Health Effects

Unconventional Natural Gas Development and Production (“FRACKING”)

Ann Bristow, Ph.D.
Marcellus Shale Safe Drilling Initiative Commissioner
Concerned Health Professionals of Maryland,
Founding Member

Garrett County Board of Commissioners
March 17, 2015
Marcellus and Other Potential Sites in MD

Maryland Gas Basins

Appalachian Basin
Culpeper Basin
Gettysburg Basin
Taylorsville Basin
Delmarva Basins

Source: U.S. Geological Survey National Assessment of Oil and Gas
**What is “Fracking”?**

**General public:**
the **entire process** for getting oil and natural gas from deep rock formations

**Industry:**
the **part of the process** in which the rock is blown open to release the gas or oil
“Fracking” Process

Hydraulic Fracturing

Hydraulic fracturing, or “fracking,” involves the injection of more than a million gallons of water, sand and chemicals at high pressure down into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.

Well turns horizontal

Marcellus Shale

The shale is fractured by the pressure inside the well.

Sand keeps fissures open

Natural gas flows from fissures into well

Mixture of water, sand and chemical agents

Shale Fissure

Well

Natural gas flows out of well

Recovered water is stored in open pits, then taken to a treatment plant

Natural gas is piped to market.

Graphic by Al Granberg

www.propublica.org/special/hydraulic-fracturing-national
For the General Public, Fracking Means:

- Silica mining
- Trucking
- Drilling
- Hydraulic Fracturing
- Flaring
- Tanks
- Compressor Stations
- Processing Plants
- LNG Terminals
Human exposure timeline with UNGD activities and human health risk

(0 is none and 10 is certain)

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<th>Drilling fluids</th>
<th>Produced water</th>
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Hydraulic Fracturing: practiced for 65 years; used in bridge pylon construction, conventional wells

High Volume Hydraulic Fracturing combined with Horizontal Drilling: since late 2007 in the Marcellus:
• uses VASTLY MORE water (high volume = high pressure) laced with a chemicals, many of them toxic

HOW OLD IS THE HEALTH RESEARCH?

Direct research less than a decade.
• Indirect research on “components” longer: air pollution from diesel engines, health effects of specific chemicals; e.g., Benzene is a known carcinogen.
Science is emerging now

Number of peer-reviewed publications that assess the impacts of shale or tight gas development by year, 2009-2014

http://psehealthyenergy.org/data/Database_Analysis_2015.1.27.pdf
HARMFUL Fracking Chemicals
(a sampling of KNOWN chemicals)

- Arsenic -- carcinogen
- Benzene – carcinogen
- Ethylene Glycol (antifreeze) -- neurotoxin
- Formaldehyde – carcinogen
- Hydrogen Sulfide – lethal at high doses
- Lead – neurotoxin
- Radium –226 -- carcinogen
- Silica dust -- carcinogen
- Thiourea -- hypothyroidism
Challenges - Chemicals

How do we determine what is “safe”? It’s not easy...

- Identification/detection
- What is a “safe” level?
- Mixtures/chemical reactions
- Variability in exposures over time
- **Toxicity of 1/3 of fracking chemicals**

UNKNOWN*

(*Stringfellow et al. (August 2014) National Meeting of the American Chemical Society*)
Research: Health Impacts

**Health: All Papers (n=49)**

- Indication of potential public health risks or actual adverse health outcomes (n=47)
- No indication of significant public health risks or actual adverse health outcomes (n=2)
Research: Air Quality

Air Quality: Original Research (n=26)

- Indication of elevated air pollutant emissions and/or atmospheric concentrations (n=24)
- No indication of significantly elevated air pollutant emissions and/or atmospheric concentrations (n=2)
Research: Water Quality

Water Quality: Original Research (n=30)

- Indication of potential, positive association, or actual incidence of water contamination (n=22)
- Indication of minimal potential, negative association, or rare incidence of water contamination (n=8)
## The Health Issues

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High = high likelihood of negative health impacts, Moderately High = moderately high likelihood of negative health impacts, Low = low likelihood of negative health impacts
Latency: time between exposure and symptoms/disease
- asbestos, Agent Orange, environmental tobacco smoke
- complex causes, industry/government suppression of data

9/11 First Responders:
- breathing difficulties same day as exposure
- monitoring for lung disorders now, 14+ years later

Short-latency effects:
  - pregnancy & birth outcomes; respiratory, dermal

Longer-latency diseases: pulmonary, cardiovascular

Longest-latency diseases:
  - cancers (10-15-20 years; sooner in children)

“Bakken cough” – citizens treating with antihistamines
Specific Health Impacts*

- McKenzie et al, 2014 (*Environmental Health Perspectives*)
  - Association between **birth defects** and maternal proximity to drilling operations

- Hill, 2013, under review (Cornell University & U. of Rochester)
  - **Low birth weight** < 2.5 km from gas wells (8200 ft/1.5 mi)

- Rabinowitz et al, 2014 (*Environmental Health Perspectives*)
  - Increased **upper respiratory and skin conditions**
    - <1 km from gas wells (3280 ft)

* attributed to air contamination
Sentinels for Health

Canary in the coalmine alerted workers to toxic air conditions.

**Pregnancy outcomes and Children**

**Animals**: companion and food source

Slizovskiy et al. (3/3/15 *Journal of Environmental Science and Health*, pgs. 473-481): pet dogs at elevated risk of health conditions in households less than 1km (3,280 ft.) from nearest gas well; dermal conditions most frequent; Washington County, PA

**Gas workers**: oil & gas fatality rate is 7.6 times higher than the all-industry rate of 3.2 deaths per 100,000 workers, “higher than the notoriously dangerous agriculture, forestry, and fishing and hunting sectors.” (Bureau of Labor Statistics, 2013)
“Natural” Animal Experiment

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<th>Cow herd conditions at dairy farm near PA gas drilling site (n = 96; split herd “design”)</th>
<th>Wastewater Contaminated Field*</th>
<th>Uncontaminated Field</th>
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<td># deaths</td>
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<tr>
<td># reproductive failures</td>
<td>16 of 60</td>
<td>1 of 36</td>
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</table>

*creek, into which wastewater was allegedly dumped, flowed through field where these cattle were fenced

FOOD SUPPLY NOT STUDIED in Maryland

“The primary stakeholders in our foodsheds are farmers, who must cope with

- changes in water levels
- soil contamination
- farmland fragmentation
- impacts on crop yields
- livestock poisoning and
- falling reproductive rates.

At the other end of the food chain is the public which must rely on food safety inspectors who are not trained to look for microscopic changes in animal organs.”

“The practice of hydraulic fracturing (fracking) has garnered considerable attention recently, especially within the farming community.

Farmers, industry leaders, and activists have lobbied against this practice, and with good cause.

For organic dairy farmers the risks are potentially significant, water contamination as a result of the chemicals used in the fracking process could affect the heath of their livestock, and the presence of banned chemicals on their land could result in the loss of organic certification.

We support organic dairy farmers who take action against this practice; after all clean water, healthy cows, and quality milk are worth fighting for.

Additionally, none of our company-owned facilities utilize process water from sources associated with or near fracking activity.”

Andrea Amparan
Consumer Response Representative
Horizon Organic Milk

December 19, 2014
WATER CONTAMINATION: Air contamination ranked higher hazard than water contamination due to lack of research on water (MIAEH).

PA-DEP found residential well contamination of VOCs, ethylene glycol and 2-butoxyethanol among 243 cases of contaminated residential water wells; PA-DEP records released 8/28/14 after MIAEH report

Pennsylvania data:
• unconventional wells show a 6x higher incidence of cement and/or casing failures compared to conventional wells
• unconventional wells drilled in the NE PA region since 2009 (2,714 wells) show a high failure rate – 9.18%. Rates go up over time as wells age (Ingraffea et al, 2014).
Well Leakage

From Mud to Cement – Building Gas Wells
PA well failure rates

1,609 wells drilled in 2010.
97 well failures.
6% rate of failure.

1,972 wells drilled in 2011.
140 well failures.
7.1% rate of failure.

1346 wells drilled in 2012
120 well failures.
8.9% rate of failure.

Figure 2. Revised results of survey of leaking wells in the Pennsylvania Marcellus play based on violations issued by the DEP and well inspector comments. Violations and comments data from http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/OG_Compliance

May 14, 2014

CERTIFIED MAIL NO. [Redacted]

Re: 58 Pa.C.S § 3218 Determination
    Complaint No. 303704.
    Springville Township, Susquehanna County

Dear: [Redacted]

The Department has investigated the possible degradation of your water supply well located at the address above in Springville Township, Susquehanna County in response to a report of foaming and odors in your water supply. On 4/8/2014, the Department collected samples from your home water supply. The samples were submitted to the Department’s laboratory in Harrisburg for analysis. The analytical reports for the samples are included.

The sample results showed methylene chloride was present at 1.66 micrograms per liter (μg/L) and tetrachloroethylene (PCE) was present at 2.28 μg/L. Acetone and t-Butyl alcohol (TBA) were present at 4.31 μg/L and 15.7 μg/L, respectively. Acetone and TBA were also detected in the field blank submitted to the laboratory. The sample results showed ethylene glycol was present at 320 μg/L and 2-butoxyethanol was present at 200 μg/L. The detections of VOCs, 2-Butoxyethanol and ethyl glycol in your water supply and the consistency of these detections with the chemical composition of Air Foam is indicative of an impact related to the use of the surfactant (Air Foam) during the drilling of the Chief Kupscznik B pad.

Because drilling activities occurred at a gas well within two thousand five hundred feet of your water supply, and the pollution occurred and was reported within one year after completion of the well, under Section 3218 of the Oil and Gas Act (58 Pa.C.S. §3218), the gas well operator is presumed to be responsible for the degradation of your water supply.

The Department is continuing to work to permanently resolve this issue. Should you have any questions concerning this matter, please feel free to contact Eric Rooney, P.G. at 570-346-5543.

Sincerely,

[Signature]

Jennifer Means
Environmental Program Manager
Oil and Gas Management
Importance of Baseline (pre-drilling) Residential Well Testing

Expensive to run a full panel for possible chemical toxicants:

$700 to $1100

Residential well owners worried about baseline water quality testing as it may indicate problems which the resident should correct.
**PA-DEP Recommended Basic Oil and Gas Pre-Drill Parameters** which lists their recommended water tests as part of Marcellus gas drilling activity.

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<td>Lead</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total petroleum hydrocarbons</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue (filterable and non-filterable)</td>
<td>2</td>
<td></td>
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</tbody>
</table>

Table 1. The table lists parameters that various agencies recommend for private water quality source testing in relationship to gas well drilling. Parameters are numbered according to tiers of relative importance, with 1 being the most important.
Oil and Gas Industry Violations in Pennsylvania

- **1.5 = avg. # violations per day**, Jan. 2011 through Aug. 2014, committed by the top 20 offending companies

- Endangering drinking water through improper well construction

- Dumping industrial waste into local waterways

- Top violators include large operators: Cabot, Chesapeake, and subsidiaries of Exxon-Mobil and Shell

- **These and other top violators own mineral rights in MARYLAND**

- Top violators include the 4 firms saying they would adhere to higher standards when they formed the Center for Sustainable Shale Development in 2013

- **Bottom line:** # and severity of violations bring into question **MDE’s ability to construct adequate & enforceable regulations??**

  (released by Environment America Research & Policy Center, 1/27/15)
Exemptions from Federal Environmental Laws

- Clean Air Act
- Clean Water Act
- Safe Drinking Water Act ("Halliburton Loophole")
- CERCLA—Superfund
- Resource Conservation and Recovery Act
- National Environmental Policy Act
- Toxic Release Inventory under the Emergency Planning and Community-Right-To-Know Act
Important studies are currently underway in several states, many of them in the Marcellus Shale close to Maryland:

**West Virginia**: experimental gas well in Morgantown will document occupational health and air and water contamination over a five-year period at this facility in the Marcellus Shale.

**Pennsylvania**: shorter-term studies on asthma and pregnancy outcomes; longer-term studies on cardiovascular indices associated with UNGDP in the Marcellus Shale.

**Texas**: study of potential pregnancy risks experienced by women living near Barnett Shale hydraulic fracturing sites.

**Colorado**: ongoing study of endocrine disrupting chemicals found in water supplies contaminated by hydraulic fracturing; new study of stress, inflammation, cardiovascular health and quality of life among people in communities with and without hydraulic fracturing.

**American Petroleum Institute**: evaluation of whether a causal relationship exists between community exposure to UNGDP operations and selected health outcomes; proposals submitted by several academic institutions, including Johns Hopkins, by 8/29/14 deadline: API has not yet awarded funding for this research
Atmospheric GHG’s

- Both methane and CO₂ are at levels in the atmosphere higher than the last 400,000 years.
- Methane is 100x more potent than CO₂ over 10 years.
- Rise in methane is largely due to agriculture and extracting and burning fossil fuels.
In conclusion:

MDE proposed regulations PRIOR to 75% of health research published.

96% of all health research shows significant risks or harms, including possible birth defects. *Animal and gas worker sentinels are very alarming!*

Pro-fracking enthusiasts rely on EPA, and **EPA has exited this arena.**

Many important health studies are under way, including regional research.

There is **no scientific evidence** that the moderately high & high risks of public health harm, identified by MIAEH, will be mitigated by the O’Malley regulations.

**Well leakage from cement and casing failures remains an engineering and material science problem that industry has been unable to fix** – no regulations can solve that -- the *greatest source of surface and groundwater contamination.*

**Lessening of the proposed regulations**, as advocated by our Western MD Delegation and the Chamber of Commerce, **will put citizens at even greater risk.**

The economic study failed to show any NET economic benefit – it didn’t even quantify costs to tourism or health care – **so why should we accept ANY health risks if there’s no clear economic benefit?**
RESOURCES

Physicians, Scientists, Engineers for Healthy Energy
Psehealthyenergy.org
  ❖ Online courses
  ❖ Database – peer-reviewed literature
  ❖ Frequent updates
  ❖ Summary materials

Concerned Health Professionals of NY
Concernedhealthny.org
  ❖ Compendium
  ❖ Videos
THE REAL COST OF FRACKING

HOW AMERICA’S SHALE-GAS BOOM IS THREATENING OUR FAMILIES, PETS, AND FOOD

MICHELLE BAMBERGER and ROBERT OSWALD

Foreword by SANDRA STEINGRABER
End of Presentation

Additional Slides in case there is more time or there are questions that may be addressed by the following. Ann Bristow, 3/17/15
EPA and GROUNDWATER CONTAMINATION INFORMATION:

Delegate Beitzel, March 3, 2015 letter to constituents:

“EPA has not, despite report to the contrary, demonstrated or proven that there has been contamination to ground water from a single well. The one case reported in Pavillion, Wyoming, where EPA drilled a test well, proved to be false.”

From EPA and Wyoming:

EPA had 2 deep monitoring wells at Pavillion, WY which found chemicals that are present in drilling & fracking fluids; however, according to WY Dept. Environmental Quality, EPA did not case their monitoring wells correctly, and EPA abandoned the study.

From EPA’s March 25, 2014 update on Pavillion, WY: “EPA is continuing to provide input to the state of Wyoming in their ongoing investigation of Pavillion groundwater issues.”

http://www2.epa.gov/region8/pavillion
While EPA is “Missing in Action,”

News outlets, including the Associated Press, are not.

Following lawsuits and numerous open-records requests,

The PA Department of Environmental Protection regulators released:

243 cases involving residential water wells contaminated by 

wastewater from conventional gas wells as well as shale gas wells.

Industry response: PA has “long-standing water-related challenges.”

PA’s State Auditor General criticized the “DEP for mishandling complaints about water quality and drilling, including poor record keeping.”

DELAYS IN SEEING HEALTH EFFECTS

Delays between release of toxic chemicals and when they affect humans and animals.

Effects from air contaminants show up earliest; exposure from contaminated soil and water can take longer.

Water-borne contaminants may leak slowly, taking 5-10 years to affect drinking water sources, depending on rock formations they travel through.

Groundwater contamination in Western MD, the mountains and valleys, numerous headwater streams, underground rivers, and springs, are one big aquifer; we might expect to see groundwater contamination occur more quickly than drilling in arid and flat lands of the West.
LOCAL COSTS: Many MIAEH recommendations involve local citizens, health care providers and/or county health departments to insure the health and safety of citizens and workers; funding mechanisms for implementation not specified.

Did not quantify the **costs to local government and health institutions** of:

- traffic accidents
- pipeline leaks
- chemical spills
- explosions
- worker injuries
- resident health problems
- domestic violence, sex trafficking, increased sexually transmitted diseases
- risks to our food supply

The **state-funded economic study** also did not address these costs.

MIAEH did not address Garrett County’s capacity for **EMERGENCY RESPONSE** (all volunteer fire departments, relies on Allegany County’s HAZMAT team)
Conclusions

• People are exposed to toxics through air, water and soil.
• The exposures are periodic and intense for several hours.
• Regulatory air and water screening will not detect the hazard.

• Most likely acute physical symptoms: “rash,” headache/fatigue, respiratory, nose bleeds, GI, depression.
• Biomonitoring methods need to be developed.

• Interventions and support at the patient level help with coping.
• Individuals must monitor their health and exposure status.
• Sense of community trust and social capital is destroyed.
• Federal, State and Local public health and environmental agencies are not able to effectively respond. **The Public Health Process has become rule bound, restricted to standard environmental tests of air and water and research health protocols.**