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Curtailment First: Why Climate Change and the Energy Industry Suggest a New Allocation Paradigm is Needed for Water Utilized in Hydraulic Fracturing

Victor Flatt
University of North Carolina School of Law

Heather Payne
University of North Carolina School of Law

ARTICLES

CURTAILMENT FIRST: WHY CLIMATE CHANGE AND THE ENERGY INDUSTRY SUGGEST A NEW ALLOCATION PARADIGM IS NEEDED FOR WATER UTILIZED IN HYDRAULIC FRACTURING

Victor Flatt *
Heather Payne **

INTRODUCTION

Water, always necessary, is becoming less available. The Organization for Economic Cooperation and Development ("OECD") predicts water use will increase by 55% between 2000 and 2050, and that by 2050, over 40% of the world's population "will live in river basins under severe water stress."[1] Climate change is making this worse. Approximately 486 million people will be exposed to water scarcity or aggravated scarcity even if the average global temperature rise is limited to 2°C.[2] If temperatures rise further,

* Thomas F. and Elizabeth Taft Distinguished Professor in Environmental Law, and Director, Center for Law, Environment, Adaptation, and Resources (CLEAR) at the University of North Carolina School of Law.

** Fellow, Center for Law, Environment, Adaptation, and Resources (CLEAR) at the University of North Carolina School of Law.

1. OECD, *Why Does Water Security Matter?*, *in* WATER SECURITY FOR BETTER LIVES 15 (2013), *available at* http://www.oecd-ilibrary.org/environment/water-security_9789264202405-en.

2. Dieter Gerten et al., *Asynchronous Exposure to Global Warming: Freshwater Resources and Terrestrial Ecosystems*, 8 ENVTL. RES. LETTERS 034032, at 4 (2013), *available at* http://iopscience.iop.org/1748-9326/8/3/034032/pdf/1748-9326_8_3_034032.pdf. Another report has found that this level of temperature rise will increase the world's population living under absolute water scarcity by an additional 40%. Jacob Schewe et al., *Multimodel Assessment of Water Scarcity Under Climate Change*, PROC. NAT'L ACAD. SCI. 1 (early online ed. 2013), *available at* http://www.pnas.org/content/early/2013/12/12/1222460110.full.pdf.

the numbers increase.[3] Looking at food production globally, a quarter of croplands lack adequate water, and 56% of irrigated land is under high to extremely high water stress.[4]

The mechanisms put into place to manage scarcity in a water-constrained world will have significant impacts on human populations, agriculture, energy, and the environment. This article addresses these issues specifically with regard to hydraulic fracturing activities,[5] providing an overview of current water projections, a discussion of how water is utilized today, and an explanation of why hydraulic fracturing is different from other industrial uses. The article then provides an overview of how water allocation decisions are currently made in representative states and proposes a new paradigm for allocations associated with hydraulic fracturing.

I. THE WATER OUTLOOK

For almost one in ten watersheds in the United States, the current demand for water outstrips the natural supply.[6] The long-term projections for water availability in North America are similar to those globally. This is true even though the number of heavy downpours is increasing because of climate change, especially in the Midwest and Northeast.[7] Projections expect this trend in precipitation to continue, with less frequent events becoming more intense.[8] In the Northeast, the amount of precipitation falling in very heavy events increased 74% between 1958 and 2011, while the Midwest experienced a 45% increase over the same time period, and the Southeast experienced a 26% increase.[9]

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3. Gerten et al., *supra* note 2, at 4.

4. Francis Gassert, *One-Quarter of World's Agriculture Grows in Highly Water-Stressed Areas*, WORLD RES. INST. BLOG (Oct. 31, 2013), http://www.wri.org/blog/one-quarter-world's-agriculture-grows-highly-water-stressed-areas.

5. "Hydraulic fracturing" and "fracking" are used interchangeably in this article.

6. Kristen Averyt et al., *Sectoral Contributions to Surface Water Stress in the Coterminous United States*, 8 ENVTL. RES. LETTERS 035046, at 3–4 (2013), *available at* http://iopscience.iop.org/1748-9326/8/3/035046/pdf/1748-9326_8_3_035046.pdf.

7. JOHN WALSH ET AL., NAT'L CLIMATE ASSESSMENT & DEV. ADVISORY COMM., FEDERAL ADVISORY COMMITTEE NATIONAL CLIMATE ASSESSMENT (DRAFT) 26 (Jan. 11, 2013) [hereinafter CLIMATE ASSESSMENT], *available at* http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap2climate.pdf.

8. *Id.* at 32.

9. *Id.* at 50.

These heavier downpours have led to more flooding, as heavier rains lead to more runoff.[10] For example, the Red River at Fargo, North Dakota, reached flood stage only in twenty-nine of the ninety years prior to 1993, but has reached flood stage in eighteen consecutive years since, with eight "10-year" floods occurring in the last twenty years.[11] Water systems, built for the traditional precipitation model of steady rainfall in predictable patterns, will be unable to capture and store much of this precipitation. Therefore, even in places where rainfall is likely to increase, communities will be left without adequate water supplies between intense events.

Because of hotter temperatures, evaporation will also increase.[12] This will strain supplies further, including in communities with previously sufficient storage capacity, as drought is expected to increase as well.[13] Therefore, it is necessary to determine the highest and best use of the freshwater resources available as we move into this changing world.

II. HOW WATER IS USED TODAY

The largest single use of freshwater in the United States is for the production of electricity by thermoelectric plants, which accounts for 41% of freshwater withdrawals[14] and 49% of total with-

10. *Id.* at 47.

11. RED RIVER BASIN COMM'N, LONG TERM FLOOD SOLUTIONS: PROGRESS REPORT TO THE MINNESOTA LEGISLATURE 15 (2010), *available at* http://www.redriverbasincommission.org/Long_Term_Flood_Solutions/2-3-2010_MN_Leg_Rpt.pdf; Paul Quinlan, *Flood Fears Downstream Hinder Plans to Divert Red River of the North*, N.Y. TIMES (Aug. 27, 2010), http://www.nytimes.com/gwire/2010/08/27/27greenwire-flood-fears-downstream-hinder-plans-to-divert-58522.html.

12. CLIMATE ASSESSMENT, *supra* note 7, at 56.

13. *Id.*

14. MELISSA WHITED ET AL., WATER CONSTRAINTS ON ENERGY PRODUCTION: ALTERING OUR CURRENT COLLISION COURSE 6 (2013), *available at* http://www.civilsocietyinstitute.org/media/pdfs/Synapse-CSI%20Water%20Constraints%20on%20Energy%20Production%20-%20Final%20Report.pdf.

drawals.[15] This equates to between 137 billion[16] and 201 billion gallons per day.[17]

After the amount used to cool electric power plants, irrigation requires the most water at 128 billion gallons per day.[18] This correlates to 31% of total water withdrawals and 37% of freshwater withdrawals.[19] Public supply, which currently includes domestic uses such as drinking water and sanitation, as well as industrial and commercial uses supplied by water utilities, accounts for 11% of the total water withdrawn.[20] This equates to approximately forty-four billion gallons per day.[21] As the population of the United States is expected to increase to 438 million by 2050 (from 296 million in 2005),[22] the amount of water necessary for domestic use could also significantly increase.

While these numbers are large, not all withdrawals—even those defined as "consumptive"—are permanently consumed.[23] In irrigation, consumed water either is excessive, seeping into the ground becoming groundwater, or is incorporated into crops, whose moisture is then released back into the water cycle when those crops dry out or are used. For domestic use, consumed water is used and then returned to the local water utility to be treated and released from a municipal water treatment plant, thereby remaining in the water cycle. Even 97% of the water withdrawn for cooling in thermoelectric plants is returned to the environment as heated water; the other 3% is consumed through evaporation, but still remains within the hydraulic cycle.[24] This

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15. U.S. GEOLOGICAL SURVEY, FACT SHEET 2009-3098, SUMMARY OF ESTIMATED WATER USE IN THE UNITED STATES IN 2005 (2009), *available at* http://pubs.usgs.gov/fs/2009/3098/pdf/2009-3098.pdf.

16. WHITED ET AL., *supra* note 14, at 7. Eighty-five billion gallons are for coal-fired power plants, forty-five billion gallons for nuclear plants, and seven billion gallons for natural gas plants. *Id.*

17. U.S. GEOLOGICAL SURVEY, *supra* note 15.

18. *Id.*

19. *Id.*

20. *Id.*

21. *Id.*

22. JEFFREY S. PASSEL & D'VERA COHN, PEW RESEARCH CTR., U.S. POPULATION PROJECTIONS: 2005-2050, at i (2008), *available at* http://www.pewsocialtrends.org/files/2010/10/85.pdf.

23. "'Consumptive use' refers to the amount of water not returned to the immediate water environment due to evaporation, transpiration, incorporation into products or crops, or consumption by humans or livestock." WHITED ET AL., *supra* note 14, at 6.

24. *See id.*

evaporation corresponds to about four billion gallons of water per day consumed by thermoelectric plants.[25] However, even considering this amount of net consumption by thermoelectric plants and ignoring the issues concerning heated water return, conflicts already exist in water-constrained locations in the United States between electric plants, irrigation for agriculture, and domestic uses.[26]

With water shortages, policy requires that supplies be curtailed. Curtailment is defined as a reduction or diminishment of the water available for a particular use or user. The curtailment mechanism—the amount of the curtailment, whether it affects all users or only some users, and whether it affects all uses or only specific uses—is often determined by local or state law.[27]

III. HYDRAULIC FRACTURING AND WATER USE

Depending on the particular drilling operation at issue (described as a "shale play"), hydraulic fracturing can require up to about six or eight million gallons of water per well for injection purposes.[28] This water will be used over a period of three to five days.[29] A recent analysis shows that natural gas production from the Marcellus Shale uses more than three times what had previously been calculated as the average usage, with wells in Pennsylvania using an average of 4.3 million gallons and wells in West Virginia using an average of five million gallons.[30] This equates to

25. *Id.*

26. *See, e.g.*, Terrence Henry, *After Water Is Cut Off, Texas Rice Farmers Say They Still Have a Future*, STATEIMPACT (Texas) (Mar. 2, 2012, 12:12 AM), http://stateimpact.npr.org/texas/2012/03/02/how-rice-farming-in-texas-could-still-have-a-future/.

27. *See, e.g.*, 30 TEX. ADMIN. CODE §§ 36.1–36.8 (2013).

28. *Compare* WHITED ET AL., *supra* note 14, at 14 ("[E]stimates of water consumed in the drilling and fracking process range from 2 million to 5.6 million gallons per well . . . ."), *with* CHARLES W. ABDALLA & JOY R. DROHAN, MARCELLUS EDUCATION FACT SHEET: WATER WITHDRAWALS FOR DEVELOPMENT OF MARCELLUS SHALE GAS IN PENNSYLVANIA 3 (2010), *available at* http://pubs.cas.psu.edu/FreePubs/pdfs/ua460.pdf ("Hydrofracturing a horizontal Marcellus well may use 4 to 8 million gallons of water . . . ."). Some reports put the number even higher, at up to thirteen million gallons. *See* JEAN-PHILIPPE NICOT ET AL., CURRENT AND PROJECTED WATER USE IN THE TEXAS MINING AND OIL AND GAS INDUSTRY 60 (2011), *available at* http://www.twdb.state.tx.us/publications/reports/contracted_reports/doc/0904830939_MiningWaterUse.pdf.

29. *E.g.*, *Just the Facts*, ENERGYINDEPTH, http://energyindepth.org/just-the-facts/ (last visited Feb. 18, 2014).

30. EVAN HANSEN ET AL., WATER RESOURCE REPORTING AND WATER FOOTPRINT FROM MARCELLUS SHALE DEVELOPMENT IN WEST VIRGINIA AND PENNSYLVANIA, at viii–ix (2013), *available at* http://www.earthworksaction.org/files/publications/FINAL_marcellus_wv_pa.

between 1.6 and 2.2 gallons of water to produce a thousand cubic feet of gas in West Virginia, and between 3.2 and 4.2 gallons in Pennsylvania.[31]

There is one main difference though, between this water use and all others: the process is intentionally designed to remove water from the water environment and from the entire hydraulic cycle permanently.[32] The permanent, consumptive use is almost complete. The vast majority of the water is eternally removed from the hydraulic cycle because it either stays in the formation where it was injected or is injected into a waste disposal well.[33] For example, 92% of the water used in hydraulic fracturing in West Virginia and 94% in Pennsylvania is permanently sequestered underground.[34] Hydraulic fracturing is the only use where consumption becomes irrevocable.

Shale gas production and, therefore, water utilization has grown significantly and is expected to continue to increase. The entire United States produced 1.293 trillion cubic feet of shale gas in 2007; that increased to 7.994 trillion cubic feet by 2011.[35] Just within Pennsylvania, there are 10,082 shale wells,[36] leading to almost forty billion gallons of freshwater already being permanently removed from the water environment.

In addition to the impact of removing so much water from the hydraulic cycle, there are impacts to the environment when hydraulic fracturing wastewater is disposed. Pennsylvania has found drillers illegally dumping wastewater at hydraulic fracturing sites.[37] Additionally, a wastewater treatment plant owner was fined for releasing excess solids containing high levels of titanium, arsenic, and cadmium and must complete a plant upgrade.[38]

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31. *See id.*

32. *E.g.*, *id.* at 25.

33. *Id.* at 20.

34. *See id.* at 25, 37.

35. *See Natural Gas: Shale Gas Production*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/dnav/ng/ng_prod_shalegas_s1_a.htm (last visited Feb. 18, 2014).

36. PA. EMERGENCY MGMT. AGENCY, MARCELLUS SHALE GAS WELLS IN PENNSYLVANIA (2014), *available at* http://www.portal.state.pa.us/portal/server.pt/document/900059/marcellus_shale_gas_wells_shaded_pdf.

37. Will Kennedy, *Exxon Charged with Illegally Dumping Waste in Pennsylvania*, BLOOMBERG SUSTAINABILITY (Sept. 11, 2013, 9:09 AM), http://www.bloomberg.com/news/2013-09-11/exxon-charged-with-illegally-dumping-waste-water-in-pennsylvania.html.

38. Deanna Garcia, *Water Group Applauds Proposed Consent Decree Between DEP*

Wastewater from fracking caused a major fish kill in Kentucky, where well pads were located in close proximity to a local creek.[39] Disposal in injection wells has its own challenges. Oklahoma now experiences the second most earthquakes in the country behind California.[40] And there is growing evidence that injection wells are causing tremors there, and elsewhere,[41] as the reported earthquakes in Oklahoma stopped once injection ceased.[42] The number of human-induced earthquakes has increased so dramatically due to oil and gas activities that the United States Geological Survey is going to create separate hazards maps for "induced seismicity."[43]

One way to address at least part of these problems is through water recycling; however, little recycling is currently occurring, since there is little economic incentive to do so. Only about 8% of freshwater is reused in West Virginia, 6% in Pennsylvania,[44] and 5% or less in the Eagle Ford Shale in Texas.[45] Additionally, there is skepticism within the waste industry that wastewater recycling and reuse could be financially lucrative, and so few businesses are investing in growing that part of their business or expanding

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and Waste Treatment Corp., WESA (Pennsylvania) (Nov. 26, 2013, 4:00 PM), http://www.wesa.fm/post/water-group-applauds-proposed-consent-decree-between-dep-and-waste-treatment-corp; Ben Klein, *Waste Treatment, DEP Respond to Alleged Violations*, THE TIMES OBSERVER (Oct. 30, 2013), http://www.timesobserver.com/page/content.detail/id/567475/Waste-Treatment--DEP-respond-to-alleged-violations.html?nav=5006.

39. Stephen Goss, *Fracking Fluids Spill Caused Kentucky Fish Kill*, ENVTL. WORKING GROUP (Sept. 20, 2013), http://www.ewg.org/enviroblog/2013/09/fracking-fluids-spill-caused-kentucky-fish-kill-0; Press Release, U.S. Geological Survey, Hydraulic Fracturing Fluids Likely Harmed Threatened Kentucky Fish Species (Aug. 28, 2013), *available at* http://www.usgs.gov/newsroom/article.asp?ID=3677#.Uuqz_Hk3-5c.

40. Mike Soraghan, *10% of U.S. Earthquakes Are in Okla. Is Drilling to Blame?*, E&E NEWS: ENERGYWIRE (Dec. 2, 2013), http://www.eenews.net/stories/1059991119/.

41. *Texans Angrily Protest Fracking After 30 Earthquakes Hit Town*, RT (Jan. 21, 2014, 6:55 PM), http://www.rt.com/usa/azle-texas-austin-fracking-979/; Mike Soraghan, *Earthquakes: USGS Sending Instruments to Record Texas Quakes*, E&E NEWS: ENERGYWIRE (Dec. 6, 2013), http://www.eenews.net/stories/1059991413.

42. *See* William Ellsworth et al., *Man-Made Earthquakes Update*, USGS BLOG (Jan. 17, 2014, 1:00 PM), http://www.usgs.gov/blogs/features/usgs_top_story/man-made-earthquake/.

43. *See* Mike Soraghan, *USGS to Make Separate Risk Map for Man-Made Quakes*, E&E NEWS: ENERGYWIRE (Dec. 23, 2013), http://www.eenews.net/stories/1059992224 (internal quotation marks omitted).

44. *See* HANSEN ET AL., *supra* note 30, at 56.

45. *See* Nathanial Gronewold, *Waste Recycler Expands Its Reach in the Oil Patch*, E&E NEWS: ENERGYWIRE (Sept. 13, 2013), http://www.eenews.net/energywire/2013/09/13/stories/1059987167.

into it.[46] That skepticism likewise exists in private equity firms and with traditional investors.[47] Where some drillers have attempted to reduce water consumption to adjust to water constraints, well performance decreased.[48]

Given the water supply needed to continue this lucrative practice, the energy industry is interested in where future water supply will come from. Groundwater and surface water sources close to drilling sites are preferred to minimize the cost of transportation.[49] However, some are investing in pipelines and pumps to ensure adequate water supply.[50] Others are turning to public water utilities, which are extending pipelines and supplying water to wells as part of their regulated business.[51] In those cases, the wells are considered industrial customers like any other.[52]

Hydraulic fracturing is economically profitable at least in part because access to freshwater is currently cheap. But current regulations are holdovers from general industrial user policy and ad hoc new regulations. Regulations have not been designed with regard to the permanent consumptive use of fracturing and the increased demands on water generally. Thus, new regulations will be necessary to affect behavior to ensure wastewater minimization. Hydraulic fracturing must be considered differently—and as

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46. *Id.*

47. David Wethe & Peter Ward, *Fracking Bonanza Eludes Wastewater Recycling Investors*, BLOOMBERG SUSTAINABILITY (Nov. 25, 2013, 7:00 PM), http://www.bloomberg.com/news/2013-11-26/fracking-bonanza-eludes-wastewater-recycling-investors.html.

48. *See, e.g.*, Marcus Oliver Gay, *Water Management in Shale Gas Plays: Seeing Through Murky Water*, IHS UNCONVENTIONAL ENERGY BLOG (Jan. 8, 2013), http://unconventionalenergy.blogs.ihs.com/2013/01/08/water-management-shale-gas-plays/ ("In their Q3 2012 earnings report, Devon Energy . . . identified that in response to water shortages in the Cana-Woodford Shale play last year 60–70 wells were stimulated with reduced water volumes and have since shown significantly compromised EURs.").

49. Emily Pickrell, *Water Flows Through Panel's Fracturing Discussion*, FUELFIX BLOG (Mar. 5, 2013, 1:01 PM), http://fuelfix.com/blog/2013/03/05/water-flows-through-panels-fracturing-discussion/. Transportation costs can account for 80% of the water budget for a drilling project, costing far more than the actual water resource itself. *Id.*

50. Gayathri Vaidyanathan, *'Huge Opportunity' to Drive Down Drilling Usage Through Management, Regulation—Report*, E&E NEWS: ENERGYWIRE (Nov. 7, 2013), http://www.eenews.net/energywire/2013/11/07/stories/1059990129.

51. *See, e.g.*, AMERICAN WATER, INVESTOR PRESENTATION 23 (July 2013), *available at* http://www.ir.amwater.com/phoenix.zhtml?c=215126&p=irol-presentations_pf.

52. *Id.* Hydraulic fracturing is not the only case where large industrial uses are being considered for curtailment before others. *See, e.g.*, Colin Woodard, *For Regulators and Nestle Waters, Conflict by the Gallon*, PORTLAND PRESS HERALD (Sept. 3, 2013), http://www.pressherald.com/news/for-regulators-and-nestle-waters-conflict-by-the-gallon_2013-09-01.html?pagenum=full (discussing controversial water contract with bottling company).

unique from other industrial uses—as we move into a water-constrained world.

IV. WATER ALLOCATION DECISIONS

Hydraulic fracturing can utilize surface water, groundwater, or utility service, depending on what is available.[53] Water allocation decisions are historically matters of state law.[54] These state policies vary with respect to fracturing, and are often unique to the location, based on the needs of the specific watershed and whether the water system is interstate or intrastate. Shale plays that use or are likely to use hydraulic fracturing are located in thirty-three states, including Alabama, Alaska, Arkansas, California, Colorado, Delaware, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Montana, Nebraska, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, and Wyoming.[55]

While most shale plays are still in early development, two areas have been more comprehensively developed: the Marcellus and multiple plays in the state of Texas. These cases provide information about fracturing water uses and suggest what we can expect from future regulation if we do not move towards a recognition of treating these consumptive uses differently in regulation.

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53. AM. WATER WORKS ASS'N, WATER AND HYDRAULIC FRACTURING 15 (2013), *available at* http://www.awwa.org/Portals/0/files/legreg/documents/AWWAFrackingReport.pdf. Decisions also depend on what is closest to the well since the cost of transporting the water can quickly exceed the cost of the actual resource. *See* Gay, *supra* note 48.

54. *See* Michael G. Proctor, Comment, *Section 10 of the Rivers and Harbors Act and Western Water Allocations—Are the Western States Up a Creek Without a Permit?*, 10 B.C. ENVTL. AFF. L. REV. 111, 111–12 (1982) (citing California v. United States, 438 U.S. 645, 653–63 (1978) (discussing the interaction between the federal government and the states regarding water law)).

55. U.S. ENERGY INFO. ADMIN., LOWER 48 STATES SHALE PLAYS (2011) [hereinafter LOWER 48 STATES SHALE PLAYS], *available at* http://www.eia.gov/oil_gas/rpd/shale_gas.pdf. The map is especially useful for understanding where in each state the plays are located.

A. *Developed Plays*

1. Marcellus Shale

For the Marcellus Shale, located in New York, Pennsylvania, Maryland, Delaware, New Jersey, and West Virginia,[56] water allocation decisions are made primarily by two interstate river commissions: the Susquehanna River Basin Commission ("SRBC") and the Delaware River Basin Commission ("DRBC"), along with each individual state.[57]

The SRBC already regulates hydraulic fracturing activities differently from other uses and requires approval before withdrawing or using any amount of water.[58] This includes both surface water and groundwater withdrawals within the Susquehanna River Basin.[59] In addition to maximum withdrawal rates and maximum daily withdrawal amounts, many permits issued for withdrawals require that withdrawals be stopped when flows reach a certain minimum, defined as the "passby flow threshold."[60] Permits are approved for four-year terms, and can be sold or shared with other natural gas producers.[61] These permits are required even if the water is being sourced on privately held land; landowners cannot sell water from existing wells, ponds, or streams, without the same permits.[62]

Unlike the SRBC, the DRBC has not adopted any regulations to date, but did issue draft regulations regarding natural gas development on November 8, 2011.[63] The commission noted that it is

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56. Hobart King, *Marcellus Shale—Appalachian Basin Natural Gas Play*, GEOLOGY.COM, http://www.geology.com/articles/marcellus-shale.shtml (last visited Feb. 18, 2014).

57. ABDALLA & DROHAN, *supra* note 28, at 3–4.

58. SUSQUEHANNA RIVER BASIN COMM'N, FREQUENTLY ASKED QUESTIONS: SRBC'S ROLE IN REGULATING NATURAL GAS DEVELOPMENT 1 (2012) [hereinafter SRBC FAQ], *available at* http://www.srbc.net/programs/natural_gas_development_faq.htm.

59. *Id.* A map of all approved projects can be found at http://gis.srbc.net/wrp. Other projects can withdraw up to 100,000 gallons per day or consume up to 20,000 gallons per day over a thirty-day period without approval. *Id.* at 2.

60. *Id.* at 5. The SRBC uses an estimate of low stream flow called the Q7-10, which is the lowest average flow that would be expected over a seven-day period once every ten years. *Id.* at 4. However, as noted elsewhere in this article, flooding and drought conditions are changing and this measure may no longer be accurate. *See supra* Part I.

61. SRBC FAQ, *supra* note 58, at 3, 5.

62. *See id.* at 6.

63. *Natural Gas Drilling Index Page*, DEL. RIVER BASIN COMM'N, http://www.state.nj.

"vital . . . to strike the appropriate balance between the use of the region's water resources for one purpose, natural gas exploration and production, and competing uses of the same water resources for drinking water supply and to meet other human, economic, and ecological needs."[64]

The New York State Department of Environmental Conservation is responsible for permitting water withdrawals for areas of New York outside the jurisdiction of the SRBC and the DRBC.[65] New York updated its water withdrawal laws in 2011 to require a permit for any type of water withdrawal system with the capacity to withdraw 100,000 gallons per day or more of either groundwater or surface water.[66] Final implementing regulations for the updated withdrawal law went into effect on April 1, 2013.[67] The regulations require permitting for construction and withdrawal activities above 100,000 gallons per day[68] and annual reporting of water withdrawals above 100,000 gallons per day.[69] Withdrawal facilities constructed prior to February 15, 2012 that have the capacity to withdraw more than 100,000 gallons per day must apply for an initial permit unless certain exemptions are met, none of which apply to the natural gas industry.[70] Initial permits can be issued for a fixed term not to exceed ten years,[71] and may include a passby flow requirement for surface water withdrawals.[72] Permits may also be modified "where necessary to prevent over-

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us/drbc/programs/natural/ (last visited Feb. 18, 2014).

64. *Id.*

65. J. DANIEL ARTHUR ET AL., WATER RESOURCES AND USE FOR HYDRAULIC FRACTURING IN THE MARCELLUS SHALE REGION 14 (2010), *available at* http://www.all-llc.com/publicdownloads/WaterResourcePaperALLConsulting.pdf. Due to its unique situation, the New York City Department of Environmental Protection ("NYCDEP") has regulatory authority for the city's drinking water supply, and can therefore also become involved in areas which supply drinking water to New York City. *Natural Gas Drilling in Marcellus Shale*, N.Y.C. ENVTL. PROT., http://www.nyc.gov/html/dep/html/news/natural_gas_drilling.shtml (last visited Feb. 18, 2014). The NYCDEP's position is that hydraulic fracturing is "incompatible with the operation of New York City's unfiltered water supply system and pose[s] unacceptable risks for more than nine million New Yorkers." *Id.*

66. N.Y. ENVTL. CONSERV. LAW § 15-1501 (Consol. 2013). For the definition of "threshold volume," see N.Y. ENVTL. CONSERV. LAW § 15-1502 (Consol. 2013).

67. N.Y. COMP. CODES R. & REGS. tit. 6 § 601.19(e)–(f) (2013).

68. *Id.* § 601.6.

69. *Id.* § 601.5(a).

70. *Id.* § 601.7(a).

71. *Id.* § 601.7(e).

72. *Id.* § 601.12(c).

allocation or use of a water source or to protect the environment and the health, safety and welfare of the public."[73]

The Pennsylvania Department of Environmental Protection is responsible for water withdrawal regulations in Pennsylvania for areas of the state outside the jurisdiction of the SRBC and the DRBC.[74] In 2008, the Statewide Water Resources Committee in the Department of Environmental Protection noted that

> over the next five years, concerted efforts should be undertaken to evaluate and evolve Pennsylvania's water rights and water withdrawal arrangements to a more consistent, secure and holistic approach that a) [o]ffers water users well-defined, stable and predictable water rights; b) [p]romotes siting and development of uses requiring withdrawals in ways that assure adequate and sustainable supplies both in normal and drought periods, without causing unacceptable impacts on instream uses and environmental resources; c) [i]s administratively efficient and avoids unnecessary duplication between agencies and programs.[75]

The report also suggested that "[w]ater use registration and reporting regulations should be adopted and implemented as expeditiously as practicable to facilitate the gathering of more accurate and timely water withdrawal and use information."[76]

All withdrawals that exceed an average of 10,000 gallons per day in any thirty-day period must be registered for that use.[77] While hydraulic fracturing requires a water management plan that shows the location or locations from which water is intended to be withdrawn, along with withdrawal quantity, rate, and timing,[78] the withdrawal impact analysis is in narrative form and asks project sponsors to propose mitigation measures.[79] Passby

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73. *Id.* § 601.15(b)(3).

74. *See* ARTHUR ET AL., *supra* note 65, at 14.

75. PA. DEP'T OF ENVTL. PROT., *Executive Summary* to STATE WATER PLAN PRINCIPLES 7 (2009), *available at* http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-76834/3010-BK-DEP4227.pdf.

76. *Id.* at 12.

77. *See* 27 PA. CONS. STAT. ANN. § 3118(b)(1) (West 2009).

78. *See* PA. DEP'T OF ENVTL. PROT., 0100-FS-DEP4217, MARCELLUS SHALE DEVELOPMENT (2013), *available at* http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-97683/0100-FS-DEP4217.pdf.

79. *See* BUREAU OF SAFE DRINKING WATER, OFFICE OF OIL AND GAS MGMT., PA. DEP'T OF ENVTL. PROT., WATER MANAGEMENT PLAN FOR UNCONVENTIONAL GAS WELL DEVELOPMENT EXAMPLE FORMAT (2013), *available at* http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-95182/8000-PM-OOGM0087%20Example%20Format.pdf.

flows or maximum withdrawals are not required to be imposed as part of the permitting process.[80]

Additionally, a permit from the Pennsylvania Fish and Boat Commission ("FBC") is required to withdraw water from impoundments holding fish.[81] The FBC has, in fact, started leasing water on properties it owns,[82] with the caveat that water withdrawals will not be allowed on opening day of trout season or other high use times like holidays.[83] While new regulations for oil and gas surface activities have been proposed,[84] these do not include anything regarding water withdrawals.[85] Conversely, public water supply agencies must obtain "Water Allocation Permits" for any surface water or groundwater withdrawals, regardless of the amount.[86]

Pennsylvania is also one of the locations where investor-owned public utilities are looking at providing water to hydraulic fracturing activities. While these utilities must obtain allocation permits, those permits "*may*" contain requirements for "[i]nstream flow protection where the surface water withdrawal may significantly impact instream and downstream uses."[87] However, no special conditions—like flow protection—are required in the permit.

Maryland, the third state in the SRBC, has much less land within the Marcellus Shale formation. The Maryland Department of the Environment requires a permit "for any activity that with-

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80. *See id.*; *see also* BUREAU OF SAFE DRINKING WATER, OFFICE OF OIL AND GAS MANAGEMENT, PA. DEP'T OF ENVTL. PROT., 8000-PM-OOGM0087, WATER MANAGEMENT PLAN EXAMPLE FORMAT INSTRUCTIONS FOR UNCONVENTIONAL GAS WELL DEVELOPMENT 2 (2013) *available at* http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-10554.

81. 30 PA. CONS. STAT. ANN. § 3506(a) (West 2009).

82. *Natural Gas & Water Access Program*, PA. FISH & BOAT COMM'N, http://www.fish.state.pa.us/ngwa.htm (last visited Feb. 18, 2014).

83. *Natural Gas & Water Access Program: FAQs*, Pa. Fish & Boat Comm'n, http://www.fish state.pa.us/water/ngwa/faq_ngwa.htm (last visited Feb. 18, 2014).

84. *Oil and Gas Surface Regulations*, PA. DEP'T OF ENVTL. PROT., http://www.portal.state.pa.us/portal/server.pt/community/public_resources/20303/surface_regulations/1587188 (last visited Feb. 18, 2014).

85. *See* Regulations for Oil and Gas Surface Activities, Pa. Dep't of Envtl. Prot. *1–3 (proposed Aug. 27, 2013) (to be codified at 25 PA. CODE ch. 78, subch. C), *available at* http://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/PublicResources/RegulationSummary-PreCommentPeriod.pdf.

86. PA. DEP'T OF ENVTL. PROT., 3940-FS-DEP4107, PENNSYLVANIA'S SURFACE WATER ALLOCATION PROGRAM (2013), *available at* http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-96326/3940-FS-DEP4107.pdf.

87. *Id.* (emphasis added).

draws water from the State's surface and/or underground waters" with certain exemptions, including that the use will be less than 5000 gallons per day as an annual average.[88] Aquifer testing and other technical analysis may be required for appropriation requests of 10,000 gallons per day or more.[89]

Delaware, the third state in the DRBC, requires permits for withdrawals from groundwater or surface water of more than 50,000 gallons per day.[90] Those applying for the permit request maximum daily, monthly, and yearly rates, and those rates will be granted "[u]nless adverse affects have, or could result from these withdrawals."[91] The Delaware Department of Natural Resources and Environmental Control application only requires a drought emergency plan for projects with a total system withdrawal over one million gallons per day.[92]

New Jersey, the fourth state in the DRBC, requires a water allocation permit for ground or surface water withdrawals in excess of 100,000 gallons per day for a period of more than thirty days.[93] Requested allocations must include the rate in millions of gallons,

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88. MD. DEP'T OF THE ENV'T, 2008 GUIDE TO ENVIRONMENTAL PERMITS AND APPROVALS 91 (2008), *available at* http://energy.maryland.gov/documents/2008_MDE_Permitguide.pdf. Even with the 5000 gpd use, the user must file a notice of exemption with the state at least thirty days before use. *Id.* The other exemptions would not apply to natural gas activities. *See id.*

89. *Id.*

90. *Compare* DEL. CODE ANN. tit. 7, § 6003(a) (2013) (requiring a permit before withdrawal of ground water or surface water), *with Water Supply Section, Water Allocation Branch*, DIV. OF WATER, DEL. DEP'T OF NATURAL RES. & ENVTL. CONTROL, http://www.dnrec.delaware.gov/wr/Services/OtherServices/Pages/WaterSupplyWaterAllocationBranch.aspx (last visited Feb. 18, 2014) (noting that the primary function of the Branch is to issue permits of withdrawals greater than 50,000 gallons per day). *See generally* DIV. OF WATER, DEL. DEP'T OF NATURAL RES. & ENVTL. CONTROL, INSTRUCTIONS FOR FILING A WATER ALLOCATION PERMIT APPLICATION 1, *available at* http://www.dnrec.delaware.gov/wr/Information/WaterSupplyInfo/DocumentInstructs/Instructions_for_filing_a_water_allocation_application.pdf (last visited Feb. 18, 2014).

91. DIV. OF WATER, DEL. DEP'T OF NATURAL RES. & ENVTL. CONTROL, INSTRUCTIONS FOR FILING A WATER ALLOCATION PERMIT APPLICATION, *available at* http://www.dnrec.delaware.gov/wr/Information/WaterSupplyInfo/Documents/Instructions_for_filing_a_water_allocation_application.pdf (last visited Feb. 18, 2014).

92. *Water Supply Section—Water Allocation Branch*, DIV. OF WATER, DEL. DEP'T OF NATURAL RES. & ENVTL. CONTROL, http://www.dnrec.delaware.gov/wr/ Services/OtherServices/ Pages/WaterSupplyWater Allo cationBranch.aspx (last visited Feb. 18, 2014).

93. *Water Allocation and Registrations*, DIV. OF WATER SUPPLY AND GEOSCIENCE, N.J. DEP'T OF ENVTL. PROTECTION, http://www.nj.gov/dep/watersupply/a_allocat.html (last visited Feb. 18, 2014). However, if the location is within the jurisdiction of the New Jersey Pineland Commission or the Highlands Preservation Area, lower limits may apply. *See id.*

source, and flow data for each surface water diversion.[94] There are also extensive mapping and aquifer testing requirements.[95] However, for diversions of 100,000 gallons or more for less than thirty-one days, a short term water use permit-by-rule is submitted, no formal permit is issued, and no review is conducted.[96] A short term water use report form must simply be submitted within one month of the diversion activity.[97] The New Jersey Department of Environmental Protection has no specific regulations applying to hydraulic fracturing activities.

West Virginia is neither part of the SRBC nor the DRBC, but does overlay part of the Marcellus Shale. West Virginia's Water Resources Protection Act requires notification of withdrawals that exceed 750,000 gallons in any given month for one facility.[98] While the law only requires post-withdrawal submission, the West Virginia Department of Environmental Protection requires a Water Management Plan as part of a Horizontal Well Permit Packet.[99] In this document, source water locations must be identified as well as anticipated volume.[100] For surface water withdraw-

94. *See* BUREAU OF WATER ALLOCATION & WELL PERMITTING, DIV. OF WATER SUPPLY & GEOSCIENCE, N.J. DEP'T OF ENVTL. PROT., BWA-001 A, WATER ALLOCATION PERMIT APPLICATION: NEW OR MAJOR MODIFICATIONS 5–7 (2013), *available at* http://www.nj.gov/dep/watersupply/pdf/bwa-001a.pdf.

95. *See id.* at 8, 10.

96. BUREAU OF WATER ALLOCATION & WELL PERMITTING, DIV. OF WATER SUPPLY & GEOSCIENCE, N.J. DEP'T OF ENVTL. PROT., BWA-003, SHORT TERM WATER USE PERMIT-BY-RULE (2013), *available at* http://www.nj.gov/dep/watersupply/pdf/bwa-003.pdf.

97. BUREAU OF WATER ALLOCATION & WELL PERMITTING, DIV. OF WATER SUPPLY & GEOSCIENCE, N.J. DEP'T OF ENVTL. PROT., BWA-004, SHORT TERM WATER USE REPORT (2013), *available at* http://www.nj.gov/dep/watersupply/pdf/bwa-004.pdf.

98. *Frac Water Reporting Form*, WATER USE SECTION, W. VA. DEP'T OF ENVTL. PROT., http://www.dep.wv.gov/WWE/wateruse/Pages/FracWaterReportingForm.aspx (last visited Feb. 18, 2014). The reporting is completed online at a site specific to hydraulic fracturing companies and also includes disposal of wastewater for each well. *Id.*; *see also* W. VA. CODE § 22-26-1 (LexisNexis Repl. Vol. 2009).

99. *§ 22-6A Horizontal Well Permit Package—Application Page*, WATER USE SECTION, W. VA. DEP'T OF ENVTL. PROT., http://www.dep.wv.gov/oil-and-gas/Horizontal-Permits/Horizontal%20Well%20Permit%20Packet/Pages/default.aspx (last visited Feb. 18, 2014). The Department has developed a guidance tool, available online, for drillers to determine whether there is sufficient water in the stream they are looking at requesting withdrawals from before submitting the permit application. *Water Withdrawal Guidance Tool*, WATER USE SECTION, W. VA. DEP'T OF ENVTL. PROT., http://www.dep.wv.gov/WWE/wateruse/Pages/WaterWithdrawal.aspx (last visited Feb. 18, 2014). The tool can suggest larger surface water locations nearby if the driller's preferred location will not support the withdrawal, or show that water will need to be obtained from farther away. *Id.*

100. W. VA. DEP'T OF ENVTL. PROT., WATER MANAGEMENT PLAN/WATER ADDENDUM 1–2 [hereinafter WATER MANAGEMENT PLAN/WATER ADDENDUM], *available at* http://www.dep.wv.gov/oil-and-gas/Water%20Management/Documents/Water%20Management%20Pl

als, the Department of Environmental Protection calculates a passby requirement for inclusion in the permit to ensure there is sufficient flow downstream unless previously agreed otherwise.[101] Currently, surface water withdrawals account for 80% of the water used in West Virginia.[102] For groundwater sources, the applicant must provide aquifer testing results.[103] However, in all cases, water cannot be withdrawn "at volumes beyond which the waters can sustain."[104]

Therefore, for the Marcellus Shale, arguably the most developed hydraulic fracturing play, only the SRBC and West Virginia regulate hydraulic fracturing activities differently at all. Only the SRBC mandates a passby flow requirement under which withdrawals must be stopped.[105] No regulatory body in the Marcellus Shale mandates cessation requirements for groundwater withdrawals.

2. Texas

In Texas, the Eagle Ford and Barnett plays, as well as several in the Permian Basin, are also well developed.[106] More than 33,000 new natural gas wells have been drilled in Texas since 2005, using 110 billion gallons of water over that time.[107] Water rights in Texas depend on the type of water. Landowners have the right to pump as much groundwater as is available, regardless of what effect the pumping may have on others.[108] Landown-

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an%20Application.pdf.

101. *Id.* at 2.

102. Jessie Thomas-Blate, *New Report: Fracking Has Serious Impact To Water Resources*, THE RIVER BLOG (Nov. 8, 2013), http://www.americanrivers.org/blog/new-report-fracking-has-serious-impact-to-water-resources/?utm_medium=email&utm_source=amrivers&utm_content=20+-+Read+More+raquo&utm_campaign=201312-current&source=201312-current.

103. WATER MANAGEMENT PLAN/WATER ADDENDUM, *supra* note 100, at 3.

104. OFFICE OF OIL AND GAS, W. VA. DEP'T OF ENVTL. PROT., WVDEP INDUSTRY GUIDANCE GAS WELL DRILLING/COMPLETION LARGE WATER VOLUME FRACTURE TREATMENTS 2 (2010), *available at* http://www.dep.wv.gov/oil-and-gas/GI/Documents/Marcellus%20Guidance%201-8-10%20Final.pdf.

105. SRBC FAQ, *supra* note 58.

106. *See* Kathy Wythe, *Fractured: Experts Examine the Contentious Issue of Hydraulic Fracturing Water Use*, 8 TXH_2O 14, 14 (2013), *available at* http://twri.tamu.edu/newsletters/txh2o-v8n1.pdf.

107. Emily Pickrell, *Texas Leads Country in Hydraulic Fractured Wells*, FUELFIX BLOG (Oct. 7, 2013, 12:47 PM), http://fuelfix.com/blog/2013/10/07/texas-leads-country-in-hydraulic-fractured-wells/.

108. *Texas Water Law*, TEX. A&M UNIV., http://www.texaswater.tamu.edu/water-law

ers have the ability to sell as much water as they can capture from below their land.[109] Generally, no permit of any kind is required, and the use of the water is not limited to what is "reasonable."[110]

To mitigate consequences of unlimited pumping, local groundwater conservation districts have been established; there are currently ninety-nine, with three more pending confirmation.[111] Groundwater conservation districts "are charged to manage groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within their jurisdictions."[112] Within their districts, the groundwater conservation districts permit water wells and develop a comprehensive management plan.[113] However, wells used solely to supply water for drilling or exploration operations for oil or gas are statutorily exempted from groundwater conservation district drilling permitting requirements.[114] Additionally, a groundwater conservation district cannot deny a permit for a water well used to supply hydraulic fracturing if the application meets all applicable rules.[115] Therefore, perhaps not surprisingly, some of the areas of shale development—particularly the Cline Shale Play and the Barnett Shale Play—are in areas that are not comprehensively covered by groundwater conservation districts.[116]

In contrast to groundwater, all surface water is publicly owned and governed by permits granted through the Texas Commission

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(last visited Feb. 18, 2014).

109. *Id.*

110. *See id.*

111. TEX. COMM'N ON ENVTL. QUALITY, TEXAS GROUNDWATER CONSERVATION DISTRICTS (2014), *available at* http://www.tceq.texas.gov/assets/public/permitting/watersupply/groundwater/maps/gcdmap.pdf.

112. TEX. COMM'N ON ENVTL. QUALITY, WHAT IS A GROUNDWATER CONSERVATION DISTRICT (GCD)?, http://www.tceq.texas.gov/assets/public/permitting/watersupply/groundwater/maps/gcd_text.pdf (last visited Feb. 18, 2014).

113. *Id.*

114. *Id.*; *see also Water Use in Association with Oil and Gas Activities Regulated by the Railroad Commission of Texas*, R.R. COMM'N OF TEX., http://www.rrc.state.tx.us/eagleford/wateruse.php (last visited Feb. 18, 2014). These wells must still be registered, as well as installed, equipped, and closed per the groundwater conservation district regulations. *Id.*

115. *Id.*; *see also* TEX. WATER CODE ANN. § 36.117(g) (West 2013).

116. *Compare* Patrick Graves, *An Energy Renaissance: New Production Upends Assumptions About Oil and Gas*, FISCALNOTES (Texas) (Mar. 26, 2013), http://www.window.state.tx.us/comptrol/fnotes/fn13Q1/energy.php, *with* TEXAS GROUNDWATER CONSERVATION DISTRICTS, *supra* note 111.

on Environmental Quality ("TCEQ").[117] Permits are required in order to use surface water for uses other than domestic or livestock purposes, wildlife management, and emergency use.[118] Additionally, the diversion of one acre-foot each day without a permit is allowed for "drilling and producing petroleum and conducting operations associated with drilling and producing petroleum . . . from the Gulf of Mexico and adjacent bays and arms of the Gulf of Mexico."[119]

For new permit applications, an applicant must provide information such as use, diversion point, and rate.[120] The application also requires a brief description of the stream or water body,[121] along with additional information if groundwater is to be used.[122] New permits are usually granted "if the record shows that at least 75 percent of the water can be expected to be available at least 75 percent of the time."[123] Texas also allows temporary water use permits for one year[124] or up to three years.[125] Term water permits can be issued for up to ten years.[126] For water rights granted under temporary permits, the permit may be suspended at any time if it is determined that surplus water is no longer

117. TEX. A&M UNIV., *supra* note 108. Interestingly, Texas merged the doctrines of riparian rights and prior appropriation, requiring riparian owners to register a claim with the TCEQ to obtain a water right. *Id.*

118. TEX. GROUNDWATER PROT. COMM., WATER IN TEXAS—WHO OWNS IT?, *available at* http://www.tgpc.state.tx.us/subcommittees/POE/FAQs/WaterOwnership_FAQ.pdf (last visited Feb. 18, 2014).

119. TEX. WATER CODE ANN. § 11.142(b) (West 2013).

120. TEX. COMM'N ON ENVTL. QUALITY, FORM TCEQ-10214, INSTRUCTIONS TO PREPARE AN APPLICATION FOR A PERMIT TO APPROPRIATE PUBLIC WATER 3–4 (2010), *available at* http://www.tceq.tex as.gov/assets/public/permitting/forms/10214.pdf.

121. *Id.* at 2.

122. *Id.* at 4.

123. TEX. COMM'N ON ENVTL. QUALITY, GI-228, RIGHTS TO SURFACE WATER IN TEXAS 18 (2009) [hereinafter TEX. COMM'N ON ENVTL. QUALITY, RIGHTS TO SURFACE WATER], *available at* http://www.tceq.texas.gov/publications/gi/gi-228.html/at_download/file.

124. *See* TEX. COMM'N ON ENVTL. QUALITY, FORM TCEQ-20425, APPLICATION FOR A TEMPORARY WATER USE PERMIT FOR UP TO 10 ACRE-FEET OF WATER AND UP TO ONE CALENDAR YEAR (2010), *available at* http://www.tceq.texas.gov/assets/public/permitting/forms/20425.pdf.

125. *See* TEX. COMM'N ON ENVTL. QUALITY, FORM TCEQ-10202, APPLICATION FOR A TEMPORARY WATER USE PERMIT FOR MORE THAN 10 ACRE-FEET OF WATER, AND/OR FOR A DIVERSION PERIOD LONGER THAN ONE CALENDAR YEAR (2006) [hereinafter TEX. COMM'N ON ENVTL. QUALITY, APPLICATION FOR LONGER THAN ONE CALENDAR YEAR], *available at* http://www.tceq.texas.gov/assets/public/permitting/forms/tempmore.pdf; TEX. COMM'N ON ENVTL. QUALITY, RIGHTS TO SURFACE WATER, *supra* note 123, at 19.

126. TEX. COMM'N ON ENVTL. QUALITY, RIGHTS TO SURFACE WATER, *supra* note 123, at 19.

available.[127] All water permit holders are required to report annual surface water use.[128]

Texas has recently suffered from drought, and multiple uses of surface water were curtailed.[129] Importantly, water permits are allotted surface water only "as long as all [domestic and livestock] users can obtain their lawful amount."[130] Otherwise, the use of the water is not taken into account. A different situation exists in the Middle and Lower Rio Grande Basin, where use does determine priority for surface water out of the Falcon and Amistad reservoirs.[131] Especially important during shortages, Texas has also devised a system of watermasters to ensure priority rights are honored in three water basins: the Rio Grande, South Texas, and the Concho.[132] Watermasters coordinate diversions and allocate flows during water shortages.[133] Water rights in Texas may also be subject to environmental requirements, such as support of endangered species, though the operation of this in practice is in dispute.[134]

Some hydraulic fracturing operations also obtain their water from municipal sources which may have requested additional allotments to account for future growth and are instead selling that water now.[135] The rule of capture and the exemption of water wells for petroleum and gas activities from groundwater conservation districts demonstrate that, as currently regulated, water will be available for hydraulic fracturing activities from ground-

127. TEX. COMM'N ON ENVTL. QUALITY, APPLICATION FOR LONGER THAN ONE CALENDAR YEAR, *supra* note 125.

128. TEX. WATER CODE ANN. § 11.031 (West 2013).

129. *See* Elizabeth Harball, *Texas Authority Votes to Cut Off Water to State's Second-Largest Estuary*, E&E NEWS: CLIMATEWIRE (Sept. 30, 2013), http://www.eenews.net/stories/1059988021; Chris Tomlinson, *In 2013, Texas Drought Could Be Worst Ever in Some Areas, Climatologist Says*, HUFFINGTON POST (Feb. 5, 2013), http://www.huffingtonpost.com/2013/02/05/2013-texas-drought-worst-eve-climte-change-n_2624106.html.

130. TEX. COMM'N ON ENVTL. QUALITY, RIGHTS TO SURFACE WATER, *supra* note 123, at 5. Water appropriated for domestic and livestock use cannot be sold by individual property owners. *Id.* at 2.

131. *Id.* at 7. A new study shows that this area will suffer even more water supply shortfalls going forward. Scott Streater, *Warming Climate Means Severe Supply Shortfalls In Lower Rio Grande—Federal Study*, E&E NEWS: GREENWIRE (Dec. 18, 2013), http://www.eenews.net/greenwire/2013/12/18/stories/1059992073.

132. *See* TEX. COMM'N ON ENVTL. QUALITY, RIGHTS TO SURFACE WATER, *supra* note 123, at 14.

133. *Id.* at 13–14.

134. *See* Aransas Project v. Shaw, 930 F. Supp. 2d 716, 778, 789 (S.D. Tex. 2013).

135. NICOT ET AL., *supra* note 28, at 35.

water sources until those sources are completely depleted. While surface waters may be more heavily regulated, it is possible those with senior rights will be willing to forgo planned activities and sell their water for sufficient profit.

B. *Other Plays*

Reviewing other representative states, the situation is not markedly different for other plays. In Arkansas, where the Fayetteville Play is being developed, the Arkansas Natural Resources Commission is responsible for regulating water use.[136] Currently, registration is required for riparian surface water withdrawals of more than 325,851 gallons per year or groundwater withdrawals of 50,000 gallons per day or more.[137] Act 154 allows for critical groundwater area designations, which could place limitations on ground water use or pumpage if an "affordable alternative" exists.[138] While these areas have been designated as critical groundwater areas, no regulations have ever been proposed.[139] There is some overlap between areas designated as critical[140] and areas of significant gas well permitting activity.[141] Within critical ground water areas, applications must be made for new ground water rights.[142] Otherwise, it appears only registration and possible metering are required to ensure accurate reporting of groundwater use.[143]

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136. ARK. DEP'T OF ENVTL. QUALITY, ENVIRONMENTAL REQUIREMENTS: NATURAL GAS ACTIVITIES IN THE FAYETTEVILLE SHALE PLAY (2012), *available at* http://www.adeq.state.ar.us/ftproot/Pub/pa/Brochures_Online/08_Water/Natural%20Gas%20Activities%20in%20the%20Fayetteville%20Shale%20Play.pdf. While Arkansas is part of two river compacts—the Red River Compact and the Arkansas-Oklahoma Arkansas River Compact—neither of these Commissions issues permits, and instead each relies on the individual state agencies to do so. *See id.*

137. ARK. NATURAL RES. COMM'N, FACT SHEET, WATER-USE REGISTRATION PROGRAM, *available at* https://www.static.ark.org/eeuploads/anrc/Water-use-Reg-Fact-Sheet.pdf (last visited Feb. 18, 2014).

138. *Id.*

139. *Critical Groundwater Areas*, ARK. NATURAL RES. COMM'N, http://www.anrc.ark.org/divisions/water-resources-management/groundwater-protection-and-management-program/critical-groundwater-areas/ (last visited Feb. 18, 2014).

140. ARK. NATURAL RES. COMM'N, THE FACTS ABOUT CRITICAL GROUNDWATER DESIGNATION, *available at* https://www.static.ark.org/eeuploads/anrc/gw_designation_graphic.pdf (last visited Feb. 18, 2014).

141. *Oil and Gas Info*, ARK. OIL AND GAS COMM'N, http://www.aogc2.state.ar.us/AOGConline/ (last visited Feb. 18, 2014).

142. 138-00-6 ARK. CODE R. § 404.4 (LexisNexis 2013).

143. *See id.* § 407.1.

Surface water use for hydraulic fracturing requires a permit, provided the driller does not own riparian land.[144] The applicant must list estimated pumping volume, duration, and source.[145] While a conservation plan is required, it is in narrative form.[146] Non-riparian users are supposed to use only "excess" surface water.[147] Permits may include special conditions but none are required; limitations on season or time also may be permit conditions.[148] While water level monitoring may occur, it is not required.[149] Permits for water withdrawals are freely transferable.[150]

Arkansas does have the ability, after granting a permit for non-riparian use, to assess surface water rights and determine what allocations "should be made if a water shortage should occur."[151] However, provisions of the allocation policy currently state that the available water will be allocated "among the uses affected by the shortage of water in a manner that each may obtain an equitable portion of the available water."[152] While water diversions have lower priority,[153] they may be granted an allocation,[154] and the use of the water being diverted is not currently taken into consideration.[155]

Alabama requires reporting for those who have the capacity to withdraw 100,000 gallons or more per day of either surface or groundwater.[156] In addition to registering, the entity must apply[157]

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144. *Non-Riparian Water Use Certification*, ARK. NATURAL RES. COMM'N, http://anrc.ark.org/divisions/water-resources-management/non-riparian-water-use-certification-program/ (last visited Feb. 18, 2014).

145. ARK. NATURAL RES. COMM'N, APPLICATION FOR WATER USE FOR GAS WELL FRACTURE STIMULATION AND HYDROSTATIC TESTING OF PIPELINES, *available at* https://static.ark.org/eeuploads/anrc/NRWU_ApplicationForDiversion_GF_HT.pdf (last visited Feb. 18, 2014).

146. *Id.*

147. *See* 138-00-2 ARK. CODE R. § 304.1 (LexisNexis 2013).

148. *See id.* § 304.6.

149. *Id.* § 304.15.

150. *Id.* § 304.10.

151. *Id.* § 304.14.

152. *Id.* § 307.1.

153. *See id.* § 307.4.

154. *Id.* § 307.10.

155. The White River seems to be the only exception to this rule, and it is dealt with under different rules. *See* 138-00-2 ARK. CODE R. §§ 314.1–314.5 (LexisNexis 2013).

156. *Water Management*, ALA. DEP'T OF ECON. & CMTY. AFFAIRS, http://www.adeca.alabama.gov/Divisions/owr/Pages/WaterManagement.aspx#Diversions (last visited Feb. 18, 2014). There are additional well requirements to prevent saline intrusion in the Alabama

and receive a Certificate of Use ("COU").[158] The COU "places few requirements on the water user other than for the applicant to certify that the proposed water use will not interfere with an existing legal use of the water and is reasonable and beneficial."[159] However, for hydraulic fracturing activities, an application for a COU may not be needed; temporary diversions or withdrawals of water may be eligible for an exemption.[160] In 2012, Alabama determined that it was necessary to "creat[e] a statewide water management plan."[161] One consideration was that "[t]here currently exists no mechanism to protect water resources from over allocation and to address emergency situations such as drought."[162] Also, the report noted that more comprehensive water withdrawal management, including for non-riparian uses, would require additional legislation.[163] There is currently no legal or policy requirement for minimum instream flows.[164] While a new drought management plan was adopted in 2013, actions to be taken by each sector are voluntary.[165]

North Dakota requires a permit for all uses of water, both ground and surface, with some exceptions not applicable to hydraulic fracturing.[166] The conditional water permit application[167] date sets the priority date going forward.[168] The permit will be ap-

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Coastal Area. ALA. WATER AGENCIES WORKING GRP., WATER MANAGEMENT ISSUES IN ALABAMA 17 (2012), *available at* http://www.adem.alabama.gov/programs/water/waterforms/WaterIssueReport.pdf.

157. ALA. DEP'T OF ECON. & CMTY. AFFAIRS, ALABAMA WATER USE REPORTING PROGRAM DECLARATION OF BENEFICIAL USE APPLICATION (2002), *available at* http://www.adeca.alabama.gov/Divisions/owr/Documents/Water%20MGMT/DBUII.pdf.

158. *Water Management*, *supra* note 156.

159. ALA. WATER AGENCIES WORKING GRP., *supra* note 156, at 12.

160. *See Water Management*, *supra* note 156.

161. ALA. WATER AGENCIES WORKING GRP., *supra* note 156, at 6.

162. *Id.* at 10.

163. *Id.* at 12.

164. *Id.* at 26.

165. *See* ALA. DEP'T OF ECON. & CMTY. AFFAIRS, ALABAMA DROUGHT MANAGEMENT PLAN 11, 13 (2013), *available at* http://www.adeca.alabama.gov/Divisions/owr/Documents/ALDroughtPlan.pdf.

166. N.D. STATE WATER COMM'N, NORTH DAKOTA'S WATER PERMITTING PROCESS 1 [hereinafter NORTH DAKOTA'S WATER PERMITTING PROCESS], *available at* http://www.swc.nd.gov/4dlink9/4dcgi/GetContentPDF/PB-2303/Water%20Permitting%20Process.pdf (last visited Feb. 18, 2014).

167. N.D. STATE WATER COMM'N, APPLICATION FOR CONDITIONAL WATER PERMIT (2012), *available at* http://www.swc.state.nd.us/4dlink9/4dcgi/GetContentPDF/PB-234/SFN%2060157%20Fillable.pdf.

168. NORTH DAKOTA'S WATER PERMITTING PROCESS, *supra* note 166, at 1–2.

proved if the use is beneficial, prior appropriations will not be affected, and it is in the public interest, which includes effects on economic activity.[169] However, as with some other states, a temporary permit[170] can be obtained which authorizes water use for up to a twelve-month period.[171] Additionally, due to water necessary for fracturing, senior irrigation water permit holders have been allowed to use their water rights for industrial purposes.[172] While the policy specifically states that "no water right is created by the issuance of a temporary permit,"[173] neither the Administrative Code nor the Century Code specify how or when water might be allocated in case of drought. There is currently no difference in temporary permit status based on final use.[174]

In South Dakota, all water uses except domestic uses less than 25,920 gallons per day, require a water right permit.[175] Permits are available so long as (1) water is available, (2) the diversion will not impair existing rights, (3) the use is beneficial, (4) and the use is in the public interest.[176] Some areas in South Dakota are facing groundwater depletion, so no new groundwater permits are being issued in those areas.[177] However, temporary water permits may be issued,[178] including specifically for drilling purposes,[179] and require applicants to provide water source, maximum volume, daily volume and rate, and start and stop dates.[180]

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169. N.D. CENT. CODE § 61-04-06 (2013); NORTH DAKOTA'S WATER PERMITTING PROCESS, *supra* note 166, at 4.

170. N.D. STATE WATER COMM'N, APPLICATION FOR TEMPORARY WATER PERMIT (2012) [hereinafter APPLICATION FOR TEMPORARY WATER PERMIT], *available at* http://www.swc.state.nd.us/4dlink9/4dcgi/GetContentPDF/PB-235/SFN%2060158%20Fillable.pdf.

171. NORTH DAKOTA'S WATER PERMITTING PROCESS, *supra* note 166, at 5.

172. *Policy for Obtaining a Temporary Water Permit for Industrial Use*, N.D. STATE WATER COMM'N (Dec. 2011), http://www.swc.state.nd.us/4dlink9/4dcgi/GetContentRecord/PB-1826.

173. *Id.*

174. APPLICATION FOR TEMPORARY WATER PERMIT, *supra* note 170.

175. *Using Water in South Dakota*, S.D. DEP'T OF ENV'T & NATURAL RES., http://denr.sd.gov/des/wr/wateruse.aspx (last visited Feb. 18, 2014).

176. S.D. DEP'T OF ENV'T & NATURAL RES., SUMMARY OF SOUTH DAKOTA WATER LAWS AND RULES 3 (2013), *available at* http://denr.sd.gov/des/wr/summary.aspx#Temporary.

177. *Id.* at 6.

178. *Id.* at 5.

179. S.D. CODIFIED LAWS § 46-5-40.1 (2004).

180. S.D. DEP'T OF ENV'T & NATURAL RES. WATER RIGHTS PROGRAM, REQUEST FOR TEMPORARY PERMIT TO USE PUBLIC WATERS (2009), *available at* https://www.state.sd.us/eforms/secure/eforms/E2052V1-TEMPAPP.pdf.

As in North Dakota, no priority is obtained from a temporary use permit and no water right is granted.[181]

In 1983, Illinois recognized the potential for water conflicts and passed the Water Use Act.[182] The Act required registration of substantial uses, allowed for recommendations regarding restrictions on groundwater withdrawals during times of drought, and required that groundwater withdrawals be for a reasonable use.[183] The Act defines "high-capacity intake" as 100,000 gallons per day for either surface water or groundwater,[184] and requires such water use be reported annually.[185] Review of whether new groundwater withdrawals would impact other users is supposed to occur before construction.[186] While a process does exist to limit groundwater withdrawals if water levels decrease to the point that normal water withdrawals can no longer occur, it only applies to certain parts of the state, and any or all users may be given specific allocations.[187] Surface water withdrawals for navigable waterways are governed by the Office of Water Resources, which can grant permits provided that (1) navigation is not impaired, (2) there is minimal encroachment, (3) there is no impairment of rights, and (4) there is no resulting bank instability.[188] However, even if encroachment or impairment would occur, a permit can still be issued with supplemental information[189] and a determination that these impacts will be minimized and there is a public benefit.[190] Allocations of water from Lake Michigan[191] and from state areas owned or managed by the Illinois Department of Nat-

181. S.D. CODIFIED LAWS § 46-5-40.1.

182. *See* 525 ILL. COMP. STAT. ANN. 45/3 (West 2004 & Cum. Supp. 2013).

183. *See id.*

184. *Id.* 45/4.

185. *Id.* 45/5.3; *see also Illinois Water Inventory Program*, ILL. STATE WATER SURVEY, http://www.isws.illinois.edu/gws/iwip/ (last visited Feb. 18, 2014).

186. 525 ILL. COMP. STAT. ANN. 45/5 (West 2004 & Cum. Supp. 2013). With a wording change in 2009, it appears this provision was limited to groundwater withdrawals and does not include surface waters. Additionally, there is evidence these reviews are not conducted. BRADLEY UKEN ET AL., A PLAN TO IMPROVE THE PLANNING AND MANAGEMENT OF WATER SUPPLIES IN EAST-CENTRAL ILLINOIS 23 (2009), *available at* http://www.sws.uiuc.edu/iswsdocs/wsp/outside/ECI-WaterPlan_062909.pdf.

187. 525 ILL. COMP. STAT. ANN. 45/5.1 (West 2004 & Cum. Supp. 2013).

188. ILL. ADMIN. CODE tit. 17, § 3704.80(a) (2013), *available at* http://www.ilga.gov/commission/jcar/admincode/017/017037040000800R.html.

189. *Id.* § 3704.80(b).

190. *See id.* § 3704.90.

191. *See id.* § 3730.101.

ural Resources[192] are addressed using other criteria and processes. Permits are not required for other surface waters.

Illinois recently passed the Hydraulic Fracturing Regulatory Act,[193] which requires a fresh water withdrawal and management plan as part of every hydraulic fracturing permit application.[194] The plan must include: the source of the water, whether the source is groundwater or surface water, the withdrawal location, the volume, and the months during which withdrawal will occur.[195] Additionally, the applicant must self-certify that the proposed actions are in compliance with the Water Use Act and applicable regional water supply plans.[196] After hydraulic fracturing is complete, a completion report must supply the total water volume used and each source from which water was drawn.[197] Recent modeling demonstrates that, in east-central Illinois, surface reservoir capacity is insufficient to meet needs during times of drought, and, in northeast Illinois, deep aquifers are being used

192. *See id.* § 120.10.

193. ILL. S.B. 1715, Pub. Act 098-0022, § 1-1 (2013), *available at* http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=098-0022.

194. *Id.* § 1-35(b)(10).

195. *Id.*

196. *Id.* § 1-35(b)(9). The regional water supply plans are still in development. *Illinois Water Supply Program*, ILL. STATE WATER SURVEY, http://www.sws.uiuc.edu/wsp/ (last visited Feb. 18, 2014). Actions listed are voluntary. UKEN ET AL., *supra* note 186, at ix. One regional report specifically states that "[i]t is beyond the scope of this initial planning cycle to make recommendations aimed at changing the existing governance structure for water supply planning and management." CHI. METRO. AGENCY FOR PLANNING, *Executive Summary* to WATER 2050: NORTHEASTERN ILLINOIS REGIONAL SUPPLY/DEMAND PLAN ix (2010), *available at* http://www.isws.illinois.edu/iswsdocs/wsp/outside/FY10-0079_RWSPG_PLAN_final_low_res.pdf. However, the reports from the regional water authorities do show surface water supply issues; for example, Carlyle Lake and Lake Shelbyville in southwestern and central Illinois have been completely allocated, and while coal mining and processing was taken into consideration during projection scenarios, hydraulic fracturing was not. BEN DZIEGIELEWSKI & TERRI THOMAS, FUTURE WATER DEMANDS AND COAL DEVELOPMENT POTENTIAL IN KASKASKIA RIVER BASIN IN ILLINOIS 3, 4 (2011), *available at* http://www.swircd.org/ICCI%20Final%20Report%208.02.11.pdf. The remainder of the water in these lakes is allocated to coal-fired power plants and navigation. H. VERNON KNAPP ET AL., WATER SUPPLY ASSESSMENT FOR KASKASKIA RIVER WATERSHED DEVELOPMENT: PHASE I REPORT (DRAFT) 3 (2011), *available at* http://www.swircd.org/Water%20Supply%20Assessment%20for%20Kaskaskia%20River%20Watershed%20Development_Phase%20I%20Report.pdf. This area also overlays the Illinois Basin. LOWER 48 STATES SHALE PLAYS, *supra* note 55.

197. ILL. S.B. 1715, Pub. Act 098-0022, § 1-75(f)(5)–(6) (2013), *available at* http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=098-0022.

at unsustainable rates.[198] East-central and northeast Illinois are both part of the Illinois Basin.[199]

Illinois is a member of several interstate compacts, including the Ohio River Valley Water Sanitation Commission ("ORSANCO").[200] However, ORSANCO is primarily interested in water quality, rather than quantity, and relies on member states' processes to address withdrawals.[201] The Great Lakes and St. Lawrence River Basin Water Resources Compact requires registration of withdrawals of 100,000 gallons per day over a thirty-day period and the registration of diversions in any amount.[202] Consumptive uses of greater than five million gallons per day or more in any ninety-day period require regional notification and review.[203] However, it is the responsibility of each state or province to manage and regulate new withdrawals, consumptive uses, or diversions.[204]

V. CURTAILMENT

Hydraulic fracturing is fundamentally different from other water uses because much of the water used is permanently removed from the hydraulic system; in other words, it is a consumptive

198. *Water Supply Planning for Illinois*, ILL. STATE WATER SURVEY, http://www.isws.illinois.edu/gws/watsupplang.asp (last visited Feb. 18, 2014).

199. *Id.*; *see* LOWER 48 STATES SHALE PLAYS, *supra* note 55.

200. *About Us*, OHIO RIVER VALLEY WATER SANITATION COMM'N, http://www.orsanco.org/about (last visited Feb. 18, 2014). Other members include Indiana, Kentucky, Ohio, West Virginia, Virginia, Pennsylvania, and New York. *Id.*

201. *Id.*; *see* OHIO RIVER VALLEY WATER SANITATION COMM'N, STRATEGIC PLAN FOR THE OHIO RIVER VALLEY WATER SANITATION COMMISSION 1 (2008), *available at* http://www.orsanco.org/images/stories/files/StratPlan2008.pdf.

202. Great Lakes—St. Lawrence River Basin Water Resources Compact art. 4, § 4.1.3, Dec. 13, 2005, *available at* http://www.cglg.org/projects/water/docs/12-13-05/Great_Lakes-St_Lawrence_River_Basin_Water_Resources_Compact.pdf.

203. *Id.* art. 4, §§ 4.6.1, 4.9.2. A report on the energy-water nexus in the Great Lakes was completed in October 2011; however, it did not address hydraulic fracturing in the Great Lakes Basin. *See generally* GREAT LAKES COMM'N, INTEGRATING ENERGY AND WATER RESOURCES DECISION MAKING IN THE GREAT LAKES BASIN (2011), *available at* http://glc.org/files/docs/2011-integrating-energy-water-resources-decision.pdf. Shale basins which overlap the Great Lakes Basin are located in the following states: Illinois, Wisconsin, Ohio, Michigan, Indiana, Pennsylvania, and New York. *Compare* LOWER 48 STATES SHALE PLAYS, *supra* note 55, *with* EPA, CONSERVATION OF BIOLOGICAL DIVERSITY IN THE GREAT LAKES BASIN ECOSYSTEM: ISSUES AND OPPORTUNITIES, fig.2 (Sept. 25, 2013), http://www.epa.gov/ecopage/glbd/issues/intro.html (showing the states within the Great Lakes Basin).

204. *See* Great Lakes—St. Lawrence River Basin Water Resources Compact, *supra* note 202, at art. 4, § 4.3.1.

use. As the above section indicates, the procurement of water for hydraulic fracturing—up to eight million gallons per well over as little as three to five days—does not take this reality into account in any meaningful way. Water use for fracking is sparsely regulated at best, and the regulations that do exist are in most cases so vague as to leave much to local interpretation. Others can be worked around in many cases by using multiple sources or assessing each well to be fractured on an individual basis. Even the Susquehanna River Basin Commission, which most heavily regulates water for hydraulic fracturing, essentially puts curtailment limits on surface water withdrawals, but does not have any similar provision for groundwater withdrawals.[205]

Instead of the current approach, a mandatory pre-withdrawal or supply (if obtaining water from a public utility) permit and curtailment regime should be adopted in states where hydraulic fracturing is occurring or could occur in the future. Implementing a clear policy and regulations now will enable swift action when drought or other shortage does occur and will provide necessary information for planning by both state and interstate agencies responsible for water management and the energy industry. Permitting of all water used in hydraulic fracturing operations—regardless of where the water comes from, including a public water utility—will enable agencies to understand how much water is utilized by the industry, and from which sources. Knowing what conditions will trigger curtailment, and how that curtailment will occur, would also provide certainty to the energy industry and could spur development of techniques for recycling and non-water fracturing.

Regulations should provide that water utilized for hydraulic fracturing be curtailed before all other uses, as a consumptive use which removes water from the hydraulic cycle. This curtailment should occur regardless of water source. This is especially important where hydraulic fracturing activities have been supplied by a public water utility, as water utilities whose primary function is to supply domestic water are often given highest priority (and, therefore, whose allotments are curtailed either the least amount or last in time). Due to conservation by end customers, some water utilities have allocations which are underutilized during normal conditions. By implementing regulations that require

205. SRBC FAQ, *supra* note 58, at 1.

the amount sold for use in hydraulic fracturing to be curtailed early in a water shortage, remaining water will be available solely for domestic and non-consumptive industrial and commercial use. This also provides an economic incentive to maximize recycling in fracturing. While this kind of regulation would require public utilities to understand the nature of the water use by their industrial customers, it is the only way to ensure that all hydraulic fracturing activity within a water area is curtailed in the same manner.

While specific curtailment triggers may occur at the basin or smaller area, at a minimum, the regulations setting specific policies should be adopted at the state level.[206] State agencies are more likely to possess the necessary expertise to ensure long-term water planning and are less susceptible to local influence.

CONCLUSION

The American economy is becoming more dependent on energy supply. While hydraulic fracturing is increasingly an important part of that supply and, therefore, the economy, its growth could have an impact on water availability in the future. Rather than wait until the problem of scarcity becomes critical, it will be important to determine how water will be allocated ahead of time and whether removing it completely from the hydraulic cycle is something that should continue indefinitely. If we do not put a paradigm into place which addresses this removal, then, when shortage does occur, there will be conflict between the competing forces of economics, agriculture, human consumption, and the environment. With more people and moneyed interests, the environment that we all depend on will likely be the loser.

Rather than have a devastating impact on the ecosystems upon which we all depend, policy and regulations should give clear guidance when curtailment or other actions will occur. With a policy adopted now, the energy industry will have sufficient time to adapt to this reality.

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206. Federal policy could be a part of a national energy policy, but the intrusion of federal law into state water policy would most likely be resisted. However, model legislation could be encouraged.