Current Water Issues in Oil and Gas Development and Production: Will Water Control What Energy We Have?

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> *Because the water supply in this country will become more and more limited, it should not be uselessly disposed of but rather should be used for the beneficial purpose of increasing oil production. . . .*[1]
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> *James Michener may well be right: "Water, not oil, is the lifeblood of Texas. . . ." But together, oil and gas are its muscle, which today fends off atrophy.*[2]

I. INTRODUCTION

Because there are growing concerns about the viability of the water resource in the context of some rapidly developing oil and gas plays, particularly gas, this paper focuses on the relationship between the water resource and our energy agenda. The simple answer to the question posed in the title is yes, at least to some extent, because no one is going to do anything significant about increasing the water supply in the foreseeable future. The longer answer given in this paper is divided into five parts. Part II identifies the developing plays and the growing concerns. Part III sets out a historical overview of the relationship between minerals and water and how the water associated with the developing plays has been treated. Part IV identifies and explains what is happening now. Part V raises questions for the water law systems about acquiring water for the plays. Finally, Part VI discusses what the future will bring and what ought to be there.

II. GROWING CONCERNS

The growing concerns about the water resource arise from three rapid developments related to oil and gas: (1) tight shale gas production;[3] (2) coal bed methane (CMB) production;[4] and (3) corn-based

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1. Crawford v. Hrabe, 44 P.3d 442, 453 (Kan. 2002).
2. Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1, 26 (Tex. 2008) (Willett, J., concurring).
3. *See* U.S. DEP'T OF ENERGY, MODERN SHALE GAS DEV. IN THE U.S.: A PRIMER 21 (2009); Nicolle R. Snyder Bagnell & Stephanie L. Hadgkiss, *Eastern Shale Plays–A Game Plan for Success*, 55 ROCKY MTN. MIN. L. INST. 32-1 (2009).

ethanol production.[5]

These three developments are important because currently, and for the immediate future, they involve an immense amount of water at a time when, even absent these developments, the interest in conserving water has been growing substantially. There are several reasons for this earlier concern about the adequacy of the water resource[6] and, therefore, the need to conserve water.[7] These reasons include, in addition to the general increase in water demand due to population growth,[8] both the rising demand for new technology, which happens to be very water consumptive,[9] and the supply uncertainty arising from global warming.[10]

As to tight shale gas production, the water concern[11] arises from the substantial need for fracing,[12] and that need is widespread.[13] For example, the Marcellus Shale Formation, which spans parts of six states with wells already drilled in Pennsylvania,[14] is estimated to contain 262

4. *See* W. Org. of Res. Councils v. Bureau of Land Mgmt., 591 F. Supp. 2d 1206 (D. Wyo. 2008).

5. *See* Andy Aden, *Water Usage for Current and Future Ethanol Production*, SOUTHWEST HYDROLOGY, Sept./Oct. 2007, at 22; *see also* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., WATER IMPLICATIONS OF BIOFUELS PRODUCTION IN THE UNITED STATES 10 (2008) (indicating only two feedstocks for ethanol: corn with 4.9 billion gallons produced in 2006 and sorghum with less than 100 million gallons produced in 2006).

6. There is, of course, a seemingly unlimited supply of water in the oceans, and the technology to desalinate that water exists. So, what is the problem with that source of supply? First, the high cost of processing; second, lack of infrastructure to transport the water, say to Kansas from California; third, the energy necessary to process and transport; and fourth, what to do with all of the unusable brine. *See generally* Jeff Kray, *Planned Water Desalination Plant in California Approved Over Opposition Regarding Marine Impacts, Energy and Climate Costs*, MARTEN LAW GROUP ENVIRONMENTAL NEWS, Sept. 9, 2009, http://www.martenlaw.com/news/?20090909-calif-deslination-plant-approved. *See also* ScienceDaily.com, *Desalination Can Boost US Water Supplies, but Environmental Research Needed*, Apr. 28, 2008, *available at* http://www.sciencedaily.com/release/2008/04/080424113456.htm.

7. Conserving water in the mineral development context is not a new consideration. *See generally* Harry Cohen, *The Relationship Between Water Conservation and Mineral Development*, 31 ALA. L. REV. 547, 590-604 (1980).

8. *See* John J. Entsminger & Michael J. Brennan, *The Challenges of Water for the Future of the West: Where Will We Get the Water?*, 51 ROCKY MTN. MIN. L. INST. 25-1 (2005).

9. *See* UN.org, *Computer Manufacturing Soaks up Fossil Fuels, UN University Study Says*, Mar. 8, 2004, *available at* http:///www.un.org/apps/news/story.asp?NewsID=10007&Cr ("[C]onstruction of an average 24-kilogram computer and 27-centimetre monitor requires at least . . . 1,500 kilograms of water . . . ."); *see also* MUKESH DOBLE & ANIL KUMAR KRUTHIVENTI, GREEN CHEMISTRY AND ENGINEERING 284 (2007) (discussing water usage in the manufacture of microchips).

10. *See generally* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT SUMMARY FOR POLICYMAKERS (2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

11. There are other environmental concerns. *See* Hannah Wiseman, *Untested Waters: The Rise of Hydraulic Fracturing in Oil and Gas Production and the Need to Revisit Regulation*, 20 FORDHAM ENVTL. L. REV. 115, 127-42 (2009).

12. Fracing or fracturing is the process of breaking up tight formations in order that the oil or gas may pass more freely to and up the bore hole. *See infra* text accompanying notes 22-23. The recent growth in coal bed methane (CBM) production also often involves tight formations. *See infra* text accompanying note 124. Thus, both tight shales and coal beds can require significant fracing.

13. *See* U.S. DEP'T OF ENERGY, *supra* note 3, at 8, Exhibit 7 (showing shale gas plays in 23 states); Wiseman, *supra* note 11; Angela C. Cupas, *The Not-So-Safe Drinking Water Act: Why We Must Regulate Hydraulic Fracturing at the Federal Level*, 33 WM. & MARY ENVTL. L. & POL'Y REV. 605 (2009).

14. As of the publication of the Primer, there were 277 drilled wells of the 518 then-approved

trillion cubic feet (tcf) of recoverable gas.[15] The U.S. Department of Energy's April 2009 Primer on Modern Shale Gas Development estimates that 3,800,000 gallons of water are needed for fracing a well with an additional 80,000 gallons needed for drilling the well.[16] Even though horizontal wells will be used—which means fewer wells in number than if vertical wells were used—and even with phased fracing,[17] concerns have been raised as to the availability of water for fracing.[18] Furthermore, because various chemicals may be mixed with the water to create fracing fluid,[19] the increased fracing also raises concerns about migration of the fluid during fracing[20] and the disposal of the waste water after fracing.[21] Thus, both water allocation and water pollution control issues are raised.

The fracing process was described in a 2008 opinion[22] of the Texas Supreme Court:

> The Vicksburg T is a 'tight' formation, relatively imporous and impermeable, from which natural gas cannot be commercially produced without hydraulic fracturing stimulation, or 'fracing', as the process is known in the industry. This is done by pumping fluid down a well at high pressure so that it is forced out into the formation. The pressure creates cracks in the rock that propagate along the azimuth of natural fault lines in an elongated elliptical pattern in opposite directions from the well. Behind the fluid comes a slurry containing small granules called proppants—sand, ceramic beads, or bauxite are used—that lodge themselves in the cracks, propping them open against the enormous subsurface pressure that would force them shut as soon as the fluid was gone. The fluid is then drained, leaving the cracks open for gas or oil to flow to the wellbore. Fracing in effect increases the well's exposure to the formation, allowing greater production. First used commercially in 1949, fracing is now essential to economic production of oil and gas and commonly used throughout Texas, the United States, and the world.[23]

With vertical wells, fracing may be a one-time event, but with shale formation development, such as in the Marcellus Shale, apparently hori-

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wells in Pennsylvania Marcellus Shale. U.S. DEP'T OF ENERGY, *supra* note 3, at 21.

15. *Id.*

16. *Id.* at 64, Exhibit 37. Generally, as to horizontal well shale gas development, the Primer suggests a typical water requirement per well of two to four million gallons, with three million as the usual. *Id.* at 64. As to the need for water for drilling a well, see *infra* note 87 and accompanying text.

17. *See infra* text accompanying notes 24-28 for a discussion of phasing.

18. *See* U.S. DEP'T OF ENERGY, *supra* note 3, at 64-70; Bagnell, *supra* note 3, at 32-9.

19. *See infra* text accompanying notes 30-31, 126.

20. Bagnell, *supra* note 3, at 32-8. The contamination has two possible routes: leakage from the fracing process and disposal of the waste water and the produced water. *Id.* at 32-8 to 32-9.

21. While most of this fluid is extracted before production begins, some will remain and mix with the produced salt water. What the ultimate wastewater will contain will depend on what has been mixed into the fluid, how much recycling would concentrate chemicals, and how much produced water comes up with the fluid, all of which may vary from well to well. In some circumstances, it likely will not be reusable or treatable and, thus, where it is to be disposed of raises a concern of potential impact on other resources. *See generally* Wiseman, *supra* note 11, at 183-87; Bagnell, *supra* note 3, at 32-9 to 32-10.

22. Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1 (Tex. 2008).

23. *Id.* at 6-7.

zontal wells will be the norm and fracing will most likely occur in stages. According to the Department of Energy's Primer,[24] the hydraulic fracture treatment process will involve: first, acid treatment;[25] second, a slickwater pad;[26] and third, the first proppant sub-stage.[27] Subsequent sub-stages will increase the volume of the proppant sand while the fluid volume will decrease, and then, even later sub-stages will use a coarser proppant.[28] "After the completion of the final sub-stage of coarse proppant, the well and equipment are flushed with a volume of freshwater sufficient to remove excess proppants from the equipment and the wellbore."[29] The number of chemicals, usually between three and twelve,[30] added to the fracing fluid will depend on the characteristics of the water and the formation with each component serving "a specific, engineered purpose."[31] Most of the fracing fluid is expected to be recovered in several hours to several weeks, although there will be instances when it can take several months.[32] Finally, some fluid may be left in the formation.[33]

During recovery, once production has started, the fracing water will come through the well along with the produced water. The produced water "can vary from fresh . . . to varying degrees of saline (5,000 ppm to 100,000 ppm TDS or higher)."[34] The amount of produced water varies. The range can be from an amount less than 30% of the fracing fluid volume to an amount more than 70% of the fracing fluid volume.[35] The scope of any water pollution risk from migration of the fluids during and after fracing depends on: (1) the proximity of the fracing to potable water supplies; (2) the permeability of the formations; and (3) the mix of chemicals used as the fracing and propping agents.[36]

As to CBM production, there is tremendous growth in the Powder River Basin of Montana and Wyoming[37] with significant development

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24. *See* U.S. DEP'T OF ENERGY, *supra* note 3, at 56-70.

25. *Id.* at 60 (Acid treatment is used for cleaning the wellbore area in which pores may have become plugged with drilling mud or casing cement.).

26. *See id.* at 60-62, Exhibit 35 (A slickwater pad is a water-based [98 to 99.5%] fracing fluid mixed with a friction reducing agent [0.5 to 2%] to ease entry of the proppants.).

27. *Id.* at 60 (This stage "combin[es] a large volume of water with fine mesh sand.").

28. *Id.*

29. *Id.*

30. For a listing, see the Primer's table of fourteen fracing additives, main compounds, and common uses. *Id.* at 63, Exhibit 36.

31. *Id.* at 61.

32. *Id.* at 66.

33. *See infra* text accompanying note 127. *See* U.S. DEP'T OF ENERGY, *supra* note 3, at 67 (discussing the fluid left behind).

34. U.S. DEP'T OF ENERGY, *supra* note 3, at 66. Produced water that is at 5,000 to 35,000 parts per million (ppm) total dissolved solids (TDS) is classified as brackish, at 35,000 to 50,000 ppm as saline, and at 50,000 to 200,000 ppm plus as supersaturated brine. *Id.* at 67.

35. *Id.* at 66.

36. Little regulation has taken place because generally none of these criteria suggested any reason for significant concern, but the expanse of new locations, the discovery of some permeable formations, and the changing information on some of the fracing fluid additions, have increased the concern. *See generally* Wiseman, *supra* note 11.

37. *See* W. Org. of Res. Councils v. Bureau of Land Mgmt., 591 F. Supp. 2d 1206 (D. Wyo.

elsewhere,[38] including Kansas.[39] The water concerns regarding CBM production arise from the substantial quantity of water that is removed from underground in order to develop the methane.[40] The Final Environmental Impact Statement (EIS) for the Wyoming portion of the Powder River Basin CBM Program points out that there could be up to 51,000 new wells pumping up to one trillion gallons of water from aquifers onto the surface with 3,100 unlined reservoirs dug to hold some of the untreated produced water.[41] The remaining water will be discharged untreated into ephemeral and intermittent drainages or sprayed onto the ground.[42] There are concerns both as to whether that water is or will be wasted[43] and whether disposal of the produced water is sufficiently controlled to prevent water pollution.[44] Thus, again both water allocation and water pollution control issues arise.

As to corn-based ethanol production,[45] again, there has been tremendous recent growth. In 2006, nearly five billion gallons of ethanol were produced in the United States and with at least seventy-three corn

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2008).

38. *See* Legal Envtl. Assistance Found., Inc. v. EPA, 118 F.3d 1467, 1471 (11th Cir. 1997); Vance v. Wolfe, 205 P.3d 1165, 1167 (Colo. 2009).

39. "Natural gas production from [coal bed methane] is rapidly expanding in the Cherokee Platform [in southeastern Kansas], where reserves have become economically recoverable." U.S. Energy Info. Admin., *State Energy Profile-Kansas*, http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=KS (last visited Jan. 19, 2010).

40. The U.S. Bureau of Land Management (BLM) in its Environmental Impact Statement (EIS) regarding CBM development in the Powder River Basin stated: "[W]ater is the number one issue in the EIS." *W. Org. of Res. Councils*, 591 F. Supp. 2d at 1209; *see infra* text accompanying note 193. The formations that contain CBM often contain significant amounts of water that create such pressure that it would not be feasible to produce the methane without dewatering to relieve that pressure. Not all of the water, however, is removed in advance. Significant amounts of water are produced along with the gas. Both the dewatered water and the produced water will be referred to in this paper as produced water. The EPA's definition of produced water is broad: "water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during the oil/water separation process." 40 C.F.R. §§ 435.11(t), 435.41(w) (1999).

41. *See W. Org. of Res. Councils*, 591 F. Supp. 2d 1206.

42. *See id.*

43. *See generally* Samuel S. Bacon, *Why Waste Water? A Bifurcated Proposal for Managing, Utilizing, and Profiting from Coalbed Methane Discharged Water*, 80 U. COLO. L. REV. 571 (2009); Thomas F. Darin, *Waste or Wasted?—Rethinking the Regulation of Coalbed Methane Byproduct Water in the Rocky Mountains: A Comparative Analysis of Approaches to Coalbed Methane Produced Water Quantity Legal Issues in Utah, New Mexico, Colorado, Montana and Wyoming*, 17 J. ENVTL. L. & LITIG. 281 (2002).

44. While there may be land pollution, see *infra* note 78, the focus of this paper is on the water resource. *See also* N. Cheyenne Tribe v. Norton, 503 F.3d 836 (9th Cir. 2007). *Norton* stated that:

> The process poses three potential environmental problems: the aesthetic harm from visibility of wells, pipes, and compressors on the ranches and farms; the pollution of the rivers and streams into which the groundwater is pumped; and the lowering of the water table, so that ranchers' and farmers' (and expanding suburban developers') wells run dry unless they are drilled deeper.

Id. at 839-40. While salt water is an important aspect to this disposal, because of the quantity of water involved, the disposal issue is broader than it is with non-coalbed gas production. *See* Pennaco Energy, Inc. v. U.S. Dep't of the Interior, 377 F.3d 1147 (10th Cir. 2004); discussion *infra* text accompanying notes 179-186. As to what the water might contain, see also *infra* note 198, and accompanying text.

45. From an oil and gas perspective, the primary interest in the ethanol is as an additive to, or substitute for, gasoline.

ethanol plants then under construction—capacity was expected to increase by another six billion gallons by 2009.[46] This led Andy Aden of the National Renewable Energy Laboratory to write: "With such rapid growth, water availability, utilization, and quality are key issues that must be addressed."[47] In 2007, the Bush Administration proposed a goal of producing thirty-five billion gallons by 2017 and sixty billion gallons by 2030.[48] Recently the ethanol industry[49] requested that the federal Environmental Protection Agency (EPA) raise the blend percentage of ethanol in gasoline from 10% to 15% for most vehicles.[50]

The water concerns have focused on allocation, both for the ethanol production process and for producing the feedstocks, currently mostly corn,[51] but water pollution control issues exist. One source puts the water need for an ethanol plant producing fifty million gallons of ethanol per year at 500 gallons of water per minute.[52] Aden puts the figure at 400,000 gallons per day.[53] Use of perennial biomass rather than annual crops may reduce water consumption.[54] One prediction is that if either forest residue or switchgrass was used for feedstock, there would be 100% less consumption of groundwater and a 100% reduction in nitrates and, thus, water pollution reduction.[55] There are two things that will keep corn in the forefront for the near future: the existing transport system and the fact that "it is currently a lot easier to get the fermentable sugars out of a starchy corn kernel than from something like wood chips or a weedy grass."[56]

46. Aden, *supra* note 5, at 22. *See generally* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., *supra* note 5.

47. Aden, *supra* note 5, at 22; *see also* Ethanol Production and Water Demand, http://ldubya.wordpress.com/2006/06/25/ethanol-production-and-water-demand (June 5, 2006); GreenCar Congress, Study Finds Water Use for Switchgrass Ethanol Production Approximately the Same as for Gasoline, http://www.greencarcongress.com/2009/08/water-20090823.html (Aug. 23, 2009) (noting projections by Argonne National Laboratory for water consumption by 2030).

48. *See* Aden, *supra* note 5, at 22.

49. Notice of Receipt of a Clean Air Act Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Request for Comment, 74 Fed. Reg. 18,228 (Apr. 21, 2009) (noting comments submitted by Growth Energy and 54 ethanol manufacturers).

50. *Id.*; *see* Rick Barrett, *Industry Pushing Blended Ethanol*, THE NEW MEXICAN, Aug. 20, 2009, at B-6 (noting that ethanol has created "another boom" in the biofuels industry).

51. *See* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., *supra* note 5 and accompanying text.

52. INST. FOR AGRIC. & TRADE POL'Y, WATER USE FOR ETHANOL PLANTS: POTENTIAL CHALLENGES 4 (2006).

53. Aden, *supra* note 5, at 22.

54. *See* GreenCarCongress.com, *supra* note 47 (discussing Argonne National Laboratory study).

55. *See* Rachel Ehrenberg, *The Biofuel Future*, SCI. NEWS, Aug. 1, 2009, at 24, *available at* http://www.sciencenews.org/view/feature/id/45583/title/The__Biofuel_Future (Information contained in chart within article.).

56. *Id.*

III. AN OVERVIEW OF THE HISTORY OF THE LAW RELATING TO WATER AND OIL AND GAS DEVELOPMENT

The basic principles applied to water-resource issues in oil and gas development arose in the context of mining for hard minerals. Putting aside the need for water for human consumption, two principal encounters with water arose early on for these mineral developers. First, water is needed for the mining process itself. Second, water often filled mining tunnels or shafts and hindered or entirely stopped the mining processs until the water was disposed of. These encounters frequently led to a third problem. In disposing of the used water, or the unwanted water, it might pollute a natural water source to another water user's detriment. Furthermore, mine wastes might intentionally or unintentionally reach or pollute a natural water source, again to another water user's detriment.

To satisfy the need for water in developing or processing the mineral in states that used the riparian rights doctrine for allocating water, courts determined that using water for mineral development or processing was a reasonable use.[57] Similarly, in states that used the prior appropriation doctrine for allocating water use, courts determined that using water for mineral development or processing was a beneficial use.[58] Indeed, the need for water to facilitate gold mining[59] was a substantial contributing factor in the rejection of the riparian rights doctrine[60] and the adoption and spread of the prior appropriation doctrine for allocating the use of water in watercourses[61] in the western United States. [62]

As to the need to dispose of unwanted water that hindered or prevented mineral development, courts generally focused first on the use of the land. After concluding that mining was a reasonable use of the land, courts would then hold that because gravity causes water to flow natu-

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57. *See* Graham v. Dahlonega Gold Mining Co., 71 Ga. 296, 299 (1883) (reversing demurrer to action challenging permanent diversion of stream, "there being valuable gold mines on the premises which he was unable to work or otherwise utilize for want of this water thus diverted"). At one time, forty-two states applied the riparian rights doctrine to watercourses.

58. *See, e.g*, Union Mill & Mining Co. v. Dangberg, 81 F. 73 (D. Nev. 1897); Hill v. King, 8 Cal. 336, 338 (1857); Fitzpatrick v. Montgomery, 50 P. 416 (Mont. 1897). Ultimately, eighteen states were to apply prior appropriation doctrine to watercourses. 2 WATERS AND WATER RIGHTS § 11.04(a), at 11-21 (Robert E. Beck & Amy K. Kelley eds., 1991 ed., rep. vol. 2008). Louisiana's water law developed through its adoption of the French Civil Code. *Id.* § 10.02, at 10-39.

59. The use of the hydraulic mining process to mine gold was commonplace. *See* Hand Gold Mining Co. v. Parker, 59 Ga. 419 (1877); *see also* O. YOUNG, WESTERN MINING: AN INFORMAL ACCOUNT OF PRECIOUS-METALS PROSPECTING, PLACERING, LODE MINING, AND MILLING ON THE AMERICAN FRONTIER FROM SPANISH TIMES TO 1893, at 102-45 (1970).

60. Ten western states did use riparian rights doctrine for some time; three states, California, Nebraska, and Oklahoma, still recognize a role for the riparian doctrine. *See* 1 WATERS AND WATER RIGHTS §§ 8.02(a), 8.03(a), at 8-15, 8-54 (Robert E. Beck & Amy K. Kelley eds., 1991 ed., repl. vol. 2007).

61. "Watercourses" is used in this article to refer to all surface water other than diffused surface water.

62. *See* Atchison v. Peterson, 87 U.S. (20 Wall) 507 (1874); 2 WATERS AND WATER RIGHTS, *supra* note 58, § 11.02, at 11-6 to 11-16.

rally to a neighbor's mine or to a neighbor's land where it causes damage, the ordinary course of mining was without remedy as long as the mine operator was neither negligent nor in violation of a statutory duty.[63] In this context, mining generally was not treated differently than any other "natural" use of the land that in its use might cause injury to another water user.[64] However, when the mine operator took action to pump[65] or ditch the water where it would not have flowed ordinarily or to collect and discharge the water in greater quantities, the operator would be liable for any injury either on a theory of interfering with someone else's water right[66] or as causing a nuisance.[67]

As to the disposal of mine waste, the courts intervened as well. Thus, in 1884, the Supreme Court of California enjoined a hydraulic gold mining operation in which tailings from the operation were destroying the navigable capacity of rivers.[68] In 1891, the Supreme Court of Ohio held that depositing coal slack and tailings on a stream bank knowing rains would come and wash it into the stream, eventually causing damage to the plaintiff, is not protected conduct as a necessary part of using the land.[69] And in 1909, the Supreme Court of Arizona enjoined copper mining, smelting, and reduction operations when "slimes, slickens, and tailings" from the operations entered the Gila River.[70] These foreign substances destroyed the irrigated farm land because their

63. *See* Corona Coal Co. v. Thomas, 101 So. 673 (Ala. 1924); Jones v. Robertson, 6 N.E. 890 (Ill. 1886); Columbus & H. Coal & Iron Co. v. Tucker, 26 N.E. 630 (Ohio 1891).

64. There was disagreement over whether mining should be considered a "natural" use of the land. *See infra* note 65.

65. Courts disagreed over whether pumping was a part of the natural process of mining. The courts that concluded it was, such as in *Pennsylvania Coal Co. v. Sanderson*, 6 A. 453, 457 (Pa. 1886), which focused on the collecting of the water in the mines as natural and the necessity to pump that water in order to be able to make use of the land for the mining. Later, in *Pennsylvania R.R. Co. v. Sagamore Coal Co.*, 126 A. 386, 391-92 (Pa. 1924), the Pennsylvania court limited *Sanderson* to the situation in which no public use of water is involved. In 1907, the Supreme Court of Tennessee, in rejecting *Sanderson* as authority, said of the decision that it was "opposed by the great weight of authority in this country and England, and is in our judgment subversive of fundamental private rights." H.B. Bowling Coal Co. v. Ruffner, 100 S.W. 116, 122 (Tenn. 1907). In *Ruffner*, the court noted that the operator "deliberately collected the mine water in pipes and, conveying it through the mine and to a distance of 75 feet beyond its mouth, emptied it into a stream or tributary." *Id.* at 119.

66. *E.g.*, Tenn. Coal, Iron & R.R. Co. v. Hamilton, 14 So. 167, 169 (Ala. 1893) (applying the reasonable use doctrine to purity of the water to allow some reduction and overturning an excessive verdict).

67. *E.g.*, Beach v. Sterling Iron & Zinc Co., 33 A. 286, 292-93 (N.J. 1895) (enjoining a mining operation from discoloring a natural watercourse on grounds that it was a nuisance when plaintiffs needed clear water to make tissue paper and a filtration system would cost $5,000). Some courts may have applied strict liability under *Rylands v. Fletcher*. *See generally* John D. Knodell, Jr., *Liability for Pollution of Surface and Underground Waters*, 12 ROCKY MTN. MIN. L. INST. 33, 35 (1967).

68. People v. Gold Run Ditch & Mining Co., 4 P. 1152, 1159 (Cal. 1884) ("[N]either State nor Federal legislatures could, by silent acquiescence, or by attempted legislation, take private property for a private use, nor divest the people of the State of their rights in the navigable waters of the State for the use of a private business, however extensive or long continued."). Earlier in *Hill v. King*, 8 Cal. 336, 338 (1857), the California Supreme Court upheld a cause of action based on the defendant's mining operation causing sedimentation of Indian Cañon above the plaintiff's diversion ditch so that the water diverted into the ditch became unusable for the purpose of the plaintiff's prior appropriation of the water for gold mining.

69. Columbus & H. Coal & Iron Co. v. Tucker, 26 N.E. 630, 632 (Ohio 1891).

70. Ariz. Copper Co. v. Gillespie, 100 P. 465, 467 (Ariz. 1909), *aff'd* 230 U.S. 46 (1913).

presence in the diverted irrigation water resulted in elevating the land, forming a compacting layer, and choking the plant roots.[71]

As a result, the need to use water in developing minerals and the need to get rid of water that interfered with developing minerals, plus the use of water bodies for mine waste disposal, have created a significant body of water law. This body of law informs decision makers when similar issues arise in oil and gas development.[72]

While used in various forms since the times of Jericho and Babylon, oil development, as generally understood today, began in 1859 with the sinking of an oil well near Titusville, Pennsylvania.[73] Development spread rapidly with around seventy-five wells in the Titusville area by November 1860.[74] Although cases challenging well location due to alleged dangers from explosion and fire arose early,[75] cases concerning the interrelationship with the water resource came later.[76] One of the earliest concerns was land pollution from the salt water[77] produced as a byproduct in the oil and gas wells.[78]

Natural gas development and use also dates from early times,[79] although it appears that the first gas well was not drilled until 1821.[80] Significant production did not begin until pipelines adequate for transporting gas were in place.[81] The first such pipeline appears to date from 1891[82] but without much expansion taking place until after World War II.[83] However, in 1928, the Kansas Supreme Court affirmed a verdict of

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71. *Id.*

72. "Development" is used in this article broadly to include any or all extraction, processing, and preparation for market.

73. DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER 23-25 (1991).

74. *Id.* at 27-29; *see also* 1 HAROLD F. WILLIAMSON & ARNOLD R. DAUM, THE AMERICAN PETROLEUM INDUSTRY: THE AGE OF ILLUMINATION 1859-1899, at 63 (1959); 2 HAROLD F. WILLIAMSON ET AL., THE AMERICAN PETROLEUM INDUSTRY: THE AGE OF ENERGY 1899-1959, at 15-63 (1963).

75. *See, e.g.*, Maxwell v. Coffeyville Mining & Gas Co., 75 P. 1047 (Kan. 1904) (noting failure to prove causation); McGregor v. Camden, 34 S.E. 936 (W. Va. 1899); *see also* Helms v. E. Kan. Oil Co., 169 P. 208 (Kan. 1917) (noting recovery for nuisance from oil refinery sustained; not known if stream was polluted).

76. *But see* Kinnaird v. Standard Oil Co., 12 S.W. 937, 939 (Ky. 1890) (recognizing cause of action in which spring was polluted due to leakage from coal oil storage facility).

77. *See generally* 4 W. L. SUMMERS, THE LAW OF OIL AND GAS §§ 655-57 (1962).

78. Commentators have observed:

> Saltwater in the Monroe Gas Field was vented onto the open ground. The problem of what to do with saltwater was often solved this way in the early oil fields. Of course this practice effectively ruined the land for cultivation. Evidences of these saltwater runs may yet be seen in areas of some of the older fields in Louisiana and Arkansas.

KENNY A. FRANKS & PAUL F. LAMBERT, EARLY LOUISIANA AND ARKANSAS OIL: A PHOTOGRAPHIC HISTORY, 1901-1946, at 100 (1982).

79. *See generally* U.S. Dep't of Energy, *The History of Natural Gas*, http://fossil.energy.gov/education/energylessons/gas/gas_history.html (last visited Jan. 19, 2010).

80. *Id.*

81. *Id.* There are early cases that deal with water pollution from the manufactured gas process. *See, e.g.*, Pensacola Gas Co. v. Pebley, 5 So. 593 (Fla. 1889) (well water corrupted); Ottawa Gas Light & Coke Co. v. Graham, 35 Ill. 346 (1864) (well water corrupted).

82. U.S. Dep't of Energy, *supra* note 79.

83. *Id.*

$2,500 for the destruction of the plaintiff's water well by salt water pollution resulting from defendant's gas well, which the defendant had failed to encase or plug upon abandonment.[84] Kansas statutes required casing or plugging to prevent salt water migration and made it unlawful to allow "salt water, oil or refuse from any such well, to escape upon the ground and flow away from the immediate vicinity of such well."[85]

When Eva Neufeld wrote her article in the 1981 Kansas Bar Journal on the Kansas water-appropriation statutes and their effect on the oil and gas industry,[86] she identified three areas of water use and/or disposal that were important in oil and gas development. These three were: (1) the need for a temporary use of water for the initial drilling of the well;[87] (2) the need to dispose of salt water produced as a byproduct incidental to the oil and gas operation;[88] and (3) the continuous need for freshwater for engaging in enhanced recovery of oil or gas.[89] These areas of concern are still important.[90]

As noted above, saltwater has been dealt with as a byproduct of oil and gas production since early on.[91] Disposition of produced water often includes: (1) underground injection into the formation from which it is produced;[92] (2) injection into another formation;[93] (3) deposition in a surface reservoir;[94] (4) deposition on the surface other than in a reser-

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84. Hall v. Galey, 271 P. 319, 321 (Kan. 1928).

85. *Id.* at 320.

86. Eva N. Neufeld, *The Kansas Water Appropriation Statutes and Their Effect Upon the Oil and Gas Industry in Kansas*, 50 J. KAN. B. ASS'N 43 (1981).

87. *Id.* at 45-46. The principal use here was for "mud," defined as "the mixture of water or oil with clay, and sometimes other special materials, used as a drill circulation liquid in drilling a borehole. Also called drill mud." U.S. DEP'T OF THE INTERIOR, A DICTIONARY OF MINING, MINERAL, AND RELATED TERMS 732 (Bureau of Mines, 1968); *see also* MCGRAW-HILL, DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS 615 (Sybil P. Parker ed., 5th ed. 1994) (noting that drilling mud is used "to seal off porous zones and flush out chippings, and to lubricate and cool the bit"). Drilling mud was developed with the rotary drilling bit; the dual head bit was patented in 1909 and the tricone bit in 1933.

88. Neufeld, *supra* note 86, at 46-48. "Fresh water, water with varying degrees of minerals, or salt water may be produced." *Id.* at 46.

89. *Id.* at 48-51.

> Fresh water is required in many enhanced oil recovery techniques . . . . [T]he salt water produced with the oil or gas may be injected into the oil field as a means of repressurizing the field and enhancing oil production. Certain geological zones are not adaptable to salt water alone and require a mixing of fresh and salt water for the injection process. Fresh water is also required for chemical or tertiary recovery projects.

Id. at 49.

For an early discussion of the law relating to water flooding, at a time when there were no reported cases dealing specifically with any issue related to water flooding for secondary recovery purposes, see Earl A. Brown & Raymond M. Myers, *Some Legal Aspects of Water Flooding*, 24 TEX. L. REV. 456 (1946). The authors identify knowledge of the value of water flooding dating back to the very early 1900s, but they identify the first formal project applying water flooding to an entire pool as dating from 1943. *Id.* at 456-58.

90. The estimate in the Primer is that it will take 80,000 gallons of water for the drilling of a well in the Marcellus Shale. *See supra* text accompanying note 16.

91. *See supra* text accompanying notes 77-78, 84-85.

92. *See infra* note 99 and accompanying text.

93. *See infra* note 99 and text accompanying notes 99, 241.

94. *See infra* text accompanying note 194.

voir, such as in a stream or lake;[95] or (5) deposition on the surface of the land.[96] These various options exist because not all produced water is salt water.[97] Most, if not all, oil and gas producing states have legislation and regulation dealing with salt water disposal,[98] although the disposition is usually under the control of the state oil and gas regulatory agency rather than an environmental pollution control agency.[99] Under these state schemes, the water does not have to go through either the regular allocation process[100] or the regular water disposal process.[101]

Because CBM wells produce salt water, these statutes would be the model for disposing of CBM-produced water.[102] For example, the Kansas statute refers to "any oil or gas well,"[103] and because the Kansas Supreme Court has held that CBM is gas and not reserved by a reservation of "all coal,"[104] arguably the Kansas statute applies to CBM-produced water.

So far this historical review has focused on state law. Direct federal involvement came when Congress enacted the Oil Pollution Act of 1924,[105] which, apparently, was largely ignored.[106] It was not until 1970 that Congress repealed the 1924 act and amended the Federal Water

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95. *See supra* note 44; *infra* text accompanying note 170.

96. *See supra* note 78; *infra* text accompanying note 195.

97. *See supra* note 88 and accompanying text.

98. *See generally* Darin, *supra* note 43. Darin reviews the statutory bases for disposal of produced water in the states listed in his title and finds that they originated in the 1950s and 1960s before CBM production was contemplated and that they treated the produced water as waste. Darin finds that in the context of CBM-produced water, it is the water that is being wasted by its treatment as waste water. He foresees challenges to the laws based on the public trust doctrine and the public interest review provided for in the state water laws. *Id.*

99. *See, e.g.*, KAN. STAT. ANN. § 55-901(a) (2005):

> The owner or operator of any oil or gas well which may be producing and which produces salt water or waters containing minerals in an appreciable degree shall have the right to return such waters to any horizon from which such salt waters may have been produced, or to any other horizon which contains or had previously produced salt water or waters containing minerals in an appreciable degree, if the owner or operator of such well makes a written application to the state corporation commission for authority to do so, and written approval has been granted to the owner or operator after investigation by the state corporation commission.

100. *See* KAN. STAT. ANN. § 82a-728 (1997). The statute provides an exception to the permit requirement for "the production and return of salt water in connection with the operation of oil and gas wells in accordance with the written approval granted therefor by the Kansas corporation commission pursuant to K.S.A. 55-901, and amendments thereto." *Id.* However, it defines salt water for purposes of the exception as "water containing more than 5,000 milligrams per liter chlorides." *Id.*

101. *See* KAN. STAT. ANN. § 65-171(e)(1) (2002). Section 65-171(e)(1) provides:

> Whenever the secretary of health and environment . . . find[s] that storage or disposal of salt water *not regulated by the state corporation commission* or refuse in any surface pond *not regulated by the state corporation commission* is causing or is likely to cause pollution of soil or waters of the state, the secretary . . . shall issue an order prohibiting such storage or disposal of salt water or refuse.

Id. (emphasis added).

102. *But see* Pennaco Energy, Inc. v. U. S. Dep't of the Interior, 377 F.3d 1147 (10th Cir. 2004).

103. *See supra* note 99 and accompanying text.

104. Cent. Natural Res., Inc. v. Davis Operating Co., 201 P.3d 680, 684 (Kan. 2009).

105. Pub. L. No. 68-238, 43 Stat. 604 (1924), *repealed by* Water Quality Improvement Act of 1970, Pub. L. No. 91-224, § 102, 84 Stat. 91 (1970).

106. *See* 5 WATERS AND WATER RIGHTS § 53.04(c)(1), at 502 (Robert E. Beck ed. 1991 ed., repl. vol. 2006).

Pollution Control Act of 1948 with a section on oil pollution.[107] Twenty years later, Congress enacted the Oil Pollution Act of 1990.[108]

In 1974, when Congress addressed underground injection, it did so not in the Federal Water Pollution Control Act, but in the Safe Drinking Water Act (SDWA)[109] under a program designated as: "Protection of Underground Sources of Drinking Water."[110] But even then, produced water, along with injections for secondary or tertiary recovery, was given special consideration.[111] The statute prohibited the administrator from promulgating regulatory requirements for those injections unless the regulations were "*essential* to assure that underground sources of drinking water will not be endangered by such injection."[112] The essentiality requirement did not apply to other injections. And in 1980, an amendment that applied only to state program provisions relating to produced water and to injections for secondary or tertiary recovery provided a less onerous alternative approval method for the EPA to approve of those provisions.[113] Finally, even though fracing involved underground injection of liquids, the EPA refused to regulate fracing as an injection under the Act.[114]

So what has been happening since the turn of the century that might change this treatment of the water involved in these developments?

A. Recent Events

In general, we appear to be in a transitional period now in which water that has been on the periphery of the main water allocation and disposal systems is being brought more fully within those systems. Sometimes this occurs through a state's initiative; often it occurs through existing water rights holders invoking administrative or judicial processes to obtain protection for those water rights. As with all transition periods, ups and downs, progress and regression will occur. However, once within those systems, the water will face the pressures inherent in those systems, some of which will be discussed in the next section. First, however, some examples principally from 2000 to the present should help illustrate the change that is taking place.

In 1997 and 2001, the United States Court of Appeals for the Eleventh Circuit held that fracing constituted underground injection under

107. Pub. L. No. 91-224, § 11, 84 Stat. 91 (1970).
108. Pub. L. No. 101-380, 104 Stat. 484 (1990) (codified at 33 U.S.C. §§ 2701-2762 (2006).
109. Pub. L. No. 93-523, 88 Stat. 1660 (codified as amended at 42 U.S.C. §§ 300f to 300j-26 (2006)).
110. 42 U.S.C. §§ 300h to 300j-26 (2006).
111. 42 U.S.C. §§ 300h(b)(2), 300h-1(c).
112. 42 U.S.C. § 300h-1(c) (emphasis added).
113. *See* 42 U.S.C. § 300h-4.
114. *See* Legal Envtl. Assistance Found., Inc. v. EPA, 118 F.3d 1467, 1469 (11th Cir. 1997).

the SDWA[115] and that the wells were to be classified and regulated as Class II injection wells.[116] This legal battle began more or less in 1994 with a petition to the EPA to withdraw approval of Alabama's Underground Injection Control (UIC) program[117] because of its failure to regulate fracing.[118] The EPA denied the petition on the basis that hydraulic fracing did not fall within the regulatory definition of underground injection because the definition encompassed only wells whose principal function was to emplace fluids underground, and here the principal function of the wells was to produce gas even though underground injections were also used for fracing.[119] The plaintiff argued on appeal to the Eleventh Circuit that the regulatory definition was inconsistent with the statute.[120] Finding the statute to be clear that all underground injection wells are covered,[121] and because these clearly were wells, the only other issue for the circuit court was whether fracing constituted underground injection under the statutory definition.[122] The court held that hydraulic fracing to enhance oil and gas production constituted underground injection, which the EPA is required to regulate under the SDWA.[123]

The Eleventh Circuit explained the Alabama situation as follows:

> In Alabama . . . [fracing] is commonly used in connection with the extraction of natural methane gas from coal beds. Coal beds, as all underground formations, are formed of porous, sometimes fractured, materials. These coal beds contain natural gas, which can be extracted through production wells. Because of the tightness of coal bed formations and their very low permeability, the rate of production of natural gas is low in the absence of production enhancement.[124]

The fracturing occurs when "[t]he application of pressure injects fluids into the coal bed thereby widening natural fractures and inducing new ones that are held open by the propping agent after the pressure is released."[125] These fluids "may contain guar gel, nitrogen or carbon dioxide gases, gelled oil, diesel oil, sodium hydroxide, hydrochloric acid, sulfuric acid, fumeric acid, as well as other additives."[126] After the fracturing, the fluids are pumped out before production begins although

115. *Id.* at 1478.

116. Legal Envtl. Assistance Found., Inc. v. EPA, 276 F.3d 1253 (11th Cir. 2001), *reh'g en banc denied*, 34 Fed. Appx. 392 (11th Cir. 2002), *cert. denied*, 537 U.S. 989 (2002).

117. The Underground Injection Control (UIC) program is developed pursuant to Part C of the Safe Drinking Water Act, 42 U.S.C. §§ 300h to 300h-8.

118. *See Legal Envtl. Assistance Found.*, 118 F.3d at 1471.

119. *Id.*

120. *Id.* at 1472.

121. State programs "shall prohibit . . . *any* underground injection . . . which is not authorized by a permit." *Id.* at 1474 (quoting 42 U.S.C. § 300h(b)(1)(B) (2006) (emphasis by the court)).

122. *Legal Envtl. Assistance Found.*, 118 F.3d at 1474.

123. *Id.* at 1478.

124. *Id.* at 1470. Thus, this topic on fracing relates directly to the next topic in this article, CBM production, in which the focus is on the disposal of produced water.

125. *Id.*

126. *Id.* at 1471.

"a portion of the injected fluids, however, remains in the ground."[127] The definition of underground injection in the act stated: "The term 'underground injection' means the subsurface emplacement of fluids by well injection. Such term does not include the underground injection of natural gas for purposes of storage."[128] Based on the foregoing description,[129] the court concluded that hydraulic fracing is "subsurface emplacement of fluids by forcing them into cavities and passages in the ground through a well."[130] Thus, it comes within the plain meaning of the definition. The court's decision was bolstered by the EPA having conceded "that Congress intended to cast a wide regulatory net in enacting the UIC program."[131]

With several thousand CBM wells in Alabama,[132] concern about potential contamination of drinking water had grown.[133] Following the 1997 court decision, Alabama revised its UIC program,[134] and the EPA approved the revised program.[135] The approval was challenged, and the case again arrived before the Eleventh Circuit.[136] In reviewing the five types of wells in the underground injection control classification scheme,[137] the court disagreed with the EPA. The EPA had concluded that these fracing injection wells came closest to the Class II category wells,[138] but instead of classifying them as Class II wells, the EPA classified them only as involving "Class II-like underground activity," so that they would not be subject to "all of the Class II regulatory requirements."[139] The court disagreed, concluding that being injection wells, they must come within one of the five classes of injection wells and to the court they "fit squarely within the definition of Class II wells. Accordingly, they must be regulated as such."[140]

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127. *Id.* "The only quantitative information contained in the record on this issue indicates a fluid loss of 20 to 30 percent." *Id.* at 1471 n.5.

128. *Id.* at 1474 (citing 42 U.S.C. § 300h(d)(1)(A)-(B) (2006)).

129. *See supra* text accompanying notes 124-127.

130. *Legal Envtl. Assistance Found.*, 118 F.3d at 1474.

131. *Id.* at 1475.

132. *Id.* at 1471. As to the CBM on-rush elsewhere, see *infra* text accompanying notes 191-197.

133. *See generally* Wiseman, *supra* note 11, at 117-42.

134. State of Alabama; Underground Injection Control (UIC) Program Revision; Approval of Alabama's Class II UIC Program Revision, 64 Fed. Reg. 56,986 (Oct. 22, 1999) (codified at 40 C.F.R. pt. 147).

135. State of Alabama; Underground Injection Control (UIC) Program Revision; Approval of Alabama's Class II UIC Program Revision, 65 Fed. Reg. 2889 (Jan. 19, 2000) (codified at 40 C.F.R. pt. 147).

136. Legal Envtl. Assistance Found., Inc. v. EPA, 276 F.3d 1253 (11th Cir. 2001).

137. *See* 40 C.F.R. § 144.6(a)-(e) (1983).

138. Class II wells are "[w]ells which inject fluids . . . [f]or enhanced recovery of oil or natural gas . . . ." 40 C.F.R. § 144.6(b) (1983). As of 2008, there were 146,797 Class II wells in the United States. EPA.gov, Factoids: Drinking Water and Ground Water Statistics for 2008, http://www.epa.gov/safewater/databases/pdfs/data_factoids_2008.pdf (last visited Jan. 19, 2010). Forty states have primacy though not all of those states have oil and gas production. U.S. DEP'T ENERGY, *supra* note 3, at 33. The EPA has programs for the other ten states, seven of which produce oil and gas. *Id.*

139. *Legal Envtl. Assistance Found.*, 276 F.3d at 1262.

140. *Id.* at 1263.

After having considered classification of the wells, the EPA had approved the revised Alabama program but under the more flexible of two statutory avenues of approval.[141] The more flexible avenue is limited to two categories of injection, but the EPA found that fracing could be placed within the second of the two categories: "that portion of any State underground injection control program which *relates to* . . . any underground injection for the secondary or tertiary recovery of oil or natural gas."[142] The EPA conceded that fracing was not "secondary or tertiary recovery," but the court found that the statutory phrase "relates to" was ambiguous and upheld the EPA's approval by finding the "EPA's interpretation more compelling."[143]

In 2005, Congress amended the above-quoted definition of "underground injection"[144] to exclude most fracing from its scope:

> For purposes of this part [Part C] . . . [t]he term "underground injection"—(A) means the subsurface emplacement of fluids by well injection; and (B) excludes—(i) the underground injection of natural gas for purposes of storage; and (ii) the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities.[145]

The effect of the amendment is to remove most, and potentially all,[146] fracing from the scope of the UIC program.

As noted earlier,[147] the SDWA limits what the Administrator can include in the regulations that prescribe what state UIC programs must contain as to "the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations" and "any underground injection for the secondary or tertiary recovery of oil or natural gas." [148] These limits also pertain to federal programs prescribed for states that do not adopt a UIC program of their own.[149] But if the regulatory "requirements are essential to assure that underground sources of drinking water will not be endangered by such injection," the requirements are allowed.[150] The 2005 amendment of the definition does not amend these

141. *Id.* at 1263-65; The EPA proceeded under 42 U.S.C. § 300h-4(a) rather than 42 U.S.C. § 300h-1(b).

142. 42 U.S.C. § 300h-4(a)(2) (2006) (emphasis added).

143. *Legal Envtl. Assistance Found.*, 276 F.3d at 1259.

144. *See* Legal Envtl. Assistance Found., Inc. v. EPA, 118 F.3d 1467, 1474 (11th Cir. 1997) (citing 42 U.S.C. § 300h(d)(1)(A)-(B) (2006)); *see also supra* text accompanying note 128.

145. 42 U.S.C. § 300h(d), *amended by* Energy Policy Act of 2005, Pub. L. No. 109-58, § 322, 119 Stat. 694 (2005).

146. The EPA has a Memorandum of Understanding with three entities that do 95% of the fracing that they will not use diesel fuel. *See* Wiseman, *supra* note 11, at 189. If each state where fracing occurs banned the use of diesel fuel in the fracing fluid, one expects that there would not be any regulation of fracing under the UIC program.

147. *See supra* text accompanying note 112.

148. 42 U.S.C. § 300h(b)(2) (2006).

149. 42 U.S.C. § 300h-1(c) (2006).

150. 42 U.S.C. §§ 300h(b)(2), 300h-1(c).

provisions to allow the Administrator to act with reference to fracing injections in the same way that the Administrator can act with reference to injections for salt water disposal or for secondary or tertiary recovery. Namely, the Administrator can act when it is "essential to assure that underground sources of drinking water will not be endangered by such [a fracing] injection."[151] The amendment did retain regulatory authority over fracing with diesel oil, which apparently was retained because diesel oil was the only component of fracing fluid then on the EPA's Contaminant Candidate List.[152] Subsequently, as Professor Wiseman points out, two more of those ingredients have made it to the Contaminant Candidate List.[153] Of course states may have stricter programs,[154] and in 2007, when Alabama removed its regulation of fracing from under the UIC program, it did not repeal the regulation but instead designated it as a separate hydraulic-fracturing regulation.[155]

In the context of fracing, the growing scarcity of water suggests that an extra level of care for existing water resources is in order, particularly for those water resources that presently are used or usable for sustenance of life. Thus, if there is any potential that any significant supply of potable water could be polluted by the fracing materials, whether when in use or when being disposed of as waste, every reasonable effort should be made to understand that potential and remove any chance of that pollution occurring. Because there appears to be a consensus that the use of diesel fuel in fracing presents an unwarranted risk,[156] the extra-care process could begin by states in which fracing occurs declaring the use of diesel fuel in fracing fluids to be illegal as Alabama did in its 2007 changes.[157] But, other potentially harmful chemicals should be studied as to the scope of their harmfulness and the degree of necessity for their use in fracing.[158] Professor Wiseman has pointed out the potential dangers and the clear lack of scientific investigation with those dangers.[159] Once the potential danger is generally understood, whatever

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151. 42 U.S.C. § 300h(b)(2); *see supra* note 146 and accompanying text.

152. *See* Wiseman, *supra* note 11, at 177.

153. *Id.* (including ethylene glycol and methanol). The Primer's list of fracing fluid ingredients does not include diesel oil or methanol, but does include ethylene glycol. *See supra* note 30.

154. 42 U.S.C. § 300h-2(d) (2006).

155. *In re* Order No. E-2007-113, No. 7-26-07-1 (Aug. 3, 2007), *available at* http://www.ogb.state.al.us/gsaogb/documents/bdorders/2007-113.pdf.

156. *See* Wiseman, *supra* note 11, at 140.

157. "Diesel oil or fuel is prohibited in any fluid mixture used in the hydraulic fracturing of a coal bed." ALA. ADMIN. CODE r. 400-3-8-.03(7) (2007). Since the Safe Drinking Water Act (SDWA) still requires the regulation of fracing if diesel fuel is used, such action would also benefit operators by removing the last threat for federal regulation of fracing. The ban on the use of diesel fuel is consistent with the congressional amendment. *See* Wiseman, *supra* note 11, at 139-45, 188-89.

158. The EPA has added two more fracing fluids to its list of contaminant candidates. *See* Wiseman, *supra* note 11, at 177.

159. *See id.* at 117-42 (providing a comprehensive description of the fracing processes and fluids used, the increase in fracing occurrences, and the possible adverse effects); *see also id.* at 128-137, 170-81 (providing an extensive critique of the EPA's Phase I (and only Phase) Report).

additional studies or regulatory measures appear justifiable to protect a particular potable water resource from particular threats in a specific project could be undertaken. However, because the chemicals used in the fracing mix vary from well to well, and because the geologic formation varies from well area to well area,[160] fracing—like surface mining[161]—is an area in which local regulation becomes most important. The SDWA specifically provides that states may consider "varying geologic, hydrological, or historical conditions" including in "different areas within a State."[162]

Legislative and regulatory actions become more important as courts foreclose common law avenues of protecting existing water rights as the Texas Supreme Court did in 2008. In *Coastal Oil & Gas Corp. v. Garza Energy Trust*,[163] fracing had led to claims of subsurface trespass. The lessors brought suit in 1997 for breach of the implied covenants to develop and prevent drainage; the lessee not only owned adjoining leases but also owned adjacent fee mineral interests.[164] Apparently, upon hearing evidence that the amount of proppants used on the lessee's fee wells was massive as contrasted with the amount used on the lessor's leases, the subsurface trespass claim was added. The court concluded that because the only loss claimed from the fracing was drainage of gas, the rule of capture applied and precluded any claim for trespass.[165] The implication may be, however, that if the fracing had caused

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160. The description of the process by the Texas Supreme Court is helpful:

> Engineers design a fracing operation for a particular well, selecting the injection pressure, volumes of material injected, and type of proppant to achieve a desired result based on data regarding the porosity, permeability, and modulus (elasticity) of the rock, and the pressure and other aspects of the reservoir. The design projects the length of the fractures from the well measured three ways: the hydraulic length, which is the distance the fracing fluid will travel, sometimes as far as 3,000 feet from the well; the propped length, which is the slightly shorter distance the proppant will reach; and the effective length, the still shorter distance within which the fracing operation will actually improve production. Estimates of these distances are dependent on available data and are at best imprecise.

Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1, 7 (Tex. 2008); *see also* U.S. DEP'T OF ENERGY, *supra* note 3, at 57.

161. *See* Surface Mining Control and Reclamation Act, 30 U.S.C. § 1201(f) (2006).

162. 42 U.S.C. § 300h(b)(3)(A) (2006).

163. 268 S.W.3d 1 (Tex. 2008).

164. *Id.* at 6.

165. *Id.* at 17. The rule of capture provides that if the owner drills a well on one's land, the owner is entitled to whatever that well captures. But if the owner bottoms its well in its neighbor's land without consent—a trespass—the owner is not entitled to the captured product. When the water flooding cases arose, it was argued that injecting water into one's neighbor's land without consent was a trespass. Under traditional trespass analysis, it would be. However, some courts concluded that water flooding was an essential operation for oil and gas recovery and prevented waste, and as long as it had been authorized by and was being regulated by the state as a regulation of a common resource for the benefit of all owners, trespass should not apply. In *Garza* it was again argued that injecting a fluid into someone else's land without her consent was a trespass, which would preclude the application of the rule of capture. However, fracing was not being regulated in Texas to protect a common resource, see *infra* note 167, so the water flooding cases would not apply. Instead of concluding trespass does not apply, the court concluded the rule of capture applies. For further discussion of *Garza*, see Theresa D. Poindexter, *Correlative Rights Doctrine, Not the Rule of Capture, Provides Correct Analysis for Resolving Hydraulic Fracturing Cases*, 48 WASHBURN L.J. 755 (2009).

physical damage, such as to the lessor's water supply, that damage might have provided a basis for recovery on a trespass theory.[166] However, with the water resource, the primary focus should be on protecting the resource from damage and not on the recovery of damages afterwards.[167]

In 2003, the United States Court of Appeals for the Ninth Circuit held that CBM-produced water is a pollutant under the Clean Water Act (CWA).[168] In 1997, Fidelity Exploration and Development Company began exploring for and developing CBM in the Powder River Basin.[169] In 1998, the company contacted the Montana Department of Environmental Quality about discharging the produced water into the Tongue River and Squirrel Creek and was informed that a discharge permit was not required under Montana law,[170] but that the EPA disagreed with the Montana law.[171] In January 1999, after having begun to discharge, the company applied for a discharge permit.[172] On June 23, 2000, the plaintiffs filed a citizen suit.[173] The parties stipulated that the only issue was whether CBM-produced water constitutes a pollutant.[174] The federal district court held that CBM-produced water was not a pollutant.[175] The Ninth Circuit disagreed and held that CBM-produced water is a pollutant, [176] noting that "[t]he water discharged is 'salty,' contains several chemical constituents identified as pollutants by Environmental Protection Agency (EPA) regulations, has characteris-

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166. However, perhaps this is not the case. The court appears to focus on "misconduct that is illegal, malicious, reckless, or intended to harm another without commercial justification." *Garza*, 268 S.W.3d at 17.

167. However, in Texas "[t]hough hydraulic fracturing has been commonplace in the oil and gas industry for over sixty years, neither the Legislature nor the Commission has ever seen fit to regulate it." *Id.*

168. N. Plains Res. Council v. Fidelity Exploration & Dev. Co., 325 F.3d 1155, 1157 (9th Cir. 2003).

169. *Id.* at 1158.

170. MONT. CODE ANN. § 75-5-401(1)(b) (2009). The statute provides:

> Discharge to surface water of groundwater that is not altered from its ambient quality does not constitute a discharge requiring a permit under this part if: (i) the discharge does not contain industrial waste, sewage, or other wastes; (ii) the water discharged does not cause the receiving waters to exceed applicable standards for any parameters; and (iii) to the extent that the receiving waters in their ambient state exceed state standards for any parameters, the discharge does not increase the concentration of the parameters.

Id.

171. *N. Plains Res. Council*, 325 F.3d at 1158-59.

172. *Id.* at 1159.

173. *Id.*

174. *Id.* at 1159-60.

175. N. Plains Res. Council v. Redstone Gas, No. 00-CV-105, 2002 WL 31054969, at *1 (D. Mont. Aug. 23, 2002).

176. As pollutant is defined in the Clean Water Act, the court considered the produced water to be "industrial waste," which the court defined as "any useless byproduct derived from the commercial production and sale of goods and services." *N. Plains Res. Council*, 325 F.3d at 1160-61; *see* Clean Water Act, 33 U.S.C. § 1362(6) (2006). This CBM-produced water was not within the produced water exclusion because that exclusion is limited to produced water that is "disposed of in a well" and, thus, regulated under the SDWA. *N. Plains Res. Council*, 325 F.3d at 1160-61; *see also* Sierra Club, Lone Star Chapter v. Cedar Point Oil Co., 73 F.3d 546, 568 (5th Cir. 1996).

tics that may degrade the soil, and is unfit for irrigation."[177] As a pollutant under the CWA, Montana would not have the authority to create an exemption.[178]

In 2004, the United States Court of Appeals for the Tenth Circuit upheld the Interior Board of Land Appeals' (ILBA) decision that CBM-water production is significantly greater than non-CBM oil and gas water production, and, therefore, an EIS was required rather than mere referencing of documents related to non-CBM produced water.[179] In 2000, the Bureau of Land Management (BLM) auctioned three oil and gas leases for land located in the Powder River Basin, but it did not prepare an EIS, having concluded that an EIS was unnecessary because the environmental impact of the expected CBM development would not be significantly different from non-CBM oil and gas development already documented.[180] The IBLA disagreed, and in 2002, reversed the BLM decision for failing to discuss CBM extraction and development[181] and, thus, violating the National Environmental Policy Act (NEPA).[182] The district court reversed the IBLA and reinstated the BLM decision.[183] In reversing the district court and upholding the IBLA decision, the Tenth Circuit found evidence in the record to support the IBLA'a conclusion on the water issue[184] "that water production associated with CBM extraction is *significantly greater* than water production associated with non-CBM oil and gas development."[185] An estimate for one area suggested that up to 84,000 gallons per day would be produced per well; an estimate for another area suggested that an average of 17,280 gallons per day would be produced per well.[186]

In 2008, the Federal District Court for the District of Wyoming re-

177. *N. Plains Res. Council*, 325 F.3d at 1157. "The mean total dissolved solids for the Tongue River is 475 mg/l as compared to 1,400 mg/l for the CBM water." *Id.* at 1158. *Id.* at 1157. The court identifies the produced water as containing "suspended solids, calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, and fluoride [plus] measurable quantities of . . . aluminum, arsenic, barium, beryllium, boron, copper, lead, iron, manganese, strontium, and radium." *Id.* at 1158.

178. *Id.* at 1164-65. The language of the Montana exclusion would not, however, need to be changed because of this opinion, because the exclusion does not apply if "industrial wastes" are involved. *See supra* note 176.

179. Pennaco Energy, Inc. v. U. S. Dep't of the Interior, 377 F.3d 1147, 1150 (10th Cir. 2004). *Pennaco* is distinguished in *Western Organization of Resource Councils v. Bureau of Land Management*, 591 F. Supp. 2d 1206, 1241 (D. Wyo. 2008), on the basis that *Pennaco* involves a pre-leasing situation, whereas, *Western Org.* involves a post-leasing situation. *See infra* text accompanying notes 187-190.

180. *Pennaco*, 377 F.3d at 1152-53.

181. *Id.* at 1153-54.

182. *Id.* at 1150; *see also* 42 U.S.C. §§ 4321-4370(f) (2003).

183. Pennaco Energy, Inc. v. U.S. Dep't of the Interior, 266 F. Supp. 2d 1323 (D. Wyo. 2003).

184. The non-water impacts discussed in the court's opinion are not noted in this article. For a review of the range of possible impacts from CBM production, see James Murphy, *Slowing the Onslaught and Forecasting Hope for Change: Litigation Efforts Concerning the Environmental Impacts of Coalbed Methane Development in the Powder River Basin*, 24 PACE ENVTL. L. REV. 399, 405-412 (2007).

185. *Pennaco*, 377 F.3d at 1158 (emphasis added).

186. *Id.*

viewed the final environmental impact statement (FEIS) for the CBM program in the Powder River Basin against numerous challenges[187] and upheld the BLM's approval of the FEIS and its record of decision.[188] Of apparent importance to the court was that this was essentially a programmatic environmental impact statement, which means that separate approvals will be required for each well. This will allow the specific circumstances of each well to be taken into account, such as in the process of each state issuing a water permit.[189] According to the court, the FEIS "demonstrates unequivocally that the agency will determine the scope of future site-specific proposals and engage in further environmental analysis."[190]

On April 3, 2003, the BLM approved the program for development of CBM in the Powder River Basin of Montana and Wyoming, an area encompassing around eight million acres,[191] authorizing 82,000 wells for the basin.[192] According to the BLM, "water is the number one issue in the EIS."[193] In Wyoming, up to one trillion gallons of water could be pumped from groundwater aquifers into 3,100 unlined surface reservoirs.[194] This untreated produced water would infiltrate into shallow aquifers. The balance of the produced water would be discharged untreated into various surface drainages or sprayed onto the ground.[195] Of these 51,000 wells, 39,367 would be new wells drilled over a ten-year period from 2003.[196] Most of the wells would be drilled by the end of 2011 with the production life of a well estimated to be seven years followed by two to three years for reclamation.[197]

The produced water would be "high in salinity and sodicity."[198]

187. W. Org. of Res. Councils v. Bureau of Land Mgmt., 591 F. Supp. 2d 1206, 1212-13 (D. Wyo. 2008). The court's opinion lists twenty-four specific alleged failures on the BLM's part. *Id.*

188. *Id.* at 1245.

189. *See id.* at 1237-40.

190. *Id.* at 1237.

191. *Id.* at 1219.

192. *Id.* at 1211.

193. *Id.* at 1209. Attached to the final environmental impact statement (FEIS) is a 230-page surface water quality analysis that was not part of the draft environmental impact statement. *Id.* at 1210. Furthermore, the BLM is adopting a water alternative that was not its preferred alternative. *See id.* at 1220-27.

194. *Id.* at 1208-09. In *Wyoming Outdoor Council v. U.S. Army Corps of Engineers*, 351 F. Supp. 2d 1232 (D. Wyo. 2005), plaintiffs challenged the use of a Corps's general permit to authorize the deposit of dredge and fill material in wetlands for, among other purposes, the creation of reservoirs to hold produced water from CBM wells. *Id.* at 1239. The challenge was upheld on several grounds and rejected on other grounds. *Id.* at 1260. The Corps had failed to "consider cumulative impacts to non-wetland resources" and "impacts to private ranchlands" and had relied "on mitigation measures wholly unsupported by the record with no definite plan for monitoring." *Id.*

195. *W. Org. of Res. Councils*, 591 F. Supp. 2d at 1208-09. As to the Montana portion of the FEIS, see *North Cheyenne Tribe v. Norton*, 503 F.3d 836, 846 (9th Cir. 2007) (upholding the district court's partial injunction which enjoined CBM development on 93% of the covered area, because the BLM had failed to do the EIS on a phased-development alternative). Disagreement was over the scope of the remedy for a NEPA failure which is beyond the scope of this paper.

196. *W. Org. of Res. Councils*, 591 F. Supp. 2d at 1219-20.

197. *Id.* at 1220.

198. *Id.* at 1209 (referring to the"(ratio of sodium to magnesium and calcium) ('SAR' or 'sodium

The plaintiffs' specific water challenges to the FEIS included allegations that the BLM failed "to consider adequately": (1) groundwater impacts; (2) aquifer draw-down and its impacts; (3) surface water impacts; (4) the quantity of produced water by watershed; (5) contaminants; and (6) water quality in the ephemeral and intermittent streams.[199]

During the development of the FEIS, several alternatives relating to water were dropped from further consideration: (1) returning all produced water to aquifers; (2) capturing and treating produced water for beneficial use; and (3) ensuring quality of the water at the Montana/Wyoming border so downstream (Montana) uses would not be affected.[200] However, in the FEIS, the BLM also dropped its preferred water alternative, which emphasized "untreated surface discharge,"[201] in favor of Alternative 2A,[202] which emphasizes infiltration into shallow Wyoming aquifers.[203] Infiltration would require the digging of 3,100 pits and, thus, cause more surface disturbance, but the alternative involves separate strategies for each sub-watershed and minimizes the amount of water that will reach the main stems in the three sub-watersheds most heavily used by irrigators.[204] Infiltration in Wyoming also "would maximize local beneficial use of the produced water" (that is, keep it in Wyoming) and encourage treatment "where feasible and practicable."[205]

The court specifically noted four aspects of implementing the water alternative.[206] First, water quality agencies have to ensure "compliance with all applicable standards."[207] Second, operators on federal leases have to offer Water Well Agreements to protect nearby wells that have Wyoming permits.[208] Third, an Interim Memorandum of Cooperation between Wyoming and Montana has been entered into to protect Montana's downstream waters.[209] The memorandum includes monitoring the Little Powder River for electrical conductivity (EC), sodium absorption ratio (SAR), and total dissolved solids (TDS), and requires Wyoming to investigate causes if there is appreciable change in any of those parameters.[210] Fourth, Water Management Plans[211] for handling pro-

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absorption ratio'). . . . This type of water can negatively affect soils and plant life and may often be unsuitable for irrigation or surface disposal. Disposal is a key issue"). This agrees with the Ninth Circuit conclusion. *See* N. Plains Res. Council v. Fidelity Exploration & Dev. Co., 325 F.3d 1155, 1157 (9th Cir. 2003); *see also supra* text accompanying note 177.

199. *W. Org. of Res. Councils*, 591 F. Supp. 2d at 1217.

200. *Id.* at 1220-21.

201. *Id.* at 1220.

202. *Id.* at 1221.

203. *See id.* at 1220, 1227.

204. *Id.* at 1227. It is, thus, a more expensive alternative.

205. *Id.*

206. *Id.* at 1222-23.

207. *Id.* at 1222.

208. *Id.* at 1222-23.

209. *Id.* at 1222 (citing FEIS Appendix C).

210. *Id.* at 1222-23. The court notes that Wyoming applies its anti-degradation standards to CBM-produced water. *Id.* at 1223.

duced water during testing and production of CBM wells must accompany CBM applications for permits to drill[212] and Plans of Development[213] and must be detailed enough to allow the BLM to do its site-specific NEPA analysis and to ensure compliance with all state and federal requirements.

In 2008, the Montana Supreme Court approved regulatory changes by Montana's water pollution control agencies that tightened two historic parameters that applied to salt water and, therefore, would apply to CBM-produced water.[214] Despite the developments discussed above in *Northern Plains Resource Council v. Fidelity Exploration and Development Co.*,[215] in which the court found CBM-produced water to be a pollutant under the CWA, since 1972, Montana has used narrative standards[216]—the SAR[217] and EC[218]—to regulate two aspects of the salt water discharged into Montana waters. In 2000, the Montana Department of Environmental Quality began studying CBM-produced water,[219] and in May 2002, it prepared draft rules to provide numeric standards for SAR and EC. In June of 2002, the Board of Environmental Review (BER) received a petition from Montana water rights holders in the Powder River Basin requesting adoption of numeric standards.[220] In 2003, the BER adopted numeric standards within the Powder River Basin for these two aspects but kept the narrative standard for anti-degradation purposes[221] and rejected the petition request that SAR and EC be designated as "harmful" parameters.[222] The practical effect was that the water in the streams could be degraded up to the numeric stan-

211. *Id.* (WPMs are detailed in Appendix D to the FEIS).

212. *Id.* at 1225. The applications for permits to drill (APD) include a surface use program and a drilling plan, followed by an onsite inspection and possible revision of the APD. *See* 43 C.F.R. § 3162.3 (2007); W. Org. of Res. Councils, 591 F. Supp. 2d at 1234-35.

213. The Plan of Development (POD) is a group of wells and their infrastructure for a geographic area or sub-watershed. *Id.* at 1235.

214. Pennaco Energy, Inc. v. Mont. Bd. of Envtl. Rev., 199 P.3d 191, 193 (Mont. 2008).

215. *See generally* N. Plains Res. Council v. Fidelity Exploration & Dev. Co., 325 F.3d 1155 (9th Cir. 2003). *See also supra* text accompanying notes 168-178.

216. Generally, numeric standards are preferred but narrative standards are used when numeric standards would be difficult to formulate.

217. *Pennaco*, 199 P.3d at 193 n.1 (identifying SAR as "the concentration of sodium relative to calcium and magnesium in water").

218. *Id.* (identifying EC as "the ability of water to conduct an electrical current at 25 degrees C").

219. *Id.* at 194. In 2001, the Montana Legislature enacted two statutes dealing with CBM production. The first enacted the Coal Bed Methane Protection Act. *See* Act of May 1, 2001, ch. 531, § 1, 2001 Mont. Laws 531 (codified at MONT. CODE ANN. §§ 76-15-901 to 76-15-905 (2009)). Among other concerns, the act notes "water quality and availability." MONT. CODE. ANN. § 76-15-902(3)-(4). The second prescribed the options available for dealing with CBM-produced water and required the offering of a "reasonable mitigation agreement" for groundwater rights holders within a certain distance of the CBM well. *See* Act of May 5, 2001, ch. 578, § 4, 2001 Mont. Laws 496 (codified at MONT. CODE ANN. § 82-11-175(3)(a) (2009)).

220. *Pennaco*, 199 P.3d at 194.

221. There is a general anti-degradation standard under the Clean Water Act (CWA). *See* 40 C.F.R. § 131.12 (2009). State programs achieving delegation to administer the CWA would contain such a feature. *See Pennaco*, 199 P.3d at 194-95.

222. *Pennaco*, 199 P.3d at 194-95.

dard. In 2005, irrigators petitioned again for the "harmful" designation[223] but also asked that treatment be required for SAR and EC.[224] A harmful designation would disallow any addition of those pollutants that would result in any degradation of the regulated water source. In 2006, the BER adopted the harmful designation but rejected the treatment proposal.[225] The revised program received approval from the EPA.[226] CBM producers appealed to the Montana Supreme Court on the basis that the district court, which had upheld the regulatory action, applied the wrong standard of review and, thus, failed to fully analyze the scientific basis for the adoption.[227] The Montana Supreme Court upheld the regulatory action.[228] Recognizing that the BER's decision may have been a policy decision rather than one based on science, the court concluded that:

> [T]here appears to be adequate scientific justification in the rulemaking record. This rule protected high quality water by requiring permit writers to stop short of allowing degradation up to the standard; it was reasonably necessary to ensure consistency in permitting and protection of the receiving waters,[229] and it was consistent with the authorizing statutes.[230]

The end result of the irrigators engaging the system was that Montana's anti-degradation standards now apply to these two parameters that apply in turn to CBM-produced water.

In April 2009, the Colorado Supreme Court decided in *Vance v. Wolfe*[231] that CBM-produced water results from a beneficial use of water. It is, therefore, within Colorado's regular water allocation system, contrary to the view of the state engineers that it was nuisance water simply to be disposed of.[232] Ranchers sought a declaratory judgment that production of CBM water was a "beneficial use" of water under Colorado's prior appropriation law and, therefore, subject to the permitting and other regulatory requirements of the Colorado statutes.[233] There are more than 4,000 CBM wells generally without well permits in the San Juan Basin in southwestern Colorado.[234] The groundwater that the ranchers are concerned about is tributary to water sources in which

223. The available designations are: carcinogenic, toxic, or harmful. *Id.* at 199.
224. *Id.* at 195.
225. *Id.*
226. *Id.* at 201.
227. *Id.* at 196. "The [district] court found that the 2003 rules were motivated by BER's concerns of prospective CBM development in the Powder River Basin . . . ." *Id.*
228. *Id.* at 201.
229. For all other pollutants with numeric standards, the numeric standards also applied to anti-degradation.
230. *Id.* at 199 (internal footnote added).
231. 205 P.3d 1165 (Colo. 2009).
232. *Id.* at 1167. See the excellent discussion of this case in its water court stage in Colby Barrett, *Fitting a Square Peg in a Round (Drill) Hole: The Evolving Legal Treatment of Coalbed Methane-Produced Water in the Intermountain West*, 38 ENVTL. L. REP. 10,661 (2008).
233. *Vance*, 205 P.3d at 1166-67.
234. *Id.* at 1167. "Except under limited circumstances, the Engineers have not, thus far, issued permits for the CBM wells because they believe they are under no obligation to do so." *Id.*

they have appropriation rights,[235] and the engineers recognize that under Colorado prior appropriation law, they have an obligation to order the cessation of water withdrawals that are harming prior appropriators. The water court held that CBM-produced water is put to a beneficial use, and the Colorado Supreme Court affirmed that holding.[236] Because of the significance of this ruling, it is important to consider its scope and the reason for it. As to identifying the precise beneficial use being made of the water, the court had the following to say:

> [T]he CBM process 'uses' water—by extracting it from the ground and storing it in tanks—to 'accomplish' a particular 'purpose'—the release of methane gas. The extraction of water to facilitate CBM production is therefore a 'beneficial use' as defined in the 1969 Act.[237]
>
> [T]he use of water in CBM production is an integral part of the CBM process itself. The presence and subsequent controlled extraction of water makes the capture of methane gas possible.[238]
>
> [T]he presence and extraction of water are integral components to the entire CBM process. CBM producers rely on the presence of the water to hold the gas in place until the water can be removed and the gas captured. Without the presence and subsequent extraction of the water, CBM cannot be produced.[239]

Colorado cases holding removal of snow, floodwater in a subsurface mine, or storm water at a construction site, to be instances of nuisance water simply to be disposed were distinguished because removal is "not integral to the task at hand."[240] In those cases, the water is moved simply to get it out of the way. In these latter situations, the water has served no purpose up to the point of removal. With CBM, the water has served a purpose prior to its removal; it has kept the gas in place.

The fact that the CBM-produced water becomes a nuisance after extraction and needs to be disposed of does not change its basic beneficial use. The court pointed out that after extraction only a "small quantity" evaporates with the balance being stored in tanks on the surface and later is "typically reinjected via underground injection control wells into designated geologic formations that lie deeper than the aquifer from which the methane is produced. The reinjection control wells are regulated by the Colorado Oil and Gas Conservation Commission ('COGCC')."[241] The point seems to be that the water is not being wasted but is being saved for any possible use much the same as it was being saved before.

235. They use the water for "irrigation, stock watering, domestic uses, farming, and piscatorial uses." *Id.* at 1168.
236. *Id.*
237. *Id.* at 1169.
238. *Id.* at 1167.
239. *Id.* at 1170.
240. *Id.*
241. *Id.* at 1167.

As to the reason for the holding, the Colorado Supreme Court was concerned about the lack of protection being accorded existing water rights, which under the "first in time first in right" doctrine, ought to be supreme.[242] The court pointed out that a duty to order cessation of harmful water withdrawals after the fact is not the same as having the prospective water user go through the application process, in which it must be shown that prior users will not be harmed by the new use, or if they will be harmed, that a satisfactory augmentation plan has been approved.

In May 2009, the Wyoming Supreme Court rejected a declaratory judgment action from ranchers complaining about how the state was not regulating CBM-produced water the way it should be.[243] Instead, the court told the ranchers that CBM-produced water is regulated in Wyoming and if they are being injured they should use the administrative process for redress.[244] The court affirmed the trial court's dismissal on two grounds. First, the plaintiffs did not meet the standing test,[245] and second, they failed to exhaust administrative remedies.[246]

The court concluded as to the failure to exhaust basis: "Moreover, administrative remedies are available to the plaintiffs to address many of their complaints. Where administrative procedures are provided, plaintiffs must utilize those procedures before bringing a declaratory judgment action."[247] Thus, the court takes the position that until one shows that the system has failed her, she cannot seek a declaratory judgment as to improper conduct on the part of system administrators. And she cannot show that the system has failed her if she has not engaged the system. She must first exhaust her administrative remedies. The inaction of the ranchers in Wyoming can be compared with the action of the Montana irrigators who petitioned their agency for rule making in 2003 and again in 2006.[248] Each time they received only partially what they asked for, but they did benefit in using the administrative process. And as to the portions of their petitions that were denied, they could have proceeded to challenge the denials in court.

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242. *See id.* at 1171-72.

243. William F. West Ranch, L.L.C. v. Tyrrell, 206 P.3d 722, 738 (Wyo. 2009).

244. *Id.* at 735-36. The court distinguished the Colorado decision in *Vance* on the basis that in Colorado the state was not regulating CBM use of water as a beneficial use while in Wyoming, the state was doing that. *Tyrrell*, 206 P.3d at 732 n.10.

245. *Id.* at 738. The court concluded as to the standing basis:

> The plaintiff's claims are simply too general to be justiciable. They do not connect the alleged deficiencies in the State's administration of water to a direct harm they have suffered. Nor do they make a sufficient showing that a ruling by the court will have an actual effect on them.

Id. Standing is not discussed in this paper.

246. *Id.*

247. *Id.* at 738. *But see supra* note 245 and accompanying text.

248. *See supra* text accompanying notes 214-230. The Wyoming court points out that "[a]ny interested person may petition an agency for promulgation, amendment or repeal of a rule." *Tyrrell*, 206 P.3d at 736.

Under the Wyoming statute, the produced water is "[b]y-product water," defined as "water which has not been put to prior beneficial use," and the statute provides authorization for appropriating this by-product water.[249] Thus, regulation in Wyoming of CBM-produced water is not the same regulation that will occur in Colorado if *Vance* stands.

These cases help demonstrate how more water rights holders are, or will be, getting involved in the administrative and judicial processes, whether state or federal, to seek protection for their water rights from the possible adverse consequences of the oil and gas developments discussed in this paper. One result is that more produced water is coming within regular allocation and pollution control systems.

But if persons are working within, or going to work within the water-allocation scheme, what issues might arise in approving the production of CBM water or obtaining water for fracing?

B. System Questions to Be Answered

For the uses newly under the water allocation system and for those already in the system, but on a small but growing scale, some questions may have to be answered soon. This part of the paper focuses on some of the issues that might arise under current water allocation systems in the United States when water is sought for the development of a projected energy form.

With the increased need for water, from where is it going to come? What if there is no existing supplier of water such as a public utility in the area with enough water to supply those needs? Or what if there is no reservoir or reservoir operator with surplus water in the area, such as the U.S. Army Corps of Engineers? What then? It is useful to remember that in *ETSI Pipeline Project v. Missouri*[250] the appellant lost in the United States Supreme Court because its permission to take water from the Oahe Reservoir was not legally sufficient.[251] The ETSI Pipeline Project had permission from the State of South Dakota and from the U.S. Department of the Interior, but what it really needed, according to a unanimous Supreme Court, was permission from the U.S. Army Corps of Engineers, which it did not have.[252] But early in 2009, the federal district judge in charge of the Alabama, Florida, and Georgia litigation over several river basins concluded that the Corps of Engineers had no authority to make water allocations to the city of Atlanta even though the Corps had been making allocations on that reservoir to Atlanta for

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249. WYO. STAT. ANN. §§ 41-3-903 to 41-3-904 (2009).
250. 484 U.S. 495 (1988).
251. *See id.* at 517.
252. *Id.*

several years.[253]

Does the oil and gas lessor have a usable supply from which a lessee could rely? From early on, clauses in oil and gas leases have granted the lessee the right to use water on the premises for oil and gas development and operations.[254] These clauses have been the subject of litigation with numerous cases interpreting their provisions.[255] However, even without these lease provisions, courts have held that a right to use water from the premises is implied, if reasonably necessary to the development of the oil or gas,[256] just as use of the surface for such purposes would be implied. It should not matter whether the lessor also owns the surface or only owns a severed mineral estate because at the severance the mineral owner should have acquired the right to use the water and, therefore, have the right to transfer it to the lessee.

But, of course, the underlying premise for these decisions is that the lessor/landowner has the right to use the water in the first instance and second, the authority to transfer such a right to the lessee. Depending on the state in which the development is located, various limitations exist as to such rights in the landowner. For surface water in watercourses[257] in a prior-appropriation doctrine jurisdiction, a landowner may not have a water right at all.[258] Except in specified situations, a

253. *See In re* Tri-State Water Rights Litig., 639 F. Supp. 2d 1308 (M.D. Fla. 2009).

254. Often they provided for the "free" use of the water. "Lessee shall have free use of oil, gas and water from said land, except water from Lessor's wells, for all operations hereunder." Ark. La. Gas Co. v. Wood, 403 S.W.2d 54, 55 (Ark. 1966). "[T]here are no provisions in the oil and gas mining lease which give the lessee the right to use, free of cost, the water so impounded. It, therefore, was without authority to appropriate the water for its own use." Mohawk Drilling Co. v. Wolf, 262 P.2d 892, 893 (Okla. 1953).

255. In *Ark. La. Gas Co.*, the clause provided: "Lessee shall have free use of oil, gas and water from said land, except water from Lessor's wells, for all operations hereunder." 403 S.W.2d at 55. Under a clause similar to the one just quoted, may a lessee use water in a stock pond? No, the provision only allows a lessee to develop a water supply on the land, not to use the lessor's developed water. *See* Arnold v. Adams, 294 P. 142, 146 (Okla. 1930) (stating that such a lease clause "means water produced by lessee by drilling wells, building tanks, or ponds, or from running streams, etc"). *Contra* Wyckoff v. Brown, 11 P.2d 720 (Kan. 1932) (allowing use of stock pond water).

256. *See* Holt v. Sw. Antioch Sand Unit, Fifth Enlarged, 292 P.2d 998, 1000 (Okla. 1955) (involving an action for subsurface trespass and conversion of salt water). The court in *Holt* distinguished *Vogel v. Cobb*, 141 P.2d 276 (Okla. 1943), in which water was used to supply housing off the leasehold, and, thus, "the water played no direct part in the removal of the oil." *Holt*, 292 P.2d at 999-1000. In *Holt*, the water was used for secondary recovery, although the recovery was taking place off the leased premises, it was within the unit, and the lessee's right extended to using such amount of water as was reasonably necessary to develop the minerals. *Id.*

257. For diffused surface water, the general concept is that the landowner is free to use that water. Would its use be covered by a water use clause in the deed? Would its use be covered by the implied right to use water if such use is necessary to the mineral development? If for example, a landowner has dug a pond at a low spot to collect diffused surface water for cattle watering, would a court allow a gas developer to use that water? *See generally* 2 WATERS AND WATER RIGHTS, *supra* note 58, §§ 10.03(c), at 10-105 to 10-110. *See also id.* § 11.06(d), at 11-47 to 11-52.

258. *See generally* 2 WATERS AND WATER RIGHTS, *supra* note 58, § 11.04(b), at 11-25 to 11-27. *See also* Tweedy v. Tex. Co., 286 F. Supp. 383 (D. Mont. 1968) (involving suit by plaintiffs to recover 50 cents per barrel for groundwater used for secondary recovery). The suit failed because "plaintiffs cannot establish any title in the water as such." *Id.* at 385. The case involved Indian reservation land that the court found to be governed by federal law due to the existence of reserved water rights. *Id.* at 383-85. To receive a permit, the applicant generally must show a "beneficial use" for the water. *See* 2 WATERS AND WATER RIGHTS, *supra* note 58, § 12.02(c)(2), at 12-23.

right to use water from a watercourse may only be acquired pursuant to a permit from a state agency. But, even if the landowner does have a water right permit, in all likelihood, a transfer to a lessee would require the approval of the regulatory agency[259] based on at least two considerations: that no harm will come to an existing water user[260] and that the use is in the public interest.[261] However, in some states a transfer can only be made to an equal or "higher" use.[262]

For surface water in watercourses in a common law riparian doctrine jurisdiction, a riparian landowner may only make a reasonable use of the water, and this is a correlative right, so it is subject to the right of every other riparian to make a reasonable use as well.[263] In this context, domestic uses have priority and may use all of the water before any non-domestic uses can be made.[264] So who in a common law riparian jurisdiction can assure the operator of a new development a sufficient quantity of water for the development? For surface water in watercourses in a regulated riparian doctrine jurisdiction,[265] a riparian landowner may still only make a reasonable use of the water, but this generally is determined by a state-permitting agency and evidenced by a permit.[266] The permit may or may not be transferable.[267] In the three states still applying both the prior appropriation and riparian rights doctrines,[268] the situation may be even trickier.[269]

Permitting systems, whether pursuant to prior appropriation or the regulated riparian doctrine, allow new permits only if there is water available. In many areas of many states, all of the water has been appropriated or otherwise allocated, and, thus, none is available.[270] In that situation, may a developer acquire a water right through purchase from some third party? The answer would appear to be generally, "yes,"[271] but a transfer is subject to approval by the regulatory agency. Again, the agency would focus on whether there would be harm to other water users and whether the use would be in the public interest.

Would the developer be able to acquire the water right through the use of eminent domain rather than private purchase? Eminent domain

259. *See generally* 2 WATERS AND WATER RIGHTS, *supra* note 58, § 14.04(a), at 14-35 to 14-41.
260. *See generally id.* § 14.04(c), at 14-47 to 14-71.
261. *See generally id.* § 14.04(d), at 14-71 to 14-103.
262. *See generally id.* § 14.04(b) nn. 182-85, at 14-47.
263. *See generally* 1 WATERS AND WATER RIGHTS, *supra* note 60, § 7.02(d), at 7-48 to 7-68.
264. *See generally id.* § 7.02(b), at 7-32 to 7-37.
265. *See generally id.* § 9.03, at 9-52 to 9-173.
266. *Id.* §§ 9.03(a)-(b), at 9-62 to 9-163. Often these statutes do not apply until the amount of water being used exceeds a specified amount. *Id.* § 9.03(a)(3) nn. 379-80, at 9-75. Thus, the common law rules would apply to the use of lesser amounts.
267. *See generally id.* § 9.03(d), at 9-166 to 9-173.
268. The states are California, Nebraska, and Oklahoma.
269. *See generally* 6 WATERS AND WATER RIGHTS 409-31, 771-87, 911-40 (Robert E. Beck ed., 1991 ed. rep. vol. 2005) (discussing California, Nebraska, and Oklahoma).
270. *See* CHARLES J. MEYERS ET AL., WATER RESOURCE MANAGEMENT 308-10 (6th ed. 2009).
271. *See* 2 WATERS AND WATER RIGHTS, *supra* note 58, § 14.02, at 14-24.

would be available only if a statute so provides, as this is a state power, which although it can be delegated to private parties, needs to be in the public interest. Most of the eminent domain statutes relating to the water resource focus not on acquiring water but on acquiring a right of way for accessing and transporting the water.[272] However, many states that have water-use statutes containing priority lists assume that those with a higher priority on the list may condemn a water right held by someone in a lower priority, but not otherwise.[273] So where would fracing and corn-based ethanol production fall on the priority list? Domestic purposes generally come first, agricultural purposes come second, and manufacturing purposes third.[274] In some states, such as Colorado,[275] Idaho,[276] and Nebraska,[277] these preferences are in the constitution, although the Idaho Constitution contains a preference for mining.[278] Is water for fracing domestic, agricultural, or manufacturing, or none of the above? Is corn-based ethanol production agricultural or manufacturing or both or neither?

Use of groundwater may be more difficult to deal with than use of surface water because the legal regimes governing use of groundwater are more divergent throughout the country than the legal regimes governing the use of surface waters. To the extent that a jurisdiction applies the same common law riparian rules or the same regulatory rules to groundwater that it applies to surface water,[279] the foregoing discussion would cover the matter. Even then, one needs to be concerned whether the waters are managed conjunctively[280] and if there are separate statutes for each category.[281]

The other groundwater regimes will not be discussed[282] except to note that several jurisdictions apply the absolute ownership or dominion rule.[283] This rule allows the overlying landowner to capture all of the water that can be captured and to dispose of it, with perhaps two limitations: that the water is neither wasted nor extracted with malice.[284] This could be the regime most favorable to water use for the energy projects discussed.

272. *Id.* § 11.07 n. 239, at 11-52 to 11-53. *See generally id.* § 14.03, nn. 136-136.2, at 14-33.
273. *Id.* § 12.02(c)(2) nn. 139-149, at 12-32 to 12-34.
274. Robert E. Beck, *Use Preferences for Water*, 76 N.D. L. REV. 753, 766-77 (2000).
275. COLO. CONST. art. XVI, § 6.
276. IDAHO CONST. art. XV, § 3.
277. NEB. CONST. art. XV, § 6.
278. IDAHO CONST. art. XV, § 3.
279. Many states do not. *See* 3 WATERS AND WATER RIGHTS §§ 19.01 to 19.07, at 19-1 to 19-75 (Robert E. Beck ed., 1991 ed. rep. vol. 2003).
280. *See* 2 WATERS AND WATER RIGHTS, *supra* note 58, § 11.06(c), at 11-34 to 11-47; § 12.02(d), at 12-45 to 12-63.
281. *See id.* § 12.02(d), at 12-45 to 12-63.
282. *See generally* 3 WATERS AND WATER RIGHTS, *supra* note 279, §§ 20.01 to 23.07.
283. *See id.* §§ 20.01 to 20.09.
284. *See id.* § 20.05, at 20-18 to 20-22.

A second inquiry is what the standards for decision-making are, and particularly, how they are to be applied. Three standards have been noted: (1) beneficial use and reasonable use; (2) no harm to existing users; and (3) the public interest. The first two have already been discussed,[285] so only public interest will be discussed now. Early on, the public interest focus was on the economic needs of the community and making sure that the water uses would assist the community in growing.[286] And while economic growth is still an important concern, the very sustenance of life, the quality of life, and the protection of environmental or ecological values have become central concerns. Thus, in 1996, the Nebraska Supreme Court upheld the denial of a permit to natural resource districts for recharging aquifers used for irrigation and other uses because the removal of the surface water could further endanger the whooping crane—an already endangered species.[287] The Nebraska Constitution provides that a water permit can be denied only if denial is "demanded by" the public interest.[288] Because the Nebraska Legislature has enacted a statute protecting endangered species and prohibiting state agencies from taking action that would further endanger the species, the court concluded that the denial of the permit was demanded by the public interest.[289]

These are questions that irrigators, ranchers, and other existing water users are going to bring to the process; so one aspect of the future will be getting answers to these questions, but can we say anything more?

IV. CONCLUSION: WHAT IS OR SHOULD BE IN STORE FOR THE FUTURE?

In 2002, the Kansas Supreme Court gave us a glimpse into the future. It said: "Because the water supply in this country will become more and more limited it should not be uselessly disposed of but rather [should be] used for the beneficial purpose of increasing oil production whenever possible."[290] For our purposes now, the important part is not the reference to an oil use for water, but rather that the court is paying attention to our water supply situation in deciding an oil and gas case. With increasing pressure from existing water users, we should expect to see courts, administrators, and legislators all paying more attention to

285. *See supra* text accompanying notes 57-62, 258, 263-269 (beneficial or reasonable use); *supra* text accompanying notes 260, 271 (no harm).
286. *See* Douglas L. Grant, *Public Interest Review of Water Right Allocation and Transfer in the West: Recognition of Public Values*, 19 ARIZ. ST. L. J. 681, 685-87 (1987).
287. Cent. Platte Natural Res. Dist. v. City of Fremont, 549 N.W.2d 112, 118 (1996).
288. NEB. CONST. art XV, § 6.
289. *Cent. Platte Natural Res.*, 549 N.W.2d at 118.
290. Crawford v. Hrabe, 44 P.3d 442, 443 (Kan. 2002).

our water supply as we progress over the next few years with these energy developments.

Where could these cases lead? What possible water law developments could the future bring that would restrict energy development? It is fairly easy to draw some conclusions. Of course, if there is a real conflict between life-sustenance uses of water and energy production, life sustenance must prevail. Use of potable water should be prohibited if non-potable water is adequate and available. Recycling should be required whenever recycling is feasible. If facilities are not bound to a particular location, they should be required to locate where there is more, rather than less, water available; and, in planning for energies of the future, energy forms that will consume less water, if otherwise feasible, must be favored over those that will consume significantly more water.

So why are these conclusions easy to draw? Water is a precious resource; oil and gas are not. A human being generally can last only from one to two weeks without water.[291] However, humans existed until the 1850s before they began to know about oil in any significant way and perhaps somewhat later even for gas. Although we have a lot of water in the ocean, potable water is getting scarcer, and we are uncertain about the impact of global warming on such supplies. On the other hand, the first law of thermodynamics tells us: "Energy can be neither created nor destroyed, only converted from one form to another."[292] So, the issue for us is to convert energy from an unusable form into a form that we can use. But, in the process of spending billions of dollars in searching for the magic-conversion elixir, if we have choices, we ought then very clearly to favor the form or forms that use less water over those that use more water.

As to prohibiting use of potable water, the California Water Code already provides that "[a] person . . . shall not use water from any source of quality suitable for potable domestic use for nonpotable uses . . . if suitable recycled water is available."[293] California is not alone.[294]

As to recycling, technology suitable under at least some circumstances must be available now. According to the U.S. Department of Energy 2009 Primer, "[a]s of early 2008, Devon [Energy Corporation] had hydraulically fractured 50 wells using recycled water."[295] The

291. SurvivalTopics.com, How Long Can You Survive Without Water?, http://www.survivaltopics.com/survival/how-long-can-you-survive-without-water/ (last visited Jan. 19, 2010).

292. FRED BOSSELMAN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS 9 (2d ed. 2006) (The first law of thermodynamics has been stated as: "Energy can be neither created nor destroyed, only converted from one form to another." The second law of thermodynamics has been stated as: "All physical processes proceed in such a way that the availability of the energy involved decreases.").

293. CAL. WATER CODE § 13551 (West 2009).

294. *See* 1 WATERS AND WATER RIGHTS, *supra* note 60, § 2.03 nn. 88-90, at 2-23 to 2-25.

295. U.S. DEP'T OF ENERGY, *supra* note 3, at 70 (said to be still in a testing phase).

Primer shows, however, that disposal of wastewater occurs through Class II injection wells in all of the seven Shale basins for which information was tabulated, with recycling occurring in four of the seven, treatment and discharge in one of those four, and land application in another one of those four.[296] The Institute for Agriculture and Trade Policy points out that modern ethanol plants have treatment techniques that permit recycling of the water.[297] And of course, produced water is and has been used for secondary recovery operations for a long time.[298]

To what extent are we really tied to a particular location? Granted there are some other considerations, but if it takes approximately 2,100 gallons of water to produce one gallon of corn-based ethanol in California and six gallons of water to produce one gallon of corn-based ethanol in Iowa, as a recent study tells us,[299] where from a water-resource perspective should we be producing ethanol? According to David Muth, Jr. of the Idaho National Lab: "What's emerging pretty quickly is how site-specific both the production systems and problems are."[300]

The result of the exercise so far has been to develop a modest or beginning set of standards for the use of water in energy production that might read as follows:

STANDARDS FOR WATER USE IN ENERGY PRODUCTION

STANDARD ONE

If non-potable water is sufficient and available for the energy operation, use of potable water should be prohibited.

STANDARD TWO

When production of an energy form requires substantial amounts of water that are not consumed, every feasible effort must be undertaken to recycle the water.

STANDARD THREE

In any real conflict between life-sustenance uses of water and uses

296. *Id.* at 69, Exhibit 39.
297. INST. FOR AGRIC. & TRADE POLICY, WATER USE BY ETHANOL PLANTS: POTENTIAL CHALLENGES 4 (2006).
298. *See supra* note 89 and accompanying text.
299. *See* Yi-Wen Chiu et al., *Water Embodied in Bioethanol in the United States*, ENVTL SCI. & TECH., Mar. 10, 2009, at 2691, *available at* http://pubs.acs.org/doi/pdf/10.1021/es8031067?cookieSet=1. California consumed 2,138 gallons of water per gallon of corn ethanol produced (the most of any state) whereas Iowa consumed six gallons of water for each gallon of corn ethanol produced (the least of any state). *Id.*
300. Ehrenberg, *supra* note 55, at 24.

for energy production, life sustenance must prevail.

STANDARD FOUR

If it is feasible to develop an energy form in a location where water is plentiful as contrasted with where water is in short supply, the energy form should be developed where the water is plentiful. If it is not feasible to do so, then STANDARD FIVE should apply.

STANDARD FIVE

In planning for energies of the future, energy forms that will consume less water, if otherwise feasible, must be favored over those that will consume significantly more water.

How far beyond these easy conclusions should we go? Even back in the 1970s, when we had the debate over, and the efforts to develop, coal slurry pipelines for transporting coal, two states, Montana[301] and Oklahoma,[302] enacted statutes stating that the use of water for coal slurry transport was not a beneficial use of water under their prior appropriation systems. We can expect that in the future, states will look more closely at what are and what are not "beneficial uses" or "reasonable uses" of water, particularly from the perspective of the amount consumed. And there will be reconsiderations of what water uses are in the "public interest" at all three levels: legislative, executive, and judicial. If we concentrate now on converting to forms of energy that require the least amounts of water in the process, we will be ahead of that game.[303]

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301. LAW OF MONT. CODE ANN. § 85-2-104 (1979) (repealed 1985).

302. Law of Oct. 1, 1977, ch. 25, § 6, 1977 Okla. Sess. Laws (codified at OKLA. STAT. ANN. tit. 27, § 7.6 (West 1997).

303. For discussion of the movement to integrate water and energy resources planning, see generally Cat Shrier et al., *Integrated Water-Energy Planning*, THE WATER REPORT, Aug. 15, 2009, *available at* http://www.gwpc.org/e-library/documents/general/Water%20Report%20Article.pdf.