

# 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](mailto:slm75@pitt.edu)

October 28, 2010

[www.chec.pitt.edu](http://www.chec.pitt.edu) | [www.fractracker.org](http://www.fractracker.org)

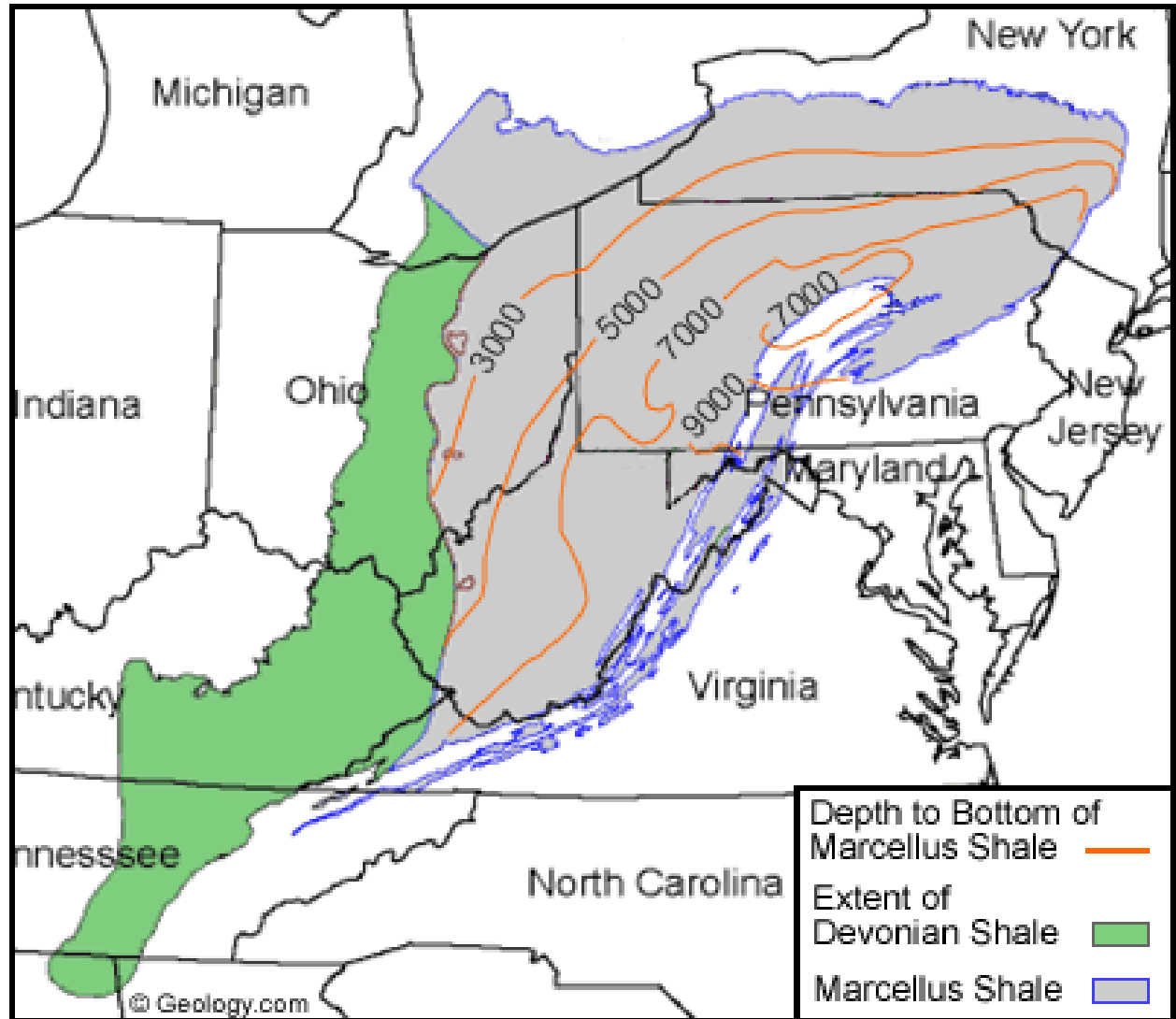


## Marcellus Shale Range & Production Estimates

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)

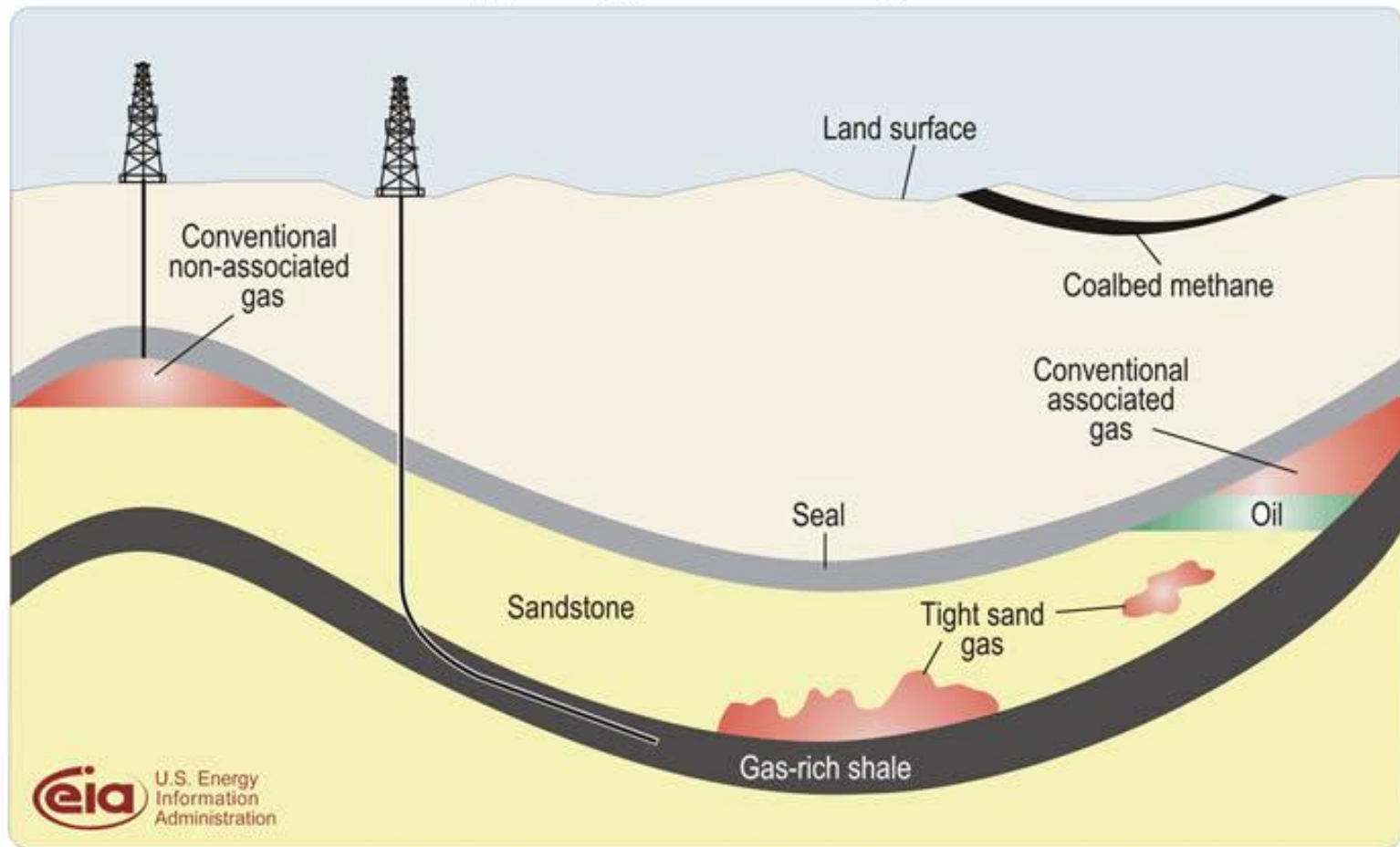
U.S. uses about 23 TCF of natural gas per year (U.S. Energy Information Administration, 2009), so the Marcellus gas resource may be adequate to supply U.S.'s needs for roughly 15 years at current rates



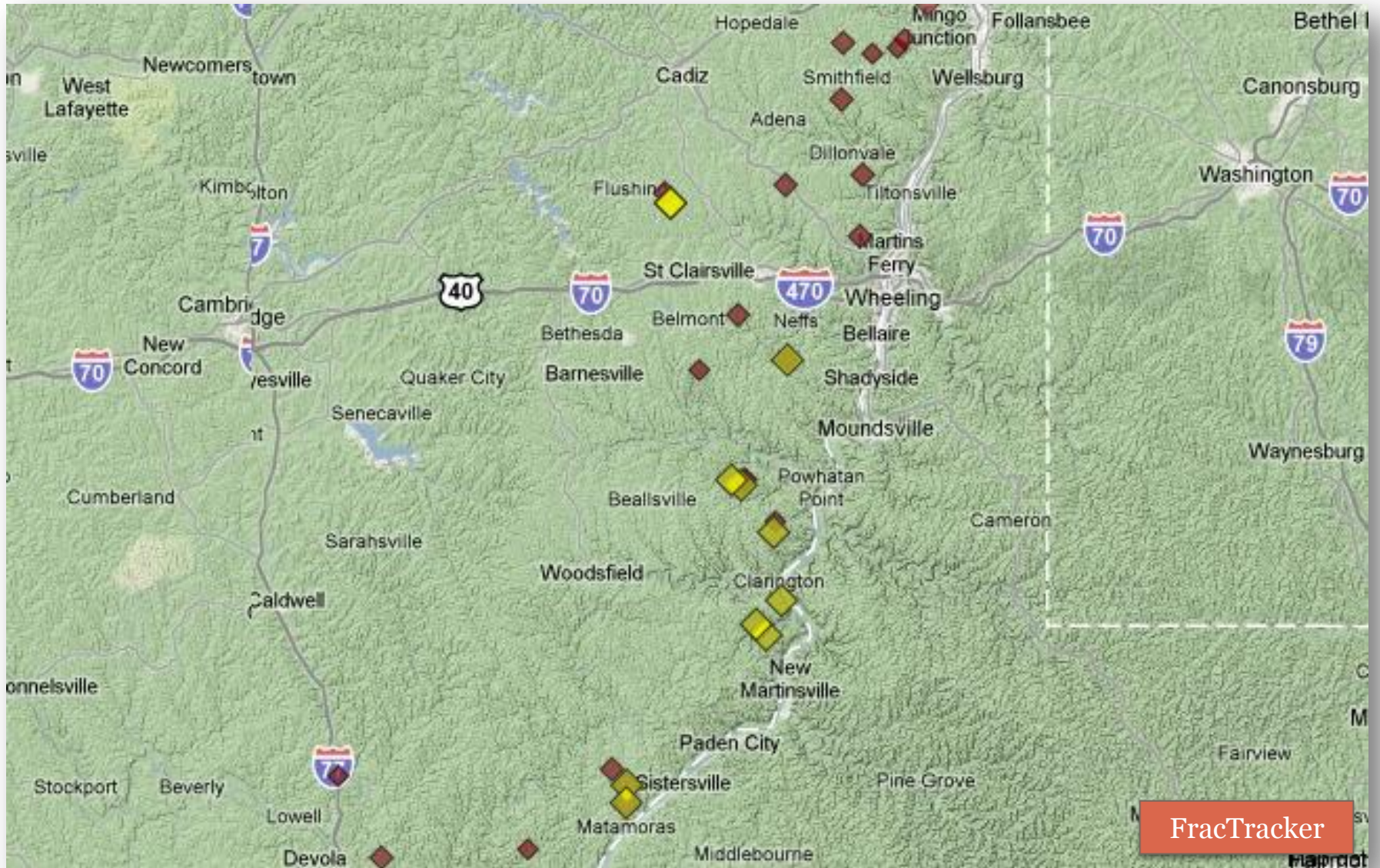
**Extent of shale in Northeast**

# Conventional and Non-conventional Natural Gas Extraction Methodologies

Schematic geology of natural gas resources



# 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)

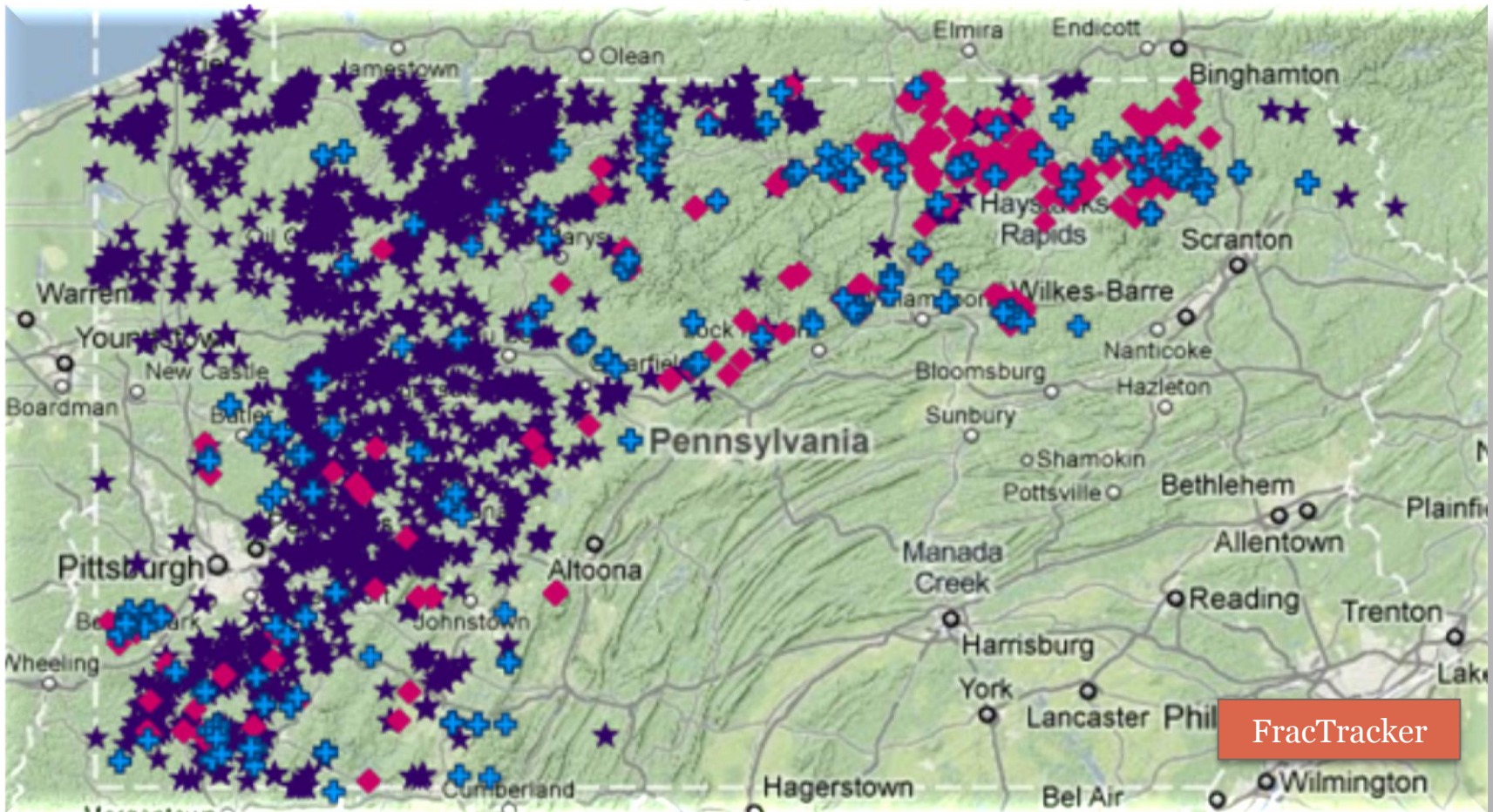


Frac fluid containers

Photo Credit: Donnan  
(2009)

Washington County, PA

# PA DEP Violations by Well Type



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



Fracking Pond Fire – Hopewell Township, PA – reported by Post Gazette April 1, 2010



Fracking Pond Fire – Hopewell Township, PA – reported by Post Gazette April 1, 2010





# 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/13780/1aboratory\\_accreditation\\_program/590095](http://www.portal.state.pa.us/portal/server.pt/community/labs/13780/1aboratory_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](http://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.

# Significant Challenges for Local Government

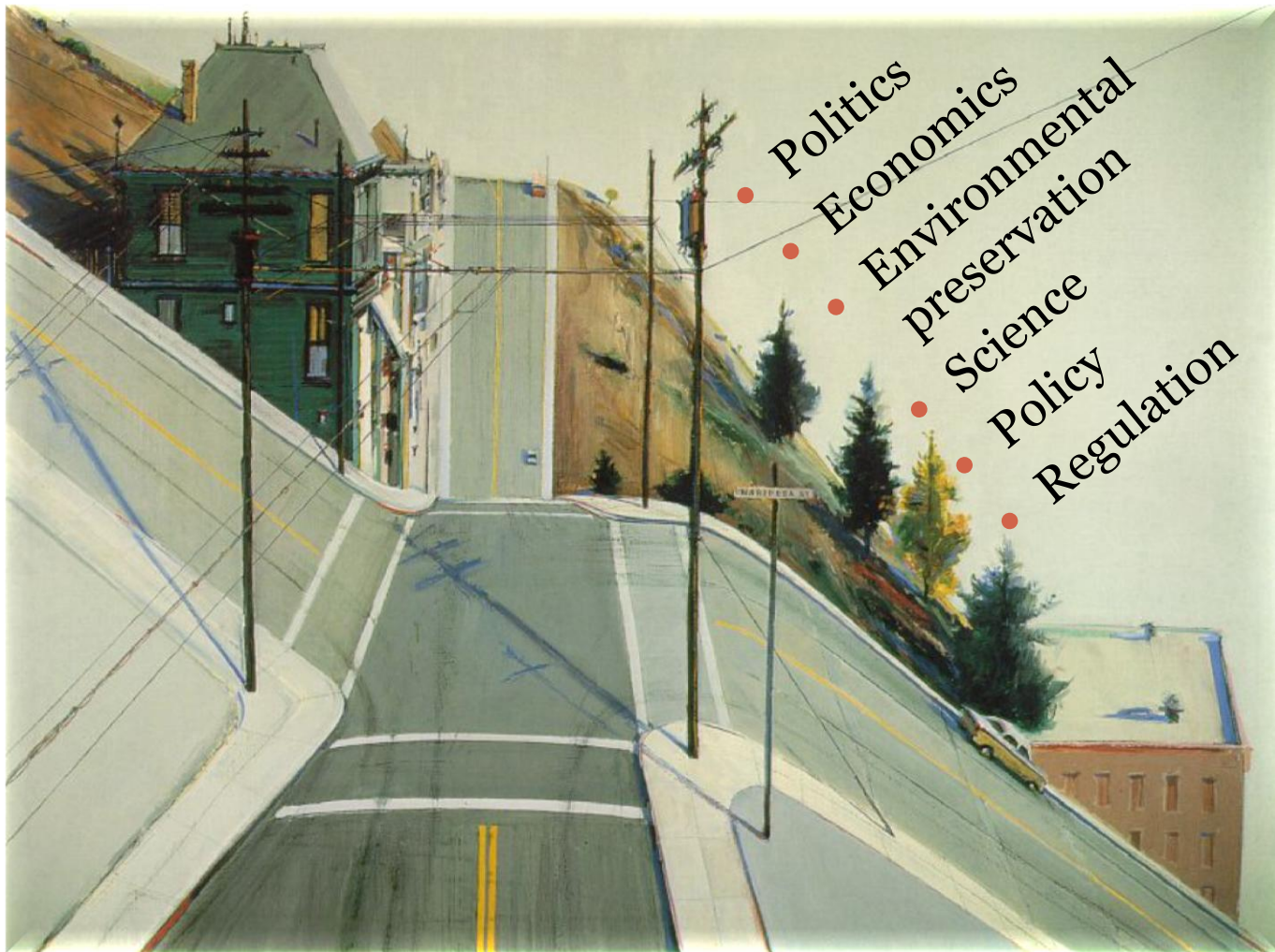


*Volatile production patterns:* The boom-bust cycle associated with energy development presents the local government with an uneven future path of public service demand.

*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 [HTTP://FRACTRACKER.ORG](http://fractracker.org)  
TO LEARN MORE.**

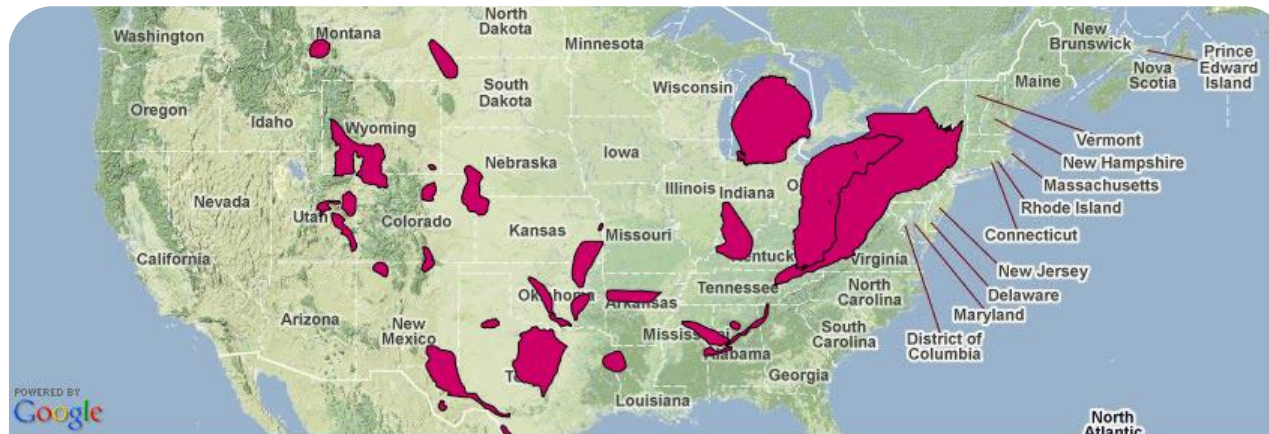
# The Purpose



## 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



Center for Healthy  
Environments & Communities  
University of Pittsburgh | Graduate School of Public Health

### Shale Gas Plays in the Continental USA

<http://data.fractracker.org/cbi/snapshot/page?concept=~017807b0de9e4411dfb75fdfab0275b52>

Created by  
Conrad Volz  
on Aug 2, 2010

Center for Healthy  
Environments & Communities  
University of Pittsburgh

Shale Gas Plays in the Continental USA

# The Theory behind FracTracker

**CROWDSOURCING**  
USING THE MASSES TO MAKE SOMETHING  
BETTER THAN YOU COULD BUILD ALONE



## Blog Features

Pages – About Us, Marcellus Resources, How FracTracker Works, DataTool, Events Calendar

Share It (Twitter, etc)

RSS Feeds – Most recent datasets from DataTool, CHEC documentary project videos, PA DEP News, Citizens' Photos

Links

Search Button

Archive

Blog Followers & Contributors

Labels/Tags from Posts



# The Blog – <http://fractracker.org>

## FRACTRACKER - MARCELLUS SHALE DATA TRACKING

TRACKING THE IMPACTS OF MARCELLUS SHALE GAS EXTRACTION

[Blog](#) [About Us](#) [Marcellus Resources](#) [How FracTracker Works](#) [DataTool](#) [Calendar](#)

TUESDAY, AUGUST 24, 2010

### 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 Volz, DrPH, MPH; Drew Michanowicz, MPH, CPH; Charles Christen, DrPH, MEd; 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 can all be environmental receptors) 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

WELCOME!

FracTracker's Blog & DataTool, (hosted by the Foundation for PA Watersheds & funded by the Heinz Endowments), provide citizens with a common place to share their Marcellus Shale drilling experiences & data. Both the Blog & DataTool are managed by CHEC.

SHARE IT

[Share this on Facebook](#)  
[Tweet this](#)

This has been shared 68 times.

[Get this for your site](#)

MOST RECENT  
FRACTRACKER DATASETS

[Community Impacts of](#)

## Register

Splash page (screen shot right)

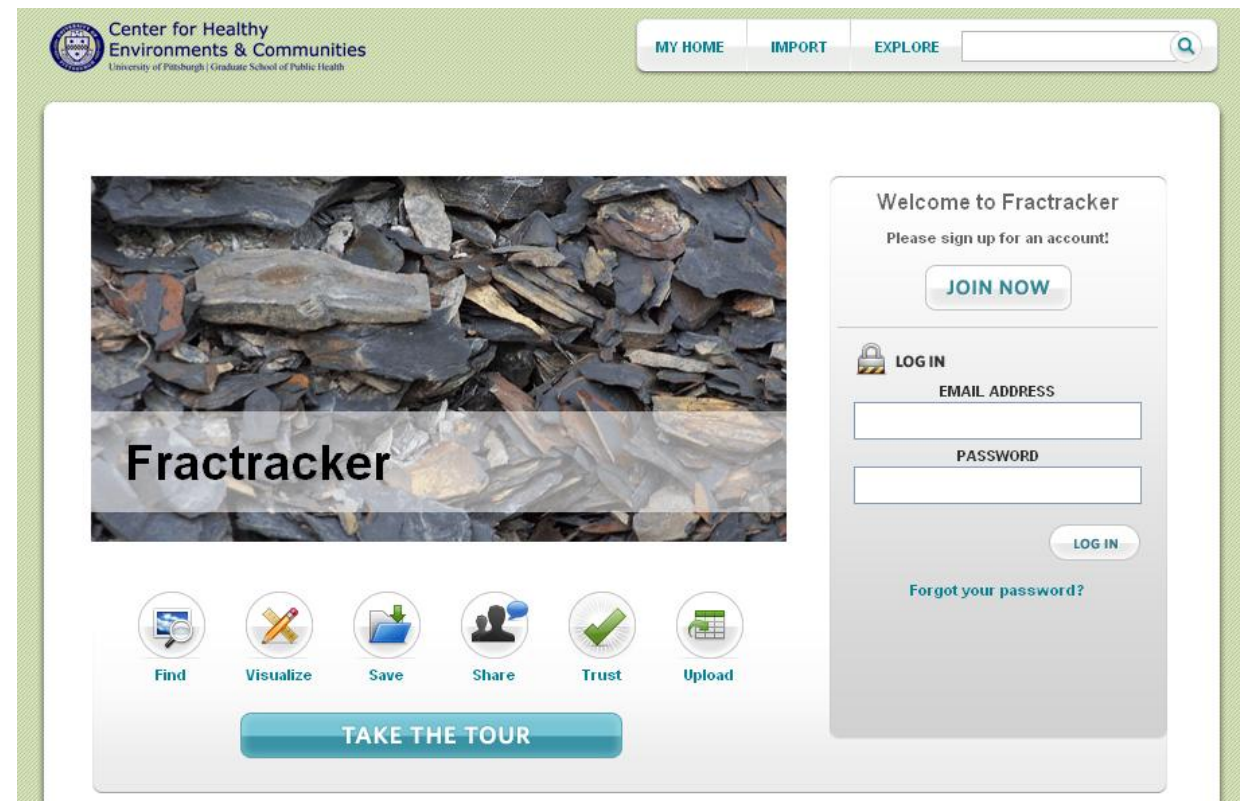
Free & automated using Rhiza tools (software developer)

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 & Explore Pages

**Center for Healthy Environments & Communities**  
University of Pittsburgh | Graduate School of Public Health

MY HOME IMPORT EXPLORE

PROFILE + LIBRARY  
**Samantha Malone**

ACTIONS

<< More details and comments about Samantha Malone

About Samantha Malone

NAME	Samantha Malone	MEMBER SINCE	19 May 2010
EMAIL	slm75 at pitt dot edu	DISCUSSION	0 Comments
WORKGROUPS	CHEC	CREATED	0 Collections
Position Title	Communications Specialist	UPLOADED	2 Datasets
Organization	Center for Healthy Environments & Communities	CREATED	10 Snapshots

EMAIL NOTIFICATIONS  ON Toggle this to turn off email notifications for comments on your items, as well as workgroup membership changes and snapshots created using your datasets.

RATING      Rate this item

LINKS Center for Healthy ... nments & Communities

Show: All Library

16 Items SORT BY: Most Recent

PA Oil and Gas Wastewater Facilities and Water Areas ★★★★★ 0 Comments Author: Samantha Malone Created: Aug 14, 2010 ACTIONS

PA Facilities Approved to Receive Oil and Gas Wastewater ★★★★★ 0 Comments Author: Samantha Malone Created: Aug 14, 2010 ACTIONS

## 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 & Explore Pages

Center for Healthy Environments & Communities  
University of Pittsburgh | Graduate School of Public Health

MY HOME IMPORT EXPLORE

Explore Data, People, and Snapshots

**Explore A Specific Geography**  
Click the button below to search for all the data in Fractrackr within a specific geographic area.

SELECT GEOGRAPHIC AREA

**Explore By Topic Or Keyword**  
Type in a topic or keyword below and press submit to search through all the information in Fractrackr.

Topic or Keyword SUBMIT

Advanced Search

Show Datasets Browse

80 Items SORT BY: Most Recent

	<b>Community Impacts of Marcellus Shale Drilling and M... xtraction Documentary Project Interviews (2010-08-24)</b> 0 Comments	Originator: Kyle Ferrar Uploaded by: <b>Kyle Ferrar</b> on Aug 24, 2010	ACTIONS
	<b>Asthma and Myocardial Infarction Rates of SW PA Counties in 2007</b> 0 Comments	Originator: CDC's National Center for Health Statistics National Vital Statistics System Uploaded by: <b>Drew Michanowicz</b> on Aug 23, 2010	ACTIONS
	<b>National Gas Transmission Pipeline Incidents 2010 to Present</b> 0 Comments	Originator: USDOT - PHMSA Uploaded by: <b>Drew Michanowicz</b> on Aug 23, 2010	ACTIONS
	<b>Marcellus Shale Drilled Wells in PA</b>	Originator: Pennsylvania Department of	ACTIONS



## 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



# Upload & View Dataset

**National Gas Transmission Pipeline Incidents 2010 to Present** ACTIONS

[<< More details and comments about National Gas Transmission Pipeline Incidents 2010 to Present](#)

**About This Dataset**

NAME	National Gas Transmission Pipeline Incidents 2010 to Present	CREATED	23 Aug 2010
UPLOADED BY	Drew Michanowicz	DISCUSSION	<a href="#">0 Comments</a>
DESCRIPTION	Data pertaining to gas transmission and gas gathering incident data. Incidents data includes: significance, operator name, location, commodity released, causes, injuries, site descriptions, minimum value for property damage, value or volume of product lost and criterion for fire and/or explosion, etc. The 2010 to present PHMSA flagged data set reports 38 total incidents across the country. Thirty Three (33) or about 87% of these incidents were reported as significant incidents.	SAVED IN	0 Collections
		DOWNLOADED	0 Times
		USED IN	<a href="#">1 Snapshot</a>
		RATING	<input type="star"/> <input type="star"/> <input type="star"/> <input type="star"/> <input type="star"/> Rate this item
		<a href="#">VISUALIZE</a> <a href="#">DOWNLOAD</a>	
CLASSIFICATIONS	Infrastructure		

**Metadata**

**Description**

TITLE	National Gas Transmission Pipeline Incidents 2010 to Present	AUTHOR/ORIGINATOR	USDOT - PHMSA
ABSTRACT	In the United States the Department of Transportation's (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA), acting through the Office of Pipeline Safety (OPS), administers a regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline. OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and	PRIMARY CONTACT PERSON	
		Email Address	
		Main Address	





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



## Visualize Data

**Visualization Tool** ACTIONS

MAP

POWERED BY Google

Lat: 41.70573 Lon: -85.69336

National Gas Transmission Pipeline Incidents 2010 to Present

All records

+ all values view

1 Dataset

National Gas Transmission Pipeline Incidents 2010 to Present

SHOW ON MAP:

all records as +

+ Search for More Datasets



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)



# Snapshots

The screenshot displays a web application interface. At the top, a navigation bar contains buttons for 'Blog', 'Register', 'Explore', 'Upload', 'Visualize', 'Snapshot', and 'Present'. The 'Snapshot' button is highlighted with a magnifying glass. Below the navigation bar, the main content area is titled 'Snapshots' and features a table with columns for 'CREATED', 'DISCUSSION', 'SAVED IN', 'BASIS OF', and 'RATING'. The table contains one row of data: 'Aug 25, 2010', '0 Comments', '1 Collection', '0 Snapshots', and a star rating system. A 'Share this Snapshot' dialog box is open on the left, showing options to share the snapshot via LINK, EMBED, THUMBNAIL, and KML. The dialog box also includes checkboxes for 'Include name & legend (large)' and 'Just the visualization (small)'. Below the dialog box, a map of the United States is shown with red markers indicating the locations of various states. The map is powered by Google and includes a legend for 'Gulf of California' and 'Gulf of Mexico'. The map data is attributed to 'Map data ©2010 AND, Europa Technologies, INEGI - Terms of'.

# Community Engagement – FracTracker Comments



## Suggestions

- Great platform to start this database work. Not sure how exactly the general public will be able to use it.
- Add a page on the blog that summarizes the datasets available on the datatool so that unfamiliar users can access categorized information.
- More data needs to be added for drilling occurring or planned outside of PA.
- Conduct user interface testing with various user groups.

## Praise

- My brain hurts in most computer situations but you made it possible for me to visit and use FracTracker in the future.
- Very excited that this tool helps to bring together diverse groups of stakeholders!
- I'm very interested to see how the tool evolves.
- The scope and successful application of technology of the FracTracker tool is fantastic. There is so much potential here.



# Center for Healthy Environments & Communities

University of Pittsburgh | Graduate School of Public Health

## 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](mailto:slm75@pitt.edu)

# References & Resources



- Catskill Mountainkeeper. Image: Catskills Natural Gas Drilling Operation. [http://www.catskillmountainkeeper.org/files/Image/images/o8gas\\_600\\_1.jpg](http://www.catskillmountainkeeper.org/files/Image/images/o8gas_600_1.jpg)
- Donnan R. (2009). Photos of drilling rigs and pit in Washington County, PA.
- Harper JA. (2008). The Marcellus Shale — an old “new” gas reservoir. In *Pennsylvania Geology: Pennsylvania Department of Conservation and Natural Resources*, v. 38, no. 1, 20 p.
- Kohrs, E.V., (1974). *Social Consequences of Boom Growth in Wyoming*.
- Occupational Safety and Health Administration. (2009). Safety and Health Topics Diesel Exhaust. <http://www.osha.gov/SLTC/dieselexhaust/index.html> & <http://www.osha.gov/SLTC/dieselexhaust/chemical.html>
- PA DEP (Pennsylvania Department of Environmental Protection). FAQ's on Marcellus Shale: <http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-77964/0100-FS-DEP4217.pdf>
- PA DEP. Laboratory Accreditation Program: [http://www.portal.state.pa.us/portal/server.pt/community/labs/13780/laboratory\\_accreditation\\_program/590095](http://www.portal.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095)
- Penn State Cooperative Extension. (2008). Marcellus Shale: What Local Government Officials Need to Know. Penn State University. Available online: <http://downloads.cas.psu.edu/naturalgas/pdf/MarcellusShaleWhatLocalGovernmentOfficialsneedtoknow.pdf>

# (continued)



- Philadelphia's Weekly Press. (2010). Shale Shame: Cabot fined heavily for Dimock water contamination. Accessed online 5/1/10:  
<http://www.weeklypress.com/default.asp?sourceid=&smenu=1&twindow=&mad=&sdetail=1896&wpage=1&skeyword=&sidate=&ccat=&ccatm=&restate=&restatus=&reoption=&retype=&repmin=&repmax=&rebed=&rebath=&subname=&pform=&sc=2392&hn=weeklypress&he=.com>
- Pittsburgh City Paper, Heather Mull photograph. Dirt access road leading to natural gas drill site. Posted in article "There Will Be Crud." 4/23/09.  
<http://www.pittsburghcitypaper.ws/gyrobase/Content?oid=oid%3A62213>
- Pittsburgh Post-Gazette (2009). The Next Page: Gas, gas everywhere -- but will water be fit to drink? Accessed online 3/2/10: <http://www.post-gazette.com/pg/09116/965379-109.stm#ixzzohYZZIQxw>
- Reuters. (2009). Pennsylvania lawsuit says drilling polluted water. Accessed online 3/4/10:  
<http://www.reuters.com/article/idUSTRE5A8oPP20091109>.
- Soeder DJ, & Kappel WM. (2009). Water Resources and Natural Gas Production from the Marcellus Shale. U.S. Geological Survey Fact Sheet 2009-3032. USGS West Trenton Publishing Service Center. Pg. 4.
- Witter R, et al. Potential Exposure-Related Human Health Effects of Oil & Gas Development: A White Paper. Denver: Colorado School of Public Health, 2008.