Marcellus Shale Gas Extraction: Potential Public Health Impacts & a Tool to Track Them

Samantha Malone, MPH, CPH

Communications Specialist & Doctorate Student
Center for Healthy Environments & Communities
University of Pittsburgh Graduate School of Public Health
slm75@pitt.edu
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www.chec.pitt.edu | www.fractracker.org
Marcellus Shale Range & Production Estimates

2008 – 50 TCF (trillion cubic feet) of estimated recoverable natural gas

November 2008 – Based on Chesapeake’s production, estimate of recoverable gas from the Marcellus Shale raised to more than 363 TCF (Esch, 2008)

U.S. uses about 23 TCF of natural gas per year (U.S. Energy Information Administration, 2009), so the Marcellus gas resource may be adequate to supply U.S.’s needs for roughly 15 years at current rates

Extent of shale in Northeast
Conventional and Non-conventional Natural Gas Extraction Methodologies

Schematic geology of natural gas resources

- Conventional non-associated gas
- Conventional associated gas
- Coalbed methane
- Tight sand gas
- Gas-rich shale
- Oil
- Sandstone
- Seal
- Land surface

U.S. Energy Information Administration
Marcellus permitting activity in Ohio 2006-10
Triggers of Potential Public Health Concerns

1. Water usage
2. Exposure to fracking chemicals
3. Flowback water spills & leaks
4. Inadequate flowback water treatment & disposal
5. Exposure to contaminants in air
6. Methane gas migration & blowouts
7. Social & behavioral disruption
Water Usage

- Approximately 5 million gallons of water needed
- Amount varies based on company’s water recycling practices
- Lowers freshwater aquifers and surface water sources
- Need to take into account cumulative water withdrawals from any fresh water source
Exposure to fracking chemicals

- Risk for spills or leaks during transit & drilling exists. (Witter 2008)
- Complaints have already been filed in Marcellus Shale region. (Soeder & Kappel, 2009)
Purple stars are non-Marcellus. All others are Marcellus.
Drilling site and frac pond close to a home

Drilling activity’s proximity to a home in Southwestern PA
Flowback water spills, leaks, & disposal

- Spills and leaks from the storage units have occurred
- Safe disposal of the large quantities of fracking fluid & waste water recovered from the wells
- Possible contaminants from ground could be present in fluid that returns to the surface
- This fluid may be difficult to treat
- Deep well injection of brine & byproducts from PA sites is occurring in Ohio:
  - Brines, radionuclides, heavy metals, & organics (Harper 2008)
Pit for recovered flowback fluid

Photo Credit: Donnan (2009)
Washington County, PA
Exposure to contaminants in air

- Notice the air emissions being emitted from this site.
- Drilling in the Marcellus is only in the developmental stage of MSGE exploration.

Photo Credit: Catskills Mountainkeeper
Air Quality Concerns

- Gas drilling process, Compressors and Fracturing Ponds can emit volatile organic compounds (VOCs), most notably BETX (benzene, ethalbenzene, toulene, xylene)
  - Benzene: known human carcinogen
  - Trimethylbenzene: Chronic exposure to trimethyl benzene has caused nervousness, tension, anxiety, asthmatic bronchitis and blood changes in humans.
  - Xylene – neurotoxin
  - Carbon Disulfide – neurotoxin
  - Dimethyl Disulfide - neurotoxin
Methane gas migration & well blowouts

- Water well contamination & explosions have been reported.
- The explosions have allegedly occurred due to a build up of methane gas (which is highly combustible) in the wells. *(Pittsburgh Post-Gazette 2009)*
- Gas well blowouts have occurred in WV, PA, and OH

Photo: Shawn Fiorentino inspects his mother Norma's well after a methane explosion in Norma's front yard in Dimock PA. Image credit: The Times-Tribune 2009
Drinking well water testing

- Well water testing is very important, but expensive.
- Negotiate water testing with the gas drilling company
- Have a baseline test done prior to drilling.
- Confirm testing is being done by a state-certified lab.

Find a lab by searching the PA DEP Laboratory Accreditation Program: http://www.portal.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095
Water Testing – What is Important

- **Flow back and Produced Water elements:**
  - **Strontium** - Exposure to stable or radioactive strontium occurs from ingesting contaminated food or drinking water or breathing contaminated air. In children, high levels of stable strontium can impair bone growth. High levels of radioactive strontium can cause anemia or cancer. (ATSDR)
  - **Barium** - Gastrointestinal disturbances followed by hypokalemia, hypertension, and heart rhythm abnormalities are frequently reported following acute oral exposure to high doses of barium. (ATSDR)
  - **Manganese** - The most common health problems in workers exposed to high levels of manganese involve the nervous system (ATSDR)
  - **Magnesium**
  - **Organics**
Additional Potential Health Effects

- Stress caused by noise & light pollution
- Nauseating odors
- Boom town effects
  - Higher mental health case loads
  - Increased rates of crime, divorce, suicide, & alcoholism

Gas flare in Marcellus Shale region
Image credit: www.marcellus-shale.us
Community Safety and Road Degradation

Wetzel County, West Virginia
(Courtesy of Wetzel County Action Group)

Below: Trucks parked along blind bend in road.

Above: Slip below drill site closes road to ambulance.

Below: Road Disintegration from Truck Traffic
Significant Challenges for Local Government

*Jurisdictional unevenness*: The energy development prompting population growth takes place in a political jurisdiction different from the one which bears the cost.

*New Comers vs. Old Timers*: Rapid growth frequently requires major new infrastructure expenditures to accommodate new residents and older residents may oppose subsidizing such expenditures under uniform taxation arrangements.

*Insufficient control of land use*: decisions about disposition of land as in federal coal or offshore leasing prevents the local government from using zoning or siting arrangements to ease adjustment.

*Severity of growth*: Sheer numbers of people entering to work, despite inadequate housing, may be unassimilatable without significant declines in quality of public services and community life.
Volatile production patterns: The boom-bust cycle associated with energy development presents the local government with an uneven future path of public service demand.

Monopoly of information: the industry or regulatory agency exercises tremendous power over the pace of development and the amount of information that is available to planners; sometimes, an incentive to misinform exists.

Risk. The uncertainty surrounding the future of many energy activities raises the risk premium, often so high that the financial sector is unwilling to lend funds to or buy bonds of local governments.

Shale Gas Drilling Represents an Intersection of:

- Politics
- Economics
- Environmental preservation
- Science
- Policy
- Regulation
Concerns with Marcellus Shale Development

- A great deal of data and information but no way to access it with ease

- A need for many different stories to be told about the impacts of this shale play

- Dissemination of information is critical because the industry has owned a good deal of the information market for a long time

Major Data Gaps!
FracTracker

Blog and Data Tool for Tracking Impacts of Shale Gas Extraction

Visit https://fractracker.org to learn more.
The Purpose

Manage Various Geo-located Datasets

- Environmental
- Environmental health
- Social & Behavioral Health
- Emergency preparedness
- Community & Public health
- Land use

Applications for All Shale Plays throughout U.S. & World
The Theory behind FracTracker

CROWDSOURCING
USING THE MASSES TO MAKE SOMETHING BETTER THAN YOU COULD BUILD ALONE
The Blog – http://fractracker.org

Potential Shale Gas Extraction Air Pollution Impacts

How Organic Compounds Contained in the Shale Layer Can Volatilize Into Air, Become Hazardous Air Pollutants and Cause Ozone Formation

By: Conrad Dan Vola, DrPH, MPH; Drew Michanowicz, MPH, CPH; Charles Christen, DrPH, MS; Samantha Malone, MPH, CPH; Kyle Ferrer, MPH - Center for Healthy Environments and Communities (CHEC), University of Pittsburgh, GSPH, EOH department

The Center for Healthy Environments and Communities has received numerous requests for information on how Marcellus shale gas extraction operations might contribute to air quality problems throughout the PA-NY-WV region, how air quality problems might develop in other shale plays around the country, and the potential human exposure to specific air contaminants generated in these processes. We are addressing this question in a very thorough academic fashion now by looking at the industrial processes involved from site clearance, to well drilling and hydrofracturing, to gas processing and methane and byproduct transport; we are developing conceptual site models of human exposure to contaminants generated by this very complicated industry with many sub-operations.

A conceptual site model is a written and/or pictorial representation of an environmental system and the biological, physical and chemical processes that determine the transport and fate of contaminants from a source, through environmental media (air, groundwater, surface water, sediment, soils, and food) to environmental receptors (humans, aquatic and terrestrial organisms) and their most likely exposure modes (ASTM, 2008). Again, because there are many sources and types of contaminants to understand and uncover within each gas
Register

Splash page (screen shot right)

Free & automated using Rhiza tools (software developer)

Provide name and email address to encourage data accuracy

Can view datasets and take a tour without registering, but cannot upload or download data

DataTool – http://data.fractracker.org
My Home

Your profile – name, contact info, & a summary of your activity

Library of datasets uploaded, snapshots created

Everything is public.

Explore

Dashboard / summary of site’s recent activity

Search / sort by datasets, snapshots, users, geographic area
My Home
Your profile – name, contact info, & a summary of your activity
Library of datasets uploaded, snapshots created
Everything is public.

Explore
Dashboard / summary of site’s recent activity
Search / sort by datasets, snapshots, users, geographic area
Upload
Accepts ESRI shape files, GeoTIFF raster imagery, KML, CSV, or GPX
Upload from URL or computer – Can be a new, part of a series, or replacement dataset
Provide metadata

View Dataset
Preview page (shown right) – Uploader info
Visualize data, comment or rate the dataset, or download the data

Metadata
Visualize = Map the data

This is why latitude and longitude are critical

Define what you want to show on the map

Adjust the screen to zoom in on an area

Learn more about an individual record

Save session for later or create a snapshot
Just like a snapshot you take with a camera, except this one can update automatically!

Provides information on how the snapshot is being used & what datasets were used to create it

Create a new visualization based on the snapshot

Download it

Or share it online (in pop up box to the right)
<table>
<thead>
<tr>
<th>Suggestions</th>
<th>Praise</th>
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<tbody>
<tr>
<td>- Great platform to start this database work. Not sure how exactly the general public will be able to use it.</td>
<td>- My brain hurts in most computer situations but you made it possible for me to visit and use FracTracker in the future.</td>
</tr>
<tr>
<td>- Add a page on the blog that summarizes the datasets available on the datatool so that unfamiliar users can access categorized information.</td>
<td>- Very excited that this tool helps to bring together diverse groups of stakeholders!</td>
</tr>
<tr>
<td>- More data needs to be added for drilling occurring or planned outside of PA.</td>
<td>- I’m very interested to see how the tool evolves.</td>
</tr>
<tr>
<td>- Conduct user interface testing with various user groups.</td>
<td>- The scope and successful application of technology of the FracTracker tool is fantastic. These is so much potential here.</td>
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Questions?

Contact Information:
Samantha Malone, MPH, CPH
Center for Healthy Environments & Communities
University of Pittsburgh Graduate School of Public Health
Bridgeside Point Building, 100 Technology Drive, Ste 553 BRIDG,
Pittsburgh, PA 15219-3130
412-624-9379
slm75@pitt.edu
References & Resources

- PA DEP. Laboratory Accreditation Program: http://www.portal.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095


