basins affords managers the opportunity to revisit traditional management approaches and provides a platform from which to explore and integrate more flexible practices deemed critical in managing water resources. Adaptive management, discussed in the following Part, is increasingly recognized as a promising strategy in addressing uncertainty,

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143. *Id.* at 189, 691 N.W.2d at 129. While Nebraska appears to be the only western state to apply the *Restatement* to disputes between surface and groundwater users, several eastern states have applied the *Restatement*'s criteria to water conflicts. *See* Robin Kundis Craig, *Defining Riparian Rights as "Property" Through Takings Litigation*, 42 ENVTL. L. 115, 118 (2012); J. David Aiken, *Hydrologically-Connected Ground Water, Section 858, and the Spear T Ranch Decision,* 84 NEB. L. REV. 962, 992–94 (2006).

144. RESTATEMENT (SECOND) OF TORTS § 850A (1979).

145. *See* Sandra Zellmer, *Floods, Famines, or Feasts: Too Much, Too Little, or Just Right*, NAT. RESOURCES & ENV'T, Winter 2010, at 20, 22 ("interference with neighboring wells and with surface water appropriations has become common, generating protracted litigation but few sustainable solutions"); Grant, *supra* note 88, at 14–28 ("*Spear T Ranch* creates notable uncertainties"); Aiken, *supra* note 143, at 994–96 (assessing the implications of litigation under the *Restatement* criteria and concluding that, although "some justice" may result, it would be "treacherous to predict the outcome of a specific conflict").

146. *Spear T Ranch, Inc.*, 269 Neb. at 178, 691 N.W.2d at 122.

augmenting flexibility, and promoting learning in natural resources management.

III. ADAPTIVE MANAGEMENT

Adaptive management is no panacea for all natural resource problems, but the concept is gaining popularity as a means to reduce uncertainty through an iterative process of learning, reflection, and mid-course corrections. This Part provides an introduction to the concept of adaptive management as well as insights into the benefits and challenges that accompany it. It then looks at when it is most appropriate to apply adaptive management methodologies. Finally, it considers whether adaptive management strategies can be pursued effectively under Nebraska's current institutional framework.

A. Defining Adaptive Management

The concept of adaptive management was first introduced into academic literature in 1978 by ecologist C.S. Holling[147] and was further developed by Carl Walters in the 1980s.[148] Employed as a scientific approach to address uncertainty in natural resources management, adaptive management revolves around the idea of using experimentation and monitoring to inform management actions. Professor Derek Armitage defines the term as a "strategic learning-by-doing or quasi-experimental approach to the management of natural resources encouraged by institutional flexibility."[149] According to Professors J.B. Ruhl and Robert Fischman, adaptive management can be useful in the law of resource management as a process that emphasizes the "definition of goals, description of policy decisions models, active experimentation with monitoring of conditions, and adjustment of implementation decisions."[150]

Since its inception, the concept has gained traction both in academic circles and in the realm of natural resources management policy and law. However, adaptive management has become a highly "malleable term . . . [that] has been defined and applied in a variety of ways," ranging from general interpretations to very detailed descrip-

147. *See* INT'L INST. FOR APPLIED SYS. ANALYSIS, ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978).

148. *See* CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES (1986).

149. *See* ARMITAGE ET AL., *supra* note 1, at 328.

150. Ruhl & Fischman, *supra* note 11, at 424; *see* Janet C. Neuman, *Adaptive Management: How Water Law Needs to Change*, 31 ENVTL. L. REP. 11432 (2001) (describing the need to incorporate adaptive management principles into the prior appropriation system).

tions.[151] While there seems to be no universal definition of what adaptive management requires,[152] it is generally agreed that adaptive management, in its most basic form, entails active "learning by doing."[153]

B. Assessing Adaptive Management

The current system of natural resource management within the United States, including both the legal framework and regulatory decision-making processes for water management, severely limits the capacity of institutions to manage change and uncertainty.[154] The law tends to promote stability and the satisfaction of reasonable expectations, thereby encouraging regulatory inaction in the face of uncertainty,[155] due at least in part to the "application of legal devices relating to standard of review and burden of proof in regulatory proceedings."[156] The premium placed by the American legal system on "firm rules of law" makes it difficult to incorporate adaptive approaches into environmental and other types of regulation, especially where property rights or other forms of entitlements are at stake.[157] While stability and certainty are essential characteristics of Western water law, efforts need to be made to facilitate management initiatives capable of addressing uncertainty and enhancing our understanding of ecosystem dynamics. Moreover, there is a fundamental need to promote agency and stakeholder learning within the natural resources decision-making process in order to reduce uncertainty and achieve more sustainable outcomes over time. Adaptive management approaches may respond to these challenges by fostering increased learning and flexibility in managing social-ecological systems that are

151. Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of "New Age" Environmental Protection*, 41 WASHBURN L.J. 50, 52 (2001).

152. *Id.* at 52; *see also* HOLLY DOREMUS ET AL., CTR. FOR PROGRESSIVE REFORM, MAKING GOOD USE OF ADAPTIVE MANAGEMENT 2 (2011) (describing the contexts in which adaptive management is appropriate).

153. Carl J. Walters & C.S. Holling, *Large-Scale Management Experiments and Learning by Doing*, 71 ECOLOGY 2060, 2060–61 (1990).

154. Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resources Management*, 89 N.C. L. REV. 1405, 1408–09 (2011).

155. Zellmer & Gunderson, *supra* note 12, at 895.

156. Thomas T. Ankersen & Richard Hamann, *Ecosystem Management and the Everglades: A Legal and Institutional Analysis*, 11 J. LAND USE & ENVTL. L. 473, 493 (1996).

157. Timothy H. Profeta, *Managing Without a Balance: Environmental Regulation in Light of Ecological Advances*, 7 DUKE ENVTL. L. & POL'Y F. 71, 86 (1996).

non-linear in nature, cross-scale in time and in space, and change over time.[158]

At first glance, basing management decisions on experimentation, learning, monitoring, and adaptation appears to be a sensible practice, especially given the numerous uncertainties associated with managing natural resources. Yet, there have been a number of cases where adaptive management efforts have failed.[159] Walters reasons that some of these failures may be attributable to the difficulties in modeling cross-scale effects and insufficient data on key ecological processes; the potential risk and cost associated with experimentation; the perceived threat to existing research programs and management regimes; and conflicts in values.[160] Further, agencies sometimes employ adaptive management as a means of placating requests for environmental protection when, in practice, they are imposing few, if any, enforceable constraints to ensure protection.[161]

As a result, adaptive management is at the center of the debate on whether it is possible to design and implement more flexible management approaches and regulations that still provide reasonable certainty to resource users and promote accountability in decisionmaking.[162] A white paper by Doremus and a group of Center for Progressive Reform scholars offers a framework that can aid resource managers in deciding whether and when to pursue adaptive management to achieve management goals.[163] As general prerequisites, there must be: (1) an information gap that needs to be filled to inform management decisions; (2) good prospects for learning within an acceptable time scale; and (3) realistic opportunities for adjustments based on learning.[164] Once these prerequisites have been met, a more in-depth analysis is required that weighs benefits of implementing adaptive management against the costs and potential complications that may arise.[165] Such analysis should be "in writing, available to the public for comment and, for large-scale, long-term or highly controversial projects, reviewed by independent experts."[166]

158. C.S. Holling et al., *Science, Sustainability and Resource Management*, *in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS 342, 342–62 (Fikret Berkes & Carl Folke eds., 1998).

159. *See* Zellmer & Gunderson, *supra* note 12, at 947; Doremus, *supra* note 153, at 54; Carl Walters, *Challenges in Adaptive Management of Riparian and Coastal Ecosystems*, 1 ECOLOGY & SOC'Y [1, 2] (1997).

160. Walters, *supra* note 159, at 1.

161. Doremus, *supra* note 151, at 53.

162. J.B. Ruhl, *Adaptive Management for Natural Resources—Inevitable, Impossible, or Both?*, 54 ROCKY MTN. MIN. L. INST. 11-1, 11-10 (2008).

163. Doremus, *supra* note 151, at 53.

164. *Id.*; *see* DOREMUS ET AL., *supra* note 152, at 7.

165. *Id* at 8.

166. *Id.*

If the decision is to go forward with adaptive management, the white paper offers the following four principles as a guideline for implementing the program: (1) Tailor the strategy to the problem;[167] (2) ensure accountability and enforceability;[168] (3) promote directed learning;[169] and (4) ensure sufficient funding.[170]

However, in determining whether to pursue adaptive management, it is vital to understand whether the existing institutional framework will support implementation of these principles. Within Nebraska, the recent move towards integration of surface and groundwater management might provide a platform from which to pursue adaptive approaches in managing water resources. The state's partial effort towards integration provides a unique lens through which to look at the opportunities and challenges of building adaptive capacity for integrated water management in systems where full legal integration of surface and groundwater resources may not be a realistic goal. In the following Part, the criteria provided above are used to evaluate the ability of Nebraska's current water management framework to support adaptive management efforts.

IV. CAN NEBRASKA'S INSTITUTIONS SUPPORT ADAPTIVE, INTEGRATED WATER MANAGEMENT?

Nebraska, like many regions around the world, is faced with the challenge of adapting to a new era in water management. While Nebraska is considered to be a state rich in surface and groundwater resources, a significant portion of Nebraska's river basins are either fully appropriated or overappropriated.[171] Increasing demands for water resources, mounting concerns over threatened and endangered species, water quality, and obligations to abide by interstate water allocation agreements have forced Nebraska to revisit traditional approaches for water management within the state.

Choosing a definitive management path within the context of a continuously changing and uncertain social-ecological system is a daunting but necessary task. Numerous information gaps exist and much is unknown about a diversity of water resources issues, such as how groundwater and surface water interact through time; the potential implications of climate change on the availability of water resources (both seasonally and into the future) and how this might impact agricultural practices and demands; and how management actions affect the ecosystem, including threatened and endangered spe-

167. *Id.* at 10.
168. *Id.* at 11–12.
169. *Id.* at 12.
170. *Id.* at 13.
171. *See supra* notes 48, 98 and accompanying text.

cies. The list goes on and on.[172] Nonetheless, perhaps equal to the unknowns are the prospects for learning and opportunities for adjustments that exist within the state. The development of Nebraska's integrated management system within water-scarce river basins has the potential to both facilitate learning and implement real change in water resources management, both locally and across the state through collaborative local, state, and federal efforts. Since water does not respect political boundary lines, scaling the project or institution to the appropriate level of authority and fostering cooperation among linked or nested authorities are vital.[173]

The following analysis uses the adaptive management criteria proposed by Doremus[174] as a jumping off point to more closely examine Nebraska's institutional capacity to pursue adaptive management under the state's recently adopted integrated management scheme. Maintaining a framework that is only partially integrated to manage a resource that is, for the most part, intrinsically hydrologically integrated presents substantial challenges.[175] Recent institutional efforts, however, offer real promise in building adaptive capacity.

A. Tailoring the Strategy to the Problem

As described above in section II.A, there is immense variability in water resources across the state. In an effort to recognize these variations, Nebraska's NRDs were developed based more or less along watershed boundaries and given authority to "provide effective coordination, planning, development, and general management of areas which have related resources problems."[176] Within their boundaries, each NRD has the recognized authority to manage groundwater as best suited to each district's particular needs. As a result, NRDs have the ability to develop clear and explicit management goals more readily informed by local knowledge and community values. Moreover, the NRDs have the ability to engage in collaborative educational, research, and planning efforts with fellow NRDs, as well as with state and federal agencies, educational institutions, and other organizations, to better address uncertainties and issues that transcend local

172. *See* Sandra Zellmer, *Wilderness, Water, and Climate Change*, 42 ENVTL. L. 313 (2012); Craig, *supra* note 10; A. Dan Tarlock, *Water Demand and Energy Production in a Time of Climate Change*, 5 ENVTL. & ENERGY L. & POL'Y J. 325 (2010).

173. *See* Craig Anthony Arnold, *Adaptive Watershed Planning and Climate Change*, 5 ENVTL. & ENERGY L. & POL'Y J. 417, 441 (2010) (identifying as a key component of adaptive planning "participatory social interaction among multiple participants at various levels of organizational structure and through multi-organization networks (including scaling up and down and using dynamic decision making processes)").

174. *See* DOREMUS ET AL., *supra* note 151, at 8–13.

175. *See* Sophocleous, *supra* note 2, at 572.

176. NEB. REV. STAT. § 2-3203(1) (Reissue 2007).

boundaries.[177] For instance, some NRDs regularly collaborate with the federal Natural Resources Conservation Service on administering the Conservation Reserve Program, the University of Nebraska's extension system on researching best management practices, and private firms on developing new technologies.[178]

Through IMPs, which are mandatory for basins designated as fully appropriated or overappropriated and optional for all other basins, NRDs and the state DNR must collaboratively develop clear goals and objectives in managing hydrologically connected water resources.[179] Further, each IMP must include the adoption of one or more groundwater controls[180] as well as one or more surface water controls.[181]

Choice in which types of groundwater controls to adopt offers the NRD flexibility in pursuing options best suited to local needs. Examples of authorized groundwater controls include allocations, rotations, reductions in irrigated acres, restrictions on groundwater irrigation expansion, transfers, municipal or industrial tracking, well-spacing requirements, installation of meters, educational requirements, and certification of irrigated acres.[182] By the same token, flexibility in choosing appropriate and effective surface water controls also exists at the state level and can include increased monitoring of diversions, moratoriums on new surface water appropriations, and conservation measures.[183] Flexibility in adapting regulatory mechanisms tailored to the specific needs of the physical and socio-economic environment can enhance adaptive capacity and may foster more effective scaling, as some of these controls may be more effective or more appropriate in some basins than in others, given each basin's unique topography, hydrology, and demographic features.

Moreover, by working together, each agency can more readily begin to understand the management challenges and needs placed on both surface and groundwater resources. Through an integrated management approach, uncertainties can be identified and strategies employed to increase learning in an effort to improve management results.

However, Nebraska requires the state DNR and local NRDs to address water quantity issues in a collaborative, integrated fashion only *after* the area has been designated as fully appropriated or overappropriated;[184] there are no requirements for non-designated basins to

177. NEB. REV. STAT. § 2-3235 (Reissue 2007).
178. Cash, *supra* note 66, at 16.
179. NEB. REV. STAT. § 46-715 (Reissue 2010).
180. NEB. REV. STAT. § 46-715(2)(c) (Reissue 2010).
181. NEB. REV. STAT. § 46-715(2)(d) (Reissue 2010).
182. NEB. REV. STAT. § 46-739 (Reissue 2010).
183. NEB. REV. STAT. § 46-716 (Reissue 2010).
184. Of the twenty-three NRDs, ten have implemented legally mandated IMPs. Further, one legally mandated basin-wide IMP for the overappropriated portion of

proactively pursue integrated management as a means of preventing a fully appropriated or overappropriated status. Decisions to pursue voluntary planning are left to the discretion of the NRD Board of Directors, highlighting the power the Board holds with respect to proactive, integrated planning.[185] Nonetheless, several NRDs are currently working with the DNR to pursue voluntary IMPs, including the Lower Elkhorn, Lower Niobrara, Lower Platte South, Lower Platte North, and Papio-Missouri River NRDs.[186] The main difference between mandatory and voluntary IMPs lies in the development of action items to meet each plan's specific goals and objectives. While IMPs for fully appropriated and overappropriated districts must include at least one surface and one groundwater control mechanism,[187] no such requirements exist for voluntary plans. The choice to adopt, or to not adopt, control mechanisms is left to the NRD Board of Directors.

A case in point is the Niobrara River, one of only two rivers within Nebraska designated as a Wild and Scenic River.[188] While greatly valued within the state for its recreational opportunities and tourism,[189] the river was placed among the top ten most threatened rivers by the non-profit organization American Rivers due to "excessive irrigation diversions" which are threatening the River's ecological integrity.[190] However, in 2011 the Nebraska Supreme Court struck down a DNR decision designating a portion of the Lower Niobrara River as fully appropriated, subsequently eliminating a requirement for the affected districts to engage in integrated management planning.[191] The portion of the Lower Niobrara River originally designated as "fully appropriated" crossed the borders of five NRDs,[192] only one of which is

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the Platte River Basin has also been implemented. *See generally Integrated Water Management: Approved Plans*, NEB. DEP'T OF NATURAL RES., http://dnr.ne.gov/IWM/docs/IWM_ApprovedPlans.html (last visited Oct. 23, 2012).

185. NEB. REV. STAT. § 46-715(1)(b) (Reissue 2010). For a description of the characteristics of NRD Boards, see *infra* section IV.B.

186. NEB. DEP'T OF NATURAL RES., NATURAL RESOURCES DISTRICTS INITIATING VOLUNTARY INTEGRATED MANAGEMENT PLANS (2012), *available at* http://dnr.ne.gov/NewsReleases/20120514_NewsRelease_volIMPs.pdf.

187. NEB. REV. STAT. § 46-715(2)(c)–(d) (Reissue 2010).

188. *Explore Designated Rivers: Nebraska*, NAT'L WILD & SCENIC RIVERS SYS., http://www.rivers.gov/rivers/nebraska.php (last visited Oct. 23, 2012).

189. *See* SHULTZ, *supra* note 46.

190. *America's Most Endangered Rivers: Niobrara River*, AM. RIVERS, http://www.nxtbook.com/nxtbooks/americanrivers/endangeredrivers/index.php?startid=38 (last visited Oct. 23, 2012).

191. Middle Niobrara Natural Res. Dist. v. Dep't of Natural Res., 281 Neb. 634, 799 N.W.2d 305 (2011).

192. NEB. DEP'T OF NATURAL RES., ORDER OF FINAL DETERMINATION THAT A PORTION OF THE LOWER NIOBRARA RIVER BASIN IS FULLY APPROPRIATED (2008), *available at* http://dnr.ne.gov/legal/notices/Niobrara_OrderFinal_012508.pdf.

currently pursuing integrated management planning.[193] Under the existing management system, basin-wide surface and groundwater resources will continue to be managed in a fragmented, disparate manner with potentially very little consideration as to how actions in one NRD may impact the resources of others and the basin as a whole. Fully integrated planning is unlikely unless each NRD takes action and pursues development of an IMP or, even better, a basin-wide plan, that looks beyond individual NRD boundaries and current demands to future scenarios and desired conditions.[194]

B. Ensuring Accountability and Enforceability

NRDs are governed by an elected Board of Directors, ranging in size from five to twenty-one members, depending on the population and land area of the district, as well as the complexity of the resource programs overseen by the NRD.[195] Board members are elected for four-year terms.[196] In order to be elected, members must be registered voters residing within the district or subdistrict that they represent.[197]

Board members have a broad range of legislative authority, including powers to tax and to issue and enforce regulations.[198] Across Nebraska, NRD Boards are made up in large part of agricultural interests. While local control is one of the key principles of long-enduring common-pool resource institutions,[199] one criticism of the NRD system is that Board members are in a position to represent their own (mostly agricultural) interests or those of their neighbors, especially when it comes to regulating, or not regulating, groundwater use. For

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193. NEB. DEP'T OF NATURAL RES., *supra* note 186.
194. The Platte River Basin is the only basin that can be declared overappropriated under NEB. REV. STAT. § 46-713(4)(a) (Reissue 2010) ("A river basin, subbasin, or reach shall be deemed overappropriated if, on July 16, 2004, the river basin, subbasin, or reach is subject to an interstate cooperative agreement among three or more states and if, prior to such date, the department has declared a moratorium on the issuance of new surface water appropriations . . ." and has requested the affected NRDs to not issue well permits.). Therefore, the Platte River Basin is the only basin required to develop and implement a basin-wide IMP under current legislation.
195. NEB. REV. STAT. § 2-3213(1) (Reissue 2007); NEB. REV. STAT. § 32-513 (Reissue 2008).
196. NEB. REV. STAT. § 32-513.
197. *Id.*; NEB. REV. STAT. § 2-3214(1) (Reissue 2007).
198. Cash, *supra* note 66, at 15.
199. A common-pool resource is "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use." ELINOR OSTROM, GOVERNING THE COMMONS 30 (1990). Ostrom identifies collective-choice arrangements where "[m]ost individuals affected by the operational rules can participate in modifying the operational rules" as a key design principle for successfully managing common pool resources, such as water. *Id.* at 90.

these reasons, "severe overdraft requires severe measures which local residents are reluctant to impose upon themselves or each other."[200]

Importantly, the integrated management planning process transcends individual Boards and Board members by requiring consultation with "irrigation districts, reclamation districts, public power and irrigation districts, mutual irrigation companies, canal companies, and municipalities that rely on water from within the affected area . . ." as well as "designated representatives of other stakeholders" identified by either the DNR or NRD.[201] The DNR and affected NRDs must also "actively solicit public comments and opinions through public meetings and other means."[202] Furthermore, the plan must be collectively approved by the affected NRDs and DNR and, if an agreement cannot be reached, the issues are elevated to the Interrelated Water Review Board.[203]

Although NRDs are the preferred regulators of groundwater resources under Nebraska law,[204] state oversight has increased in recent years with the passage of LB 962, which requires the state DNR to annually evaluate basins to determine if areas are either fully appropriated or overappropriated, thereby kicking off the integrated planning process, and to work with NRDs in developing IMPs.[205] Annual basin evaluations as well as efforts toward integrated planning enhance accountability of both the state and the local NRD to address water resource issues through the development of goals and objectives ultimately agreed upon by both agencies. Moreover, by requiring the DNR and NRD to work together to collectively develop a plan, the process strengthens accountability between the respective agencies and facilitates scaling the authority to the appropriate level.

Nonetheless, under the current water management system, NRDs continue to have much discretion in shaping groundwater management within their district. NRDs have the authority to decide which groundwater control mechanisms to implement and are responsible for enforcement of these regulations. Of the ten NRDs required to implement IMPs, only six have chosen to implement allocations and to install meters to monitor groundwater use in at least a portion of their district.[206] The other NRDs have chosen to focus on alternative

200. James W. Johnson, *The 1980 Arizona Groundwater Management Act and Trends in Western States Groundwater Administration and Management: A Minerals Industry Perspective*, 26 ROCKY MTN. MIN. L. INST. 1031, 1049 (1980).
201. NEB. REV. STAT. § 46-715(5)(b) (Reissue 2010).
202. NEB. REV. STAT. § 46-717(2) (Reissue 2010).
203. NEB. REV. STAT. § 46-718(3) (Reissue 2010).
204. NEB. REV. STAT. § 46-702 (Reissue 2010).
205. *See supra* subsection II.B.3.
206. The following NRDs require metering of surface and groundwater diversions and have implemented allocations, in at least part of their district: the South Platte NRD, a part of the larger Platte River Basin; the Tri-Basin NRD (only the portion

groundwater control options, ranging from reductions in irrigated acres to water transfers.[207] Moreover, enforcement of groundwater control mechanisms is left to the judgment of the NRD Board of Directors and has the potential to vary from one NRD to the other since each Board is composed of a unique set of members. Further, NRDs that are not engaged in integrated management planning are solely responsible for groundwater management within their boundaries and are not accountable to the state or to other NRDs.

In summary, efforts towards integrated management planning as a whole have strengthened accountability and enforceability in managing water resources in Nebraska, at least to some extent. The development of IMPs increases accountability at both the state and local level. From a procedural standpoint, providing a voice to stakeholders and other interested members of the public is a vital first step in building adaptive capacity to better manage natural resources.[208] Increased involvement in the IMP process allows a diverse array of interests to voice their opinions and concerns. However, as the current system stands, the DNR and respective NRD are only required to consult with outside interests; there is no subsequent obligation for either entity to respond to external recommendations or concerns. A failure to address such concerns in a meaningful way can leave stakeholders and the public unsatisfied with the process and unaccepting of the outcomes.

Substantively, IMPs must include set goals and objectives and must incorporate at least one surface water control mechanism and at least one groundwater control mechanism in an effort to reduce water use.[209] By establishing goals and objectives and by identifying control mechanisms by which to achieve them, IMPs specify clearly defined actions that must be implemented. On the other hand, accountability and enforceability are heavily influenced by the DNR and NRD's fortitude to follow through, implement, and enforce the IMP's requirements. As a result, the current system promotes, but does not guarantee, accountability and enforceability in water resources management.

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of the district residing in the Republican River Basin); and the Lower, Middle, and Upper Republican NRDs, all part of the larger Republican River Basin. For access to all of the approved IMPs, see *Integrated Water Management: Approved Plans*, *supra* note 186.

207. *Id.*

208. *See* Claudia Pahl-Wostl et al., *Social Learning and Water Resources Management*, 12 ECOLOGY & SOC'Y [1, 2] (2007) ("complex issues and integrated management approaches cannot be tackled without taking into account stakeholders' information and perspectives and without their collaboration").

209. *See* NEB. REV. STAT. § 46-715(2) (Reissue 2010).

C. Promoting Directed Learning

Developing and maintaining an institutional framework that values learning not only has the potential to promote knowledge and strengthen accountability, but also to facilitate deliberation among agency personnel, stakeholders, and policy makers so that tradeoffs between management strategies can be identified and taken into consideration.[210] In order to engage in effective adaptive management programs, organizations must have the ability and the incentive to identify and pursue opportunities for learning that will improve management.[211] Further, there must be systematic data collection and evaluation and a steady flow of data sharing between agencies.[212]

Directed learning is possible under Nebraska's institutional structures for managing water resources[213] and, to a significant extent, it is occurring. First, all IMPs are required to incorporate a "plan to gather and evaluate data, information, and methodologies" that could be used to implement surface and groundwater control mechanisms, increase understanding of hydrologically connected surface and groundwater resources, and "test the validity of the conclusions and information upon which the IMP is based."[214]

In addition, for overappropriated basins that cover more than one NRD, LB 962 requires the DNR and the affected NRDs to adopt an iterative assessment process to measure progress toward the IMP's goals. They must take an incremental approach to achieve the goals and objectives of the statute (i.e., a water balance) and, during the ten years following the adoption of each incremental step, must "conduct a technical analysis of the actions taken in [each] such increment to determine the progress towards meeting the goals and objectives . . . ." Specifically:

> The analysis shall include an examination of (A) available supplies and changes in long-term availability, (B) the effects of conservation practices and natural causes, including, but not limited to, drought, and (C) the effects of the plan on reducing the overall difference between the current and fully appropriated levels of development. . . . The analysis shall determine whether a subsequent increment is necessary in the integrated management plan to

210. Camacho, *supra* note 154, at 1453.
211. DOREMUS ET AL., *supra* note 152, at 12.
212. *Id.*
213. NEB. REV. STAT. § 2-3232 (Reissue 2007) states:

> Each district shall have the power and authority to: (1) Make studies, investigations, or surveys and do research as may be necessary to carry out its authorized purposes . . . for the purpose of conducting such studies, investigations, surveys, and research, and publish and disseminate the results . . . To avoid duplication of effort, any such studies, investigations, surveys, research, or dissemination shall be in cooperation and coordination with the programs of the University of Nebraska, or any department thereof, and any other appropriate state agencies . . . .

214. NEB. REV. STAT. § 46-715(2)(e) (Reissue 2010).

> meet the goals and objectives . . . and reduce the overall difference between the current and fully appropriated levels of development. . . . If necessary, the steps . . . shall be repeated until the department and the affected natural resources districts agree that the goals and objectives . . . have been met.[215]

In addition to expertise at the state level, many NRDs have their own technical staff that, to varying degrees, includes hydrologists, soil scientists, and foresters.[216] State, federal, and local agencies have the opportunity to draw upon each other for data and expertise, and can collaborate on research initiatives involving educational institutions, agencies, and a variety of other organizations. To date, there are several examples of ongoing research-oriented projects. One of the most notable is the Platte River Cooperative Hydrology Study (COHYST), a collaborative effort between Nebraska, Wyoming, Colorado, and the Department of the Interior to improve hydrological and geological understanding of the Upper Platte River Basin and to help meet the objectives of the Platte River Recovery Program.[217]

Further, the state has recently launched a new program, the Integrated Network of Scientific Information and GeoHydrologica Tools (INSIGHT), to provide water managers and the public with a one-stop shop for water related data.[218] The main objective of the INSIGHT program is to "aid water managers in understanding current and future demands, evaluating the effectiveness of water management strategies, and assessing the most critical areas of water shortage."[219] There are also a multitude of collaborative groundwater modeling efforts throughout the state, including the Republican River Model, the COHYST model and the Western Water Use Model in the Upper Platte River Basin, as well as models for the Elkhorn, Loup, Lower Platte, Lower Niobrara, and Blue Basins.[220]

The institutional expertise and capability of Nebraska's water resource institutions, combined with the ongoing technical efforts underway in partnership with other state and federal entities, offer support for directed learning and implementation of more adaptive approaches towards water resources management. Moreover, the

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215. NEB. REV. STAT. § 46-715(5)(d)(iii)–(v) (Reissue 2010).
216. *Id.* The extent to which each NRD can employ valuable technical, scientific, and administrative support staff is largely dependent on the financial resources of the particular NRD, which varies from district to district. Revenue generated from taxing irrigated acres means that districts with a larger number of irrigated acres will likely have a larger financial resource basis from which to hire staff.
217. *See Platte River Cooperative Hydrology Study*, NEB. DEP'T OF NATURAL RES., http://cohyst.dnr.ne.gov/ (last visited Oct. 23, 2012). For details on the Recovery Plan, see *supra* notes 113–14 and accompanying text.
218. Stephanie Ashley et al., *An Integrated Network of Scientific Information and GeoHydrologic Tools*, WATER MATTERS, Sept. 2011, at 1–2, *available at* http://dnr.ne.gov/IWM/WaterMatters/WaterMatters_No6.pdf.
219. *Id.* at 2.
220. *Id.* at 3–4.

NRD managers and staff have the unique capability of communicating research goals to the local community, which can build support and add legitimacy to projects while also serving as a means of obtaining local knowledge to inform research efforts.[221] However, these initiatives could be improved and reinforced by implementing a comprehensive and standardized state-wide water use monitoring and reporting program to aid scientifically-based decision making. Currently, only a small percentage of NRDs require groundwater users to install meters to monitor water use.[222] This is regrettable, for "[o]ne of the keys to good water regulation and management depends on having accurate information about water use on which to base decisions."[223]

D. Ensuring Sufficient Funding

Employing adaptive approaches to natural resources management can be an expensive endeavor. There must be stable and sufficient sources of funding to support project implementation, which includes data collection and analysis, monitoring, and implementation of management changes.[224] One of the unique aspects of NRDs is their access to funding sources.[225] NRDs have the authority to levy taxes on property owners for NRD related activities[226] and to issue bonds.[227] There are also several grant programs available to NRDs as a mechanism to fund natural resource and water related projects, including the Nebraska Resources Development Fund, the Nebraska Environmental Trust, the Water Resources Trust Fund, and the Interrelated Water Management Plan Program. Additionally, NRDs can leverage their own funding from state and federal agencies to collaborate on joint projects.[228]

Two recent Nebraska Supreme Court cases illustrate the parameters of NRD taxing authority. Both cases dealt with the constitutionality of LB 701,[229] which allowed Republican River NRDs to issue bonds to fund river management activities intended to keep Nebraska in compliance with regulations imposed by the Republican River Compact between Kansas, Colorado, and Nebraska. The first case, *Garey v. Nebraska Department of Natural Resources*,[230] arose over an annual property tax (up to .045 cents per 100 dollars of taxable valuation for all property within the district) that was put in place to help repay

221. Cash, *supra* note 66, at 16.
222. *See Integrated Water Management: Approved Plans*, *supra* note 184.
223. Sophocleous, *supra* note 2, at 569.
224. DOREMUS ET AL., *supra* note 152, at 13.
225. Cash, *supra* note 66, at 15.
226. NEB. REV. STAT. § 2-3225(1)(a)–(b) (Supp. 2011).
227. NEB. REV. STAT. § 2-3226 (Reissue 2007).
228. Cash, *supra* note 66, at 17.
229. L.B. 701, 100th Leg., 1st Sess. (Neb. 2007).
230. 277 Neb. 149, 759 N.W.2d 919 (2009).

river management bonds.[231] The Nebraska Supreme Court held that NRDs levying a property tax to repay bonds for the purpose of acquiring water rights violated the state constitution's prohibition against "levying a property tax for a state purpose."[232] In contrast, the second case, *Kiplinger v. Nebraska Department of Natural Resources*,[233] upheld the constitutionality of allowing NRDs in the Republican Basin to assess an occupation tax of up to $10 per irrigated acre as a means of paying off the bonds.[234] The Nebraska Supreme Court held that the tax was not a property tax for state purposes but rather an excise tax, not associated with land values but with the "activity of irrigation."[235] Further, the court ruled that the statute authorizing the tax was not special legislation and did not violate a constitutional proscription against commuting a tax.[236] These cases illustrate that NRDs do not have the taxing authority to generate funds for *statewide* water management initiatives, but that they can wield the authority to generate funding for district-wide water-related activities.

Additionally, NRD boundaries are somewhat flexible in that two or more districts can merge into a single district or a single district can be divided, if approved by the affected NRDs and the DNR.[237] This has only occurred once in the history of the NRD system (which originally started out with 24 NRDs) when the Middle Missouri and the Papio NRDs merged in 1989 to form the Papio-Missouri NRD. The merger was likely motivated by the fact that the districts faced relatively few complex management issues, in addition to the Middle Missouri's lack of available financial resources to manage the district on its own.[238]

Overall, NRDs have a diversity of options through which to pursue and secure funding. However, while the NRDs' taxing authority does offer a financial foundation from which to operate, this resource base can be dependent on the number of irrigated acres available for taxing.[239] The number of irrigated acres varies considerably between NRDs, resulting in significant differences in the tax base between districts.[240] Moreover, tying tax revenues to irrigated acres provides an

231. *See* L.B. 701, § 6(a).
232. *Garey*, 277 Neb. at 150, 759 N.W.2d at 922.
233. 282 Neb. 237, 803 N.W.2d 28 (2011).
234. *See* L.B. 701, § 6(a).
235. *See Kiplinger*, 282 Neb. at 243, 803 N.W.2d at 36.
236. *See id.* at 239, 803 N.W.2d at 33–34.
237. NEB. REV. STAT. § 2-3207 (Reissue 2007).
238. JENKINS, *supra* note 65, at 2.
239. *Kiplinger*, 282 Neb. at 243, 803 N.W.2d at 36.
240. The number of irrigated acres various extensively across Nebraska. *See* LORI MCGINNIS, INST. OF AGRIC. & NATURAL RES., NEBRASKA'S INCREASE IN IRRIGATED ACREAGE PUTS STATE FIRST IN THE NATION 2 (2009), *available at* http://water center.unl.edu/archives/2009/2009%20Nebraska%20Increase%20Irrigated%20 Acreage.pdf ("Areas of the state not over the Ogallala Aquifer, such as extreme

incentive for NRDs to keep the number of irrigated acres within the district high (and growing) to generate funding for NRD staff and various natural resource related projects. As a result, NRDs may be unlikely to adopt one of the most effective groundwater control mechanisms in their IMPs—reducing irrigated acres.

E. Supporting Adaptive, Integrated Management

Nebraska's efforts towards integrated management have the potential to support more adaptive approaches to water resources management and could serve as a guidepost for other western states trying to find better ways to integrate divergent legal and institutional systems to manage water resources. The NRD system, in conjunction with efforts toward integrated management planning, are two major efforts that have facilitated increased flexibility within Nebraska's water management system, making it possible to pursue and support more adaptive approaches in managing water resources. In developing IMPs and in addressing natural resources related problems, the DNR and local NRDs have the opportunity to tailor strategies to the problem at hand, improve accountability and enforceability, promote direct learning, and generate funding. However, the extent to which each of these best practice strategies can be achieved depends on the ability of the DNR and NRDs to work together to holistically manage connected surface and groundwater resources and their willingness to enforce and adapt their strategies when necessary.

As highlighted in the preceding section, Nebraska's current framework for water resources management is not without faults. More needs to be done to continue to move the state towards greater integration, namely, to expand integrated planning initiatives to NRDs throughout the state. Proactively addressing surface and groundwater issues before areas become fully appropriated or overappropriated can provide resource managers with increased flexibility in finding ways to adapt to changing conditions down the road.

V. ADAPTIVE, INTEGRATED WATER RESOURCES MANAGEMENT IN OTHER WESTERN STATES

With the realization that institutions as they existed in the past are an ill fit for addressing today's complex and continuously changing water resource scenarios, many western states have taken steps to integrate surface and groundwater systems, albeit to varying de-

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southeast Nebraska, and areas with more marginal cropland like the western Sandhills region, have limited acres under irrigation. In other counties, the majority of cropland is irrigated."). For a map of irrigated acres per county, see BRUCE JOHNSON ET AL., UNIV. OF NEB.-LINCOLN DEP'T OF AGRIC. ECON., NEBRASKA IRRIGATION FACTSHEET 1, 3 (2011).

grees.[241] Arguably, a failure to manage surface and groundwater in an integrated manner not only has the potential to undermine security in water use, but can inhibit a state's ability to pursue more adaptive approaches to manage connected water resources. A unified system of surface and groundwater management through a single framework, a single authority, and a single schedule of priorities would be the most effective way to correlate the conservation and use of hydrologically connected water resources.[242] However, the lack of data in many basins about actual usage, available supplies, seasonal variability, and hydrological interactions creates uncertainty about how to best go about integration.[243] Moreover, surface water users with prior appropriation rights are loath to relinquish or even consider limits on their seniority, making it difficult if not impossible to integrate groundwater usage, much of which is more recent, into a unitary system without creating gross inequities.[244]

Modifying institutional designs to create more integrated management frameworks also raises the question of state versus local control over water resources. Proponents of top-down management emphasize the vital role of the state in setting overarching policy goals and performance standards, and in providing technical expertise. In addition, state involvement may be necessary because the effects of pumping transcend local boundaries[245] and localized agencies often do not have the capacity or jurisdictional reach to coordinate broad-ranging transboundary actions and priorities.[246] Even when empowered with regulatory authority, local agency action may be shortsighted and may give in to the pressure of local constituents who oppose regulation.[247] Choices made by individual pumpers and irrigation districts whose board members include pumpers and their neighbors might neglect the interests of the larger region and of future generations.[248]

Conversely, advocates of bottom-up approaches assert that local entities, rather than state authorities, are better able to devise "workable operating rules"[249] for managing water resources based on the region's specific physical, social, and economic conditions. Further, downsizing (or scaling down) water institutions can make agencies more accountable to local interests and needs, whereas decisions made

241. Tellman, *supra* note 15.
242. Sophocleous, *supra* note 2, at 572; Aiken, *supra* note 143, at 996.
243. Barton H. Thompson, *Beyond Connections: Pursuing Multidimensional Conjunctive Management*, 47 IDAHO L. REV. 273, 282 (2011); Grant, *supra* note 18, at 64.
244. *See supra* note 23 and accompanying text.
245. HANAK ET AL., *supra* note 21, at 393.
246. *Id.* at 195.
247. *Id.*; *see* Getches, *supra* note 13, at 39 (observing that "[d]ecisions that caused mining of the Ogallala Aquifer were too localized").
248. *See* HANAK ET AL., *supra* note 21, at 195.
249. *See id.*; OSTROM, *supra* note 199, at 30, 90.

at the state level can fail to realize regional variations and priorities.[250]

Instead of advocating for a single approach, we highlight the importance of integrating both state and local control in managing water resources.[251] Finding ways to better integrate the management of surface and groundwater resources, through linked or nested local, state, and even federal institutional arrangements, will be vital in managing water resources into the future.

This Part looks at the efforts of other western states in moving toward more integrated water management strategies. Outside of Nebraska, most western states follow a statewide approach for all water resources, but a few have experimented with local control over groundwater.[252] We focus most closely on Kansas and Colorado, assessing their attempts to reform their institutional frameworks to achieve a more holistic approach to water resources management. We also consider positive developments in the institutional designs of Alaska, Montana, and several other western states.

A. Examples of Integrated Management Systems in the West

Alaska, Kansas, Montana, Nevada, New Mexico, North Dakota, and Utah have adopted unified state-led systems that treat both surface and groundwater as one for management purposes.[253] However, the intricacies of how each system evolved and how each currently operates vary.

In Alaska, surface and groundwater are managed conjunctively as a single resource regulated by the Alaska Department of Natural Resources, Division of Mining, Land, and Water.[254] Alaska's unified system of water management dates back to its 1959 statehood when the state constitution was passed, adopting the prior appropriation system.[255] This scenario makes Alaska unique in that it was able to adopt a unified system from the start, when the connection between groundwater and surface water was well established.[256] Further, un-

250. Getches, *supra* note 13, at 39.
251. Thomas Dietz et al., *The Struggle to Govern the Commons*, 302 SCIENCE 1907, 1910 (2003).
252. David A. Sandino, *California's Groundwater Management Since the Governor's Commission Review: The Consolidation of Local Control*, 36 MCGEORGE L. REV. 471, 475–76 (2005).
253. Tellman, *supra* note 15, at 16. For a detailed discussion of the Kansas system, see *infra* section V.B.
254. *Water Rights in Alaska*, ALASKA DEP'T OF NATURAL RES., http://dnr.alaska.gov/mlw/water/wrfact.cfm (last visited Oct. 24, 2012).
255. "Wherever occurring in a natural state, the water is reserved to the people for common use and is subject to appropriation and beneficial use . . . ." ALASKA STAT. ANN. § 46.15.030 (West 2004).
256. Tellman, *supra* note 15, at 17.

like many western states, Alaska has relatively abundant water resources and a population density of just 1.2 people per square mile, the lowest in the United States.[257]

Montana's state constitution, like many of those adopted in the West during the nineteenth century, proclaims that all waters, including both surface and groundwater, are the property of the state and are subject to appropriation for beneficial uses.[258] In 1973, the Montana Water Use Act created a permit system for obtaining new or additional water rights and also required that all water rights existing prior to July 1, 1973, be adjudicated in state courts,[259] a process that is still underway almost forty years later.[260] Prior to 1973, there was no system of centralized recordkeeping for water rights and the right to use water was obtained simply by putting water to a beneficial use.[261] Under Montana's current system, the Department of Natural Resources and Conservation is charged with administering the Montana Water Use Act as it relates to water uses after June 30, 1973.[262] However, the agency plays a limited, mainly advisory role, in adjudicating pre-1973 water rights.[263] Instead, district water courts are responsible for adjudicating claims.[264]

Reforms in Montana have also attempted to address conjunctive water use. The doctrine of prior appropriation governs both surface and groundwater users. Applicants for a new use must show "no injury" to senior users in order to secure a permit. In practice, however, "the check on new ground water withdrawals is only invoked when senior water rights holders—surface water users—object to new permits."[265] Senior users may be reluctant to object because they then "face the formidable expense of retaining legal counsel and obtaining

257. *Resident Population Data*, U.S. CENSUS BUREAU, http://2010.census.gov/2010census/data/apportionment-dens-text.php (last visited Oct. 24, 2012).
258. MONT. CONST. art. IX, § 3.
259. *See* MONT. CODE ANN. §§ 85-2-101 to -907 (1973).
260. The slow pace of the adjudication process is attributed in large part to the lack of staff and funding. In 2005, a water rights fee was placed by the legislature to increase funding to the Montana Department of Natural Resources and Conservation and the Montana Water Court to speed up the process. *See* CLARK FORK RIVER BASIN TASK FORCE, MANAGING MONTANA'S WATER: CHALLENGES FACING THE PRIOR APPROPRIATION DOCTRINE IN THE 21ST CENTURY 2 (2008), *available at* http://dnrc.mt.gov/wrd/water_mgmt/clarkforkbasin_taskforce/pdfs/appropriation_paper.pdf.
261. *Id.*
262. Since 1982, the state of Montana has been working to adjudicate around 215,000 claims. John Grassy, *Montana's New Cure for a Water-Rights Problem*, MONT. LAW., Dec. 2007–Jan. 2008, at 9.
263. *See* CLARK FORK RIVER BASIN TASK FORCE, *supra* note 260, at 6.
264. *Id.*
265. Laura S. Ziemer et al., *Groundwater Management in Montana: On the Road from Beleaguered Law to Science-Based Policy*, 27 PUB. LAND & RESOURCES L. REV. 75, 79 (2006).

expert hydrologic analyses to demonstrate 'injury' from the proposed new ground water withdrawals."[266] As such, basin closures have become an alternative mechanism for surface water users to limit the impacts of groundwater pumping. To address depletion and overappropriation, by the early 1990s the Montana legislature had enacted a series of basin-closure laws that impose moratoria on the processing of new appropriation applications in specific regions of the state. The moratoria will remain in place until the final decrees of water claims in each basin are issued, which may take decades.[267]

A report published by the Montana Clark Fork Basin Task Force identified a major challenge of the current system: "[R]eliance on the judicial system and contested case administrative process [places] the burden on individual water users to adjudicate, enforce, protect, and make changes to existing water rights [and] can literally take years and tens of thousands of dollars."[268] According to the report, the burden on individual right holders threatens the viability of the rights themselves, for a water right that "cannot be defined, enforced, protected, and/or changed, has little or no value."[269] Moreover, surface water flows are still being adversely affected by increased groundwater pumping, despite the reforms.[270] As a result, the system is not ideal due to the uncertainties, time, and expense of the permit proceedings.[271]

Under Nevada law, both surface and groundwater rights are governed by prior appropriation systems.[272] The state engineer is in charge of the administration and enforcement of all surface and groundwater uses within the state.[273] The state engineer was first given control over artesian wells and definable underground aquifers in 1913 with the passage of the Nevada General Water Law Act, followed by control of all groundwater in the state with the enactment of the 1939 Nevada Underground Water Act.[274] Subsequent amend-

266. *Id.* at 79.
267. *Id.* For Montana's permitting regime, see MONT. CODE ANN. §§ 85-2-311, -321, -330, -336, -337, -344, -342, -343 (2005) (describing the general permit criteria and particular restrictions applicable to the Milk, Teton, Upper Clark Fork, Bitterroot, and Upper Missouri River Basins).
268. *See* CLARK FORK RIVER BASIN TASK FORCE, *supra* note 260, at 7.
269. *Id.* at 15.
270. *See* Ziemer et al., *supra* note 265, at 78 ("[R]apid population growth means that the aquifer that feeds the Gallatin River is being tapped for ground water at an unprecedented rate. . . . Just in the last 20 years, the number of permitted ground water appropriations has nearly tripled. Over-tapping the aquifer can have a devastating effect on the flows in the Gallatin River.").
271. *Id.* at 93.
272. NEV. REV. STAT. § 533.030 (2007).
273. NEV. REV. STAT. §§ 532.010 to .230 (2007).
274. *Nevada Water Law 101*, NEV. DEP'T OF CONSERVATION & NATURAL RES., http://dcnr.nv.gov/documents/documents/nevada-water-law-101/ (last visited Oct. 24,

ments addressed the forfeiture of groundwater rights and clarified the nature of rights to use groundwater.[275] State law coexists, sometimes uneasily, with myriad federal laws governing reclamation projects and the implementation of the Colorado River Compact.[276] And in Nevada, perhaps more than in any other western state, the urban interests of large cities (specifically Las Vegas) clash markedly and sometimes irreconcilably with the interests of farmers and mining concerns. These tensions plus "Nevada's relative tardiness in regulating the rights of its water users [have] produced a quagmire of competing vested rights exempted from the permit system and generated endless litigation and adjudications."[277]

In addition to Montana[278] and New Mexico,[279] whose unified approach to managing water resources came online in the 1970s, several western states adopted the prior appropriation doctrine to jointly manage both surface and groundwater resources relatively early, before extensive groundwater development took hold:[280] Utah in

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2012). For details, see Sylvia Harrison, *The Historical Development of Nevada Water Law*, 5 U. DENV. WATER L. REV. 148, 167, 172 (2001).

275. Harrison, *supra* note 274, at 172–73 n.213. Under Nevada law, "a vested right is a water right on underground water acquired from an artesian or definable aquifer prior to March 22, 1913, and an underground water right on percolating water, the course and boundaries of which are incapable of determination, acquired prior to March 25, 1939" as determined by the state engineer. NEV. REV. STAT. § 534.100(1) (2007).

276. Doug Grant, *Water Law at the Boyd School of Law*, NEV. LAW., Sept. 2009, at 38–39.

277. Harrison, *supra* note 274, at 182.

278. In 1972, a revised Montana Constitution was adopted, recognizing and confirming all surface, underground, flood, and atmospheric waters within the boundaries of the state are the property of the state subject to appropriation for beneficial uses. MONT. CONST. art. IX, § 3; *see supra* notes 259–62.

279. New Mexico's Constitution provides that "[t]he unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use." N.M. CONST. art. XVI, § 2. While New Mexico's constitution fails to mention groundwater, the subject was later addressed in 1978 when the state passed a comprehensive groundwater statute proclaiming that "[t]he water of underground streams, channels, artesian basins, reservoirs or lakes, having reasonably ascertainable boundaries, is declared to belong to the public and is subject to appropriation for beneficial use." N.M. STAT. ANN. § 72-12-1 (LexisNexis Supp. 2005). Any person claiming to have a vested water right from any underground source by application of water for a beneficial use can make and file an application with the state engineer and, after verification of the information, can use the record as prima facie evidence of the truth of its contents. N.M. STAT. ANN. § 72-12-5 LexisNexis 1997). For an early case holding that the state engineer had authority to impose conditions on groundwater permits to protect surface water supplies, see City of Albuquerque v. Reynolds, 379 P.2d 73 (N.M. 1962).

280. *See* GLENNON, *supra* note 69, at 26. Groundwater usage rapidly escalated in the 1940s and 1950s due to technological advances and increased availability of low-cost energy sources. *See* Peck, *supra* note 77, at 312 (describing that the dominant period of groundwater development took place following Kansas's adoption

1935,[281] Nevada in 1939,[282] Kansas in 1945,[283] and North Dakota in 1955.[284] Furthermore, in addition to maintaining unified water management systems, Kansas, Montana, Nevada, New Mexico, and Utah have comprehensive state water plans that address both water quality and quantity.[285] Incorporating water supply planning into land use planning is a modest but useful step on the path to sustainable use. A few states, including Nevada, have gone further by conditioning new urban development on proof of an adequate water supply.[286]

Other states maintain a system that manages surface and groundwater resources separately, but integrates management (at least in certain areas) so that permit applications in one system are reviewed for existing or future impacts on the other type of water use.[287] Varying examples of such approaches can be found in Colorado, Idaho, Oregon, South Dakota, Washington, and Wyoming.[288] A unifying theme for these states is that all hydrologically connected water rights are based on the doctrine of prior appropriation.[289] For instance, Wyoming follows the prior appropriation doctrine for both surface[290] and groundwater[291] but manages the resources separately unless they are found to be hydrologically connected, in which case they are coordi-

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of the prior appropriation system for groundwater in 1945); Zellmer, *supra* note 37, at 398–99.

281. 1935 Utah Laws 195 (requiring a state-issued permit to appropriate groundwater); Wrathall v. Johnson, 40 P.2d 755 (Utah 1935) (holding that all groundwater within the state is subject to appropriation); *see* John Ruple, *Clear Law and Murky Facts: Utah's Approach to Conjunctive Surface and Groundwater Management*, 47 IDAHO L. REV. 217 (2010).

282. *See* NEV. REV. STAT. § 534.100(1) (2007).

283. KAN. STAT. ANN. § 82a-701 (1997). For a discussion of Kansas law, see *infra* section V.B.

284. Wells A. Hutchins, *Trends in the Statutory Law of Ground Water in the Western States*, 34 TEX. L. REV. 157, 170 (1955). In North Dakota, all waters *except* diffused surface waters are subject to appropriation. N.D. CENT. CODE § 61-01-01 (2003).

285. *See* JAMES E. KUNDELL ET AL., GA. STATE UNIV., ANDREW YOUNG SCH. OF POLICY STUDIES, DEVELOPING A COMPREHENSIVE STATE WATER MANAGEMENT PLAN 5–6 (2000). New Mexico also requires that the state prepare and implement a comprehensive state water plan, focusing on both water quantity and quality. N.M. STAT. ANN. § 72-14-3.1 (LexisNexis Supp. 2005).

286. Dan Tarlock & Sarah Bates, *Western Growth and Sustainable Water Use: If There Are No "Natural Limits," Should We Worry About Water Supplies?*, 38 ENVTL. L. REP. 10582, (2008). "Nevada, for example, requires that all water suppliers prepare conservation plans based 'on the climate and living conditions of' the service area, and includes weak future supply assessment duties in the state's mandatory comprehensive regional water plans. The only mandatory components are drought reserves and future growth margins." *Id.* at 10586.

287. *See* Tellman, *supra* note 15, at 14.

288. *Id.*

289. For a detailed discussion of Colorado law, see *infra* section VI.C.

290. WYO. CONST. art. 8, § 3.

291. WYO. STAT. ANN. § 41-3-915 (2011).

nated as one.[292] The state engineer has the authority to approve or reject water right applications[293] and can further impose conditions or limitations on the application to protect existing water-right holders.[294] Idaho has also devised a conjunctive management scheme for surface and groundwater areas determined to share a common groundwater supply.[295] This system is guided by the doctrines of prior appropriation[296] and reasonable use.[297] Within hydrologically connected areas, senior-priority surface and groundwater users can place a delivery call[298] on the river against junior groundwater pumpers. Under the Rules for Conjunctive Management of Surface and Ground Water Resources, the director of the Idaho Department of Water Resources is responsible for responding to the delivery call and determining if the senior water user has suffered a material injury.[299] The director considers a suite of factors to determine material injury.[300] If a material injury is found, the director may regulate the

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292. WYO. STAT. ANN. § 41-3-916 (2011).
293. The state engineer has authority over "the waters of the state and of their appropriation, distribution and diversion . . . ." WYO. CONST. art. 8, § 2. "No well shall be constructed . . . unless a permit has been obtained from the state engineer." WYO. STAT. ANN. § 41-3-905 (2011).
294. WYO. STAT. ANN. § 41-3-915 (2011).
295. IDAHO ADMIN. CODE r. 37.01.01.000 to .03.12.060 (2012). Areas with a common groundwater supply are defined as a "ground water source within which the diversion and use of ground water or changes in ground water recharge affect the flow of water in a surface water source or within which the diversion and use of water by a holder of a ground water right affects the ground water supply available to the holders of other ground water rights." IDAHO ADMIN. CODE r. 37.03.11.010 (2012). For an overview of Idaho's current water management system, as well as a review of current and future challenges, see FRED L. OGDEN & MELINDA HARM-BENSON, U.S. GEOLOGICAL SURVEY, INTEGRATED MANAGEMENT OF GROUNDWATER AND SURFACE WATER RESOURCES (2010).
296. IDAHO ADMIN. CODE r. 37.03.11.020 (2012).
297. *Id.*

> These rules integrate the administration and use of surface and ground water in a manner consistent with the traditional policy of reasonable use of both surface and ground water. The policy of reasonable use includes the concepts of priority in time and superiority in right being subject to conditions of reasonable use as the legislature may by law prescribe . . . .

Id.; *see also* Am. Falls Reservoir Dist. No. 2 v. Idaho Dep't of Water Res., 154 P.3d 433, 439, 453–54 (Idaho 2007) (rejecting a constitutional challenge to the new Rules for Conjunctive Management of Surface and Ground Water Resources).
298. A delivery call is a "request from the holder of a water right for administration of water rights under the prior appropriation doctrine." IDAHO ADMIN. CODE r. 37.03.11.010 (2012).
299. IDAHO ADMIN. CODE r. 37.03.11.031 (2012). "Material injury" is defined as a "[h]indrance to or impact upon the exercise of a water right caused by the use of water by another person as determined in accordance with Idaho Law . . . ." IDAHO ADMIN. CODE r. 37.03.11.010 (2012).
300. The director may consider the following factors in determining whether water rights holders "are suffering material injury and using water efficiently and with-

water users in "accordance with the priorities of rights" or allow out-of-priority use by the junior groundwater user pursuant to an approved mitigation plan.[301] Mitigation plans detail "actions and measures to prevent, or compensate holders of senior-priority water rights for, material injury caused by the diversion and use of water by the holders of junior-priority ground water rights within an area having a common ground water supply."[302]

A few states, including Arizona, California, Oklahoma, and Texas, have distinctly separate frameworks for managing surface and groundwater resources and, in California's case, a formal system has yet to be put in place to manage groundwater.[303] Arizona's divided legal framework maintains a system of reasonable use for groundwater[304] and prior appropriation for surface water.[305] The Arizona Department of Water Resources was created in 1980 to oversee water use within the state;[306] however, management of surface and groundwater resources remains split under the agency's framework, which maintains separate directors for its surface and groundwater divisions, which are further separated into Adjudications and Active Management Areas sections.[307] There are five Active Management

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out waste": (a) the amount of water available; (b) the effort or expense of the water right holder to divert the water; (c) the affect junior-priority pumping has on the quantity and timing of water availability; (d) If for irrigation, the rate of diversion compared to acreage of land served, volume of water diverted, system efficiency, and irrigation methods employed; (e) water use compared to water rights; (f) existence of water monitoring devices; (g) the extent to which the senior-priority water right could be met through "reasonable diversion and conveyance efficiency and conservation practices;" and (h) the extent to which the senior-priority water right could be met using alternative means, including use of wells. IDAHO ADMIN. CODE r. 37.03.11.042 (2012); *see Am. Falls Reservoir Dist. No. 2*, 154 P.3d at 447.

301. IDAHO ADMIN. CODE r. 37.03.11.040 (2012).

302. IDAHO ADMIN. CODE r. 37.03.11.010 (2012).

303. *See* Joseph L. Sax, *We Don't Do Groundwater: A Morsel of California Legal History*, 6 U. DENV. WATER L. REV. 269, 270 (2003). For an assessment of recent developments giving local entities greater authority to manage groundwater, see REBECCA NELSON, WOODS INST. FOR THE ENV'T, UNCOMMON INNOVATION: DEVELOPMENTS IN GROUNDWATER MANAGEMENT PLANNING IN CALIFORNIA, at iv (2011); Sandino, *supra* note 252, at 482–90.

304. Bristor v. Cheatham, 255 P.2d 173, 180 (Ariz. 1953).

305. Chris Avery et al., *Good Intentions, Unintended Consequences: The Central Arizona Groundwater Replenishment District*, 49 ARIZ. L. REV. 339, 340 (2007); Robert Jerome Glennon, *In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water*, 36 ARIZ. L. REV. 567, 568 (1994).

306. ARIZ. REV. STAT. ANN. § 45-102 (2009).

307. Charlotte Benson, *Integrated Water Management When Surface and Groundwater are Legally Separate*, 106 J. CONTEMP. WATER RES. & EDUC. 27, 29 (1997).

Areas within the state that consist of densely populated areas where severe groundwater overdraft has occurred.[308]

Texas is unique in that it follows the prior appropriation doctrine for surface water but employs the rule of capture for groundwater resources in all but a few critically designated areas.[309] The rule of capture gives the overlying landowner an unlimited right to withdraw water found beneath the owned land, with no liability for harm caused to other users.[310] Notably, Texas, unlike many other western states, gives control over its sixteen designated groundwater areas to local authorities.[311]

Under Oklahoma law, groundwater is considered private property and is owned by the overlying landowner.[312] Groundwater is governed by the rule of reasonable use, regulated by Oklahoma groundwater law and administered by the Oklahoma Water Resources Board.[313] Further, the landowner owns standing surface water and diffuse surface water on the property as long as it does not form a "definite stream."[314] Streams are regulated by a combination of ripa-

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308. Allison Evans, *The Groundwater/Surface Water Dilemma in Arizona: A Look Back and a Look Ahead Toward Conjunctive Management Reform*, 3 PHX. L. REV. 269, 278 (2010).

309. *See* Sipriano v. Great Spring Waters of Am., Inc., 1 S.W.3d 75 (Tex. 1999); Hous. & T.C. Ry. Co. v. East, 81 S.W. 279 (Tex. 1904).

310. Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 826 (Tex. 2012).

311. Sandino, *supra* note 252, at 475–76. In 2005, Texas was divided into sixteen Groundwater Management Areas (GMAs) that "work with local groundwater districts (and areas without districts) to estimate 'desired future conditions' for an aquifer in a given GMA for the next fifty years." Christopher R. Brown, *A Hole in the Bucket:* Aspermont*'s Impact on Groundwater Districts and What It Says About Texas Groundwater Policy*, 39 TEX. ENVTL. L.J. 1, 2 (2008). However, there are significant restrictions on the districts' enforcement powers. *See id.* at 28 ("Texas has not yet achieved another feature of effective groundwater regulation: efficient local mechanisms for conflict resolution.").

312. OKLA. STAT. ANN. tit. 60, § 60 (West 2010).

313. OKLA. STAT. ANN. tit. 82, § 1020.9 (West 1990). The amount of groundwater apportioned is based on the amount of land owned. "Each applicant is allotted two acre-feet/year per acre of land in basins where maximum annual yield studies have not yet been completed, and slightly more or less than that amount in basins where studies have determined how much water may be safely withdrawn." *Groundwater Permitting*, OKLA. WATER RES. BD., http://www.owrb.ok.gov/supply/watuse/gwwateruse.php (last visited Oct. 23, 2012).

314. OKLA. STAT. ANN. tit. 60, § 60 (West 2010) ("The owner of the land owns water standing thereon, or flowing over or under its surface but not forming a definite stream."). A "definite stream" is defined as a "watercourse in a definite, natural channel, with defined beds and banks, originating from a definite source or sources of supply. The stream may flow intermittently or at irregular intervals if that is characteristic of the sources of supply in the area." OKLA. STAT. ANN. tit. 82, § 105.1 (West 1990).

rian and appropriative rights.[315] In contrast to groundwater, streams are considered public water subject to appropriation.[316]

Only recently removed from this category of states, Nebraska is caught somewhere in limbo between an integrated and a non-integrated system. While IMPs have been put in place for fully appropriated and overappropriated basins, local districts still remain the preferred regulators of activities that may contribute to groundwater depletion, even if those activities have transboundary effects.[317] Disputes between groundwater users are resolved by litigation employing the hybrid correlative rights–reasonable use doctrine, disputes between surface water users are resolved by the prior appropriation system, and disputes between the two types of users are governed by the *Restatement (Second) of Torts*.[318]

B. The Kansas Model for Water Management

In the 1800s, Kansas followed the absolute ownership doctrine for groundwater resources and the riparian doctrine for surface water resources.[319] However, with the passage of the Kansas Water Appropriation Act in 1945, the state moved to the prior appropriation system for both surface and groundwater.[320] Under the Act, all water rights must be obtained through the prior appropriation system; however, mechanisms were established for preserving pre-1945 rights as "vested rights"[321] under the new system.[322]

The chief engineer of the Division of Water Resources (DWR) within the Kansas Department of Agriculture is charged with administering water allocation and use through a permit system under the Kansas Water Appropriation Act.[323] In addition to the DWR, Kansas has Groundwater Management Districts that came into existence with the enactment of the Groundwater Management District

315. L. Mark Walker & Reagan E. Bradford, *The Basics of Oklahoma Water Law*, 80 OKLA. B.J. 1748, 1749–50 (2009).
316. OKLA. STAT. ANN. tit. 60, § 60 (West 2010).
317. NEB. REV. STAT. § 46-702 (Reissue 2010).
318. *See supra* subsections II.B.1–2.
319. City of Emporia v. Soden, 25 Kan. 588 (1881). For a more complete history of Kansas groundwater management, see John C. Peck, *Groundwater Management in Kansas: A Brief History and Assessment*, 15 KAN. J.L. & PUB. POL'Y 441 (2006).
320. *See* KAN. STAT. ANN. § 82a-701 (1997).
321. A "vested right" is defined as "the right of a person under a common law or statutory claim to continue the use of water having actually been applied to any beneficial use, including domestic use, on or before June 28, 1945, to the extent of the maximum quantity and rate of diversion for the beneficial use made thereof . . . ." *Id.*
322. *See* John C. Peck et al., *Kansas Water Rights: Changes and Transfers*, 57 J. KAN. B. ASS'N 21 (1988).
323. *See* KAN. STAT. ANN. § 82a-701 (1997).

Act (GMDA) of 1972.[324] These districts were established in response to extensive groundwater mining that was occurring as a result of pumping permits granted from 1945 to the 1970s.[325] The GMDA recognized the need for local management entities that could "determine their destiny with respect to the use of the groundwater insofar as it does not conflict with the basic laws and policies of the state of Kansas."[326] Under the GMDA, each district, in cooperation with the chief engineer, develops a district management plan with the ultimate goal of conserving and prolonging the life of the aquifer.[327]

Unlike Nebraska, which has twenty-three locally created NRDs that cover the entire state, Kansas has only five Groundwater Management Districts located in the western and middle portions of the state[328] that were put in place to manage and conserve the groundwater resources of designated areas.[329] As noted by Kansas attorney Leland Rolfs, Groundwater Management Districts have the statutory authority to "recommend regulations to the chief engineer relating to the conservation and management of groundwater within the district" as long as they do not conflict with the GMDA or the Appropriation Act.[330] The chief engineer then has the option of adopting the regulations (which would hold only for that Groundwater Management District), but usually a negotiation ensues until an agreement is reached.[331] Thus, unlike Nebraska's NRDs, which have the ultimate say as to how groundwater resources are managed within their districts,[332] in Kansas the chief engineer has the final say when it comes to the management of both surface and groundwater resources.

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324. KAN. STAT. ANN. § 82a-1020 (1997).
325. *See* Peck, *supra* note 77, at 299.
326. KAN. STAT. ANN. § 82a-1020 (1997).
327. *See* KAN. STAT. ANN. § 82a-1028 (1997).
328. For a map of the current Groundwater Management Districts, see *Ground Water Management Districts*, KAN. GEOLOGICAL SURVEY, http://www.kgs.ku.edu/Hydro/gmd.html (last updated Sept. 12, 2012).
329. *See* KAN. STAT. ANN. § 82a-1020 (1997).
330. Leland E. Rolfs, *Comparing and Contrasting the Roles of the Division of Water Resources and the Groundwater Management Districts in Groundwater Management and Regulation*, 15 KAN. J.L. & PUB. POL'Y 505, 508 (2006). Regulations cover issues including "well spacing, prohibitions on wasting water, safe-yield and depletion formulas, and metering requirements." Marios Sophocleous, *The Evolution of Groundwater Management Paradigms in Kansas and Possible New Steps Towards Water Sustainability*, 414 J. HYDROLOGY 550, 552 (2012).
331. Rolfs, *supra* note 330, at 508.
332. *See* NEB. REV. STAT. § 46-702 (Reissue 2010). For fully appropriated and overappropriated NRDs, once the IMP is collectively approved by both the DNR and respective NRD, the NRD is in charge of enforcing groundwater regulations and overall management of groundwater resources and the state has no control over groundwater resources. However, the DNR has the power to not approve the IMP in the first place if they feel the goals of the IMP will not be achieved by the proposed groundwater controls.

Amendments to the GMDA in 1978 also gave the chief engineer the authority to establish Intensive Groundwater Use Control Areas (IGUCAs) through a public hearing process for areas suffering from severe groundwater mining.[333] Within IGUCAs, the chief engineer has extraordinary powers of regulation, including the authority for mandatory water reductions.[334] The IGUCA process provides the only explicit authority for reducing water rights in Kansas.[335] There are currently eight IGUCAs in place within the state.[336]

Comprehensive water planning in Kansas has been mandatory since the State Water Resources Planning Act was passed in 1963. The Act pronounces that "the state can best achieve the proper utilization and control of the water resources of the state through comprehensive planning which coordinates and provides guidance for the management, conservation and development of the state's water resources."[337] Developed as a way to coordinate local, state, and federal actions, the state water plan considers long-range planning goals through a "comprehensive, coordinated, and continuous adaptive planning approach."[338] The Kansas Water Authority, a twenty-four member group representing a diversity of interests throughout the state, is responsible for approving the State Water Plan. The entire basin plan is reviewed at least every five years, with the latest version of the plan approved in January 2009.[339]

C. The Colorado Model for Water Management[340]

With the adoption of the state constitution in 1876, Colorado was the first state[341] to embrace the prior appropriation doctrine as the governing method for administering the water of its natural streams.[342] Major groundwater legislation did not come into existence until much later, with the passage of three main pieces of legis-

333. KAN. STAT. ANN. §§ 82a-1036 to -1038 (1997).
334. *Id.*
335. *See* Sophocleous, *supra* note 2, at 567.
336. KAN. DEP'T OF AGRIC., INTENSIVE GROUNDWATER USE CONTROL AREAS IN KANSAS (2010), *available at* http://www.ksda.gov/includes/document_center/appropriation/IGUCA_Orders/KS_IGUCA.pdf.
337. KAN. STAT. ANN. § 82a-901a (1997).
338. *See* KAN. WATER OFFICE, KANSAS WATER PLAN: PLANNING HISTORY, PURPOSE AND PROCESS 3 (2009), *available at* http://www.kwo.org/Kansas_Water_Plan/KWP_Docs/VolumeI/Rpt_KWP_2009_PlanningHistory_Purpose_Process.pdf.
339. *Id.* at 5.
340. For an in-depth look at the history of Colorado water law, see Justice Gregory J. Hobbs, Jr., *Protecting Prior Appropriation Water Rights Through Integrating Tributary Groundwater: Colorado's Experience*, 47 IDAHO L. REV. 5 (2010).
341. Marios Sophocleous, *Groundwater Legal Framework and Management Practices in the High Plains Aquifer, USA*, *in* GROUNDWATER MANAGEMENT PRACTICES 325, 347 (Angelos N. Findikakis & Kuniaki Sato eds., 2011).
342. COLO. CONST. art. XVI, § 6.

lation: the 1957 Groundwater Laws;[343] the 1965 Ground Water Management Act;[344] and the 1969 Water Rights Determination and Administration Act.[345]

The 1957 Groundwater Laws required all groundwater users to register with the state engineer, mandated those wanting to drill a new well to obtain a permit from the state engineer (an action that did not grant or confer a groundwater right to a user), and authorized the Colorado Groundwater Commission to designate critical groundwater areas that "have approached, reached or exceeded the normal rate of replenishment."[346] However, the 1957 Groundwater Laws were largely ineffective, as rapidly expanding groundwater use continued to harm senior surface water users.[347] This led to the passage of the Groundwater Management Act of 1965, followed by the Water Rights Determination and Administration Act of 1969. The 1965 Act authorized the Colorado Ground Water Commission to designate groundwater basins where groundwater had little or no connection to a surface stream, to establish a permit system to allocate and regulate groundwater within designated groundwater basins based on a modified prior appropriation system, and to create local groundwater management districts to regulate the designated groundwater basins.[348] Subsequently, the 1969 Act declared: (1) all surface water and tributary groundwater would be governed according to the prior appropriation doctrine;[349] (2) vested water rights would be protected in order of their decreed priorities;[350] (3) non-adjudicated wells would have two years in which to file from their original appropriation date;[351] and (4) augmentation plans could be decreed to allow out-of-date diversion.[352]

As a result of these provisions, groundwater management within Colorado depends largely on how the water is classified. There are four classifications of groundwater: "tributary groundwater" and "designated groundwater" established in the 1965 and 1969 Acts; "nontributary groundwater" located outside of designated groundwater basins, a classification added in 1973; and "nontributary and not-non-

343. 1957 Colo. Sess. Laws 863–73.

344. 1965 Colo. Sess. Laws 1246–68.

345. 1969 Colo. Sess. Laws 1200–30.

346. *See* Hobbs, *supra* note 340, at 12.

347. *See id.*; Lain Strawn, *The Last Gasp: The Conflict over Management of Replacement Water in the South Platte River Basin*, 75 U. COLO. L. REV. 597 (2004).

348. Luke W. Harris & Christopher J. Sanchez, *Considerations for Analyzing Colorado Ground Water: A Technical Perspective*, 15 U. DENV. WATER L. REV. 105, 116 (2011).

349. Water Right Determination and Administration Act, 1969 Colo. Sess. Laws 1200.

350. *Id.* at 1205–06.

351. *Id.* at 1212.

352. *Id.* at 1202–03.

tributary groundwater" in designated Denver Basin bedrock aquifers, included as a classification in 1985.[353]

Tributary groundwater—water hydrologically connected to a surface stream—[354] and surface water are collectively administered by state authorities under the prior appropriation system. Designated groundwater—water that is not hydrologically connected to surface water but is situated in designated groundwater basins—on the other hand, is appropriated through a permit system regulated by the Colorado Ground Water Commission.[355] Non-tributary water is water that is located outside designated groundwater basins and "has little to no hydrologic connection to surface streams."[356] Non-tributary groundwater is not subject to the prior appropriation doctrine and is instead allocated based on overlying land ownership.[357] Lastly, not-nontributary groundwater, described as "water located within the Denver Basin that does not meet the statutory definition of non-tributary ground water,"[358] is allocated on the basis of overlying land ownership, similar to non-tributary groundwater.

The Colorado Division of Water Resources has statutory authority to oversee the administration and distribution of water throughout the state, under the supervision of the state engineer.[359] Colorado also has an established water court system with jurisdiction over many water-related issues, including responsibility for granting surface and groundwater rights.[360] In order to obtain a surface or groundwater right, an application must be filed within one of seven water courts within the state. The courts' jurisdictions are based on watershed boundaries established in the Water Right Determination

353. *See* Hobbs, *supra* note 340, at 13–14.

354. The test for establishing water that is not a tributary (non-tributary water) is rather rigorous in that the proposed diversion cannot deplete surface streams more than one-tenth of 1% of the proposed diversion volume in any single year for up to 100 years. COLO. REV. STAT. § 37-90-103 (2012). Further, the responsibility of proof for establishing non-tributary water lies with the water applicant.

355. "Designated groundwater" has two definitions, either of which can be used by the Commission to designate a groundwater basin: (1) ground water "which in its natural course would not be available to and required for the fulfillment of decreed surface water rights," and (2) ground water "in areas not adjacent to a continuously flowing natural stream wherein ground water withdrawals have constituted the principal water usage for at least fifteen years." COLO. REV. STAT. § 37-90-103(6) (2012).

356. Harris & Sanchez, *supra* note 348, at 119.

357. COLO. REV. STAT. § 37-92-305(11) (2012).

358. Harris & Sanchez, *supra* note 348, at 120.

359. COLO. REV. STAT. § 37-92-301 (2012).

360. COLO. REV. STAT. § 37-92-203 (2012). Colorado water courts do not have jurisdiction over designated water. Any person wishing to appropriate groundwater for a beneficial use in a designated groundwater basin must apply to the Colorado Groundwater Commission in a prescribed form. COLO. REV. STAT. § 37-90-107 (2012).

and Administration Act of 1969.[361] The application, which must be filed in the jurisdiction where the intended diversion is located, is put on public notice so that opponents can file a formal protest.[362] If an application is protested, the case will be reviewed by the water referee and a division engineer who then may refer the case to the water judge for trial.[363] The judge has the authority to decide whether to grant the water right based on the factual issues in the case and how they relate to statutory and case law criteria.[364]

In order to accomplish the task of integrated conjunctive management of surface and groundwater resources, the Colorado legislature authorized the use of augmentation plans in the 1969 Water Right Determination and Administration Act.[365] Augmentation plans are court-approved plans that allow junior water users to divert water out of priority so long as the water is replaced and no harm is caused to senior water-right holders.[366] The replacement water must be of similar quantity and quality, must be available at a suitable location and time, and the rights of others must not be harmed when implementing the water exchange.[367] By developing a mechanism for junior users to make use of water that would otherwise be unavailable, augmentation plans add flexibility to the prior appropriation system. However, augmentation plans are not always a viable solution for junior water-right holders who are unable to find affordable replacement water to run their operations.[368]

Further, one of the deficiencies of the 1969 Act—a feature that makes the Act fall short when it comes to integrated management of surface and groundwater—is its exemption for certain types of wells. An exemption can be obtained for limited commercial purposes and for household use for lots with less than thirty-five acres if the lot was created prior to 1972 or created by an exemption to subdivision laws by a local planning authority.[369] Good data on the impacts of exempt wells on Colorado stream systems is not readily available, but it seems

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361. 1969 Colo. Sess. Laws 1202–03.

362. COLO. REV. STAT. § 37-92-302 (2012); COLO. WATER CT. R. 3.

363. COLO. WATER CT. R. 6.

364. COLO. REV. STAT. § 37-92-305 (2012).

365. *See* Water Right Determination and Administration Act, 1969 Colo. Sess. Laws 1202.

366. R. Waskom & M. Neibauer, *Glossary of Water Terminology*, COLO. STATE UNIV., http://www.ext.colostate.edu/Pubs/crops/04717.html (last updated Oct. 12, 2012).

367. Empire Lodge Homeowners' Ass'n v. Moyer, 39 P.3d 1139, 1150 (Colo. 2001).

368. *See* Sophocleous, *supra* note 341, at 350.

369. Ramsey L. Kropf, *Colorado Groundwater Law*, 49 ROCKY MTN. MIN. L. INST. 7B (2003). If a lot is thirty-five acres or larger, a permit can be granted for up to three single-family dwellings, with one acre of associated lawn and domestic livestock. *Id.*

clear that the exempt well statute is "a departure from conjunctive management."[370]

D. Varying Degrees of Integration

Colorado, Kansas, and Nebraska have all adopted institutional frameworks to pursue more effective, integrated water management, but they have taken a diversity of approaches. Using the adaptive management framework proposed by Doremus,[371] comparisons can be made as to which systems may be better able to tailor management strategies to address the particular water related problem while ensuring accountability and enforceability, promoting focused learning, and securing sufficient funding for data collection and responsive management actions.

1. Tailoring the Strategy to the Problem

Kansas has a unified system for managing surface and groundwater resources, while Colorado and Nebraska have partially integrated systems. While Kansas and Colorado follow the prior appropriation doctrine in managing and settling disputes between connected surface and groundwater, Nebraska's framework employs the prior appropriation doctrine to manage surface water, a hybrid correlative rights–reasonable use doctrine to manage groundwater uses, and § 858 of the *Restatement (Second) of Torts* to settle disputes between the two types of users.[372] Arguably, following a single legal doctrine for the management of hydrologically connected surface and groundwater clarifies the standards for management and facilitates conflict resolution more effectively than managing connected resources under separate legal systems. In Nebraska's case, even with recent changes towards integrated management, the new system is limited in its ability to solve preexisting or even future private conflicts. Conversely, while the prior appropriation doctrine presents more clearly defined rules for all water-right holders based on seniority, the system promises stability rather than flexibility. In places like Colorado, where surface water resources were developed first, surface water users are senior to most groundwater users.[373] This provides certainty but raises issues of equity and efficiency, at least when it comes to tributary groundwater. "Protecting surface water rights holders [under the prior appropriation system] forecloses access

370. *Id.*
371. *See supra* section III.B and Part IV.
372. *See* NEB. REV. STAT. § 46-702 (Reissue 2010); Spear T Ranch, Inc. v. Knaub, 269 Neb. 177, 691 N.W.2d 116 (2005).
373. William Blomquist et al., *Institutions and Conjunctive Water Management Among Three Western States*, 41 NAT. RESOURCES J. 653, 674 (2001).

to much of the groundwater aquifer because intensive groundwater pumping injures the rights of surface water appropriators."[374]

With respect to declining groundwater, Colorado, Kansas, and Nebraska have all developed systems for designating critical groundwater areas. However, unlike Nebraska, whose NRDs focus on a suite of natural resource issues, the groundwater management districts in Colorado and Kansas are single-issue districts that focus solely on issues related to groundwater.[375] Within Kansas, the single-issue focus of districts has made it difficult to integrate surface and groundwater efficiently.[376] While the DWR and the Kansas Water Authority have experimented with a basin-wide management approach in areas of significant decline, this endeavor has had only limited success.[377] This approach, which strives to satisfy local districts, irrigators, and stakeholders through incentive-based alternatives in targeted problem areas throughout the basin, has proved "problematic . . . either because the agency was also the regulatory agency or because it was a top-down approach or . . . because the incentive programs were never sufficiently funded."[378]

One way Kansas has demonstrated flexibility is through the Wichita Aquifer Storage and Recovery Program. Aquifer storage and recovery (ASR) is a process that uses surface water to recharge groundwater resources either through direct recharge (when precipitation or surface water percolates through soils to reach aquifers) or through artificial recharge (when a percolating basin or injection well is used to transfer water into the ground).[379] The goal of the Wichita project is to divert water during above average flows from the Little Arkansas River and recharge it back to the aquifer via basins, trenches, or injection wells.[380] The Wichita project is designed to provide municipal water for Wichita and area irrigators, while also forming a barrier to prevent the migration of saltwater plumes to the Wichita well field.[381] To ensure legitimacy and remove potential legal barriers,[382] the Kansas DWR worked with the City of Wichita to develop a new set of regulations specifically aimed at ASR permitting,[383]

374. *Id.*
375. *See* Peck, *supra* note 77, at 300; Sophocleous, *supra* note 2, at 570 (discussing Kansas's focus on specific-issue groundwater management districts).
376. *See* Cash, *supra* note 66, at 19.
377. *See* Sophocleous, *supra* note 2, at 555.
378. *Id.* Consequently, Kansas's efforts have been "scaled down with regard to creating further management plans or holding meetings with stakeholders." *Id.*
379. Blomquist et al., *supra* note 372.
380. *See* Sophocleous, *supra* note 2, at 550.
381. *Id.*
382. *See* Peck, *supra* note 77, at 306.
383. KAN. ADMIN. REGS. §§ 5-12-1 to -3 (2009).

highlighting the state's ability to tailor the strategy to the problem at hand.

Colorado's approach in tailoring the strategy to the problem comes largely by way of groundwater designations, requiring different management strategies based on how the groundwater is characterized. If groundwater is characterized as tributary to a surface stream, management of surface water and tributary groundwater rights is left to the specialized water courts. Colorado has attempted to build flexibility into the rather rigid system of prior appropriation by allowing for the creation of court-approved augmentation plans, providing junior users with the opportunity to divert water out of priority so long as the water is replaced and no harm is caused to senior water-right holders.[384] However, as recently demonstrated in Colorado's South Platte Basin,[385] augmentation plans might not be a feasible solution in all situations because junior water-right holders who are unable to find affordable replacement water have little choice but to cease operating their wells.[386] Further, while Colorado's management approach strives to address the immediate needs of downstream appropriators, it does not protect river flows.[387]

When it comes to proactive, well-tailored water resources management, it appears that Kansas is a step ahead of Nebraska and Colorado. Proactive planning is vital when it comes to addressing uncertainty because it allows for increased flexibility in addressing potential problems before they happen instead of reacting to what has already occurred, when a number of otherwise viable options may be foreclosed. Kansas water policy not only calls for achieving an absolute reduction in water consumption from the Ogallala aquifer to slow aquifer-decline rates,[388] state-wide water planning dating back to 1963[389] increases the state's capacity to deal with an array of complex water resource issues.[390] Neither Colorado nor Nebraska has undertaken the task of state-wide water planning in a meaningful way.[391]

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384. *See* COLO. REV. STAT. § 37-92-305 (2012).
385. For a more in-depth summary of the recent situation in the South Platte Basin of Colorado, see Hobbs, *supra* note 340, at 16–17; P. Andrew Jones, *South Platte Well Crisis, 2002–2010*, WATER REP., Aug. 2010, at 1, 10.
386. *See* Jones, *supra* note 385, at 10.
387. *See* Harris & Sanchez, *supra* note 348, at 118; Ziemer et al., *supra* note 265, at 76 n.1.
388. *See* Sophocleous, *supra* note 2, at 571.
389. *See* KAN. STAT. ANN. §§ 82a-901a to -954 (1997).
390. *See* Getches, *supra* note 13, at 38.
391. The Nebraska DNR's website includes a section entitled "State Water Plan," but the documents listed, which are mostly from the 1970s, don't resemble an actual water plan but simply refer to funding, potential projects, and plans to engage in future planning. *See, e.g.*, NEB. NATURAL RES. COMM'N, STATUS SUMMARY OF POTENTIAL PROJECTS, at i (1979), *available at* http://dnrdata.dnr.ne.gov/PublicScanDisplay/PdfDisplay.aspx?ScanID=1248231 ("The Natural Resources Commission

On the other hand, when it comes to developing solutions that are most readily informed by local concerns and conditions, Nebraska's NRD system stands out. Each NRD Board of Directors is locally elected and has the ultimate authority to make decisions about how groundwater resources are managed. While Kansas and Colorado groundwater management districts also have locally elected boards,[392] in Kansas district recommendations are subject to the veto of the state engineer while in Colorado the districts may request local exceptions but tend to implement state policies.[393]

2. *Ensuring Accountability and Enforceability*

Responsibility for ensuring accountability and enforcement for integrated water management differs dramatically between the three states. In Colorado, water courts are accountable for managing and enforcing regulations as they relate to hydrologically connected surface and tributary groundwater. In Kansas, accountability in managing water resources lies largely with the chief engineer, who has a statutory mandate to "enforce and administer" the provisions of the Kansas Water Appropriation Act.[394] However, while the chief engineer ultimately decides how water resources are managed, Kansas groundwater management districts can recommend regulations to the chief engineer as they relate to groundwater management within their local district. Further, once regulations are adopted by a groundwater management district, the district has the power to "enforce by suitable action, administrative or otherwise," those regulations for the conservation and management of groundwater within the district.[395] In Nebraska, both the state DNR and the local NRDs are responsible for deciding how surface and groundwater resources are to be managed through the development of IMPs. However, once these plans are complete, the state is responsible for enforcing issues related to surface water rights and each local NRD has the responsibility to enforce groundwater related issues. If conflicts arise between surface and groundwater resources, the dispute must be resolved in the courts.

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is submitting this revision of Volume 1 of the Status Summary as the final publication in the original State Water Plan series. In response to the Legislature's directive to redirect and accelerate water resources planning, the involved state agencies have developed a revised State Water Planning and Review Process that does not include a 'State Water Plan' as originally designed. Since it will still be some months before the revised process can be fully implemented, the Commission has prepared this publication to provide current information on potential projects . . . .").

392. Stephen E. White & David E. Kromm, *Local Groundwater Management Effectiveness in the Colorado and Kansas Ogallala Region*, 35 NAT. RESOURCES J. 275, 283 (1995).

393. *Id.* at 279.

394. KAN. STAT. ANN. § 82a-706 (1997).

395. KAN. STAT. ANN. § 82a-1028(q) (1997).

Long-running debates have persisted over the merits of state versus local control over natural resources and it is not the goal of this Article to come down on either side of this topic.[396] From an adaptive management standpoint, however, there are valid arguments to support each viewpoint.[397] Nobel Prize winner Elinor Ostrom emphasized the importance of local involvement in governing common pool resources as a basis for establishing accountability and effective-enforcement.[398] Her arguments weigh in favor of local governance of groundwater resources, at least those that are non-tributary to surface water flows; however, she also maintains the importance of "nested enterprises" where authority exists at multiple levels of governance, from local to global.[399]

On the other hand, those responsible for making and enforcing decisions must be accountable to the ideals and priorities of the larger whole as opposed to narrow individual or special interest group demands. Broad-based public involvement is an essential ingredient in making publicly supported decisions about how local water resources are managed, but it is not at all clear that members of the public actively engage in the decisionmaking process.[400] Instead, local agencies may be more susceptible to "capture" by individuals and special interest groups than state or, for that matter, federal interests.[401]

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396. *See supra* notes 244–51 (describing pros and cons of state versus local control). A strong argument can also be made that the federal government has a role to play, especially in managing surface water resources and water-dependent species, but also in managing groundwater. *See* Sporhase v. Nebraska *ex rel.* Douglas, 458 U.S. 941 (1982) (finding that groundwater is an article of commerce that may be subject to federal regulation); Reed D. Benson, *Deflating the Deference Myth: National Interests vs. State Authority Under Federal Laws Affecting Water Use*, 2006 UTAH L. REV. 241.

397. *Cf.* Susan C. Nunn, *The Political Economy of Institutional Change: A Distribution Criterion for Acceptance of Groundwater Rules*, 25 NAT. RESOURCES J. 867, 877 (1985) (noting that, regardless of its source, irrigators "will not support an alternative rule designed to increase security of future water availability if it strips the land owner of discretion and authority that is valued more highly than the future security").

398. OSTROM, *supra* note 199, at 90. Ostrom identifies the eight principles of successful water resource management as: (1) clearly defined boundaries; (2) congruence between appropriation and provision rules and local conditions; (3) collective-choice arrangements; (4) monitoring; (5) graduated sanctions; (6) conflict-resolution mechanisms; (7) minimal recognition of rights to organize; and (8) nested enterprises. *Id.*

399. Dietz et al., *supra* note 251, at 1910.

400. White & Kromm, *supra* note 392, at 306. The authors note that, with respect to Kansas and Colorado groundwater management, "[f]ew people appear at regularly scheduled board meetings or more widely publicized meetings held for public input. Not many cast votes in the elections for board members." *Id.*

401. *See* Carol Rose, *Property in All the Wrong Places?*, 114 YALE L.J. 991, 1012 (2005) (describing how stockmen who captured local grazing boards "got just about everything they wanted").

3. *Promoting Directed Learning*

Kansas's statewide water use reporting system is one notable way in which it has strengthened its capacity for directed learning through data collection and dissemination. In 1988, in an effort to generate comprehensive and accurate information on water use, water supplies, and recharge, the Kansas legislature made water use reporting mandatory.[402] Failure to timely file complete and accurate reports can lead to a civil fine of up to $250 per water right.[403] Once received, the data is reviewed, follow-ups are made, and an annual statewide water use report is jointly published by the DWR, the Kansas Water Authority, and the U.S. Geological Survey.[404] As Kansas attorney Leland Rolfs explains, the program has been extremely successful and each year 99.9% of all water use reports are filed.[405] Such information can be used to guide sound water management decisions throughout the state, as well as to facilitate iterative learning.

Unlike Kansas, neither Colorado nor Nebraska has adopted statewide water-use reporting requirements. However, all three states have extensive water modeling efforts underway and engage in directed learning through collaborative local, state, and federal research activities.[406]

4. *Ensuring Sufficient Funding*

Nebraska's NRDs, as well as groundwater management districts in both Kansas and Colorado, have at least some ability to generate funding. Kansas districts are authorized to tax irrigated land and issue bonds, while Colorado districts can tax groundwater use.[407] Kansas districts generate sufficient funding to maintain a staff of at least two full-time employees, in addition to part-time help, while Colorado districts have more limited staffing capabilities.[408] However, Kansas's incorporation of groundwater into the prior appropriation doctrine, combined with its requirement of permits before use,

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402. KAN. STAT. ANN. § 82a-1028(m) (1997). Between both the Ground Water Management Districts and the Department of Water Resources mandatory water use reporting requirements, "over 30,000 points of diversion out of approximately 38,000 active points of diversion are, or have been, required to be metered." Rolfs, *supra* note 335, at 511. Tax incentives for groundwater users are provided for installation of well meters, and the Groundwater Management Districts assist with testing and maintain water flow meters. Sophocleous, *supra* note 2, at 569.

403. Rolfs, *supra* note 330, at 511.

404. *Id.*

405. *Id.*

406. *See supra* notes 213–20 and accompanying text.

407. White & Kromm, *supra* note 392, at 303.

408. *Id.*

necessitates significant resources, both in terms of money and staff, to administer the system of water rights.[409]

Compared to Kansas and Colorado groundwater districts, NRDs in Nebraska not only have greater responsibilities over a suite of natural resources issues, they also tend to have larger staffs, including a full time manager and full-time administrative and technical support. Although there are some limitations on NRD taxing powers under the state constitution, the NRDs have relatively broad funding authorities to accomplish groundwater management controls.[410] Moreover, when it comes to IMPs in fully appropriated and overappropriated basins, the resources of the state DNR are called into play as well.

VI. CONCLUSION

While western states share similarities in their struggles to manage scarce water resources, each state has distinct physical, social, and economic characteristics, as well as a unique history, that have shaped development of their water institutions. States that maintain a unified water management system seem to be most capable of supporting adaptive, integrated management approaches. However, while Alaska, Kansas, Nevada, North Dakota, and Utah integrated the management of surface and groundwater resources before the advent of extensive groundwater development, significant challenges remain in maintaining an integrated management scheme under the prior appropriation doctrine. While the rigid nature of the prior appropriation law understandably springs from the need to protect investments and livelihoods through reliable supplies of water, the inherent inflexibility of the doctrine can undermine efforts to meet new demands for water, such as ecosystem protection and recreational uses, and can limit more efficient, junior uses of water from coming on line in areas where water is already fully allocated.

For Nebraska, as for other western states with bifurcated water management systems, institutional barriers provide the greatest obstacles when it comes to pursuing and implementing more adaptive approaches for integrated surface and groundwater management. However, Nebraska's NRD system and the state's recent move towards integrated management planning offer a unique institutional approach for cultivating improved linkages between local and state water management authorities. These developments, still in their infancy, are promoting learning and water management strategies better tailored to the issues at hand while encouraging accountability and

409. *See* Peck, *supra* note 77, at 312 ("areas with large numbers of groundwater irrigation users per unit area might find the costs of administration of the Prior Appropriation Doctrine prohibitive").

410. *See supra* section IV.D.

enforceability. Funding for current and future actions is always a struggle, but there are an array of tools and resources to be tapped. Nebraska's framework, while not perfect, offers a promising model for western states trying to devise alternative institutional arrangements better able to support adaptive, integrated water resources management.