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effective extraction method because it releases large quantities of gas that were previously trapped in tight shale formations. Upon its release, the gas travels through the fissures and up the vertical well to the surface.

During the drilling process, workers inject concrete into the well around steel

ethylene, glycol, glycol ethers, hydrochloric acid, and sodium hydroxide.[4] These chemicals serve a variety of purposes in the fracking process and provoke intense debate about the environmental impact of fracking.[5] Most of the fracking fluid is removed from the well following the fracking process, but a portion of the fracking fluid remains underground and is never removed. Gas company representatives and environmental groups disagree about the percentage of the fracking fluid that is typically recovered from the average well.[6]

The fracking fluid returns to the surface after mixing with salts, metals, chlorides, sulfates, and other subterranean substances.[7] Each well produces over a million of gallons of briny "flowback" waste that is even more toxic than the original fracking fluid.[8]

well site in large waste pits lined with tarp barriers as to prevent seepage of waste into the underlying soil.[9] A portion of this waste is treated at the well site and then reused or reinjected into the ground.[10] Trucks ship the remainder to state and private water treatment facilities. As discussed below in detail, there is currently no federal regulation of the treatment of the wastewater produced throughout the fracking process.

B. Capture, Leaseholds, and Subterranean Trespass

to a “gas rush” in states with large shale gas reserves including Texas, Arkansas, Pennsylvania, West Virginia, and New York. The Marcellus Shale Formation, which lies beneath southwestern New York, western Pennsylvania, eastern Ohio, and most of West Virginia, is believed to hold 168 trillion to 516 trillion cubic feet of natural gas.[15] Gas companies drilled 1,121 wells in West Virginia and Pennsylvania in 2009 alone.[16] The same companies have applied for thousands of drilling permits in New York, but a current moratorium on drilling has stalled the gas rush there. Pennsylvania and New York are expected to be the leaders in the growth of natural gas production in the northeast.[17]

Increased production made possible by new fracking technologies appears to have a led a dramatic decline in gas prices.[18] The wellhead price for natural gas throughout the 1980s and 1990s was about $2.00 per million British thermal units (“MMBtu”).[19] Prices increased dramatically in the early 2000s, and by 2008 the price for gas had quadrupled to nearly $8.00/MMBtu.[20] The 2009 fracking boom in Pennsylvania coincided with a dramatic drop from those all-time highs. Since 2009, the average price of gas per

[15] John S. Gray, *The Marcellus Shale: Regulation, Litigation, and Legislation* in *Navigating Legal Issues Around the Marcellus Shale*, 61, 63 ASPATORE SPECIAL REP. 5 (Melanie Zimmerman ed., 2011).

[16] Timothy J. Considine, Ph.D., *The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia—A Repoeana2 (n)2 (Re)3 (n)2 2 (a)enloe81 0 41 0.2F4 0Ncm2BT0eJT98Tc45(t05)6RGBTDQ0TBIQTc1*

fracking waste—considered even more toxic than the original fluid—are overwhelming water treatment facilities and the untreated toxic wastewater is finding its way to steams and rivers[24]. Quite simply, hydraulic fracturing operations seriously threaten drinking water supplies for the millions of residents in New York and Pennsylvania, including New York City, Pittsburgh, and Philadelphia.

A. Groundwater Contamination From Fracturing Operations

The effect of HVHF on local groundwater supplies is the most hotly debated environmental impact of HVHF. Consumer groups, local landowners, and political leaders claim hydraulic fracturing contaminates groundwater in two ways: (1) natural gas trapped in the target formations migrates to subsurface soils and aquifers; and (2) chemically-laced HVHF fluids enter into subsurface soils and aquifers from the earth's surface.[25] The EPA began citing evidence of groundwater contamination caused by hydraulic fracturing as early as .

report was “scientifically unsound.”[32] EPA whistleblowers insist that numerous documented cases of tainted groundwater exist but are sealed due to settlements between landowners and gas companies.[33] Furthermore, recent EPA testing more clearly demonstrates a link between hydraulic fracturing and contaminated groundwater.[34] The industry, however, continues to claim that HVHF is safe.

The gas industry cannot possibly deny the well-documented contamination of the aquifer that once supplied water to Dimock, Pennsylvania, “where more than 60 gas

photographed a creek that "turned red with diesel fuel."[40] Similar cases have been filed by landowners against gas companies in Arkansas, Colorado, Louisiana, New York, Pennsylvania, Texas, and West Virginia.[41]

Environmental groups have prepared numerous reports about the adverse impacts of hydraulic fracturing on groundwater. In 2002, the Natural Resources Defense Council summarized complaints from citizens in Alabama, Virginia, Colorado, Wyoming, and Montana, and found the fracturing fluids used there were "likely to contain toxic and carcinogenic chemicals."[42] In 2005, the Earthworks Oil and Gas Accountability Project critiqued the 2004 EPA study and concluded that fracking fluids migrate into underground drinking water.[43]

Perhaps the most compelling study to date was published in 2011 by researchers from Duke University.[44] The researchers collected 68 drinking-water samples in

[40] Bateman, *supra* note 35.

[41] *See e.g.* complaint, Ginardi v. Frontier Gas Servs., *LLC,* (E.D. Ark. May 17, 2011) (No. 4-11-cv-0420-BRW); complaint, Tucker v. S.W. Energy Co., (E.D. Ark. May 17, 2011) (No. 1:11-cv-0044-DPM); complaint, Strudley v. Antero Res. Corp., (Denver Cnty. Dist. Ct. Mar. 23, 2011) (No. 11-cv-2218); complaint, Andre v. EXCO Res., Inc., (W.D. La. Apr. 15, 2011) (No. 5:11-cv-00610-TS-MLH); Baker v. Anschutz Exploration Corp., (N.Y. Sup. Ct., Feb. 11, 2011) (No. 2011-1168); complaint, Zimmermann v. Atlas Am., LLC, (Pa. Ct. Com. Pl., Sept. 21, 2009) (No. 2009-7564); Berish v. S.W. Energy Prod. Co., 763 F. Supp. 2d 702, 704 (M.D. Pa. 2011); complaint, Scoma v. Chesapeake Energy Corp., (N.D. Tex., July 15, 2010) (No. 3:10-cv-01385); complaint, Hagy v. Equitable Prod. Co., (S.D.W. Va., Dec. 10, 2010) (No. 2:10-cv-01372). For a brief synopsis of the litigation in each state, *see generally* Barclay Nicholson and Kadian Blanson, *Tracking Fracking Case Law: Hydraulic Fracturing Litigation*, 26 FALL NAT. RESOURCES & ENV'T, Fall 2011, at 25.

[42] Wiseman, *supra* note 29, at 137.

[43] *Hydraulic Fracturing 101*, EARTHWORKS.COM, http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101, concluding that:

> [F]racing fluids are a threat to human health even when diluted, that many fluids are injected directly into underground sources of drinking water or migrate to nearby underground water, and that some fracing fluids are left "stranded" in fraced formations, meaning they could contaminate groundwater far into the future as the water table rises.

[44] Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner and Robert B. Jackson, *Methane Contamination of Drinking Water Accompanying Gas*

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> through a transparent, peer-reviewed process that will ensure the validity and accuracy of the data.[57]

The forthcoming EPA study essentially reopens the much-refuted and scientifically-discredited 2004 EPA study. The EPA's findings will undoubtedly provide the scientific foundation for future federal regulation of HVHF. The report, however, is not expected until late 2012.

B. Groundwater Contamination From Untreated Waste

Fracking waste is treated off-site at both public and private wastewater treatment facilities. Evidence suggests that Pennsylvania facilities were overrun with fracking wastewater during the HVHF boom.[58] According to Earthjustice attorney Deborah Goldberg, "[t]he nation is in the midst of a fracking-fueled gas rush which is generating toxic wastewater faster than treatment plants can handle it."[59]

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impact" on gas industry workers.[68] Several industry workers have brought tort actions against their employers for exposure to radioactive material. More testing is needed to determine whether the fracking wastewater that is being released into streams and rivers from treatment facilities contains elevated levels of NORM.

IV. REGULATION

A. Federal Regulation

Congress enacted the Safe Water Drinking Act of 1974 ("SWDA").[69] The SWDA prohibited any underground injection that endangered drinking water sources, defined as any injection that:

> Result[s] in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant . . . adversely affects the health of persons.[70]

However, the EPA determined that HVHF does not qualify as an "underground injection" "because the principal function of [hydraulic fracturing] wells is not the underground emplacement of fluids; their principal function is methane gas production."[71] Although the EPA's interpretation seems counterintuitive, it was not immediately challenged, and states were not required to regulate hydraulic fracturing until 1997.[72] In 1997, the Eleventh Circuit overruled the EPA's position on the applicability of the SWDA to hydraulic fracturing in *Legal Envtl. Assistance Found. v. EPA* ("*LEAF*") and held "hydraulic fracturing activities constitute 'underground injection' under Part C of the

[68] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 19.
[69] 42 U.S.C. §§ 300(f)-(j)(26).
[70] 42 U.S.C. § 300h(d)(2).
[71] Legal Envtl. Assistance Found. v. U.S. Envtl. Prot. Agency, 118 F.3d 1467, 1471 (11th Cir. 1997).
[72] Orford, *supra* note 31, at 3.

Twenty-seven states account for 99.9% of all oil and natural gas production in the United States.[81] All 27 states regulate natural gas exploration and production, although the scope and specificity of the regulations vary.[82] Common regulatory requirements include well permitting, well construction, and wastewater handling.[83] State legislatures generally delegate authority to issue permits "to an oil and gas division, commission or board."[84] The issuance of such permits typically requires the gas company to submit location and geological information of the proposed site to the state-permitting agency.[85] Only a few states require a permit for construction of the well pad or waste pits.[86]

Methods and materials of well construction are largely unregulated. Rather, the industry follows its own internal guidelines.[87] Cement is often used to form a barrier around steel well casing and is crucial in

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was referred to the Environment and Public Works Committee on April 12, 2011.[96] The House version, House Bill 1084, sponsored by Representative Diana DeGetee of Colorado, was referred to the Committee on Energy and Commerce and the Subcommittee on Environment and the Economy on March 21, 2011.[97]

The companion bills would amend the SDWA to repeal the "Halliburton Loophole" and allow the EPA to reregulate hydraulic fracturing.[98] The FRAC Act would also require disclosure of all non-proprietary chemicals used at each well site, and disclosure of all chemicals, including proprietary chemicals, in the case of a medical emergency.[99] If passed, the bill would specifically require the disclosure of chemicals, and would further enable the EPA to set industry-specific minimum standards for safe hydraulic fracturing operations. States would be able to set stricter standards, but would be required to at least meet the EPA's minimum standards. In support of the FRAC Act, Senator Casey stated:

> Drilling for natural gas in the Marcellus Shale across much of Pennsylvania is part of our future. I believe that we have an obligation to develop that natural gas responsibly to safeguard the drinking water wells used by 3 million Pennsylvanians. We already have private wells contaminated by gas and fluids used in hydraulic fracturing. We need to make sure that this doesn't become a state-

current state regulations are sufficient to address the concerns over hydraulic fracturing.[101] According to Cornyn, "[a]dditional regulations would take with them jobs and local, state and federal revenue."[102] The political debate over the FRAC Act remains highly partisan, as is common with energy policy. The FRAC Act's ultimate fate may hinge on the outcome of the 2012 elections.[103]

V. CONCLUSION AND RECOMMENDATIONS

An increasing body of research proves hydraulic fracturing operations are contaminating groundwater in rural communities across the country. An evaluation of the likelihood that fracking will contaminate urban drinking water supplies downstream from waste treatment plants requires further testing. Most notably, watersheds serving New York City, Pittsburgh, Pennsylvania, and Dallas, Texas may be at risk. Perhaps most importantly, large quantities of fracking fluid that remain underground could contaminate water resources for many future generations.

Labeling natural gas as a "clean-burning" fuel is misleading. Every time a well is fracked, thousands of diesel-burning transport trucks haul the fracking fluid waste off-site to be processed. Wastewater evaporators at, or near, the drill sites emit unknown amounts of greenhouse gases into the air long before the natural gas being produced is

[101] Heather Caygle, *Senator John Cornyn Cautions Against Additional Drilling Regulations*, C

ever consumed. Even though natural gas is generally regarded as cleaner than burning coal, the air pollution caused by the extraction and production of natural gas may very well make natural gas consumption equally harmful to Earth’s atmosphere.

HVHF allows gas companies to dramatically increase production, but the industry fails to include the cost of negative externalities in the price of natural gas. This leads to inadequate price signals as gas consumers are not paying for the true cost of natural gas.

While many politicians insist that state laws are sufficient to regulate drilling operations, the unfortunate reality is that too many of our political leaders are overly focused on job creation and their states' economies to take any meaningful stance against the oil and gas lobby. The reinstatement of federal regulation in this area is the only way to avoid a race to the bottom scenario among state regulatory commissions.

If authorized by Congress, the EPA will be able to protect our domestic water supply by enforcing appropriate minimum standards on the gas drilling industry. Specifically, the EPA minimum requirements should (1) protect surface aquifers by enacting and enforcing strict standards for well construction and contamination containment, (2) ban specific chemicals known to be harmful to humans and ecosys1 (ed) -0 5.0 0 Tm

inspections during and after HFHV operations.

Perhaps most importantly, the EPA will need to establish minimum requirements for testing groundwater around HVHF sites and similar standards for testing treated water released from waste treatment plants. There should be contamination thresholds and any drilling site that exceeds the contamination threshold should be shut down