TOWNSHIP OF FRANKLIN
COUNTY OF HUNTERDON

ORDINANCE NO. 2016-08

AN ORDINANCE BY FRANKLIN TOWNSHIP BANNING THE USE OF HYDRAULIC FRACTURING IN THE MUNICIPALITY AND AMENDING AND SUPPLEMENTING THE "CODE OF THE TOWNSHIP OF FRANKLIN, NEW JERSEY" IN CONNECTION THEREWITH

WHEREAS, hydraulic fracturing ("fracking") for natural gas involves the use of chemicals and hazardous materials during construction, drilling, hydraulic fracturing, gas production and delivery, well maintenance, and workover operations. The fracking process is shown in figure 1; and

WHEREAS, hydraulic fracturing of underground geologic formations is often accomplished by injecting a complex mix of fluids and chemicals, including large volumes of water, on average 4.5 million gallons per well, under very high pressure to create fractures in gas bearing geologic formations. Chemicals used during the fracking process are exempt from the "Right to know laws"; and

WHEREAS, the US Geological Survey (FS 2012-3075) has identified what could be up to 1.6 trillion cubic feet of gas in the South Newark Basin which extends under a portion of Hunterdon County and is shown in figure 2; and

WHEREAS, many of the chemical constituents injected during hydraulic fracturing have documented adverse health effects and/or adverse environmental impacts. Physicians Scientists & Engineers organization surveyed the Environmental Public Health peer-reviewed publication literature and summarized results from 550 publications. The summary by Physicians Scientists & Engineers organization is shown in figure 3. The summary report was accessed on Sept. 1, 2015, WEB page http://www.psehealthyenergy.org; and

WHEREAS, there have been documented cases of water contamination near fracking sites. Example of published reports on the impact of fracking is given in figure 4; and

WHEREAS, wastewater from fracking may contain radioactive elements and other toxic components and has been discharged into rivers that supply drinking water; and

WHEREAS, Pennsylvania's Department of Environmental Protection has documented three facilities in New Jersey as accepting waste from hydraulic fracturing operations, posing a direct threat to New Jersey's drinking water; and

WHEREAS, use of these hydraulic fracturing mixes exposes air, aquifers and adjacent land and surface waters to the risk of contamination through spills and accidents, open pit storage, truck transport on roadways, and activities during well development; and

WHEREAS, former President George W. Bush's federal Environmental Protection Agency ("EPA") point person on water now admits that fracking should never have been exempted from regulation; and

WHEREAS, New Jersey's Legislature and Governor enacted a one-year moratorium on fracking that expired in January of 2013; and

WHEREAS, since the New Jersey Legislature originally acted to ban fracking, the case for a ban on fracking has been strengthened by an EPA report of contaminants associated with fracking have been found in an aquifer in Pavilion Wyoming, and separate incidents involving earthquakes linked to fracking waste disposal injection wells. A study by the University of Colorado at Boulder and the U.S. Geological Survey, published in the journal *Science* states: "A dramatic increase in the rate of earthquakes in the central and eastern U.S. since 2009 is associated with fluid injection wells used in oil and gas development" WEB page accessed on Sept. 1, 2015
http://www.colorado.edu/news/releases/2015/06/18/us-mid-continent-seismicity-linked-high-rate-injection-wells-0#sthash.TJPpodhx.dpuf

Figure 5 is a graph of the number of recorded earthquakes in Oklahoma before and after fracking began in 2009.

Figure 6 shows the location of identified faults near Franklin Township, NJ, Geologic map by the USGS,USGS I-2540- A and B; and

WHEREAS, wastewater, wastewater solids or sludge, drill cuttings and/or other byproducts from the fracking processes are known to contain toxic levels of contaminants, including unknown quantities of undisclosed chemical additives used in hydraulic fracturing fluid, as well as contaminants from sources underground; Benzene, naphthalene, formaldehyde, cadmium, mercury, arsenic, total dissolved solids, and radioactive material, such as radium, are among the known contaminants; and

WHEREAS, methods of treatment and disposal for fracking waste do not eliminate the risks that hydraulic fracturing wastewater, wastewater solids or sludge, drill cuttings and/or other byproducts pose to human health and the environment; and

WHEREAS, A575/S253 passed the New Jersey Legislature in June 2012 with strong bipartisan support, and would prohibit treatment, discharge, disposal, or storage of waste from hydraulic fracturing in New Jersey; and

WHEREAS, Governor Christie vetoed A575/S253 in September 2012; and

WHEREAS, fracking is exempt from important regulations meant to protect public health and the environment, specifically sections of the Clean Water Act, Clean Air Act, Safe Drinking Water Act, Superfund, National Environmental Policy Act, Resource Conservation and Recovery Act; and

WHEREAS, the wise stewardship of our natural resources involves protection of Franklin's air, water supplies and water resources for generations to come; and

WHEREAS, protection of Franklin's air, water supplies and resources is better accomplished by preventing contamination and environmental degradation, rather than attempting to remediate contamination and restore degraded environments after the fact; and

WHEREAS, under existing State law regulating drilling for oil and natural gas under *N.J.S.A.* 13:1M-18 and *N.J.S.A.* 13.1M-1 *et seq.*, a local governing body may ban drilling for natural gas, and exploration for natural gas beyond the "reconnaissance" phase;

NOW THEREFORE, BE IT ORDAINED BY THE MAYOR AND TOWNSHIP COMMITTEE OF FRANKLIN AS FOLLOWS:

Township Land Use Ordinance Amended. Section 220-30, Article VI: General Zone Regulations, "Prohibited uses" of Chapter 220, "Land Use" of the "Code of the Township of Franklin, New Jersey" is hereby supplemented and amended as follows:

Chapter 220. Land Use

Article VI. General Zone Regulations

§ 220-30. Prohibited uses.

Where a use is not specifically permitted in a zoned district, it is prohibited. In addition, without limiting the foregoing language:

(a) Drilling for natural gas, using the drilling technique of hydraulic fracturing and exploring for natural gas beyond the reconnaissance phase.

Section 1. Applicability. The provisions of this ordinance shall apply to the entire municipality of Franklin and the "Code of the Township of Franklin, New Jersey" shall be deemed amended accordingly.

Section 2. Severability. If any section, paragraph, subsection, clause, or provision of this ordinance shall be adjudged by the courts to be invalid, such adjudication shall apply only to the section, paragraph, clause, or provision so adjudged, and the remainder of this ordinance shall be deemed valid and effective.

Section 3. Referral to Planning Board. A copy of this ordinance shall be referred to the Franklin Planning Board following its introduction on first reading in accordance with the provisions of *N.J.S.A.* 40:55D-64.

Section 4. Effective Date. This ordinance shall take effect upon its passage and publication and filing with the Hunterdon County Planning Board, as required by law.

The purpose of this ordinance is to prohibit the use of hydraulic fracturing for gas throughout the Township of Franklin.

ADOPTION: 6-23-2016

Susan Soloway
SUSAN SOLOWAY, MAYOR
TOWNSHIP COMMITTEE

Ursula V. Stryker
URSULA V. STRYKER, RMC
MUNICIPAL CLERK

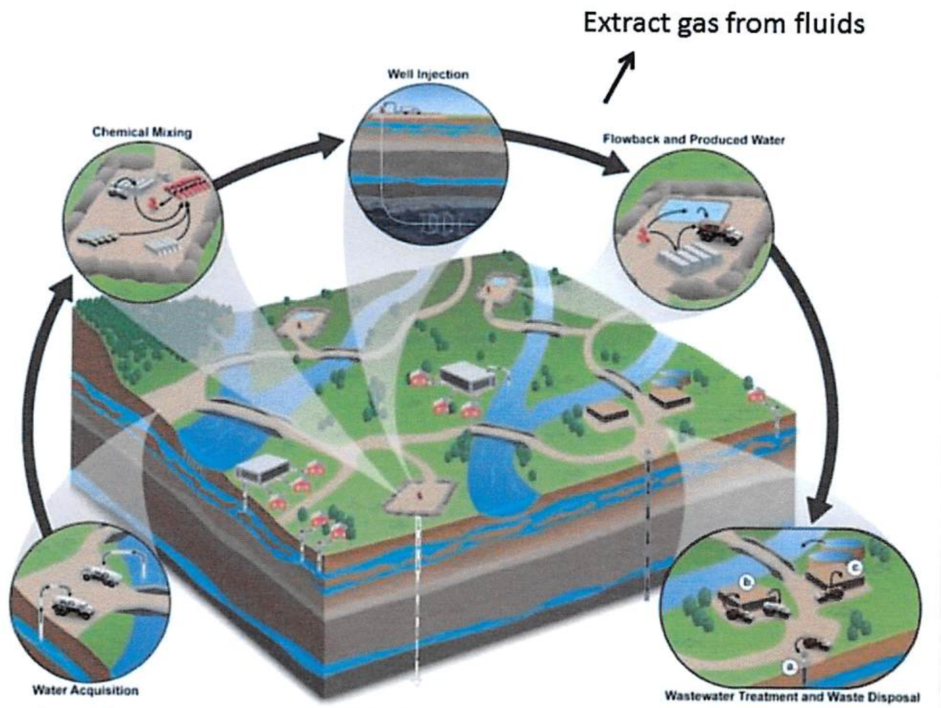

Figure 1. Processes of fracking

Figure 2. Modified from U.S. Geological Survey report, 'Assessment of Undiscovered Oil and Gas Resources of the East Coast Mesozoic Basins of the Piedmont, Blue Ridge Thrust Belt, Atlantic Coastal Plain, and New England Provinces, 2011', Fact Sheet 2012-3075

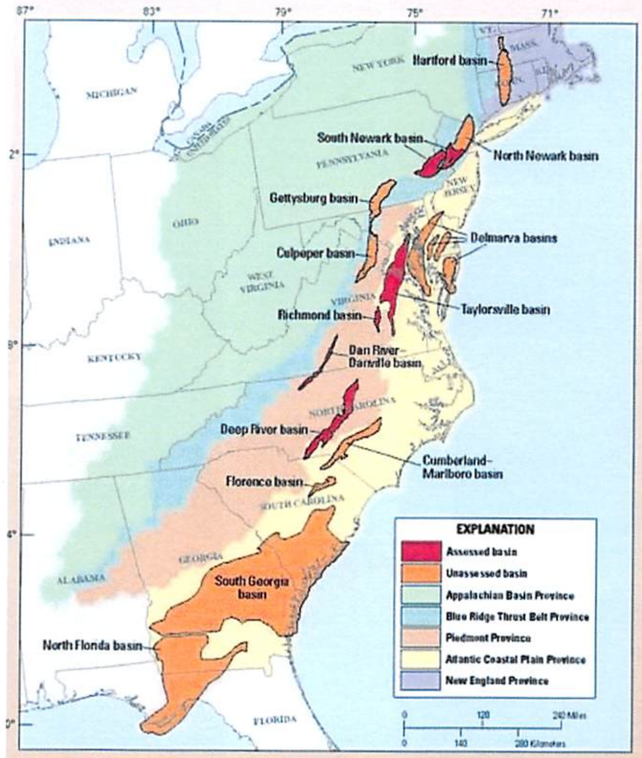

Figure 1. Map of the Eastern United States showing the locations of the five quantitatively (volumetrically) assessed East Coast Mesozoic basins, the nine basins that were not volumetrically assessed, and the U.S. Geological Survey province boundaries. Each basin includes one continuous gas assessment unit (tables 1, 2).

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Fact Sheet 2012–3075
June 2012

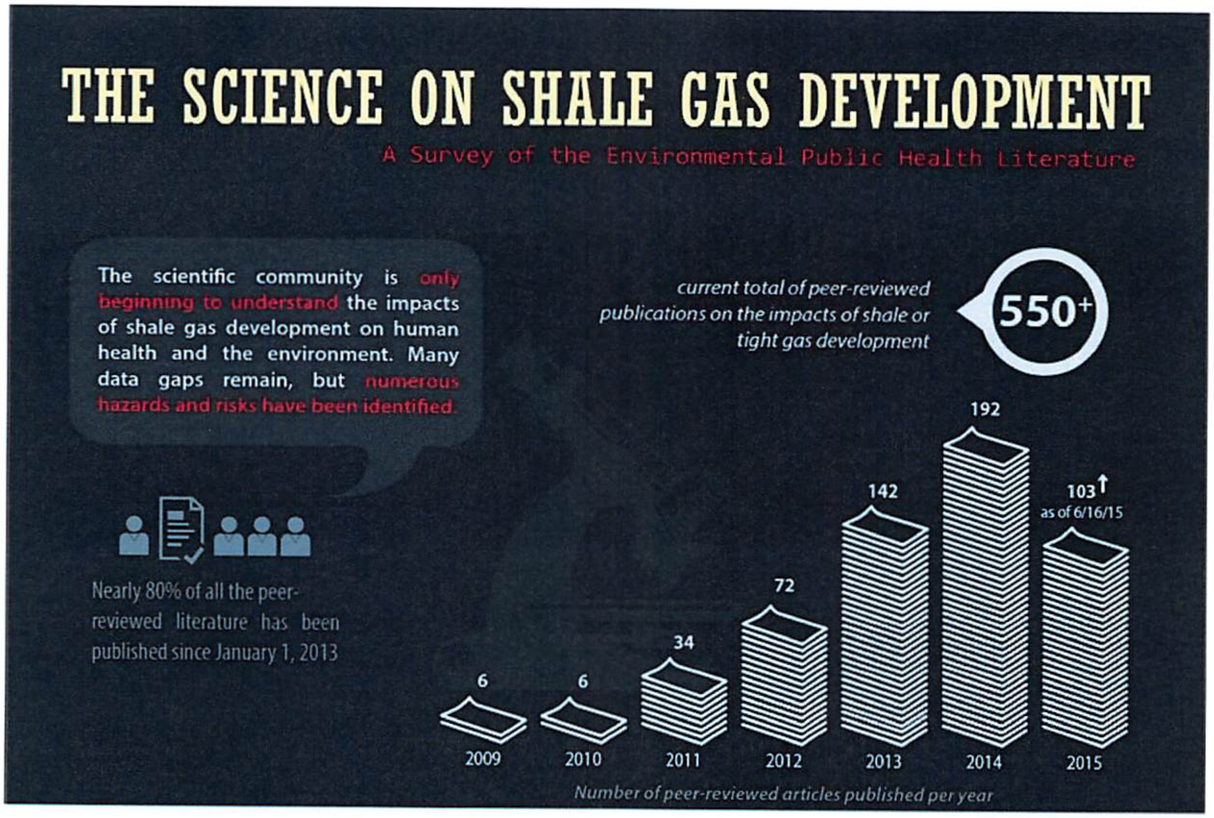

Figure 3. From PSE - Physicians Scientists & Engineers
WEB page http://www.psehealthyenergy.org

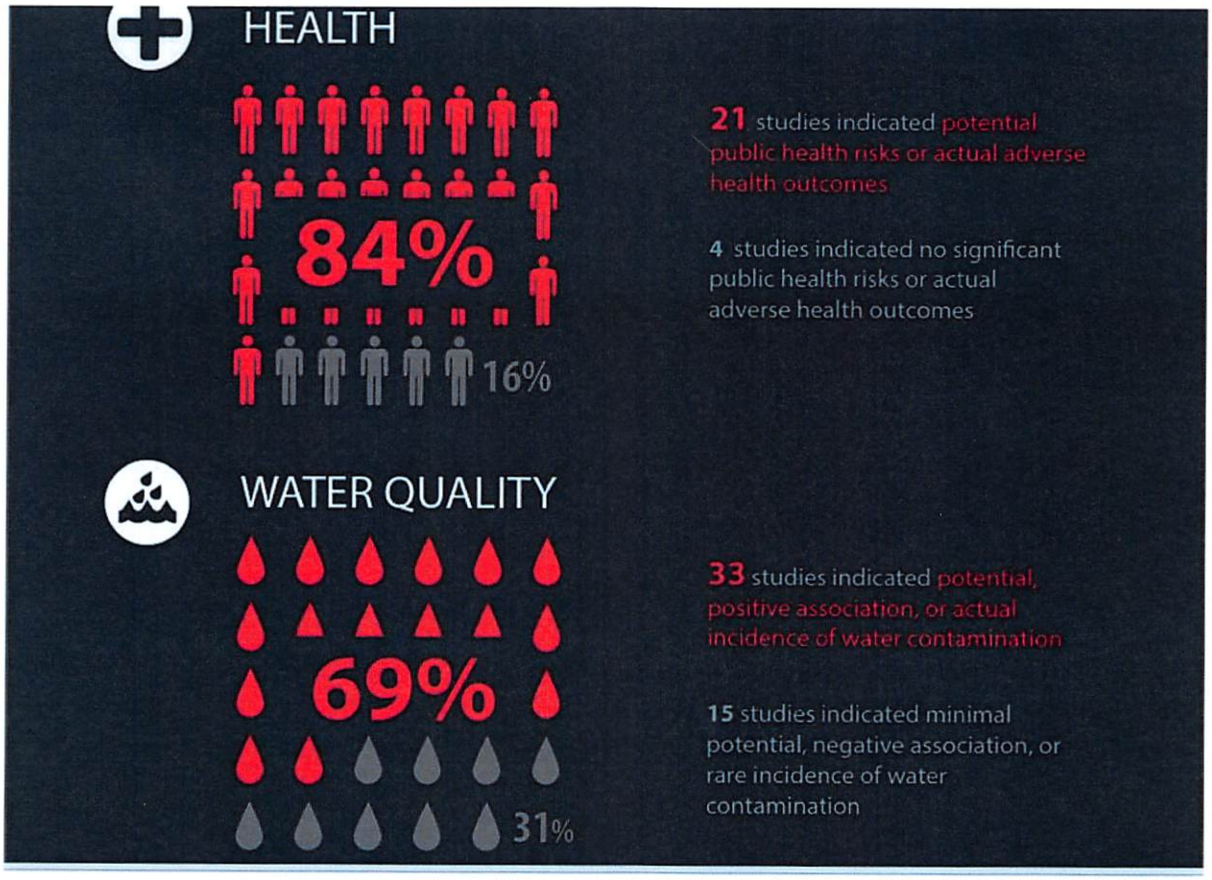

Figure 3 – Continued

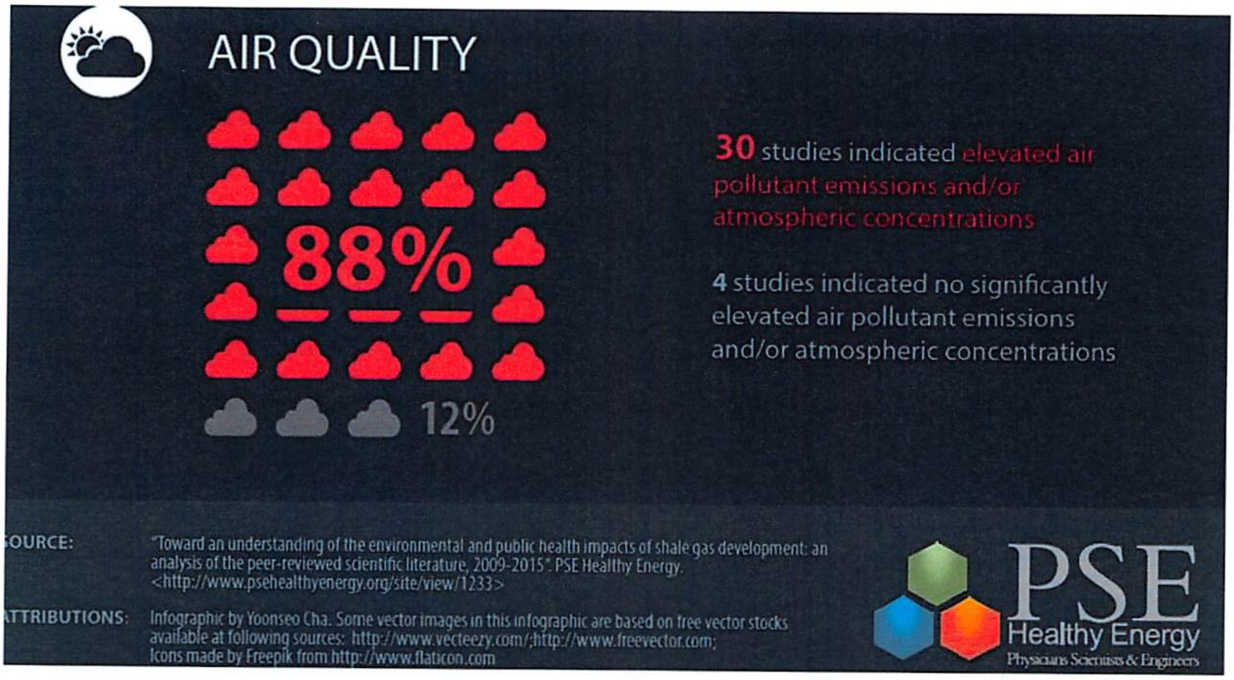

Figure 3 – continued

Authors of summary:
Jake Hays (1), Seth B.C. Shonkoff (2,3,4)
1 PSE Healthy Energy, New York, NY
2 PSE Healthy Energy, Oakland, CA
3 Department of Environmental Science, Policy and Management
University of California, Berkeley, CA
4 Lawrence Berkeley National Laboratory, Berkeley, CA

Figure 4. Example of published reports on the impact of fracking.

Water Quality: Original Research (n=48)

- *Indication of potential, positive association, or actual incidence of water contamination (n=33)*

1. Alawattegama SK. Kondratyuk T. Krynock R. Bricker M. Rutter JK. Bain DJ. et al. 2015. Well water contamination in a rural community in southwestern Pennsylvania near unconventional shale gas extraction. Journal of Environmental Science and Health. Part A 50: 516–528.
2. Austin BJ. Hardgrave N. Inlander E. Gallipeau C. Entrekin S. Evans-White MA. 2015. Stream primary producers relate positively to watershed natural gas measures in north-central Arkansas streams. Science of The Total Environment 529:54–64; doi:10.1016/j.scitotenv.2015.05.030.
3. Bern CR. Clark ML. Schmidt TS. Holloway JM. McDougal RR. 2015. Soil disturbance as a driver of increased stream salinity in a semiarid watershed undergoing energy development. J. Hydrol. 524:123–136; doi:10.1016/j.jhydrol.2015.02.020.
4. Darrah TH. Vengosh A. Jackson RB. Warner NR. Poreda RJ. 2014. Noble gases identify the mechanisms of fugitive gas contamination in drinking-water wells overlying the Marcellus and Barnett Shales. PNAS 201322107; doi:10.1073/pnas.1322107111.
5. Davies RJ. Almond S. Ward RS. Jackson RB. Adams C. Worrall F. et al. 2014. Oil and gas wells and their integrity: Implications for shale and unconventional resource exploitation. Marine and Petroleum Geology 56:239–254; doi:10.1016/j.marpetgeo.2014.03.001.
6. Ferrar KJ. Michanowicz DR. Christen CL. Mulcahy N. Malone SL. Sharma RK. 2013. Assessment of effluent contaminants from three facilities discharging Marcellus Shale wastewater to surface waters in Pennsylvania. Environ. Sci. Technol. 47:3472–3481; doi:10.1021/es301411q.
7. Fontenot BE. Hunt LR. Hildenbrand ZL. Carlton Jr. DD. Oka H. Walton JL. et al. 2013. An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation. Environ. Sci. Technol. 47:10032–10040; doi:10.1021/es4011724.
8. Gassiat C. Gleeson T. Lefebvre R. McKenzie J. 2013. Hydraulic fracturing in faulted sedimentary basins: Numerical simulation of potential contamination of shallow aquifers over long time scales. Water Resour. Res. 49:8310–8327; doi:10.1002/2013WR014287.
9. Grant CJ. Weimer AB. Marks NK. Perow ES. Oster JM. Brubaker KM. et al. 2015. Marcellus and mercury: Assessing potential impacts of unconventional natural gas extraction on aquatic ecosystems in northwestern Pennsylvania. Journal of Environmental Science and Health. Part A 50: 482–500.

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Factors controlling Li concentration and isotopic composition in formation waters and host rocks of Marcellus Shale, Appalachian Basin

Thai T. Phan, Rosemary C Capo, Brian W. Stewart, Gwen Macpherson, Elisabeth L. Rowan, Richard W. Hammack

2015, Chemical Geology (420) 162-179

In this study, water and whole rock samples from hydraulically fractured wells in the Marcellus Shale (Middle Devonian), and water from conventional wells producing from Upper Devonian sandstones were analyzed for lithium concentrations and isotope ratios (δ7Li). The distribution of lithium concentrations in different mineral groups was determined using...

Extraction of hydrocarbons from high-maturity Marcellus Shale using supercritical carbon dioxide

Palma B. Jarboe, Philip A. Candela, Wenlu Zhu, Alan J. Kaufman

2015, Energy & Fuels (29) 7897-7909

Shale is now commonly exploited as a hydrocarbon resource. Due to the high degree of geochemical and petrophysical heterogeneity both between shale reservoirs and within a single reservoir, there is a growing need to find more efficient methods of extracting petroleum compounds (crude oil, natural gas, bitumen) from potential source...

Organic and inorganic composition and microbiology of produced waters from Pennsylvania shale gas wells

Denise M. Akob, Isabelle M. Cozzarelli, Darren S. Dunlap, Elisabeth L. Rowan, Michelle M. Lorah

2015, Applied Geochemistry (60) 116-125

Hydraulically fractured shales are becoming an increasingly important source of natural gas production in the United States. This process has been known to create up to 420 gallons of produced water (PW) per day, but the volume varies depending on the formation, and the characteristics of individual hydraulic fracture. PW...

Landscape disturbance from unconventional and conventional oil and gas development in the Marcellus Shale region of Pennsylvania, USA

Terry E. Slonecker, Lesley E. Milheim

2015, Environment (2) 200-220

The spatial footprint of unconventional (hydraulic fracturing) and conventional oil and gas development in the Marcellus Shale region of the State of Pennsylvania was digitized from high-resolution, ortho-rectified, digital aerial photography, from 2004 to 2010. We used these data to measure the spatial extent of oil and gas development and...

Geochemical and mineralogical sampling of the Devonian shales in the Broadtop synclinorium, Appalachian basin, in Virginia, West Virginia, Maryland, and Pennsylvania

Catherine B. Enomoto, James L. Coleman Jr., Christopher S. Swezey, Patrick W. Niemeyer, Frank T. Dulong

2015, Open-File Report 2015-1061

Reconnaissance field mapping and outcrop sampling for geochemical and mineralogical analyses indicate that the Middle Devonian Marcellus Shale in the Broadtop synclinorium and nearby areas from southeastern West Virginia to south-central Pennsylvania has an organic content sufficiently high and a thermal maturity sufficiently moderate to be considered for a shale...

Water quality of groundwater and stream base flow in the Marcellus Shale Gas Field of the Monongahela River Basin, West Virginia, 2011-12

Douglas B. Chambers, Mark D. Kozar, Terence Messinger, Michon L. Mulder, Adam J. Pelak, Jeremy S. White

2015, Scientific Investigations Report 2014-5233

The Marcellus Shale gas field underlies portions of New York, Pennsylvania, Ohio, Virginia, Maryland, Tennessee, and West Virginia. Development of hydraulic fracturing and horizontal drilling technology led to extensive development of gas from the Marcellus Shale beginning about 2007. The need to identify and monitor changes in water-quality conditions related...

Thermal maturity patterns (conodont color alteration index and vitrinite reflectance) in Upper Ordovician and Devonian rocks of the Appalachian basin: a major revision of USGS Map I-917-E using new subsurface collections: Chapter F.1 in *Coal and petroleum resources in the Appalachian basin: distribution, geologic framework, and geochemical character*

John E. Repetski, Robert T. Ryder, David J. Weary, Anita G. Harris, Michael H. Trippi

Leslie F. Ruppert, Robert T. Ryder, editor(s)

2014, Professional Paper 1708-F.1

Introduction The conodont color alteration index (CAI) introduced by Epstein and others (1977) and Harris and others (1978) is an important criterion for estimating the thermal maturity of Ordovician to Mississippian rocks in the Appalachian basin. Consequently, the CAI isograd maps of Harris and others...

Landscape consequences of natural gas extraction in Cameron, Clarion, Elk, Forest, Jefferson, McKean, Potter, and Warren Counties, Pennsylvania, 2004-2010

L. E. Milheim, E. T. Slonecker, C. M. Roig-Silva, S. G. Winters, J. R. Ballew

2014, Open-File Report 2014-1152

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing hydrocarbon-rich geologic formations, have led to an intense effort to find and extract unconventional natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

A reconnaissance spatial and temporal assessment of methane and inorganic constituents in groundwater in bedrock aquifers, Pike County, Pennsylvania, 2012-13

Lisa A. Senior

2014, Scientific Investigations Report 2014-5117

Pike County in northeastern Pennsylvania is underlain by the Devonian-age Marcellus Shale and other shales, formations that have potential for natural gas development. During 2012–13, the U.S. Geological Survey in cooperation with the Pike County Conservation District conducted a reconnaissance study to assess baseline shallow groundwater quality in bedrock aquifers...

Baseline groundwater quality from 34 wells in Wayne County, Pennsylvania, 2011 and 2013

Ronald A. Sloto

2014, Open-File Report 2014-1116

Wayne County, Pennsylvania, is underlain by the Marcellus Shale, which currently (2014) is being developed elsewhere in Pennsylvania for natural gas. All residents of largely rural Wayne County rely on groundwater for water supply, primarily from bedrock aquifers (shales and sandstones). This study, conducted by the U.S. Geological Survey in...

Landscape consequences of natural gas extraction in Bedford, Blair, Cambria, Centre, Clearfield, Clinton, Columbia, Huntingdon, and Luzerne counties, Pennsylvania, 2004-2010

E.T. Slonecker, L.E. Milheim, C.M. Roig-Silva, S.G. Winters

2014, Open-File Report 2014-1089

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Surface disposal of produced waters in western and southwestern Pennsylvania: potential for accumulation of alkali-earth elements in sediments

Katherine J. Skalak, Mark A. Engle, Elisabeth L. Rowan, Glenn D. Jolly, Kathryn M. Conko, Adam J. Benthem, Thomas F. Kraemer

2014, International Journal of Coal Geology (126) 162-170

Waters co-produced with hydrocarbons in the Appalachian Basin are of notably poor quality (concentrations of total dissolved solids (TDS) and total radium up to and exceeding 300,000 mg/L and 10,000 pCi/L, respectively). Since 2008, a rapid increase in Marcellus Shale gas production has led to a commensurate rise in associated...

Geohydrologic and water-quality characterization of a fractured-bedrock test hole in an area of Marcellus shale gas development, Bradford County, Pennsylvania

Dennis W. Risser, John H. Williams, Kristen L. Hand, Rose-Anna Behr, Antonette K. Markowski

2013, Pennsylvania Geological Survey Open-File Report OFMI 13-01.1

Open-File Miscellaneous Investigation 13–01.1 presents the results of geohydrologic investigations on a 1,664-foot-deep core hole drilled in the Bradford County part of the Gleason 7.5-minute quadrangle in north-central Pennsylvania. In the text, the authors discuss their methods of investigation, summarize physical and analytical results, and place those results in context....

Methane occurrence in groundwater of south-central New York State, 2012: summary of findings

Paul M. Heisig, Tia-Marie Scott

2013, Fact Sheet 2013-3118

A survey of methane in groundwater was undertaken to document methane occurrence on the basis of hydrogeologic setting within a glaciated 1,810-square-mile area of south-central New York that has not seen shale-gas resource development. The adjacent region in northeastern Pennsylvania has undergone shale-gas resource development from the Marcellus Shale. Well construction...

Landscape consequences of natural gas extraction in Sullivan and Wyoming Counties, Pennsylvania, 2004–2010

Terry E. Slonecker, Lesley E. Milheim, Coral M. Roig-Silva, Alexander R. Malizia

2013, Open-File Report 2013-1261

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Landscape consequences of natural gas extraction in Armstrong and Indiana Counties, Pennsylvania, 2004–2010

Terry E. Slonecker, Lesley E. Milheim, Coral M. Roig-Silva, Alexander R. Malizia

2013, Open-File Report 2013-1263

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Landscape consequences of natural gas extraction in Beaver and Butler Counties, Pennsylvania, 2004-2010

Coral M. Roig-Silva, E. Terry Slonecker, Lesley E. Milheim, Alexander R. Malizia

2013, Open-File Report 2013-1226

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Landscape consequences of natural gas extraction in Lackawanna and Wayne Counties, Pennsylvania, 2004-2010

L.E. Milheim, E.T. Slonecker, C.M. Roig-Silva, A.R. Malizia

2013, Open-File Report 2013-1227

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Dissolved methane in groundwater, Upper Delaware River Basin, Pennsylvania and New York, 2007-12

William M. Kappel

2013, Open-File Report 2013-1167

The prospect of natural gas development from the Marcellus and Utica Shales has raised concerns about freshwater aquifers being vulnerable to contamination. Well owners are asking questions about subsurface methane, such as, "Does my well water have methane and is it safe to drink the water?" and "Is my well...

Water resources and shale gas/oil production in the Appalachian Basin: critical issues and evolving developments

William M. Kappel, John H. Williams, Zoltan Szabo

2013, Open-File Report 2013-1137

Unconventional natural gas and oil resources in the United States are important components of a national energy program. While the Nation seeks greater energy independence and greener sources of energy, Federal agencies with environmental responsibilities, state and local regulators and water-resource agencies, and citizens throughout areas of unconventional shale gas...

Baseline groundwater quality from 20 domestic wells in Sullivan County, Pennsylvania, 2012

Ronald A. Sloto

2013, Scientific Investigations Report 2013-5085

Water samples were collected from 20 domestic wells during August and September 2012 and analyzed for 47 constituents and properties, including nutrients, major ions, metals and trace elements, radioactivity, and dissolved gases, including methane and radon-222. This study, done in cooperation with the Pennsylvania Department of Conservation and Natural Resources,...

Landscape consequences of natural gas extraction in Somerset and Westmoreland Counties, Pennsylvania,2004--2010

L.E. Milheim, E.T. Slonecker, C.M. Roig-Silva, A.R. Malizia

2013, Open-File Report 2013-1126

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Landscape consequences of natural gas extraction in Fayette and Lycoming Counties, Pennsylvania, 2004–2010

E.T. Slonecker, L.E. Milheim, C.M. Roig-Silva, A.R. Malizia, B.H. Gillenwater

2013, Open-File Report 2013-1119

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

The Energy-Water Nexus: potential groundwater-quality degradation associated with production of shale gas

Yousif K. Kharaka, James J. Thordsen, Christopher H. Conaway, Randal B. Thomas

2013, Procedia Earth and Planetary Science (7) 422

Oil and natural gas have been the main sources of primary energy in the USA, providing 63% of the total energy consumption in 2011. Petroleum production, drilling operations, and improperly sealed abandoned wells have caused significant local groundwater contamination in many states, including at the USGS OSPER sites in Oklahoma....

Landscape consequences of natural gas extraction in Allegheny and Susquehanna Counties, Pennsylvania, 2004--2010

E.T. Slonecker, L.E. Milheim, C.M. Roig-Silva, A.R. Malizia

2013, Open-File Report 2013-1025

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Landscape consequences of natural gas extraction in Greene and Tioga Counties, Pennsylvania, 2004-2010

E.T. Slonecker, L.E. Milheim, C.M. Roig-Silva, G.B. Fisher

2012, Open-File Report 2012-1220

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, have led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau,...

Geology of the Devonian Marcellus Shale--Valley and Ridge province, Virginia and West Virginia--a field trip guidebook for the American Association of Petroleum Geologists Eastern Section Meeting, September 28-29, 2011

Catherine B. Enomoto, James L. Coleman Jr., John T. Haynes, Steven J. Whitmeyer, Ronald R. McDowell, J. Eric Lewis, Tyler P. Spear, Christopher S. Swezey

2012, Open-File Report 2012-1194

Detailed and reconnaissance field mapping and the results of geochemical and mineralogical analyses of outcrop samples indicate that the Devonian shales of the Broadtop Synclinorium from central Virginia to southern Pennsylvania have an organic content sufficiently high and a thermal maturity sufficiently moderate to be considered for a shale gas...

Landscape consequences of natural gas extraction in Bradford and Washington Counties, Pennsylvania, 2004-2010

E.T. Slonecker, L.E. Milheim, C.M. Roig-Silva, A.R. Malizia, D.A. Marr, G.B. Fisher

2012, Open-File Report 2012-1154

Increased demands for cleaner burning energy, coupled with the relatively recent technological advances in accessing unconventional hydrocarbon-rich geologic formations, led to an intense effort to find and extract natural gas from various underground sources around the country. One of these sources, the Marcellus Shale, located in the Allegheny Plateau, is...

Dissolved methane in New York groundwater, 1999-2011

William M. Kappel, Elizabeth A. Nystrom

2012, Open-File Report 2012-1162

New York State is underlain by numerous bedrock formations of Cambrian to Devonian age that produce natural gas and to a lesser extent oil. The first commercial gas well in the United States was dug in the early 1820s in Fredonia, south of Buffalo, New York, and produced methane from...

Baseline groundwater quality in national park units within the Marcellus and Utica Shale gas plays, New York, Pennsylvania, and West Virginia, 2011

David A. V. Eckhardt, Ronald A. Sloto

2012, Open-File Report 2012-1150

Groundwater samples were collected from 15 production wells and 1 spring at 9 national park units in New York, Pennsylvania, and West Virginia in July and August 2011 and analyzed to characterize the quality of these water supplies. The sample sites generally were selected to represent areas of potential effects...

Groundwater quality and simulation of sources of water to wells in the Marsh Creek valley at the U.S. Geological Survey Northern Appalachian Research Laboratory, Tioga County, Pennsylvania

Dennis W. Risser, Kevin J. Breen

2012, Scientific Investigations Report 2012-5042

This report provides a November 2010 snapshot of groundwater quality and an analysis of the sources of water to wells at the U.S. Geological Survey (USGS) Northern Appalachian Research Laboratory (NARL) near Wellsboro, Pennsylvania. The laboratory, which conducts fisheries research, currently (2011) withdraws 1,000 gallons per minute of high-quality groundwater...

Radon-222 content of natural gas samples from Upper and Middle Devonian sandstone and shale reservoirs in Pennsylvania—preliminary data

E.L. Rowan, T.F. Kraemer

2012, Open-File Report 2012-1159

Samples of natural gas were collected as part of a study of formation water chemistry in oil and gas reservoirs in the Appalachian Basin. Nineteen samples (plus two duplicates) were collected from 11 wells producing gas from Upper Devonian sandstones and the Middle Devonian Marcellus Shale in Pennsylvania. The samples...

Production and disposal of waste materials from gas and oil extraction from the Marcellus Shale Play in Pennsylvania

Kelly O. Maloney, David A. Yoxtheimer

2012, Environmental Practice (14) 278-287

The increasing world demand for energy has led to an increase in the exploration and extraction of natural gas, condensate, and oil from unconventional organic-rich shale plays. However, little is known about the quantity, transport, and disposal method of wastes produced during the extraction process. We examined the quantity of...

Radium content of oil- and gas-field produced waters in the northern Appalachian Basin (USA)—Summary and discussion of data

E.L. Rowan, M.A. Engle, C.S. Kirby, T.F. Kraemer

2011, Scientific Investigations Report 2011-5135

Radium activity data for waters co-produced with oil and gas in New York and Pennsylvania have been compiled from publicly available sources and are presented together with new data for six wells, including one time series. When available, total dissolved solids (TDS), and gross alpha and gross beta particle activities...

Assessment of undiscovered oil and gas resources of the Devonian Marcellus Shale of the Appalachian Basin Province

James L. Coleman Jr., Robert C. Milici, Troy A. Cook, Ronald R. Charpentier, Mark Kirshbaum, Timothy R. Klett, Richard M. Pollastro, Christopher J. Schenk

2011, Fact Sheet 2011-3092

Using a geology-based assessment methodology, the U.S. Geological Survey (USGS) estimated a mean undiscovered natural gas resource of 84,198 billion cubic feet and a mean undiscovered natural gas liquids resource of 3,379 million barrels in the Devonian Marcellus Shale within the Appalachian Basin Province. All this resource occurs in...

Water Resources and Natural Gas Production from the Marcellus Shale

Daniel J. Soeder, William M. Kappel

2009, Fact Sheet 2009-3032

The Marcellus Shale is a sedimentary rock formation deposited over 350 million years ago in a shallow inland sea located in the eastern United States where the present-day Appalachian Mountains now stand (de Witt and others, 1993). This shale contains significant quantities of natural gas. New developments in drilling technology,...

Figure 5. Updated USGS-Oklahoma Geological Survey Joint Statement on Oklahoma Earthquakes Originally Released: 10/22/2013; Updated May 2, 2014. Web page accessed on Sept 1, 2015, WEB page, http://earthquake.usgs.gov/contactus/golden/newsrelease_05022014.php

Fracking started in 2009

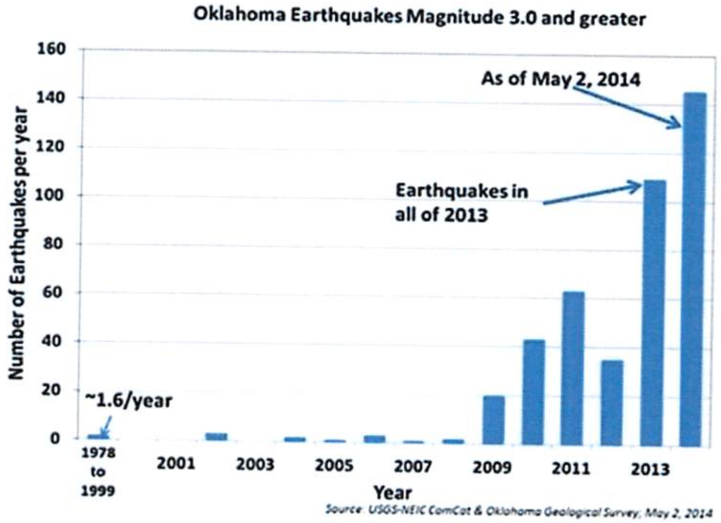

Figure 6. Geologic map modified from USGS I-2540- A and B
Black lines – Location of identified faults