Deep-Shale Gas Drilling

Concerns for farmers and rural communities

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Director of Agricultural Policy
Ohio Environmental Council
(DATE 2011)
Gas drilling in deep shale = unconventional

Water, sand, and chemicals are injected at high pressure to release trapped gas.

Well casing cemented into place to protect aquifers and other geologic zones.

After drilling vertically to the depth that reaches slightly above the shale, the drill bit is turned horizontally and pushed into the shale a mile or more.

Fractures are created in the targeted area with perforating charges (explosions).

Fracturing fluids (sand, water and chemicals) are injected at high pressure to further crack the rock and release the gas.
Developed in the late 1990s, not the 1940s.

Really began to be used more extensively after 2005, when exempted from several important provisions of the federal environmental regulations.

“Slick-water hydraulic fracturing” because it uses a different mix of chemicals than the older methods—reducing the amount of gelling agents and adding friction reducers (thus the term “slick”).

The hydraulic fracturing technique to be used in the Marcellus shale is also known as “high volume” hydraulic fracturing (HVHF) because it uses much more fluid than old hydraulic.
How is high-volume hydrofracturing different?

More fresh water used

More chemicals

More toxic air emissions

More toxic waste requiring disposal

More heavy truck traffic

More intense, industrial-scale development
Implications for farming and rural communities?

• Competition for water resources

• Contamination of water resources

• Impact of toxic air emissions on plant growth and animal health

• Landscape disruption – fragmentation

• Community and economic impacts
Competition for water resources

HVHF typically uses 2 to 7.8 million gallons of fluid (or an average 5.6 million gallons)

Each well can be “fracked” up to 18 times, using millions of gallons of water each time

70 - 300 x more water than conventional hydrofracturing!
Forcing waste into deep injection “disposal wells”
Impact on drinking water resources

Surface spills

Abandoned wells & natural faults

Gas migration into aquifers from high pressure (recent study – 17%)

May be located near heavily populated areas or areas with private wells, agricultural ponds

Horizontal orientation increases likelihood of pollution because more likely to run under surface water sources – aquifers, lakes, streams, springs, rivers & ponds
Impact on crop production

Colorado Oil and Gas Industry Spills
- Spills Affecting Water -

Data Source: Colorado Oil and Gas Conservation Commission
2005 – 2009: 14 Oil and gas service companies used more than 2,500 hydraulic fracturing products containing 750 chemicals and other components.
Methanol – Methanol has a high toxicity in humans. And most widely used chemical found in 342 hydraulic fracturing products

- Hazardous air pollutant on candidate list for potential regulation under the SDWA
- Can cause central nervous system depression, headache, dizziness, nausea, lack of coordination and confusion

Between 2005 and 2009, the oil and gas service companies used 29 chemicals in 650 different hydraulic fracturing products that are

- known or possible human carcinogens,
- regulated under the Safe Drinking Water Act for their risks to human health, or
- listed as hazardous air pollutants under the Clean Air Act.
The problem is not only what goes in, but also what comes out ....

*NORM*: normally occurring radioactive materials – strontium, uranium, radon, etc.

Heavy metals: lead, mercury, etc.

Methane gas

Chemicals and other additives
Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

Stephen G. Osborn, Avner Vengoshb, Nathaniel R. Warneb, and Robert B. Jackson
Edited* by William H. Schlesinger, Cary Institute of Ecosystem Studies, Millbrook, NY, and approved April 14, 2011 (received for review January 13, 2011)

Methane concentrations were 17% higher on average closer to natural gas wells

Average distance between PA drinking water wells and the Marcellus Shale = 2,900 – 5,900 feet

Did not find contamination from fracking fluids

But concern is whether chemical contaminants that are left underground (up to 85 – 90%) could follow similar trajectory over time
Failed Cement Job: Migration Through Natural Fissures

“One quarter of all cement jobs fail immediately. Three quarters fail eventually.”

Cornell Engineering Professor and Rock Fracturing Specialist, Dr. Anthony Ingraffea
Risks to livestock

April 28, 2009

Fluid leaked from the well pad then ran into an adjacent pasture in South Caddo Parish, Louisiana.

17 cows died from exposure to frac chemicals

In July 2010 the Pennsylvania Department of Agriculture quarantined 28 head of Tioga County cattle after they were exposed to natural gas wastewater seeping from a holding pond. The cattle were on pasture adjacent to the pond built to collect flow-back liquids.
Toxic air emissions

*Emissions are invisible to the naked eye*
# Toxic emissions

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Impacts from ozone

• Ground level ozone causes more damage to plants than all other air pollutants combined.

• Dicot species (soybean, cotton & peanut more susceptible to yield loss caused by ozone.

• Other “ozone sensitive” crops include beans, rice, spinach, tomato and alfalfa and other forage, clover and other forages.
Municipal Sludge

EPA cannot assure the public that current land application [of sewage sludge] practices are protective of human health and the environment.
Ozone and crop yield

Effect of $O_3$ on Yield of Crops

- Sorghum
- Field Corn
- Winter Wheat
- Soybean
- Peanut
- Cotton

Range of Ambient $O_3$

Seasonal Mean Ozone (ppb)

Relative Yield (%)
Soil contamination

Heavy metals found in soils near gas sites:

*Cadmium*
*Chromium*
*Arsenic*
*Lead*
*M Mercury*

3,280 mg/l *strontium*
Water Soluble Strontium

• A study published in the *Journal of Petroleum Technology* focusing on the concentrations of selected important contaminants in Pennsylvania from Marcellus Shale flowback water found that approximately 3,280 mg/L of strontium—or 16,737 pounds—are released every day into the Monongahela River.

• It is in those high concentrations that strontium poses a risk of bone cancer, cancer of the soft tissue near the bone, and leukemia.
Pathways for plant uptake of organic chemicals

Dry and wet deposition of particles follow by desorption into the leaf

Gaseous deposition to leaf via cuticle and stomata

Suspension of soil particles by wind and rain

Deposition from soil follow by root uptake from soil solution
Habitat and farmland fragmentation

Drilling well pads, roads, ponds and other infrastructure in New York farmland
Larger disturbed areas, significant footprint

Each well pad can be 4 – 5 acres (or larger)

Contains multiple wells – up to 8 per well pad

Multiple horizontal “fracs”
More industrialization – *not* your grandfather’s well

Preference for many wells in a region

Average density in Marcellus shale is expected to range from 6 – 8 wells per square mile (based on 640 acre unit) to 16 or more per square mile.

Infill wells and drilling in other shale layers can increase well density even more.
More truck traffic

One well may require:

1,760 to 1,905 trips

Typical well pad with 7 wells = **13,000** round trips to local roads

Includes tanker trucks for water, sand, drilling rig equipment, waste (flowback) water removal
Economic Impact?

Boom and bust – job creation and job loss tend to follow pattern of boom & bust

Few “local” jobs – relatively small, experience-driven workforce (roughnecks, rig crews) who travel from well site to well site

June 2009 study: single well could directly create 11.53 full-time jobs/year, not compounding yearly (depends on number of new wells drilled). 98% of these jobs required only while wells are being drilled (Marcellus Shale Workforce Needs Assessment).

Only 0.17 long-term, full-time “permanent” jobs associated with the production phase of development for each well drilled, but jobs compound annually. 100 wells drilled each year for ten years = 17 production jobs each year = a total of 170 production jobs after 10 years

Economic “boom” doesn’t typically factor in high costs of industrialized gas drilling – bridge repairs, declines in farming and tourism revenue, reduced property values and property tax revenues
Good For The Local Economy?

Economic Impact?

Potential Marcellus Shale Royalties Compared to Other Upstate New York Incomes Over 20 Years

- Wildlife Watching
- Hunting & Fishing
- Dairy
- Grapes and Wine
- Farm Receipts
- Tourism

Dollars (Billions)

- All Other: $350 Billion
- Gas: $16 Billion

Based on data provided by Dr. John Schwartz
Impact to Organic Production

- **National Organic Program (NOP)** of the USDA implements and enforces regulation of certified organic facilities.

- Fracturing chemicals pose a risk to organic certification through accidental application of prohibited materials or spillage to certified land (NOP §205.202).

- Product ingredient information for all products used in certified organic production must be disclosed as part of the Organic System Plan (NOP §205.201).

- Products released into the soil (such as gas/heavy metals in amounts that are excessive or pose a soil/water quality risk) can compromise certification- even if naturally occurring.

- Soil, product, tissue sampling can be taken by inspector or by certification agency at any time to verify compliance (NOP §205.201).

- Sewage sludge application to land is a prohibited practice per NOP §205.105.
The Halliburton Exemption

Important environmental oversight and regulation of the natural gas production was removed by the executive branch and Congress in the 2005 Federal Energy Appropriations Bill

Exempted from important provisions of the:

- Clean Water Act (CWA)
- Safe Drinking Water Act (SDWA)
- Clean Air Act (CAA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)(Superfund)
- Emergency Planning and Community Right to Know Act (EPCRA)(Toxic Right-to-Know Act)
New U.S. EPA study

EPA will investigate how fracking affects drinking water – budgeted at $3.5 million over 2 years (2012) (2014)

Study to be transparent and peer reviewed, 4 hearings

EPA’s study is based on *life cycle impacts* of fracking fluids

Impacts from water demands and the air pathways included
Ohio is not prepared for high volume, horizontal hydraulic hydrofracturing

SB 165 (2009) – First modernization of Ohio’s 40 year old oil and gas drilling laws

Did not adequately address the challenges from intensive industrialization from high volume, horizontal hydraulic fracturing

Important environmental and public health protections related to the use of toxic chemicals, well siting, air emissions, public safety, and more, were left unresolved

2010 “STRONGER” Report (State Review of Oil and Gas Environmental Regulations) noted that . . . “future program changes in Ohio would be necessitated by the anticipated development of the Marcellus and Utica Shales”
Ron Gulla

- Landowner, Agriculture Producer
- Washington County, PA
- Testimony to first-hand experience with horizontal and vertical well fracturing experimentation on own land and neighboring parcels
- Exposures started in his community in 2005
Recommendation

The Ohio General Assembly should immediately issue a moratorium ordering the Ohio Department of Natural Resources (ODNR) to withhold approval of new well permits involving high volume, horizontal hydraulic drilling, exploration, or extraction until such time as drilling practices are demonstrated to be safe for the environment and human health, and are properly regulated.
Thank you!

Questions?