Hydraulic Fracturing for Shale Gas Production: Practices & Progress

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Objectives

- Dispel misconceptions
- Clarify potential risks
- Inform public about regulations
- What can concerned Michiganders do?
Scope of Today’s Discussion

- Shale Gas Drilling & Fracturing Primer
- What are the Environmental Concerns?
- Michigan Activity and Regulations
- Protecting Michigan’s Fresh Water

My Interests in Fracturing

- Professional responsibility to the public and clients (oil & gas; water supply)
- Resource extraction and environmental protection are not mutually exclusive
- More that the public understands, the more responsible development can proceed
Why So Much Fracking?

- Demand for natural gas
- Favorable geology over much of the United States

Directional & horizontal drilling technology

"Unlocks" previously difficult to recover natural gas

Allows a much greater capture area than a vertical well.

Image courtesy USEPA
Fracking 101

- **Hydraulic Fracturing**: a well stimulation process used to maximize the extraction of underground resources
- Pressurized injection of fluid (99.5% water + 0.5% additives) to open or enlarge fractures. Typical: 2 to 6.5 million gallons, injected over multiple fracking pulses
- **6.5 Million gallons =**
  - 3/8-inch rainfall over ~ 1 square mile
  - Daily dewatering of a limestone quarry in Michigan
  - 150-ft cube of aquifer with 25% porosity

Typically, shallow aquifers and shale gas zones are separated by thousands of feet of rock.

The two zones are separated by multiple steel casing “strings”.

Image courtesy API
Fracking 101

Multiple well casings ("telescoping") are cemented into the formations to restrict movement of gas and frac fluid up and down the borehole.

A bond log is run to test for secure cementing.

An inert "propping agent" (silica sand or ceramic beads) is pumped into the fractures to keep them open.

Natural gas is released from pores and fractures into the well for subsequent extraction.

Frac fluid "backflow" returns to surface storage with the gas.
Concerns & Risks

Primary concerns include:

- Migration of gas or fracture fluids to aquifers
- Identification of chemical additives
- Management of backflow; surface spills; secondary containment & tanks vs. pits
- Groundwater withdrawal for frac fluid mixing

Concerns & Risks: Migration

Q: Does fracking allow released gas to “waft” upward into an aquifer?
A: Doubtful – assuming good construction

- Most shale gas is too deep; injected frac fluid volume is too small
- Shale is a layered rock – it tends to fracture horizontally, not vertically
- Possible migration up casing?
- What if fracked zone is shallow?

Image courtesy MDEQ
Concerns & Risks: Chemical Additives

Q: How can one know what’s in frac fluids?

A: Suggestion:
FracFocus.Org

Partial list:
- Quaternary Ammonium Chloride
  Eliminates bacteria in the water that produces corrosive by-products
- Tetrakis Hydroxymethyl-Phosphonium Sulfate
  Eliminates bacteria in the water that produces corrosive by-products
- Ammonium Persulfate
  Allows a delayed break down of the gel
- Sodium Chloride
  Product Stabilizer
  Breaker
- Magnesium Peroxide
  Allows a delayed break down of the gel
- Calcium Chloride
  Product Stabilizer
- Choline Chloride
  Prevents clays from swelling or shifting
- Tetramethyl ammonium chloride
  Prevents clays from swelling or shifting
- Sodium Chloride
  Prevents clays from swelling or shifting
- Isopropanol
  Product stabilizer and / or winterizing agent
- Acetaldehyde
  Prevents the corrosion of the pipe
- Petroleum Distillate
  Carrier fluid for borate or zirconate crosslinker

Source: FracFocus.org
Concerns & Risks: Chemical Additives

Q: How can one know what’s in frac fluids?
A: Suggestion: MSDS sheets available from MDEQ/OOGM

- Instruction 1-2011 (June 22, 2011): Operators must provide DEQ with MSDS for additives used in hydraulic fracturing fluid

- MSDS must include information on physical characteristics, toxicity, health effects, reactivity, storage, disposal, spill response, et al.

- Some chemical compounds are still exempt due to: a) threshold requirement and b) manufacturers can withhold “trade secrets.”

- MSDSs not required until 60 days following drilling completion.

Concerns & Risks: Backflow Management

- Michigan DEQ does not permit pits for storage of backflow frac fluid

- Backflow commonly re-used

- Most spent frac fluid is disposed via deep injection wells (USEPA – UIC Program)

- No dust control allowed in MI

Image courtesy API
Concerns & Risks: Water Withdrawal

- The Water Withdrawal Assessment Tool (WWAT) estimates the hydraulic impact of a water withdrawal.
- Required for a new or increased large quantity withdrawal (over 70 gallons per minute).
- WWAT is required to determine if a proposed withdrawal is likely to cause an Adverse Resource Impact (ARI).
- MDEQ will not approve water withdrawals that will create an ARI.

Hydraulic Fracturing in Michigan

- Since 1952, over 12,000 wells have been hydraulically fractured in Michigan.
- Most are vertical wells in the Antrim Shale - lower volume fracture jobs than horizontal drilled Utica and Collingwood completions.

Source: MDEQ/OOGM
Hydraulic Fracturing in Michigan

Horizontal drilling and high-volume fracking for deep shale gas is less active in Michigan than the eastern United States.

Protecting Michigan’s Water Resources

If you are a:
- current or potential lease holder
- a neighbor of a lease holder
- a water supply manager
- a concerned citizen

How can you become better informed toward protecting your fresh water resources?
Protecting Michigan’s Water Resources

Access to information for planning and protection:

- MDEQ/Office of Oil, Gas, and Minerals:  
  http://www.michigan.gov/deq/0,1607,7-135-3306_57064-87386--,00.html

- USEPA hydraulic fracturing website:  
  http://www.epa.gov/hydraulicfracture/

- Michigan Oil & Gas Association:  
  http://www.michiganoilandgas.org/News.aspx

Other trade association and public forum websites:

- Propublica:  
  http://www.propublica.org/series/fracking

- Frack Focus:  
  http://fracfocus.org/

- Energy From Shale:  
  http://www.energyfromshale.org/

- National Geographic:  
Protecting Michigan’s Water Resources

- Establish a background monitoring program before shale gas drilling and fracking begin
- Test for naturally-occurring gas and petroleum hydrocarbons
- Are there natural or man-made sources of gas in your area?

Conclusions

- In a properly constructed well, hydraulic fracturing of shale formations does not cause gas to migrate upward into aquifers.
- Reported occurrences of impacted groundwater and surface suggest other migration pathways. Proper grouting and backflow management are the keys to water resource protection.
- Gas is released naturally from shallow formations into shallow water supplies – there is a need to define pre-drilling background conditions.
- Producers and the MDEQ/OOGM are committed to safe shale gas production.
For additional information, please contact me at:

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