insights

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Ohio's New Oil and Gas Boom Raises Environmental Legal Issues

A recent headline in the *Washington Post* asked: "Can the Shale Gas Boom Save Ohio?"[1] The headline reveals the economic potential of the oil and gas boom that has swept Ohio in recent years, as major energy producers position to tap natural gas and oil reserves in the Utica Shale formation a mile and a half below the surface of a large swath of Ohio. Estimates of the scale of the economic impact the oil and gas rush could have on Ohio vary, but one recent study found that the industry will spend $34 billion on exploration and development alone over the next five years and more than 200,000 jobs could be created.[2]

By Joseph S. Simpson

Production of oil and natural gas from shale relies upon hydraulic fracturing or "fracking." The process involves drilling deep wells and one or more horizontal shafts from each vertical well. By pumping a mixture of water, sand and chemicals under pressure into the horizontal borings, the shale is fractured, releasing oil and gas, which is then produced through the vertical well.

The fracking process has raised environmental concerns that have triggered significant legal disputes in states where development of other major shale formations is more advanced. For instance, regulatory agencies and citizens have claimed that fracking operations have polluted groundwater, contaminated drinking water wells, fouled surface waters or created nuisance conditions.[3] As explained below, development of the Utica Shale in Ohio will likely raise similar disputes.

Ohio's History as an Oil and Gas Giant

Ohio's rich history of oil and gas production dates back nearly two centuries. Two men drilling for salt in Noble County cursed their luck when they encountered a black liquid oozing into their pit at a depth of 475 feet.[4] The year was 1814, and Silas Thorla and Robert McKee had unwittingly produced America's first crude oil from a drilled well near Caldwell, Ohio.[5] The find meant little to them beyond the nuisance it caused to their quest for food-preserving salt.[6] At the time, whale oil was Ohio's burning fluid of choice, and would remain so until at least 1860, when perfection of oil refining greatly enhanced the value of crude.

Ohio's first commercial oil well was placed in production in 1860 in Macksburg, Washington County, around the same time that Colonel Drake drilled his historic well in Titusville, Pennsylvania in 1859.[7] Subsequently, discovery of oil in the Trenton limestone near Lima in northwestern Ohio triggered a 20-year oil and gas boom beginning in 1884.[8] That period saw Ohio transformed into the leading oil producing state in the nation and a world leader from 1895-1903. In 1896 alone, Ohio produced nearly 24 million barrels of oil.[9] Natural gas was initially a by-product of oil production, but by 1884 was being commercially produced.[10]

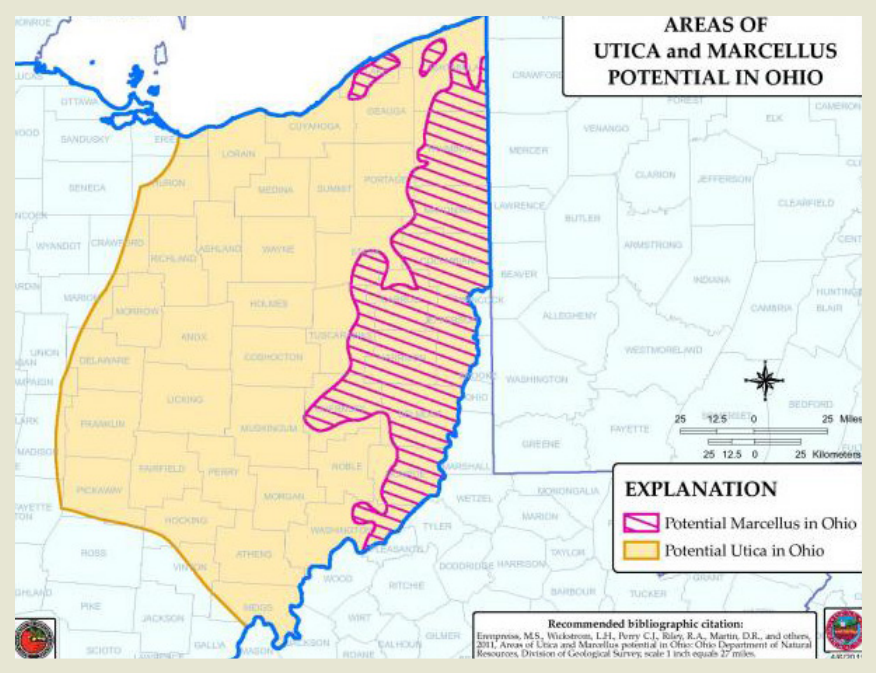
Ohio has never again reached the production level of 1896. By comparison, in 2011[11] a little less than 5 million barrels of crude were produced in Ohio. Nevertheless, Ohio has continuously produced oil and gas, even decades after the focus of the industry shifted to the mid-continent oil fields in Kansas, Oklahoma, Texas and Louisiana in the early 1900s. Oil and gas has been found and produced in 76 of Ohio's 88 counties.[12] There have been over 275,000 wells drilled in Ohio to date, second only to

Pennsylvania. Today, there remain 64,378 oil and gas wells in production in Ohio.[13] Many are "stripper wells" with very low production (e.g. less than 10 barrels per day or 60 thousand cubic feet (mcf) of natural gas significant leasehold positions to take advantage of the potential of the Utica Shale. On April 2, 2012, Chesapeake Energy, a major player in the Utica Shale, announced initial results for production from several test wells in Ohio. While the overall results were open to interpretation, one well produced 1.52 billion cu. ft. of natural gas, equating to 2% of the total production for the State of Ohio in just 198 days of drilling. [22]

Hydraulic Fracturing: How it Works

The process of fracking begins with building the necessary infrastructure at the well site, including well construction. Production wells in shale gas are typically drilled in the vertical direction with horizontal or directional sections. Vertical well sections may be drilled hundreds to thousands of feet below the land surface and lateral sections may extend up to a mile or so away from the well. The advantages of horizontal drilling and hydraulic fracturing are significant. Historically, to develop a one square mile (640 acre) parcel, about 16 vertical wells, each with a two-acre drill site would have been required to produce the parcel.[23] Utilizing horizontal drilling and fracking, the same one square mile parcel can be produced with 5 to 6 horizontal wells from a single 3 to 6 acre drill site. Minimally optimal lease tracts today would encompass roughly two contiguous square mile tracts to permit horizontal drilling in two directions from a centrally located pad. [24]

After the well has been drilled, steel casing is installed in the well. The casing is perforated within the target zones that contain oil or gas. When the



fracturing fluid is injected into the well it flows through the perforations into the target zones. Fluids, commonly made up of water and chemical additives, as well as a propping agent (typically sand) are pumped into the shale at high pressure (7,000 to 10,000 psi) during hydraulic fracturing. When the pressure exceeds the rock strength, the fluids open or enlarge fractures that can extend several hundred feet away from the well. The propping agent lodges within the fractures to keep them from closing when the pumping pressure is released. The fractures permit natural gas or oil to escape the shale and flow into the well. When fracturing is complete, the internal pressure of the shale formation causes a portion of the injected fracturing fluids to rise to the surface. The recovered fracking fluids are referred to as flowback. An informative video of the hydraulic fracturing process can be viewed at: http://www.epa.state.oh.us/shale.aspx.

Up to four million gallons of fresh water may be required to fracture a single well.[25] The water used in the fracking process typically comes from a stream, river, reservoir or lake near the drill site.[26] Generally, a large percentage of the fracking fluid (up to 85%) remains underground, while the remainder (15-20%) returns to the surface as flowback. Flowback water is typically stored temporarily at the drill site in lined pits or steel tanks. Ultimate options for disposing of flowback include discharge into surface water after treatment, recycling, or underground injection.

Potential Environmental Issues Associated With Fracking

As noted above, the rise of hydraulic fracturing of shale for gas and oil has been accompanied by significant controversy, as critics have questioned its impact on the environment. There is no question that hydraulic fracturing

raises the specter of legal disputes pertaining to environmental issues.

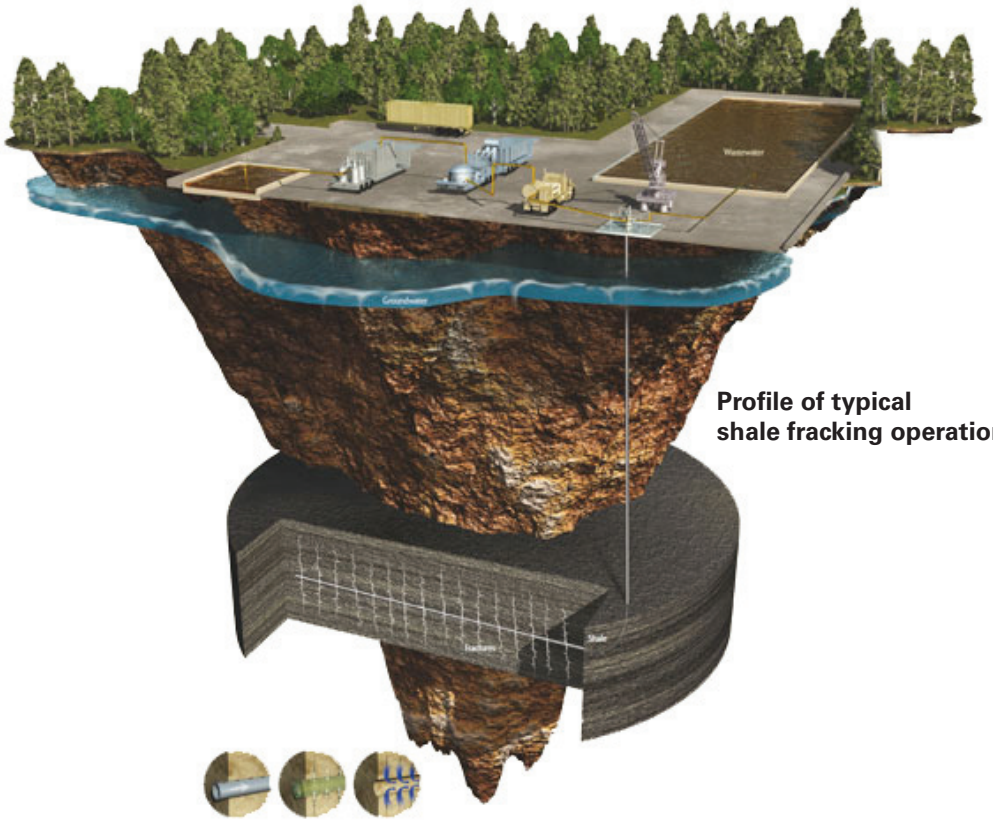
Groundwater

Contamination of groundwater is perhaps the highest profile concern raised with regard to hydraulic fracturing. Ohio EPA and ODNR, as well as other technical experts in hydraulic fracturing, have stated that they have no data showing a risk of groundwater contamination from flowback water migrating thousands of feet from the Marcellus or Utica Shale formations into drinking water aquifers much closer to the earth's surface. Those agencies do acknowledge, however, that:

"There is the potential, although unlikely, for contamination of drinking water wells because of problems occurring closer to the surface. Gas and oil can migrate from a production well into an aquifer if a well casing is damaged, leaking or poorly constructed. Natural gas can also enter aquifers from old, abandoned oil and gas wells that are unplugged or poorly plugged. A new water well that is drilled can penetrate gas-rich organic shales or coal seams at shallow depths, allowing gas to enter the well. Buried organic deposits from old swamps or landfills may also release natural gas into soils overlying aquifers."

See, e.g. Ohio EPA, "*Drilling for Natural Gas in the Marcellus and Utica Shales: Environmental Regulatory Basics*," July 2011, p. 6. Importantly, Ohio EPA and ODNR go on to stress that "there have been thousands of oil and gas production wells drilled throughout Ohio without significant adverse impacts to drinking water resources." Id at 6.

Other risks are posed to groundwater from potential leaks or spills at or near the surface of drilling operations from tanks, trucks, equipment or brine/flowback pits. Contaminants



Profile of typical shale fracking operation

that could potentially threaten groundwater include BTEX (benzene, toluene, ethylbenzene, xylene) compounds, VOCs, and other materials. Groundwater litigation has generally accompanied hydraulic fracturing in states where development of shale is ongoing. See e.g. *Becka v. Antero Resources, LLC*, Case No. 2:11-CV-1040, U.S. District Court (W.D. Pa. 2011) (alleging contamination of groundwater with fracking chemicals); *Harris v. Devon Energy Production Co.*, Case No. 4:10-CV-708, U.S. District Court (E.D. Tex. 2011) (alleging groundwater contamination); *Berry v. Southwestern Energy Co.*, Case No. 1:11-CV-0045, U.S. District Court (E.D. Ark. 2011) (alleging contamination of groundwater with methane, hydrogen sulfide and other contaminants).

Wastewater Disposal

Because a typical fracking operating may use up to 4 million gallons of fracking water and fluids, proper disposal of flowback water remains a primary environmental concern with regard to fracking. Flowback water generally includes, salts, hydrocarbons, and additives, as well as barium, strontium and low levels of naturally occurring radioactive materials ("NORM") in the form of radon and radium. As of May 16, 2011, Ohio has prohibited discharge of flowback water into surface waters or sending it to publicly owned treatment works ("POTWs"). As a result the primary means for disposal of flowback water in Ohio is injection into Class II Underground Injection Wells, or recycling. Use of POTWs for treatment of flowback water has triggerred

litigation in other states. See e.g. *Clean Water Action v. City of McKeesport*, Case No. 2:11-CV-00940 (W.D. Pa. 2011).

Nuisance

Fracking of shale for oil and gas raises a number of different nuisance issues that can potentially lead to litigation or other responses. Such nuisance conditions include noise, odor, and vibrations associated with drilling and fracking activities. Additionally, drilling operations frequently involve heavy truck traffic, with associated traffic, dust and road damage issues. All of these disturbances raise the threat of litigation from private citizens against operators for nuisance conditions. Such claims have been common in States where fracking has been ongoing. See e.g. *Maring v. Nalbone*, Case No. K12009001499 (N.Y. Sup. Ct. 2009) (nuisance due to contamination of drinking water wells with methane); *Zimmerman v. Atlas America, LLC*, Case No. 2009-7564 (Pa. Ct. Cm. Pls. 2009)(nuisance due to pollution of aquifer with fracking chemicals); *Fiorentino v. Cabot Oil and Gas Corp.*, Case No. 3:09-CV-2284, U.S. District Court (M.D. Pa. 2009) (nuisance due to methane in water wells, explosions, pollution of soils with diesel fuel, combustible gas in well headspaces); *Berry v. Southwestern Energy Co.*, Case No. 1:11-CV-0045, U.S. District Court (E.D. Ark. 2011) (alleging odors from fracking operation, as well as contamination of groundwater with methane, hydrogen sulfide and other contaminants).

Air Emissions

Production of oil and gas through hydraulic fracturing raises issues with regard to air emissions from drilling, fracking, compressor stations, generators and other equipment. Other potential air emissions issues include volatilization of contaminants from the flowback water pits as well as flaring from natural gas. Potential air contaminants include: BTEX compounds, PAHs (polycyclic aromatic hydrocarbons), formaldehyde, NOx, SO2 and CO. Although fewer in number than lawsuits alleging groundwater contamination, numerous cases have been filed alleging air pollution from oil and gas production through fracking. See e.g. *Citizens for Pennsylvania's Future v. Ultra Resources, Inc.*, Case No. 4:11-CV-01360, U.S. District Court (M.D. Pa. 2011) (citizen suit under Clean Air Act alleging air pollution in the form of NOx and other emissions from fracking operation); *Strudley v. Antero Resources Corp.*, Case No. 2011-CV-2218 (Colorado Dist. Ct. 2011) (alleging discharges of hydrogen sulfide, hexane, toluene, propane butane and other pollutants into air and water); *Tucker v. Southwestern Energy Co.*, Case No. 1:11-CV-0044, U.S. District Court (E.D. Ark. 2011) (class action alleging water and air contamination); *Ginardi v. Frontier Gas Services, LLC*, Case No. 4:11-CV-0420, U.S. District Court (E.D. Ark. 2011) (alleging pollution of air and water, as well as noise nuisance).

Surface Water and Soils

Production of oil and gas through fracking raises significant potential surface water and soil contamination issues. In some instances, fracking activities may result in contamination of surface waters due to stormwater runoff from drilling pads and sites. The storage of chemicals and materials on pads and drill sites creates potential exposure to leaks, spills and other events that may result in contamination of surface waters or site soils. Further, holding pits or containers pose a risk of leaks into surface waters and soils. Trucks or equipment maintained at drilling sites also bring the potential for leaks and spills of fuel and other materials. Potential contaminants include total dissolved solids, total suspended solids, VOCs, methane and BTEX compounds. Contamination of soils and surface water have also engendered litigation in other jurisdictions where fracking operations are prevalent. See e.g. *Fiorentino*, Case No. 3:09-CV-2284, U.S. District Court (M.D. Pa. 2009) (nuisance due to methane in water wells, explosions, pollution of soils with diesel fuel); *Berry*, Case No. 1:11-CV-0045, U.S. District Court (E.D. Ark. 2011) (alleging pollution of soil, as well as contamination of groundwater with methane, hydrogen sulfide and other contaminants).

It should be noted that the lawsuits identified above are, in most respects, in the early stages of winding their way through the courts. As a result it is far too early to draw significant conclusions about the effect such litigation may have, if any, on hydraulic fracturing in the major shale plays. However, it appears certain that litigation over hydraulic fracturing operations will accompany development of the Utica Shale in Ohio.

Regulation of Drilling and Fracking in Ohio

Overview of Regulatory Structure

ODNR, through its Division of Oil and Gas Resources Management ("DOGRM"), has primary regulatory authority over oil and gas drilling in Ohio. ODNR's authority encompasses issuing permits for oil and gas wells; regulating well construction, siting, design and operation; disposal of brine and drilling fluids; and regulation of transporters of such fluids. See generally, Ohio Rev. Code, Chapter 1509.

Ohio EPA shares responsibility for regulation of fracking activities with ODNR. Ohio EPA's authority extends to approval of drilling construction

activity that may impact wetlands, streams, rivers or other waters of the state. Ohio EPA also regulates sources of air emissions, and recently promulgated a general permit requirement for Oil and Gas Well-Site Production Operations. See Ohio Rev. Code §3745-31-29 (GP12). The general permit streamlines the permitting process and provides emissions limits for various contaminants from: glycol dehydration units, diesel engines, fixed tanks, flares, and other equipment. Id. Finally, any solid waste sent off-site for disposal must be properly managed, either at a solid waste landfill, or beneficially reused, as authorized by Ohio EPA's Division of Materials and Waste Management ("DMWM"). Table 1 below illustrates the substance of the shared regulatory authority of ODNR and Ohio EPA over oil and gas drilling.

Ohio's regulatory response to environmental concerns associated with hydraulic fracturing for production of oil and gas in the Marcellus and Utica Shale formations has been significant. In 2010, the General Assembly passed Senate Bill 165, overhauling the State's oil and gas laws as set forth in Ohio Rev. Code, Chapter 1509. The S.B. 165 legislation, which was intended to provide a firm foundation for proper oversight of the oil and gas industry in Ohio, became effective on June 30, 2010. Currently, ODNR and Ohio EPA are engaged in drafting regulations to implement the provisions of S.B. 165 in the Ohio Administrative Code.

Some of the more significant changes to Ohio's oil and gas laws stemming from S.B. 165 are:

- Modified definitions to more clearly include well stimulation, including fracturing. [Ohio Rev. Code §1509.01].
- Significantly expanded ODNR's regulatory authority to allow more protection of public health and safety and the environment. [Ohio Rev. Code §1509.04].
- Authorized ODNR to expend agency monies to initiate corrective actions where necessary; allows the agency to compel a company to reimburse for monies expended. [Ohio Rev. Code §1509.071].
- Requires drillers to submit wireline electronic logs and well completion records, including those associated with hydraulic fracturing; includes reporting of type and volume of materials used; the methods used to contain such fluids; and data (such as pumping pressures and return volumes). [Ohio Rev. Code §1509.10].
- Requires submission of MSDS sheets; and rulemaking may require the inclusion of CAS (chemical abstract service) information. [Ohio Rev. Code §1509.10].
- Expands the agency's authority to require the plugging of wells with defective casing or well construction. [Ohio Rev. Code §1509.12].
- Expands well construction requirements expressly for the protection of underground sources of drinking water. [Ohio Rev. Code §1509.17].
- Authorizes the agency to require remedial testing to assure construction requirements have been met and mandates plugging of wells that are irreparably damaged. [Ohio Rev. Code §1509.17].
- Addresses well stimulation, agency notification, and well integrity testing. [Ohio Rev. Code §1509.17].
- Clarifies the definition of contamination to include those activities that may be associated with hydraulic fracturing. [Ohio Rev. Code §1509.22].
- Prohibits surface application of fluids associated with well stimulation. [Ohio Rev. Code §1509.226].
- Authorized the agency to promulgate rules to further enhance these statutory changes. [Ohio Rev. Code §1509.23].[27]

ODNR has asserted that Ohio has strong rules in place to regulate extraction of oil and natural gas from the Utica Shale based on changes made by S.B. 165 and existing regulations. Carlo LoParo, spokesman for the agency, stated that:

We're confident that those [S.B. 165] reforms, plus others we're looking at, will make Ohio one of the most carefully monitored and regulated states in the nation regarding well-construction and natural gas extraction.

Marietta News & Sentinel, March 4, 2012.

Emerging Federal Regulations

Regulation of hydraulic fracturing has thus far been an issue primarily for the states. The federal government has moved with caution in seeking to regulate natural gas production through fracking. Nevertheless, federal activity concerning regulation of fracking is emerging. Three recent initiatives of the federal government are notable.

First, in 2010, Congress directed U.S. EPA to undertake a comprehensive "study on the relationship between hydraulic fracturing and drinking water, using a credible approach that relies upon the best available science, as well as independent sources." U.S. EPA "Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources," November 2011, p. 1. U.S. EPA released its plan for the study in late 2011 and is expected to release an initial report by late 2012. The full study is not expected to be complete before late 2014. Id. The study will examine all stages of hydraulic fracturing, including, acquisition of water, mixing

TABLE 1

	ODNR	OHIO EPA
Horizontal oil and gas drilling in shale formations	• Issues permits for drilling oil and gas wells. [Ohio Rev. Code § 1509.05]. • Sets requirements for location, design and construction of oil and gas wells. [Ohio Rev. Code §1509.021, §1509.022, §1509.24]. • Inspects and oversees drilling, stimulation, and production. [Ohio Rev. Code § 1509.09]. • Requires controls to prevent discharges and releases. • Requires that wells no longer capable of production are properly plugged and abandoned. [Ohio Rev. Code § 1509.13-1509.151]. • Requires registration and/or permitting for operators with capacity to withdraw water at a quantity greater than 100,000 gallons per day. [Ohio Rev. Code § 1521.16]	• Requires authorization for construction activity where there is an impact to a wetland, stream, river or other water of the state. [Ohio Rev. Code §6111.041; Ohio Admin. Code §3745-1]. • Requires an air permit to install and operate (PTIO) for units or activities that have emissions of air pollutants. [Ohio Admin. Code, §3745-31]. • Involved in emergency response activities related to spills, or releases, in coordination with ODNR and other emergency response authorities. [Ohio Rev. Code, Chapter 3750].
Fracking fluids and drill cuttings at drill sites	• Sets design requirements for on-site pits used to store drill cuttings and fracking fluids. [Ohio Rev. Code § 1509.21]. • Requires closure of on-site pits after drilling operations are completed. • Sets standards for managing drill cuttings and derived sediments left at drill site. [Ohio Rev. Code §1509.22].	• Requires contaminated drill cuttings shipped off-site be taken to a licensed solid waste facility for disposal. [Ohio Admin. Code §3745-27]. • Reviews and approves proposals for beneficial reuse of cuttings off-site.
Fracking fluids disposal	• Regulates disposal of brine and other fluids. [Ohio Rev. Code §1509.22]. • Oversees permitting and operation of Class II injection wells used to dispose of waste fluids from oil and gas drilling. [Ohio Admin. Code §1501:9-3]. • Issues permits for Class II injection wells. [Ohio Admin. Code §1501:9-3].	
Transport of fracking fluids	• Registers transporters hauling brine and other oil and gas waste fluids in Ohio. [Ohio Rev. Code §1509.222].	• Involved in emergency response activities related to spills and releases, in coordination with ODNR and other emergency response authorities. [Ohio Rev. Code, Chapter 3750].

of chemicals, injection and fracturing, post-fracturing production, management of flowback waters and treatment and disposal of the same. Id. at 1-2.

Second, on April 17, 2012, U.S. EPA issued modifications to its New Source Performance Standards ("NSPS") and National Emissions Standards for Hazardous Air Pollutants ("NESHAPs") under the Clean Air Act for the oil and natural gas sector. The modified rules include provisions to regulate air emissions from natural gas fracking operations.[28] These provisions represent the first significant federal regulation imposed on fracking operations. In essence, the new standards target VOCs (and indirectly methane) emissions from fractured wells that are ready for production by requiring "reduced emissions completions" also known as "green completions" during flowback. A reduced emissions completion is accomplished through use of portable equipment to separate gas and hydrocarbons from flowback water generated when a well is fracked. The gases and hydrocarbons can then be treated and utilized on-site or sold. In a concession to industry, U.S. EPA delayed requiring "green completions" until January 1, 2015, when necessary equipment is expected to be more widely available. In the interim, operators may comply through use of flares designed to reduce at least 95% of VOC emissions. Id.

Third, on May 4, 2012, the Department of Interior promulgated rules governing fracking on federal lands that are intended, in part, to provide a model for state regulation of fracking on non-federal lands.[29] Those rules provide for: (1) public disclosure of chemicals used in hydraulic fracturing on public land; (2) enhanced regulation concerning well-bore integrity of wells; and (3) enhanced management of flowback water, Id. These proposed rules will undergo public comment and response before final promulgation.

Outlook for Development of Oil and Gas in Utica Shale in Ohio

Development of the Utica Shale in Ohio is in its infancy. As a result, it is too early to tell whether the legal disputes that have marked oil and gas production by fracking in other states will emerge on the same scale and with the same intensity in Ohio. Nevertheless, given the scale of the fracking operations likely to occur in Ohio, there is every reason to think that there will be significant

litigation in Ohio concerning hydraulic fracturing operations, as there has been in virtually every other state with a major shale play. Likewise, operators seeking to develop the Utica Shale in Ohio have a significant regulatory structure to navigate in order to ensure compliance in their fracking operations, and this too, can engender litigation in the event of compliance failures.

Already, Ohio has seen early signs of the legal battles and that may play out ahead. At least two related lawsuits have already been filed in Ohio by landowners alleging that fracking activities and poorly constructed wells resulted in groundwater contamination. See e.g. *Mangan v. Landmark 4, LLC*, Case No. 1:12-CV-00613, U.S. District Court (N.D. Ohio 2012) (alleging contamination of groundwater by fracking operations due to improper cement job on wells); *Boggs v. Landmark 4, LLC*, Case No. 1:12-CV-00614, U.S. District Court (N.D. Ohio 2012)(asserting similar claims to *Mangan* case). Similarly, a group of landowners has filed suit against an operator, contending that, in securing leases from the landowners, the operator concealed and misrepresented the environmental disruptions that would be caused by fracking. *Koonce v. Chesapeake Exploration, LLC*, Case No. 4:12-CV-0736, U.S. District Court (N.D. Ohio).

Further, in 2011, Youngstown, Ohio experienced 12 separate low-magnitude earthquakes ranging from 2.1 to 4.0 on the Richter scale. The quakes triggered significant controversy based upon speculation that they may have been triggered by injections of fracking wastewater into the nearby Northstar 1 Class II underground injection well. A subsequent study conducted by ODNR concluded that the seismic events *were* likely caused by the injection operations near a previously unknown underground fault system.[27] The finding resulted in a moratorium on drilling of deep injection wells pending further study. Id. Class action litigation has been threatened by persons affected by the Youngstown earthquakes.

In summary, Ohio's oil and gas boom associated with the Utica Shale seems likely to have an enormous impact on Ohio's economy. Along with its economic impact, the oil and gas boom will undoubtedly engender a number of significant legal disputes concerning the potential environmental issues associated with fracking.

"Can the Shale Gas Boom Save Ohio?," Washington Post, March 3, 2012.

[2] "Ohio's Natural Gas and Crude Oil Exploration and Production Industry and the Emerging Utica Gas Formation, Economic Impact Study," September 2011, prepared for the Ohio Oil and Gas Energy Education Program. A separate study projected that by 2014, more than 65,000 jobs would be created and that Ohio's Gross State (Domestic) Product would increase by more than $4.9 billion in 2014. See, "An Analysis of the Economic Potential for Shale Formations in Ohio," 2011, prepared for the Ohio Shale Coalition by Ohio State University, Cleveland State University and Marietta College.

[3] See e.g. *Maring v. Nalbone*, Case No. K12009001499 (N.Y.Sup. Ct. 2009)(contamination of drinking water wells with methane); *Zimmerman v. Atlas America, LLC*, Case No. 2009-7464 (Pa. Ct. Cm. Pls. 2009) (alleging pollution of aquifer with fracking chemicals); *Fiorentino v. Cabot Oil and Gas Corp.*, Case No. 3:09-CV-02284, U.S. District Court (M.D. Pa. 2009) (alleging methane in water wells, explosions, pollution of soils with diesel fuel, combustible gas in well headspaces); *Berish v. Southwestern Energy Production Co.*, Case No. 3:10-CV-01981, U.S. District Court (M.D. Pa. 2010) (alleging diesel fuel, barium, strontium, and manganese in drinking water wells due to improper well construction); *Ginardi v. Frontier Gas Services, LLC*, Case No. 4:11-CV0420, U.S. District Court (E.D. Ark. 2011) (alleging pollution of air and water, as well as noise nuisance).

[4] Ohio Geology, Spring 1993, ODNR.

[5] Id.

[6] Thorla and McKee contemplated a use for the oil, but efforts to burn it by local residents in lamps resulted in a foul odor and heavy soot. As a result, Thorla and McKee bottled some crude and sold it for medicinal purposes as "Seneca Oil". Id.

[7] ODNR: http://ohiodnr.com/mineral/program/tabid/17865/default.aspx.

[8] Id.

[9] Id.

[10] *"Ohio Crude Oil and Natural Gas Producing Industry,"* Ohio Oil and Gas Association: http://burchfieldcraig.org/FamLib/FamBus/OilGasGeneral/OhioOilandGasIndustryOverview-OOGA.pdf.

[11] ODNR: http://ohiodnr.com/mineral/production/tabid/15389/Default.aspx.

[12] ODNR, Division of Geological Survey.

[13] Id.

[14] Despite their minimal individual production, the large number of "stripper wells" or "marginal wells" render them a significant source of overall production. Collectively U.S. stripper oil wells produce 20 percent of the country's oil or 1.2 million barrels per day – as much as the U.S. imports from Saudi Arabia. National Stripper Well Association: http://nswa.us/dyn/showpage.php?id=16.

[15] "Review of Emerging Resources: U.S. Shale Gas and Shale Oil Plays", U.S. Energy Information Administration, July 2011.

[16] The Utica Shale overlies the Point Pleasant formation, an interlayered limestone and shale formation that is actually "thicker and higher in total organic content" than the Utica proper. "Vast Resource Potential Has Operators Gearing Up to Test Utica Shale Formation", The American Oil and Gas Reporter, November 2011: http://www.aogr.com/index.php/magazine/editors-choice/vast-resource-potential-has-operators-gearing-up-to-test-utica-shale-format.

[17] See, http://geology.com/articles/utica-shale.

[18] ODNR, "The Marcellus and Utica Shale Plays in Ohio", presented March 11, 2011 to Ohio Oil and Gas Association.

[19] "Wet gas" generally contains natural gas liquids with appreciable quantities of non-methane hydrocarbons such as propane, butane, and ethane. These heavier hydrocarbons increase the value of "wet gas" over "dry gas" which is comprised predominantly of methane.

[20] Id.

[21] Id.

[22] ODNR, 2011 Utica Shale Production Report.

[23] ODNR Presentation: *The Utica-Point Pleasant Shale Play of Ohio*, 2012.

[24] Id.

[25] Ohio EPA, "Drilling for Natural Gas in the Marcellus and Utica Shales: Environmental Regulatory Basics", July 2011, p. 2.

[26] Id.

[27] Pending legislation (S.B. 315) in the Ohio General Assembly would impose further regulations concerning fracking, including: (1) additional reporting requirements concerning chemicals used to drill or fracture a well; (2) requirements to sample water within 1500 feet of a proposed well and disclose the sampling results in the drilling permit application; (3) requirements to disclose the source of water to be used in well stimulation process; (4) encouragement for well operators to enter into a Road Use Maintenance Agreement with local governments; and (5) authorization for cooperative agreements between ODNR and other state agencies concerning fracking operations.

[28] http://www.epa.gov/airquality/oilandgas/pdfs/20120417finalrule.pdf

[29] http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&pageid=293916

[30] "Preliminary Report on the Northstar 1 Class II Injection Well and the Seismic Events in the Youngstown, Ohio Area", ODNR, March 2012.