

# LEGAL PROTECTION FOR GROUNDWATER-DEPENDENT ECOSYSTEMS

*Collin Gannon\**

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## INTRODUCTION

This Note concerns the legal protection of groundwater-dependent ecosystems in the United States and abroad. By first describing the science and ecology of ecosystems that are dependent on groundwater and then surveying the current American legal system that fails to adequately protect groundwater-dependent ecosystems (GDEs), this Note proposes legal reforms that could vastly improve groundwater management systems. State protection of GDEs is sparse and often only operates indirectly as a result of states' water policies focused on water quantity upkeep for consumptive purposes. Part I provides an overview of GDEs. Part II discusses state legal protection, including indirect state protection measures and the public trust

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\* J.D. Candidate 2015, University of Michigan Law School. The author would like to first thank Denise Fort for recommending the topic, as well as for her inspiring dedication toward solving groundwater-related issues in New Mexico and abroad; and second, Noah Hall, for motivating many of the arguments and teaching the Water Law course at Michigan. Many thanks to MJEAL for their helpful suggestions and edits.

doctrine. Part III gives an assessment of the federal government's ability to protect GDEs. The federal government may explicitly reserve federal water rights to protect GDEs through the *Winters* Doctrine, which has successfully protected some at-risk ecosystems by ensuring adequate groundwater resources within federally reserved lands.<sup>1</sup> Additionally, the federal government, like the states, can also indirectly protect GDEs. As highlighted in this Note, such federal actions include attempts to influence state policies through education concerning the hydrological connectivity of surface and ground waters, and thus the necessity to sustainably manage water sources, as well as threats regarding federal funding which effectively forced states to adopt those sustainable water management policies. The Endangered Species Act has unsurprisingly had considerable success in protecting GDEs, but this success is necessarily restricted to situations in which a threatened or endangered species is present. This Note also includes an analysis of the *Sporhase* Doctrine, which involves the protection of GDEs by requiring the open trade of groundwater resources through the Dormant Commerce Clause. But in practice, this doctrine has been generally ineffective.<sup>2</sup>

Part IV addresses international legal regimes and examines Australia, the European Union, and South Africa, all of which have successfully implemented legal protection for GDEs. This Note addresses each regime in turn, exploring the policies and methods taken directly to protect ecosystems. In particular, Australia's mapping initiatives might be a blueprint for similar future endeavors in the United States.<sup>3</sup>

Part V explores one of water law's major "elephants in the room": the definition of "navigable waters" under the Clean Water Act (CWA). The issue of what constitutes "navigable waters" has been debated since the 1970s, with reasonable argument on the side of both narrow and expansive interpretation. Following the Supreme Court's 2006 plurality decision in *Rapanos*, though, Justice Kennedy's controlling opinion establishing the "significant nexus" test for classifying "navigable waters," might have expanded the regulatory scope of the CWA to now reach a greater amount of GDEs.<sup>4</sup> Should this hold true, then the purviews of the CWA's strict liability protection mechanisms could increase conservation of groundwater, and thereby the ecosystems dependent on said groundwater.

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1. See *Winters v. United States*, 207 U.S. 564 (1908).

2. See *Sporhase v. Nebraska ex rel. Douglas*, 458 U.S. 941 (1982).

3. See, e.g., Proposed Directive on Groundwater Resource Management, Forest Service Manual 2560, 79 Fed. Reg. 25815 (proposed May 6, 2014) (suggesting groundwater management on National Forest System lands).

4. *Rapanos v. United States*, 547 U.S. 715, 759 (2006) (Kennedy, J., concurring).

In conclusion, this Note proposes that legal reform in GDE management must in part come through lawful enforcement of the CWA under *Rapanos*. A major component of this Note's argument concerns the Environmental Protection Agency's (EPA) latest scientific report on connectivity that establishes the scientific bases for supplying the requisite elements of Kennedy's "significant nexus" test for navigable waters. This Note argues that increased enforcement of the CWA is legally required post-*Rapanos*, and explains how this increased enforcement can provide GDEs a measure of legal protection that has long been withheld.

Lastly, the Note suggests that a positive step in protecting GDEs could be achieved through the thorough mapping of hydrological connections between groundwater and surface water ecosystems. While the EPA's recent scientific report on connectivity is a start, more research will be needed in light of the uncertainty and lack of publicity surrounding GDEs. The Nature Conservancy, for instance, has sponsored an expansive groundwater-mapping project in Oregon that is similar to the mapping initiatives underway in California. A groundwater mapping initiative that focuses on describing GDEs, similar to the program employed in Australia, can supply lawmakers with a more accurate account of the realities underlying ecosystem and groundwater connectivity. Without an adequate geologic and ecologic data set, to demonstrate the connectivity between groundwater and ecosystems, the danger to ecosystem destruction appears to be too attenuated to inherently demand necessary legal protections.

## I. PRIMER ON GROUNDWATER-DEPENDENT ECOSYSTEMS

The Salt Basin Aquifer in Southern New Mexico, part of which underlies the Otero Mesa, covers 2400 square miles and contains at least fifty-seven million acre feet of groundwater.<sup>5</sup> The Otero Mesa represents the last bastion of Chihuahuan desert grasslands in the United States as overgrazing has led to the invasion of scrublands across virtually every other desert grassland.<sup>6</sup> *Bouteloua eriopoda*, also known as Black Grama, is the primary grass on the Mesa and is highly drought-resistant, a characteristic that makes it difficult to study its reliance on groundwater. In fact, it appears that the area overlaying the Otero Mesa could subsist primarily on the supply of surface waters that flow from the Sacramento Mountains.<sup>7</sup> While the

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5. G.F. HUFF & D.A. CHACE, U.S. GEOLOGICAL SURVEY, OPEN-FILE REPORT 2006-1358, KNOWLEDGE AND UNDERSTANDING OF THE HYDROGEOLOGY OF THE SALT BASIN IN SOUTH-CENTRAL NEW MEXICO AND FUTURE STUDY NEEDS 1 (2006).

6. *Otero Mesa*, SW. ENVTL. CTR., <http://www.wildmesquite.org/what-we-do/desert-lands-wildlife/otero-mesa> (last visited Nov. 18, 2014).

7. See HUFF & CHACE, *supra* note 5, at 1.

surface ecosystem of the Otero Mesa might not be groundwater dependent, flowing and percolating groundwater may still be a conduit of recharge for the aquifer below.<sup>8</sup> This heightens the possibility that contamination from oil and gas development could reach the underlying aquifer.<sup>9</sup> Injection wells, related to oil and gas development in high-density fractured zones around the Otero Mesa, may potentially facilitate the vertical underground migration of injected fluids.<sup>10</sup> There is no direct field evidence indicating the presence of impermeable cap layers (shale-like rock layers capable of containing the underground flow of migrating fluids), a factor which, if present, could warrant deep well injection beneath the water-bearing layers.<sup>11</sup> Models of injected water movement suggest migration at a speed of .05 miles per year from potential zones of deep well injection into the shallow water aquifers underlying the Mesa.<sup>12</sup> Still, there is no definitive proof that the aquifer will be contaminated – and even less evidence of the reliance of the ecosystems above the Salt Basin Aquifer on the groundwater below.

Groundwater hydrology and the classification of ecosystems potentially dependent on groundwater are complex subjects. A more comprehensive understanding of their relationship is needed to effect sustainable conservation measures. This Note focuses on the role that legal protection can play in preserving “invisible” waters like the Salt Basin Aquifer, and other similarly situated aquifers across the country, in the face of great scientific uncertainty (like variable ecosystem reliance over a wide range of geographic area) and the competing demands of different water users across the nation.

Groundwater-dependent ecosystems are products of complex hydrologic interactions between groundwater, surface water, and any dependent flora or fauna. In a GDE, species composition and natural ecological processes are determined by groundwater.<sup>13</sup> There are various established types of GDEs, each varying in dependence on their respective groundwater sources. Aspects of groundwater such as rate and volume of flow, depth of the water table, chemical factors, pH levels, and nutrient concentrations may be important contributors to the health of a particular ecosys-

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8. *Id.* at 10.

9. Melanie L. Luna, Potential for Ground-Water Contamination From the Deep Well Injection of Produced Waters in the Salt Basin, New Mexico 5 (May 2005) (unpublished Master of Water Resources theses, University of New Mexico), available at <http://hdl.handle.net/1928/9235>.

10. *Id.* at 13.

11. *Id.* at i.

12. *Id.* at 48.

13. N.S.W. DEP'T OF LAND AND WATER CONSERVATION, THE NSW STATE GROUNDWATER DEPENDENT ECOSYSTEMS POLICY 9 (2002).

tem.<sup>14</sup> GDEs, reliant on any number of those hydrological qualities, typically vary in their level of dependence from locality to locality. GDEs may be entirely dependent, highly dependent, proportionally dependent, or opportunistically dependent on a groundwater source.<sup>15</sup> The level of dependence affects the potential impact that will be felt within an ecosystem from an imbalance in groundwater quantity or quality.<sup>16</sup> These complex and variable factors that affect groundwater are integral considerations to a holistic approach of managing groundwater resources effectively with regard to social and economic concerns, as well as ensuring the fulfillment of a dependent ecosystem's water needs.<sup>17</sup>

Hydrologists typically designate GDEs into three different categories of dependence. There are ecosystems that depend on the surface expressions of groundwater (rivers, wetlands, and streams), aboveground Phreatophytic ecosystems that depend on the sub-surface expressions of groundwater (plants with deep roots),<sup>18</sup> and cave/aquifer ecosystems that are wholly reliant on groundwater.<sup>19</sup> Aquatic ecosystems, especially those in arid environments, are obligatorily dependent on groundwater.<sup>20</sup> Groundwater can provide a base flow under rivers and streams that can sustain ecosystems through times of drought.<sup>21</sup> A minor disturbance to the supply of groundwater could spell catastrophe for a dependent ecosystem already under the stress of a drought.<sup>22</sup> Groundwater contributes valuable nutrients and organic matter to surface waters and often regulates water tempera-

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14. R.S. BRODIE, R. GREEN & M. GRAHAM, MAPPING GROUNDWATER-DEPENDENT ECOSYSTEMS: A CASE STUDY IN THE FRACTURED BASALT AQUIFERS OF THE ALSTONVILLE PLATEAU, NEW SOUTH WALES, AUSTRALIA 4 (2002), available at [http://aquadoc.typepad.com/waterwired/files/gde\\_brodie\\_et\\_al.pdf](http://aquadoc.typepad.com/waterwired/files/gde_brodie_et_al.pdf).

15. *Id.*

16. *See id.*

17. *See id.*

18. These ecosystems do not depend on classic surface expressions of water, like rivers and streams, but instead on the subsurface expressions of groundwater accessed by plants via capillary fringe (long roots) or tapping into subsurface water that sits just above the water table but that is not wholly saturated. *See* DEREK EAMUS ET AL., ECOHYDROLOGY: VEGETATION FUNCTION, WATER AND RESOURCE MANAGEMENT 169, 171 (2006).

19. *See id.* at 169.

20. *See, e.g.,* Derek Eamus & Ray Froend, *Groundwater-Dependent Ecosystems: The Where, What and Why of GDEs*, 54 AUSTL. J. BOTANY 91, 94 (2006) ("In the absence of groundwater input during extended periods of zero rain . . . many dryland rivers . . . would cease to flow.").

21. *See* JENNY F. BROWN ET AL., OVERCOMING DATA SHORTFALLS TO LOCATE GROUNDWATER-DEPENDENT ECOSYSTEMS AND ASSESS THREATS TO GROUNDWATER QUANTITY AND QUALITY 3 (2007), available at [http://aquadoc.typepad.com/waterwired/files/iah\\_paper\\_jbrown\\_final.pdf](http://aquadoc.typepad.com/waterwired/files/iah_paper_jbrown_final.pdf).

22. *See id.* at 2.

tures.<sup>23</sup> When significant human extraction or contamination occurs, the delicate balance between groundwater and surface water is altered, threatening the health of the ecosystem at large.

An aquifer is a sustainable and dynamic ecosystem with comparable complexity and biodiversity to surface ecosystems.<sup>24</sup> The fauna living in aquifers often descend from ancient lineages that have survived various periods of geologic times.<sup>25</sup> Still, groundwater ecosystems in North America have only recently been recognized for their biodiversity.<sup>26</sup> Based on the interconnection of surface and groundwater systems, it is evident that the exchange of energy between surface plants and groundwater species has important biological implications.<sup>27</sup> Stygofauna, or groundwater invertebrates, display various levels of dependence on groundwater much the same as above ground ecosystems.<sup>28</sup> These groundwater ecosystems typically support a chain of “dependence,” since the groundwater contained in the aquifer may subsequently flow near the surface, supplying Phreatophytic ecosystems, or perhaps discharge into streams, rivers, or wetlands.<sup>29</sup> Stygofauna include worms, snails, crustaceans, fish, and other forms of microbial fauna.<sup>30</sup> These species likely provide aid in maintaining groundwater quality.<sup>31</sup> Functionally, these species can preserve voids in pore space, alter redox gradients, enhance the release of organic carbon and cycling nutrients, promote biofilm activity, and accelerate mass transfer of energy through aquifer sediments.<sup>32</sup> They can purify water by breaking down pathogens, and they perform the critical ecosystem function of breaking down organic matter.<sup>33</sup> Their value is immense to the sustained health of surface biodiversity, but they also represent a bastion of valuable biodiversity themselves.

Aquifer GDEs are highly vulnerable to the consequences of mismanagement of groundwater resources. Such ecosystems have unique ecological characteristics that make them susceptible to contamination and distress

23. Jenny Brown et al., *Groundwater-Dependent Ecosystems in Oregon: An Assessment of Their Distribution and Associated Threats*, FRONTIERS IN ECOLOGY & ENV'T, March 2011, at 97.

24. William F. Humphreys, *Aquifers: The Ultimate Groundwater-Dependent Ecosystems*, 54 AUSTL. J. BOTANY 115, 115, 119 (2006).

25. *Id.* at 115.

26. *Id.*

27. *See id.*

28. *See* BRODIE, GREEN & GRAHAM, *supra* note 14, at 5.

29. *See id.* at 1.

30. Humphreys, *supra* note 24, at 116.

31. *See id.* at 119.

32. *Id.* at 121.

33. Janet S. Herman, David C. Culver & James Salzman, *Groundwater Ecosystems and the Service of Water Purification*, 20 STAN. ENVIL. L.J. 479, 479 (2001).

from over-extraction; further, their intimate contact with their milieu, lack of resting or dispersal stages, slow growth, long life spans, little reproduction, and scarcity in general also renders them vulnerable.<sup>34</sup> They are also referred to as short-range endemics, meaning the species are “restricted to a small geographic area, are vulnerable to change and are a significant issue for biodiversity conservation.”<sup>35</sup> Rapid changes in groundwater quality threaten aquifer GDEs, much the same as a reduction in quantity from over-extraction. Over-extraction directly eradicates their habitat; while contamination may disrupt the requisite chemical balances needed to sustain life.<sup>36</sup> When there is relatively little recharge and long residence time, the effect of a contaminant can be especially disastrous. This type of injury is especially exacerbated when heavy depletion, as a result of water extraction, has reduced the resource to an unsustainable level.<sup>37</sup>

## II. STATE LEGAL PROTECTION FOR GDEs IN THE UNITED STATES

There has been minimal groundwater management and conservation in the United States, perhaps as a result of groundwater’s “misinformation, misunderstanding, and mysticism.”<sup>38</sup> Scientists have only recently come to understand the interconnection between groundwater, groundwater organisms, and surface species. Generally, state groundwater law has not reflected this interconnected nature of the hydrological cycle between surface and groundwater. Yet, while groundwater management has primarily been regulated under the purview of state law, a few federal legal protections do exist in rare circumstances.

### A. Indirect State Protection of GDEs

Water resource management is usually described as being under the domain of the states. A patchwork of laws for regulating water use exists today, essentially amounting to fifty different legal regimes.<sup>39</sup> States in the East generally follow the riparian approach (focused on maintaining watersheds and sharing during drought), whereas states in the West employ the prior appropriation doctrine (recognizing water rights for the first user to put water to beneficial use—be it agriculture, industrial, etc.).<sup>40</sup> Laws regu-

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34. Humphreys, *supra* note 24, at 116.

35. *Id.*

36. See, e.g., BRODIE, GREEN & GRAHAM, *supra* note 14, at 5.

37. See *id.* at 2, 4.

38. John D. Leshy, *The Federal Role in Managing the Nation's Groundwater*, HASTINGS W.-NW. J. ENVTL. L. & POL'Y 1 (Fall 2004).

39. Mark S. Davis & Michael Pappas, *Escaping the Sporhase Maze: Protecting State Waters Within the Commerce Clause*, 73 LA. L. REV. 175, 183 (2012).

40. *Id.* at 184.

lating groundwater management are even more variable across the states. While surface water regimes are generally predictable according to the East/West distinction, groundwater management schemes vary across the country. Most states regard water rights as usufruct,<sup>41</sup> meaning that waters are publicly owned by the state with licenses granted for use. Other states recognize a water right as a freely alienable property right.<sup>42</sup> For example, in New Mexico (a state situated in the heart of the arid southwest) all surface waters “belong to the public and are subject to appropriation for beneficial use.”<sup>43</sup> Groundwater in New Mexico also belongs to the public, and once the State Engineer “declares” (delineates the boundaries of) a groundwater basin, he or she manages appropriations for beneficial use through a permitting system that might theoretically take into account the protection of GDEs.<sup>44</sup> Yet, state determinations of an aquifer’s yield, like that done by the New Mexico State Engineer when permitting appropriations, do not typically involve consideration of any potentially dependent ecosystems.<sup>45</sup>

Some states provide protection for surface flows that are affected by groundwater flows, and in that sense indirectly protect groundwater. In Kansas, groundwater control districts take into consideration the minimum flow requirements of groundwater sustained surface waters when permitting new groundwater withdrawals; this is not unlike similar surface water protections in New Mexico which only provide indirect methods of protecting certain classes of GDEs.<sup>46</sup> The Washington state legislature similarly requires consideration of minimum instream flows for streams in particular management areas when estimating available groundwater for appropriation.<sup>47</sup>

Professor Barton Thompson of Stanford Law School argues that integrated management of surface and groundwater rights, as demonstrated by the two examples above, requires consideration of instream flow and could therefore theoretically provide indirect protection for GDEs.<sup>48</sup> The crux of

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41. That is, a right to use rather than to own. See ROBERT W. ADLER, ROBIN K. CRAIG & NOAH D. HALL, *MODERN WATER LAW* 1 (2013).

42. *E.g., id.* at 182-83 (describing aspects of the doctrine of capture in Texas).

43. N.M. STAT. ANN. § 72-1-1 (1978).

44. *Id.* § 72-12-1; see *id.* §§ 72-12-12, 72-12-20, 72-12-25; see also UTTON TRANSBOUNDARY RES. CTR., *WATER MATTERS!*, at 6-2 to 6-4 (2014), available at <http://uttoncenter.unm.edu/pdfs/water-matters-2014/06-groundwater.pdf>.

45. See Barton H. Thompson, Jr., *Beyond Connections: Pursuing Multidimensional Conjunctive Management*, 47 IDAHO L. REV. 273, 291 (2011).

46. See KAN. STAT. ANN. §§ 82a-928, 82a-1038 (2013) (discussing the conjunctive regulation of groundwater appropriations in accordance with the public interest).

47. WASH. REV. CODE § 90.82.070(g) (2011).

48. Thompson, *supra* note 45, at 291-92; see also KAN. STAT. ANN. § 82a-1038; WASH. REV. CODE § 90.82.070(g).

the argument is that where a surface water user's rights are based in flows from a GDE, like a spring or a river, such user's assertion of senior appropriation rights ought to indirectly protect that very same GDE; if a state requires a certain minimum environmental flow in a river, that flow will be maintained against the junior appropriator, which will indirectly provide for the natural requirements of a GDE.<sup>49</sup> Thompson points to the Idaho Snake River and Eastern Snake Plain Aquifer as examples of successful indirect conservation of GDEs through integrated management of surface and groundwater rights.<sup>50</sup> The Idaho Department of Water Resources adopted certain "conjunctive management rules,"<sup>51</sup> which subject those areas of common groundwater supply (such as the Idaho Snake River and Eastern Snake Plain Aquifer watershed) to integrated management. The Eastern Snake Plain Aquifer discharges numerous cold water springs, held in surface water rights by major fish farms.<sup>52</sup> When a junior groundwater user's withdrawal threatened those springs, the fish farms successfully enjoined the withdrawal on the basis of prior appropriation, thereby protecting the ecosystems dependent on the groundwater.<sup>53</sup> It is possible for the integrated management of surface and groundwater rights, as seen in the Idaho example, to indirectly protect GDEs from the effects of over-extraction. Oregon, like Idaho, requires that groundwater withdrawals do not substantially interfere with surface water rights where surface and groundwater are hydraulically connected.<sup>54</sup>

Some states regulate using more explicit forms of integrated management of surface and groundwater. For example, in Michigan, groundwater withdrawals are regulated to avoid an "adverse resource impact" on waters of the state,<sup>55</sup> defined as a change in flow that impairs the ability of a water body to support characteristic fish populations.<sup>56</sup> In Michigan, the conditions of a healthy ecosystem, measured by the presence of fish, are specifically protected with regard to groundwater withdrawal.<sup>57</sup> These state regulatory measures, which protect groundwater associated with surface water, protect GDEs by indirectly targeting biota associated with instream flows; however, these approaches still neglect other varieties of GDEs.

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49. Thompson, *supra* note 45, at 292.

50. *Id.* at 293.

51. IDAHO ADMIN. CODE r. 37.03.11 (2014).

52. Thompson, *supra* note 45, at 293.

53. *Id.*

54. OR. REV. STAT. § 537.525(9) (1989).

55. Allison Aldous & Leslie Bach, *Protecting Groundwater-Dependent Ecosystems: Gaps and Opportunities*, NAT'L WETLANDS NEWSLETTER, May-June 2011, at 20.

56. MICH. COMP. LAWS § 324.32701(1)(a)(ii) (2008).

57. Aldous & Bach, *supra* note 55, at 20.

Such protections aimed only at preserving surface and groundwater “quantity” inherently fail to appropriately protect against threats to groundwater “quality” from pollution and contamination. Both quantity and quality of groundwater are necessary attributes for sustaining GDEs.<sup>58</sup>

In Florida, the Water Resources Act of 1972 provides legal means for protecting GDEs beyond those protected by instream flow protection.<sup>59</sup> The Act requires that regional management districts regulate groundwater according to a “reasonable-beneficial” standard so that it will not interfere with senior uses and its use is consistent with the public interest.<sup>60</sup> In some management districts, the basis for reviewing a permit application to pump groundwater is the effect the proposed action will have on surrounding wetlands, determined by an evaluation of the potential changes in vegetation, aquatic species, and the wetlands themselves.<sup>61</sup> Some management districts also provide for the “warm water” refuges relied upon by the manatee and gulf sturgeon.<sup>62</sup> Modeled minimum groundwater levels to support the complex and dependent flora and fauna across Florida must be relied upon in the permitting process in order to sustainably balance groundwater withdrawal and other potential environmental effects.<sup>63</sup>

In Rhode Island, the Fresh Water Wetlands Act authorizes similar protection for wetland GDEs and recognizes the value of a GDE to the “general well being of the general populace.”<sup>64</sup> Under the Act, any proposed action that may affect a wetland, no matter how far removed (such as groundwater withdrawal), requires a permit subject to a review assessing water availability for sustaining the wetland.<sup>65</sup> While Florida and Rhode Island seemingly have legislative measures to directly protect GDEs, these measures are still limited in their application. The Florida and Rhode Island approaches only specifically target wetlands and coastal estuaries, leaving certain ecosystems, like aquifer GDEs, unaddressed in the similar legislative measures.

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58. See PUD No. 1 of Jefferson Cnty. v. Wash. Dep’t of Ecology, 511 U.S. 700, 719 (1994) (stating that the distinction between water quality and quantity regulation is artificial).

59. See FLA STAT. § 373.016(3)(b) (1998) (declaring “the policy of the Legislature . . . to promote the conservation, replenishment, recapture, enhancement, development, and proper utilization of surface and groundwater”).

60. See *id.* § 373.036(2)(d)(4); see also § 373.016(4)(a).

61. Aldous & Bach, *supra* note 55, at 20.

62. *Id.* at 20-21.

63. FLA STAT. §§ 373.036(2)(b), 373.042(1)(a).

64. See R.I. GEN. LAWS § 2-1-18 (2013).

65. See *id.* §§ 2-1-21, 2-1-22(d).

The Arizona Department of Water Resources (ADWR) has recognized environmental groundwater requirements.<sup>66</sup> Under the Arizona Groundwater Management Act, the ADWR regulates rights to use groundwater, water conservation programs, and sustainable water supplies for growing cities (such as Tucson) in “Active Management Areas” of the state.<sup>67</sup> A “Draft Demand and Supply Assessment” for the Tucson “Active Management Area” compiled by the ADWR describes riparian needs as a natural demand on the regional water supply, with riparian needs specifically referring to evapotranspiration of the vegetation along the Santa Cruz River.<sup>68</sup> In light of more complete and available science concerning hydrology, the ADWR revised its groundwater management policies to account for the lack of updated legislation.<sup>69</sup> Dr. Sharon Megdal, Director of the University of Arizona Water Resources Research Center, notes that ad hoc voluntary efforts, such as the steps taken by the ADWR (which does not need to make such assessments), have been the primary methods for ecological consideration in surface and groundwater management.<sup>70</sup>

### B. *The Public Trust Doctrine*

The public trust doctrine, whereby a state manages public resources in trust for its citizens, may provide additional indirect protection to GDEs should a state voluntarily choose to apply the doctrine in that manner. States variably enforce the doctrine, which at its core represents the duty of the government to maintain public resources for reasonable use by its citizens. One issue is that this doctrine is undefined in scope and authority from state to state. If a state applies the public trust doctrine to water resources, the doctrine may require conservation.<sup>71</sup> However, it is important to note that the public trust doctrine is indifferent to the type or nature of a threat, and is singularly focused on the conservation of a resource itself.<sup>72</sup> Where a groundwater resource is threatened by over-extraction or contamination from oil or gas drilling, the public trust doctrine could be applied to protect the groundwater, and thereby indirectly protect dependent ecosys-

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66. See Sharon Megdal et al., *The Forgotten Sector: Arizona Water Law and the Environment*, 1 ARIZ. J. ENVTL. L. & POL'Y 243, 250 (2011) (referencing an ADWR report as “an example of Arizona’s water managers’ attempts to recognize environmental water needs.”).

67. *Id.* at 246.

68. ARIZ. DEP’T OF WATER RES., DRAFT DEMAND AND SUPPLY ASSESSMENT, 1985-2025: TUCSON ACTIVE MANAGEMENT AREA 11 (2010), available at <http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/FINALTAMAASSESSMENT.pdf>.

69. See *id.* at vi.

70. Megdal et al., *supra* note 66, at 246, 250.

71. Thompson, *supra* note 45, at 293-94.

72. *Id.* at 294.

tems as a byproduct. Thompson notes that since the public trust doctrine is a creature of common law, a state's traditional water laws that may or may not account for the hydrological connectivity of surface and groundwater should not restrain the doctrine's application.<sup>73</sup>

The Hawaii Supreme Court has applied the public trust doctrine to groundwater, noting that ground and surface waters "represent no more than a single integrated source of water with each element dependent upon the other for its existence"<sup>74</sup> and holding that the "public trust doctrine applies to all water resources, unlimited by any surface-ground distinction."<sup>75</sup> The Hawaii Supreme Court reasoned further that there should be a balancing act of all relevant interests when applying the public trust doctrine to groundwater withdrawal regulations and that potential users must justify their use in light of the threatened resources.<sup>76</sup> The California Supreme Court has extended California's public trust doctrine regarding water withdrawal regulation to "non-navigable" rivers when there are negative impacts downstream.<sup>77</sup> Thompson believes this extension of the doctrine implies that California could extend the doctrine in the future to groundwater withdrawals with similar negative downstream impacts (and presumably protect instream flow GDEs).<sup>78</sup>

The use of the public trust doctrine to protect GDEs is still only an indirect method of protection that is abstractly premised on conservation of groundwater. As in the integrated surface and groundwater management approach, the effect of sustainably maintaining the resources for consumptive uses supposedly ensures that the GDEs benefit as well. Yet, considering the nature of groundwater hydrology and the expansive transboundary ecosystems dependent on particular groundwater resources, patchwork systems of state water management still do not adequately regulate and protect GDEs.

### III. FEDERAL LEGAL PROTECTION OF GDEs

#### A. *The Winters Doctrine*

When the federal government reserves land for federal purposes, it reserves all unappropriated waters that are necessary for fulfilling the re-

73. *Id.*

74. *In re Water Use Permit Applications*, 9 P.3d 409, 447 (Haw. 2000) (quoting *Repun v. Bd. of Water Supply*, 656 P.2d 57, 73 (Haw. 1982)).

75. *Id.* at 447.

76. *Id.* at 454.

77. *Nat'l Audubon Soc'y v. Superior Court*, 658 P.2d 709, 721 (Cal. 1983).

78. Thompson, *supra* note 45, at 295.

served land's federal purposes.<sup>79</sup> This principle is commonly known as the *Winters* Doctrine and has been developed under Federal Indian law.<sup>80</sup> The most recent application of this rule to groundwater was in *Cappaert v. United States*, which involved Devil's Hole. In 1952, President Truman issued a Presidential Proclamation that reserved Devil's Hole as a national monument.<sup>81</sup> Devil's Hole is a deep cavern in Niagara Falls, Nevada, containing underground pools of water home to a variety of unique fish species. When the Cappaerts began pumping groundwater to their ranch, the water level of the pools declined to such an extent that the Pup Fish species was unable to spawn in sufficient quantity to maintain a natural population.<sup>82</sup> The Ninth Circuit Court of Appeals affirmed the District Court's injunction of Cappaert's pumping to the extent necessary to preserve the fish, holding that when the United States reserved Devil's Hole as a monument, it reserved water rights in unappropriated water sufficient to maintain the level of the pool so as to preserve the scientific value that was the foundation behind the 1952 Presidential Proclamation.<sup>83</sup> The United States Supreme Court affirmed, noting the *Winters* holding that the federal government by implication reserves water rights sufficient to accomplish the purposes of any federal reservation of land from private ownership.<sup>84</sup>

The primary issue in *Cappaert* was that of the implied reservation of water rights to groundwater, an extension to which the *Winters* Doctrine had yet been applied.<sup>85</sup> The Supreme Court held that the pool at issue was considered surface water and that federal surface water rights were being depleted because the ground and surface waters are "physically interrelated as integral parts of the hydrologic cycle."<sup>86</sup> Noting that Nevada law reflects this hydrologic relationship,<sup>87</sup> the Court reasoned that under the *Winters* Doctrine, the United States can protect water as necessary for the purpose of a reservation from subsequent diversion regardless of its scientific classification as surface or groundwater.<sup>88</sup> The key feature of the *Cappaert* holding is that the federal government may succeed in an action to enjoin

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79. *Winters v. United States*, 207 U.S. 564, 574-78 (1908); see also *Cappaert v. United States*, 426 U.S. 128, 138-39 (1976) (applying the *Winters* Doctrine).

80. See *Cappaert*, 426 U.S. at 138; *Winters*, 207 U.S. at 574-78.

81. *Cappaert*, 426 U.S. at 131.

82. *Id.* at 133-34.

83. *Id.* at 136-37.

84. *Id.* at 138-39.

85. *Id.* at 142.

86. *Id.* (quoting C. CORKER, GROUNDWATER LAW, MANAGEMENT AND ADMINISTRATION, NATIONAL WATER COMMISSION LEGAL STUDY NO. 6 at xxiv (1971)).

87. *Cappaert*, 426 U.S. at 142 (citing NEV. REV. STAT. §§ 533.010 *et seq.*, 534.020, 534.080, 534.090 (1973)).

88. *Id.* at 143.

groundwater extraction to the point necessary to protect federal interests on federally reserved lands. When the scientific values for which Devil's Hole was reserved faced threats from subsequent groundwater extraction, the Court permanently enjoined pumping as necessary to fulfill the purposes of the original reservation.<sup>89</sup> Since *Cappaert*, the federal government has imposed groundwater restrictions in some cases concerning stream flows.<sup>90</sup> To comply with *Cappaert*, Utah, the United States, and relevant state water conservation agencies entered into a 1996 settlement agreement which addressed the breadth of federally reserved water rights associated with the Zion National Park and thereby established groundwater protection zones in order to ensure minimum flow levels in the Virgin River, one of the National Park's main features, the agreement restricted groundwater pumping along the Zion National Park's boundaries.<sup>91</sup> There have also been similar negotiated settlements of federal reserved water rights within Glacier and Yellowstone National Parks, ensuring that groundwater management outside of both of these park's boundaries will protect in-park wetlands and GDEs.<sup>92</sup>

### B. Indirect Federal Approaches

In 1973, the National Water Commission released a report calling for more federal attention on economic efficiencies, equity (primarily in Indian water rights), and environmental quality related to groundwater use.<sup>93</sup> Unfortunately, the vast majority of state water management agencies have failed to adopt the Commission's non-binding advice which included augmenting state policies to integrate surface and groundwater management, address the overall impairment of groundwater quality, and to address the depletion of aquifers occurring due to greater extraction rates than rates of natural recharge.<sup>94</sup> The Commission further recommended increased funding for the United States Geological Survey (USGS) to study and monitor surface and groundwater interactions.<sup>95</sup> As the Commission itself predicted, when an economy has to rely upon two separate legal regimes governing

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89. *Id.* at 147.

90. Thompson, *supra* note 45, at 298.

91. Zion National Park Water Rights Settlement Agreement, Dec. 4, 1996, available at <http://www.wcwcd.org/downloads/agreements/Zion%20National%20Park.pdf> (last visited Nov. 7, 2014).

92. Thompson, *supra* note 45, at 298.

93. NAT'L WATER COMM'N, WATER POLICIES FOR THE FUTURE, at iii (1973).

94. Leshy, *supra* note 38, at 10, 13.

95. NAT'L WATER COMM'N, *supra* note 93, at 243, 245.

surface and groundwater, coordinated administration is inherently difficult.<sup>96</sup>

A promising development is the United States Forest Service's (USFS) newly proposed groundwater directive which recognizes the connected nature of surface and groundwater, and calls for conjunctive management of such resources on National Forest System lands to "promote long-term maintenance or restoration of groundwater systems and the groundwater-dependent ecosystems they support."<sup>97</sup>

Specifically, the [internal agency directive] would provide direction on the consideration of groundwater resources in agency activities, approvals, and authorizations; encourage source water protection and water conservation; establish procedures for reviewing new proposals for groundwater withdrawals on NFS lands; require the evaluation of potential impacts from groundwater withdrawals on NFS resources; and provide for measurement and reporting for some larger groundwater withdrawals."<sup>98</sup> Clearly a step towards holistic water resource management on federal lands, by its terms, the directive will not affect procedures or impose any new conditions on state-issued water rights on non-Forest Service lands—a limitation that restricts the directive's potential impacts.<sup>99</sup>

While the federal government has never attempted to influence the groundwater management policies of the states in order to create a uniform national regime, it can play an indirect role in protecting GDEs (despite the patchwork of state groundwater laws). Even before the National Water Commission published its findings in 1973, Congress passed legislation in 1968 authorizing the Central Arizona Water Project,<sup>100</sup> initially meant to provide Colorado River water to Arizona for the full-scale irrigation that Arizona desired.<sup>101</sup> Yet, Congress restricted the use of the irrigation water to areas with adequate means to control the expansion of irrigation.<sup>102</sup> In effect, Congress forced the Arizona government to adopt sustainable groundwater reform measures in exchange for the valuable water resources from the Colorado River.<sup>103</sup> This "carrot" method of forcing Arizona to

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96. *Id.* at 233.

97. Proposed Directive on Groundwater Resource Management, *supra* note 3, at 25816.

98. *Id.* at 25815.

99. *See id.* at 25822-23.

100. Colorado River Basin Act, Pub. L. No. 90-537, § 301, 82 Stat. 885, 887-88 (1968) (currently codified at 43 U.S.C. § 1521 (2013)).

101. Leshy, *supra* note 38, at 9.

102. Colorado River Basin Act § 304(c) (currently codified at 43 U.S.C. § 1524(c)).

103. Leshy, *supra* note 38, at 9.

adopt sustainable water management practices could be a guiding example when trying to implement legal reform for sustainable management of GDEs, providing the federal government with a means to protect GDEs where a state will not.<sup>104</sup> Though, it is likely that what happened in Arizona will be an isolated occurrence—there is no present indication that the federal government will want to continue this type of regulation.

The federal government tried to bring about sustainable management of Arizona's San Pedro River watershed, including efforts to incorporate the environmental needs of relevant GDEs, by declaring the watershed a Bureau of Land Management (BLM) managed Riparian National Conservation Area.<sup>105</sup> The relevant legislation reserves federal water rights<sup>106</sup> for the conservation and protection of the "riparian area and the aquatic, wildlife, archaeological, paleontological, scientific, cultural, educational, and recreational resources" of the federally reserved land.<sup>107</sup> The legislation also requires the numerous federal and private entities in the area to reassess their groundwater usage under the guidelines of *Cappaert*.<sup>108</sup> Furthermore, the Secretary of the Interior was also directed to take an active role in protecting the federally reserved waters.<sup>109</sup> Congress, responding to the slow pace of the adjudication aimed to protect these asserted federal water rights, used the National Defense Authorization Act for Fiscal Year 2004<sup>110</sup> as the basis to require the Secretary of the Interior to make reports and recommendations concerning progress toward a sustainable yield of the groundwater at issue.<sup>111</sup> In order to enforce these recommendations and ensure sustainable groundwater use, the legislation suggested that any future federal money allocations to these groundwater users would take into account their progress toward sustainable management.<sup>112</sup> The entities at issue collaborated to implement various projects and public participation plans in furtherance of the stated conservation goals, with the help of a \$33.9 million allocation, even expanding efforts so as to involve cities along the northern Mexican border.<sup>113</sup> According to John Leshy, of the University of California Has-

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104. *Id.* at 15.

105. 16 U.S.C. § 460xx(a) (2013).

106. *Id.* § 460xx-1(d).

107. *Id.* § 460xx-1(a).

108. *See* Leshy, *supra* note 38, at 17.

109. *Id.* § 460xx-1(d).

110. Pub. L. No. 108-136, § 321(c)(1), 117 Stat. 1392, 1438 (2003). In this case, the close proximity and water requirements of the Fort Huachuca military base make this Act relevant.

111. Leshy, *supra* note 38, at 17.

112. § 321(f), 117 Stat. at 1439.

113. Anne Browning-Aiken et al., *Upper San Pedro Basin: Fostering Collaborative Binational Watershed Management*, 20 INT'L J. WATER RESOURCES DEV. 353, 359-60 (2004).

tings College of the Law, this is a situation where the “carrot or stick” method is used as both a “carrot” and the “stick”: federally reserved water rights exist for the purpose of protecting the GDEs at issue (“stick”), but due to the slow pace of enforcement litigation, the federal government relies on the threat of withheld monies (“carrot”) to force sustainable management of groundwater resources.<sup>114</sup>

### C. *The Endangered Species Act*

The nature of the hydrological connection between surface and groundwater is complex and expansive. Water can travel hundreds of miles before it reaches its final destination, supplying a variety of dependent ecosystems along the way. A hydrological system may also be purely intrastate and local, adding further complexity to applicable state laws and regulations. Considering the patchwork regime of state and federal laws governing groundwater management—be it under the *Winters* Doctrine, or isolated and indirect local policy—GDE conservation has, for the most part, been neglected because of the inherent difficulties in coordinating a complex administrative problem over a resource which transcends jurisdictional boundaries. In addition to the federal government’s reservation of groundwater rights for large transboundary monuments or national parks, the Endangered Species Act (ESA) has had some success in providing GDE protection, in a manner that reflects the true interconnected nature of hydrological resources.<sup>115</sup>

The ESA has garnered success in sustainable management of groundwater sources and their dependent ecosystems. A United States District Court in Texas held in *Sierra Club v. Lujan* that the City of San Antonio’s depletion of the groundwater resources of the Edwards Aquifer jeopardized the endangered Fountain Darter, constituted a taking under the ESA, and that any continued depletion would be unlawful.<sup>116</sup> If there is an endangered species threatened by the quantity or quality of groundwater, “the ESA may (1) directly proscribe groundwater withdrawals under Section 9, (2) prevent federal governmental support or permitting of groundwater withdrawals under Section 7, or (3) provide for the development and implementation of recovery plans that call for more sustainable groundwater withdrawals.”<sup>117</sup>

While successfully protecting GDEs, such as the Texas Fountain Darter ecosystems dependent on the Edwards Aquifer, the ESA approach to pro-

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114. Leshy, *supra* note 38, at 18.

115. See, e.g., *Sierra Club v. Lujan*, No. MO-91-CA-069, 1993 WL 151353 (W.D. Tex. Feb. 1, 1993).

116. *Id.* at \*33.

117. Thompson, *supra* note 45, at 297.

tection is limited and sporadic.<sup>118</sup> Citizens wishing to file suit must prove that the alleged injury is fairly traceable to a particular federal agency or private entity action, which can difficult to demonstrate in a complex hydrological system.<sup>119</sup> The connection between an aquifer and stream may be difficult to prove, particularly in fractured or expansive aquifers whose flow patterns are hard to trace. Such aquifers that become contaminated by oil and gas development present a difficult causation issue; ascertaining precisely where contamination occurred and how far it spread once it has infiltrated different beds can be prohibitively difficult when geologic and groundwater mapping is incomplete or nonexistent. If the requisite connections between contamination, groundwater, and the ecosystem are established, the ESA can always be used in the future to indefinitely halt development, overuse, or contamination in the presence of an endangered species.

#### D. *The Sporhase Doctrine*

It was once fairly unclear whether a state has the authority to completely bar groundwater permits to other states in an effort to maintain and improve its ecosystems. The Dormant Commerce Clause (DCC) precludes a state from putting an impermissible burden on interstate commerce. The *Sporhase* Doctrine has interpreted the DCC to prevent a state from withholding water resources in an attempt to keep the resources within the state. In *Sporhase v. Nebraska ex rel. Douglas*, the Supreme Court struck down a Nebraska restriction on the export of groundwater.<sup>120</sup> The Court considered the question of whether surface or groundwater were articles of commerce and thus subject to the DCC, whether the Nebraska restrictions on exportation constituted an impermissible burden on commerce, and whether Congress had granted permission to the states to regulate in this area.<sup>121</sup> In light of the groundwater's classification as an article of interstate commerce, and in response to the DCC requirements, the Supreme Court held that regulation of groundwater exportation needed to closely fit "its asserted local purpose."<sup>122</sup> Following *Sporhase*, the District Court of New Mexico in *City of El Paso* held that all New Mexico water is an article of commerce.<sup>123</sup> The court also held that New Mexico may discriminate in

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118. See generally Catherine Bennett, *Groundwater Rights and the Endangered Species Act: Potential ESA Suits When S.B. 332 Is Implemented*, 42 TEX. ENVTL. L.J. 151 (2012).

119. *Id.* at 166.

120. 458 U.S. 941, 960 (1982).

121. *Id.* at 943.

122. *Id.* at 957.

123. *City of El Paso v. Reynolds*, 563 F. Supp. 379 (D.N.M. 1983).

favor of retaining groundwater for its own citizens, and deny exportation to Texas completely, only to the extent that is essential for human survival.<sup>124</sup> The New Mexico legislature amended its complete ban on groundwater exports to restrict its denial of exports to those exports contrary to conservation of water within the state or which otherwise harmed public welfare.<sup>125</sup> When the new statutes were again challenged before the same court, the court held that these new restrictions were even-handed since they resembled similar in-state appropriation requirements.

The main departure in the second *El Paso* holding was that the court reasoned “health and safety, recreational, aesthetic, environmental and economic interests” could be sufficient “public welfare” concerns to justify in-state preference for groundwater appropriation.<sup>126</sup> Thus, *Sporhase* introduces a new element for consideration in a state’s potential groundwater management program. Yet, common law precedent in New Mexico also appears to account for the reservation of water for the conservation of GDEs. Under *Sporhase*, to avoid Dormant Commerce Clause inquiry, state groundwater managers must account for that state’s characterization and treatment of water resources as an article of commerce, the even-handed and general nature of restrictions pertaining to all appropriators, as well as the existence of careful data and record keeping of water needs in order to successfully claim a water shortage when withholding groundwater resources.<sup>127</sup> If New Mexico, for example, attempted to provide wholesale protection to GDEs, and withhold groundwater appropriations to achieve such purposes, the holding in *El Paso* leaves open the possibility that such water needs could be considered in addition to consumptive human needs. Yet, no such action has been taken by a state, suggesting other means of conserving GDEs are needed.

#### IV. INTERNATIONAL APPROACHES

A legal framework for protecting GDEs in the United States could draw from the example set by the evolution of groundwater laws abroad. A few countries, some with climate and ecological conditions similar to the southwestern United States, have addressed the topic to varying degrees.

##### A. South Africa

The post-Apartheid Water Act of 1998 in South Africa guarantees water reserves for human needs will be sustainably balanced with the envi-

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124. *Id.* at 389.

125. N.M. STAT. ANN. § 72-12B-1(C) (1978).

126. *City of El Paso v. Reynolds*, 597 F. Supp. 694, 700 (D.N.M. 1984).

127. Davis & Pappas, *supra* note 39, at 198.

ronmental requirements of aquatic ecosystems.<sup>128</sup> The reserves are maintained in the form of appropriations and are given precedence much the same as senior water rights in the western United States.<sup>129</sup> In effect, South African groundwater management makes protection of GDEs a primary policy goal.<sup>130</sup> Importantly, inventories and sustainability assessments for water appropriation have recently recognized subterranean aquifer ecosystems as a new and unique category of aquatic ecosystems to consider—meaning South African appropriations take into account a more realistic picture of groundwater ecosystems.<sup>131</sup>

### B. *European Union*

The Water Framework Directive, enacted by the European Union in 2000, and the subsequent Groundwater Directive, both take into consideration surface waters and ecosystems dependent on groundwater.<sup>132</sup> Environmental objectives related to the health of these ecosystems must be considered before allocation of any waters for human use, though they have been applied narrowly to only the most major rivers and wetlands.<sup>133</sup>

### C. *Australia*

Since 2000, Australian water management agencies have instituted a policy framework that allows for the implementation of GDE protection. Federally mandated local management plans and committees have worked to identify GDEs and to ensure that water is provided to meet environmental needs and the needs of present and future users.<sup>134</sup> The goal is sustainable use, taking into account social, economic, and environmental requirements.<sup>135</sup> The primary focus in sustainable groundwater management is conducting detailed mapping and research in order to understand the complexities of surface and groundwater interactions.<sup>136</sup> Flow patterns are inherently variable, determined by fracturing, porosity, and permeability, making mapping and research quite difficult, and possibly impossible where there are insufficient resources.<sup>137</sup> Throughout Australia, there was a general ignorance of invertebrate biodiversity in underground GDEs specif-

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128. Aldous & Bach, *supra* note 55, at 22.

129. *See id.*

130. *See id.*

131. *See id.*

132. *Id.* at 21.

133. *Id.*

134. N.S.W. DEP'T OF LAND AND WATER CONSERVATION, *supra* note 13, at 7-8.

135. *Id.* at 7.

136. *See id.* at 29-30.

137. *Cf. id.* at 36-38 (outlining a methodology for such mapping and research).

ically and in GDEs in general.<sup>138</sup> Revamped groundwater management policies now account for the high degree of small range endemic species and the intimate link between surface and groundwater ecosystems—that is, the ecological reality of the link between water and ecosystems is becoming more prevalent in Australian lawmaking discussions.<sup>139</sup> Australian legislation requires the inclusion of stygofauna impacts in an environmental impact assessment that must be conducted during water appropriations, recognizing the need to manage water in a manner that includes all ecological values.<sup>140</sup>

A legal mechanism of protection for all GDEs, including the aquifer ecosystems themselves (discussed further *infra*, and considered in Australia and South Africa policy), is necessary for the protection of groundwater resources and the ecosystems that rely on them in the United States.

## V. THE CLEAN WATER ACT AND GDE REGULATION

If the historical course of the environmental laws that arose during the 1970s proves anything, it is that theoretically-available legal mechanisms for preservation and conservation of water resources have been overwhelmingly restricted in their application and enforcement. The patchwork of doctrine, statute, and policy described above falls short of a uniform and targeted approach that can effectively account for the inherent ecological complexities surrounding groundwater. The Clean Water Act in particular exists for the purpose, “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.”<sup>141</sup> One might think that such broad authorizing language would translate to comprehensive protection for the nation’s waterways and systems, yet that is far from the case. The Supreme Court has added complexity while purportedly differentiating between waters that fall under the CWA’s intended jurisdiction and those waters that lack federal legal protection.<sup>142</sup> The lack of clarity about which waters the EPA and Army Corps of Engineers might lawfully regulate under the CWA has spawned copious litigation to the detriment of our nation’s waters. In the process, the issue of GDEs often evades court interest during determinations regarding jurisdictional waters.

This prolonged confusion exists in part because Congress, in furtherance of its lofty goal to restore and maintain water integrity under the CWA, prohibits in Section 301(a) the unauthorized “discharge of any pollu-

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138. Humphreys, *supra* note 24, at 125.

139. *Id.* at 126.

140. *See id.*

141. 33 U.S.C. § 1251(a) (2013).

142. *See generally* Rapanos v. United States, 547 U.S. 715 (2006).

tant” into “navigable waters.”<sup>143</sup> Section 402, outlining an EPA-administered permitting program which regulates discharges of pollutants from point sources<sup>144</sup> and section 404, governing the discharge of “dredged or fill material” as administered by the Corps,<sup>145</sup> operate as the primary enforcement mechanisms for ensuring compliance with Section 301(a). Both Section 402 and Section 404 broadly define the term “navigable waters” as “the waters of the United States,” which, to some extent, betrays an intent to diminish the role of navigability as a necessary jurisdictional prerequisite.<sup>146</sup> As one generally cannot navigate a ship through groundwater contained in the pores of bedrock, such resources have historically not met the navigability prerequisite.

Still, just how far beyond traditional navigability the CWA’s reach goes has proven controversial. Three major Supreme Court cases have considered the contours of CWA jurisdiction, with the most recent case possibly providing a unique opportunity for legal reform that, in theory, should facilitate greater conservation of a certain subset of GDEs.<sup>147</sup>

The primary point of contention is obvious: how far in the chain of the hydrological cycle might the CWA lawfully reach, in light of the ambiguity created through Congress’s use of the broadly defined term “navigable waters”? In *United States v. Riverside Bayview Homes*, the Supreme Court upheld the Corps’ exertion of jurisdiction over wetlands that were adjacent to traditionally navigable waters.<sup>148</sup> Noting that Congress “intended to repudiate limits . . . placed on federal regulation by earlier water pollution control statutes,” the Court reinforced the placement of the jurisdictional barrier far away from the archaic requirement of navigability.<sup>149</sup> Thus, for example, in addition to the Mississippi River, the wetlands and other waters adjacent to that traditionally navigable water enjoyed a wide variety of CWA protections.

Later, the Corps promulgated the Migratory Bird Rule,<sup>150</sup> and in *Solid Waste Agency v. U.S. Army Corps of Eng’rs (SWANCC)*, the Court determined that, in that instance, the Corps had expanded its regulatory authority past

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143. §§ 1311(a), 1362(11). For a more detailed discussion regarding the pervasive “navigable waters” conundrum in U.S. environmental law, see generally J.W. Looney & Steven G. Zraick, *Of Cows, Canoes, and Commerce: How the Concept of Navigability Provides an Answer if You Know Which Question to Ask*, 25 U. ARK. LITTLE ROCK L. REV. 175 (2002).

144. § 1342.

145. § 1344(a), (d).

146. § 1362(7).

147. See generally *Rapanos*, 547 U.S. 715.

148. 474 U.S. 121, 139 (1985).

149. *Id.* at 133.

150. See generally 51 Fed. Reg. 41206, 41206-41260 (Nov. 13, 1986).

the originally intended dividing line between jurisdictional and non-jurisdictional waters. The Court found that the waters at issue were wholly isolated and apparently dissociated, in the rational meaning of that word, from traditionally navigable waters.<sup>151</sup> The Migratory Bird Rule represented an attempt by the Corps to regulate waters that bore an ecological connection with jurisdictional waters, in the sense that migratory birds relied on the waters at issue in *SWANCC*.<sup>152</sup> Essentially, while the Court recognized in *Riverside Bayview Homes* that the science underlying hydrological connectivity demanded a finding of jurisdiction in order to ensure the integrity of our nation's waters, the science presented in defense of jurisdiction in *SWANCC* was insufficient to overcome a fair perception that these waters were only tenuously connected to traditionally navigable waters. Therefore, those waters could not possibly be thought of serving a role of ecological importance within the larger conception of the hydrologic system.<sup>153</sup>

Given *SWANCC*, traditional concepts of actual navigability will most likely always play some role of importance in determining CWA jurisdiction; isolated waters with only tenuously proven connections to others will likely not pass the Court's scrutiny.<sup>154</sup> The federal government has made a conscious decision not to regulate and protect the quality of each and every water source in the United States, primarily a result of the fact that the CWA's existence is tethered to Congress's Commerce Clause powers.<sup>155</sup>

The most recent case on the matter is *Rapanos*, and while the Court espoused its intention of clarifying this CWA ambiguity once and for all by illuminating precisely which waters were in fact regulable, this holding instead created more confusion.<sup>156</sup> At issue in this case were four wetlands; one separated from a non-navigable tributary by a berm and the other three actually bearing a continuous surface connection to navigable waters.<sup>157</sup> The four-Justice *Rapanos* plurality opinion articulated a test for jurisdiction requiring that water be "relatively permanent," bearing a "continuous surface connection" with traditionally navigable water.<sup>158</sup> Justice Kennedy though, concurring only in the judgment to remand, provided that waters not traditionally navigable might still be jurisdictional where there exists "a significant nexus between the wetlands in question and navigable waters in the

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151. 531 U.S. 159, 171-72, 174 (2001).

152. *Id.* at 164.

153. *See id.* at 167-68.

154. *See id.* at 172.

155. *See, e.g.,* *Rapanos v. United States*, 547 U.S. 715, 738 (2006) (discussing the scope of Commerce Clause power in the context of the CWA).

156. *See generally id.*

157. *Id.* at 729-30.

158. *Id.* at 732-33, 742 (plurality opinion).

traditional sense.”<sup>159</sup> Thus, for Justice Kennedy, it is the ecological interactions amongst the “waters of the United States” that should guide the Corps’ and the EPA’s case-by-case factual analyses in application. When the waters, “either alone or in combination with similarly situated lands in the region,” possess a significant nexus with traditionally navigable waters they, by inference, “significantly affect the chemical, physical, and biological integrity” of such navigable waters.<sup>160</sup> It is generally accepted that this “significant nexus” test is the controlling rule of law, as it is the narrower of the two opinions.<sup>161</sup> While ostensibly extending coverage to a larger sector of the waters in any given hydrologic system, Justice Kennedy does temper the test’s reach by requiring more than just a mere hydrologic linkage—there must be a significant nexus.<sup>162</sup>

The ideological point of disagreement between the plurality of *Rapanos* and Justice Kennedy centers on an understanding of *Chevron* deference.<sup>163</sup> By outlining tangible and visually measurable requirements, the plurality endeavors to limit the discretionary role of the Corps or the EPA in fulfilling their statutory duties under the CWA.<sup>164</sup> Justice Kennedy, on the other hand, leaves the door open for agency discretion to incorporate ecological considerations into their analyses thus enabling CWA protection across a hydrologic system’s continuum, even down to points on the chain previously thought to have a legally insignificant connection to navigable waters.<sup>165</sup>

Following *Rapanos*, in an attempt to make sense of the splintered opinion and the new roles the agencies were relegated to play in administering the CWA, the EPA and the Corps issued joint guidance meant to provide a definitive answer to the “navigable waters” gray area.<sup>166</sup> According to the 2011 guidance document, the logical implication of the relevant case law and

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159. *Id.* at 779 (Kennedy, J., concurring in the judgment).

160. *Id.* at 779-80.

161. *See, e.g.,* *United States v. Gerke Excavating, Inc.*, 464 F.3d 723, 724-25 (7th Cir. 2006) (“Justice Kennedy’s proposed standard . . . we conclude must govern the further stages of this litigation. . . .”).

162. *Rapanos*, 547 U.S. at 782 (Kennedy, J. concurring in the judgment).

163. *See* *Chevron, U.S.A., Inc. v. Natural Res. Def. Council*, 467 U.S. 837, 844 (1984); *see also* *The Supreme Court, 2005 Term – Leading Cases*, 120 HARV. L. REV. 125, 358-59 (2006) (exploring the logical inferences regarding *Chevron* deference applied in *Rapanos*).

164. *See Rapanos*, 547 U.S. at 741 n.10 (plurality opinion) (limiting the impact of *Riverside Bayview* by reiterating that the holding rests on physical connectivity and not some sort of significant nexus incorporating ecological considerations).

165. *See id.* at 780-81 (Kennedy, J., concurring in the judgment) (requiring only that the ecological nexus be significant).

166. *See generally* U.S. ENVIL. PROT. AGENCY & U.S. DEP’T OF THE ARMY, CLEAN WATER ACT JURISDICTION FOLLOWING THE U.S. SUPREME COURT’S DECISION IN *Rapanos v. United States & Carabell v. United States* (2007), available at <http://www.epa.gov/owow/wetlands/pdf/RapanosGuidance6507.pdf>. *See also* U.S. ENVIL. PROT. AGENCY & U.S. DEP’T OF THE ARMY, DRAFT

regulations demands jurisdiction by the EPA and the Corps over traditionally navigable waters, interstate waters, wetlands adjacent to traditional navigable waters or interstate waters, relatively permanent non-navigable tributaries to traditional navigable waters, and wetlands that are directly proximate to relatively permanent waters.<sup>167</sup> In response to Justice Kennedy's concurrence, the guidance document outlines the intention to undergo fact-specific jurisdictional analyses and exert jurisdiction over non-navigable tributaries, wetlands adjacent to such tributaries, and any "other waters"—no matter whether they are physically adjacent to jurisdictional waters—when they bear a "significant nexus" with traditionally navigable or interstate waters.<sup>168</sup> In addition, the EPA and the Corps provide a non-exhaustive description of certain waters that do not fall under the purviews of the CWA. Some examples of these certain excluded waters include various types of artificial ponds and pools, groundwater drained through sub-surface irrigation drainage systems, and water-filled depressions incidental to construction activities.<sup>169</sup> Notably, the guidance document implies that the linchpin of any analysis seems to be whether the non-navigable waters at issue in any fact-specific scenario bear a significant nexus with typically jurisdictional waters by a chemical, physical, or biological connection.<sup>170</sup>

Ultimately, this Note seeks to pinpoint where the outer bounds of the CWA's jurisdictional limits might lawfully and reasonably fall in the wake of *Rapanos*, and any subsequent agency regulations seeking to codify the principles provided by the Supreme Court in that opinion. I contend that by extending CWA protection to as many waters as possible, as is congruent both with the CWA's stated purposes and Justice Kennedy's significant nexus jurisdictional test, there might exist a workable method for indirectly providing federal protection, in the sense of water quality management, for a variety of GDEs. Groundwater's lack of visibility has mostly relegated consideration of its values to background discussions in the major CWA decisions. However, the hydrologic significance of the connection between surface water GDEs and any tenuously related groundwater requires heightened scrutiny in order to preserve the integrity of the nation's waters, as the CWA directs.

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GUIDANCE ON IDENTIFYING WATERS PROTECTED BY THE CLEAN WATER ACT (2011), available at [http://www.epa.gov/tp/pdf/wous\\_guidance\\_4-2011.pdf](http://www.epa.gov/tp/pdf/wous_guidance_4-2011.pdf) [hereinafter 2011 GUIDANCE DOCUMENT].

167. See 2011 GUIDANCE DOCUMENT, *supra* note 166, at 5.

168. *Id.*

169. *Id.*

170. See *id.*; *United States v. Cundiff*, 555 F.3d 200, 212-14 (6th Cir. 2009) (extending jurisdiction over wetlands with a significant nexus to non-navigable tributaries of a traditionally jurisdictional water, as demonstrated by a chemical flow path, and finding surface connection absent perpetual flow).

The argument in favor of federal jurisdiction is better defined within the existing body of CWA law when discussing GDEs that depend on the surface expressions of groundwater in the form of major wetlands, rivers, and streams, compared to other less visible types of GDEs. As these are generally the more visible and attractive ecosystems, these water sources have served as the “battle ground” bodies of water in most major CWA litigation.<sup>171</sup> Consistently applying the significant nexus test in the context of major non-navigable wetlands, rivers, and streams will likely result in increased conservation of a substantial segment of all GDEs by the obligations created under the CWA and *Rapanos*.

Consider, for example, a deep, unconfined groundwater aquifer exhibiting a flow pattern that ultimately results in a wetland, river, or stream. While the most obvious extension of Justice Kennedy’s significant nexus test ought to protect those wetland, river, and stream GDEs where there is a connection to jurisdictional waters, it is not so clear whether the possible Phreatophytic ecosystems along this imagined groundwater flow path, or that aquifer GDE itself, would enjoy a comparably favorable extension of CWA protection even when the hydrologic connection is readily demonstrated.

For Phreatophytic ecosystems that are variably dependent on the subsurface expressions of groundwater resources (perhaps a hypothetical ecosystem survives on account of the equal contributions from a groundwater resource and an unconnected non-navigable surface water resource), indirect protection under the CWA seems elusive. Often this hydrologic phenomenon will mimic the subsurface drainage systems used by agriculturists, which the EPA and the Corps explicitly refuse to protect even under the lenient significant nexus rationale.<sup>172</sup> These Phreatophytic GDEs might also be comparable to the case of an unconfined aquifer with minimal surface expression, which does not garner the level of dependence from large-scale and noticeable ecosystems typically attributable to large wetlands, rivers, and streams. In the cases of such seeps, or perhaps prairie potholes, any connection or nexus with a traditionally navigable water will be tenuous at best, meaning that while the scientific proof of some hydrologic connection might exist, the situation is just too analogous to the ponds in *SWANCC*.<sup>173</sup> I predict that the EPA and the Corps might be unable to successfully exert jurisdiction over such GDEs absent any real and substantiated scientific data regarding hydrological connectivity, a requirement that may be not as elusive following a recent EPA and Corps publication discussed *infra*.

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171. See, e.g., *Rapanos v. United States*, 547 U.S. 715 (2006).

172. 2011 GUIDANCE DOCUMENT, *supra* note 166, at 5.

173. See *Solid Waste Agency v. U.S. Army Corps of Eng’rs*, 531 U.S. 159, 171-72 (2001).

A potential pursuit in the quest to extend CWA protections to these GDEs that are variably dependent on somewhat isolated groundwater resources would be the *Rapanos* plurality's physical adjacency test. Would there be a case where two bodies of water lacked a mutual nexus as it relates to the water's chemical, biological, or physical attributes but exhibited the adjacency needed to satisfy the plurality's construction of the CWA? On a micro-geologic level, even confined aquifers are subject to tectonic shifting.<sup>174</sup>

Even trickier are the cases of the confined aquifer GDEs bearing no legally plausible significant nexus to traditionally navigable waters. Perhaps there exists a confined aquifer physically adjacent to an unconfined aquifer that contributes to the demands of large-scale and sympathetic surface GDEs bearing a significant nexus with jurisdictional waters. In such a case, the same logic that held in extending CWA jurisdiction to the physically adjacent wetlands in *Bayview* and *Rapanos* could extend to this confined aquifer, by it having the potential to be contaminated and thereafter infiltrate waters that are jurisdictional by way of a significant nexus with navigable waters.<sup>175</sup>

Establishing a significant nexus, or any semblance of a hydrologic connection, between groundwater and GDEs will involve the expertise of EPA and Corps field scientists. Ample data must be amassed to strengthen the evidence of hydrologic connectivity to the point that a judge examining a record will not rule ignorantly based on the tenuous interactions between these obviously non-navigable waters.

These hypothetical applications of the CWA to GDEs that previously bore too attenuated a connection to navigable waters reflect optimism in a seemingly changing paradigm in the field of hydrological sciences. As we come to understand more about the substantial impacts of one tenuously connected water source on its counterparts, the application of federal water quality protections to groundwater resources in the pursuit of preserving the ecological integrity of our nation's GDEs appears less and less radical. In fact, as this Note was being written, the EPA and the Corps have pro-

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174. Two underground sources might very well lack the requisite significant nexus or continuous surface connection, but can science demonstrate a risk of infiltration sufficient enough to extend jurisdiction over the confined aquifer for the sake of the unconfined aquifer's extended hydrologic ecosystems? This seems analogous to the Corps and EPA's treatment of the term "adjacent" in regards to the berms separating wetlands. See 2011 GUIDANCE DOCUMENT, *supra* note 166, at 15-19.

175. See *id.* at 16.

posed a new rule,<sup>176</sup> which would exert jurisdiction over a larger sector of the nation's waterways in light of Justice Kennedy's significant nexus test. The agencies have also compiled the results of comprehensive hydrologic research into a report entitled "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence."<sup>177</sup> Now that report is undergoing further peer review, but it importantly suggests that the EPA and the Corps can feasibly amass the scientific rationale requisite to lawfully exert jurisdiction over intermittent and ephemeral streams, as well as wetlands and other waters in floodplains, since such waters have a significant nexus with jurisdictional waters.<sup>178</sup> The proposed rule itself essentially codifies the key principles regarding hydrologic connectivity that this Note extracts from *Rapanos*.<sup>179</sup> Following the research and effort put into detailing the basic scientific facts involved in hydrologic connectivity, it might be reasonable to pursue some form of GDE mapping initiative.

In Australia, the state has sponsored the creation of a "GDE Atlas" to better understand the locations and specific aquatic demands of Australia's variably dependent ecosystems. Motivated by necessity to preserve ecological integrity in an arid climate while dealing with competing pressures for groundwater allocation, the first step in holistic and sustainable management was to accurately map the GDEs. To some extent the USGS has profiled and mapped the major groundwater resources in the United States, yet is likely insufficient considering the notoriously tenuous and spatially removed connections many GDEs have with their groundwater resources.

In the courtroom, scientific data is often overlooked, as the unsympathetic viewpoints of attorneys and judges trying to strike a compromise will overlook ecosystem requirements in their decisions because finding that an ecosystem hundreds of miles away from an aquifer might have a legally significant nexus with that aquifer looks like a "radical" legal assertion. The "radical" perception is likely why the EPA proposed the most recent rule codifying *Rapanos* in conjunction with a peer reviewed hydrology report. In California, researchers have endeavored to map GDEs across the state in an effort to rectify the apparent disconnect between human consumptive uses

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176. See generally Definition of "Waters of the United States" Under the Clean Water Act, 79 Fed. Reg. 22188 (proposed Apr. 21, 2014), available at <http://www.gpo.gov/fdsys/pkg/FR-2014-04-21/pdf/2014-07142.pdf>.

177. See generally U.S. ENVTL. PROT. AGENCY, CONNECTIVITY OF STREAMS AND WETLANDS TO DOWNSTREAM WATERS: A REVIEW AND SYNTHESIS OF THE SCIENTIFIC EVIDENCE (2013), available at [http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr\\_activites/7724357376745F48852579E60043E88C/\\$File/WOUS\\_ERD2\\_Sep2013.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/7724357376745F48852579E60043E88C/$File/WOUS_ERD2_Sep2013.pdf).

178. See *id.* at 4-1.

179. *Supra* note 176.

of water and competing ecological demands on the water.<sup>180</sup> A mapping initiative like Australia's GDE Atlas could address the fundamentally mistaken perceptions many have about both groundwater and ecology.

### CONCLUSIONS

The tone of this Note is somber, as the landscape of environmental law in the United States reflects compromise and union between industry and ecology. We protect certain tracts of forests, but uproot others; the system is not about cohabitation, but instead fosters separate habitation. This fundamental fact means that it is nearly impossible to protect ecosystems that span vast distances (often underground) and gather as well as depend on resources from various different sources.

Yet, there is always more that those concerned about GDEs can do to change the conversation. As this Note proposes, there may be potential to reform the application and enforcement of the CWA in such a manner that a wide variety of GDEs will likely benefit. Further, the state of hydrological science in our country demonstrates the ability to accurately map the nation's GDEs, which could alter perceptions of the subject in the courtroom; greater knowledge will result in more informed decision-making. In addition, as the pressures of climate change and increased aridity in the West further depress our water resources in areas like the Salt Basin Aquifer in New Mexico, necessity could also drive efforts for better groundwater management indirectly for the benefit of GDEs.

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180. Jeanette Howard & Matt Merrifield, *Mapping Groundwater Dependent Ecosystems in California*, PLoS ONE, June 2010, at 1.

