

Environmental & Public Health Impacts of Drilling for Natural Gas in the Marcellus Shale: What to Expect, How to Mediate



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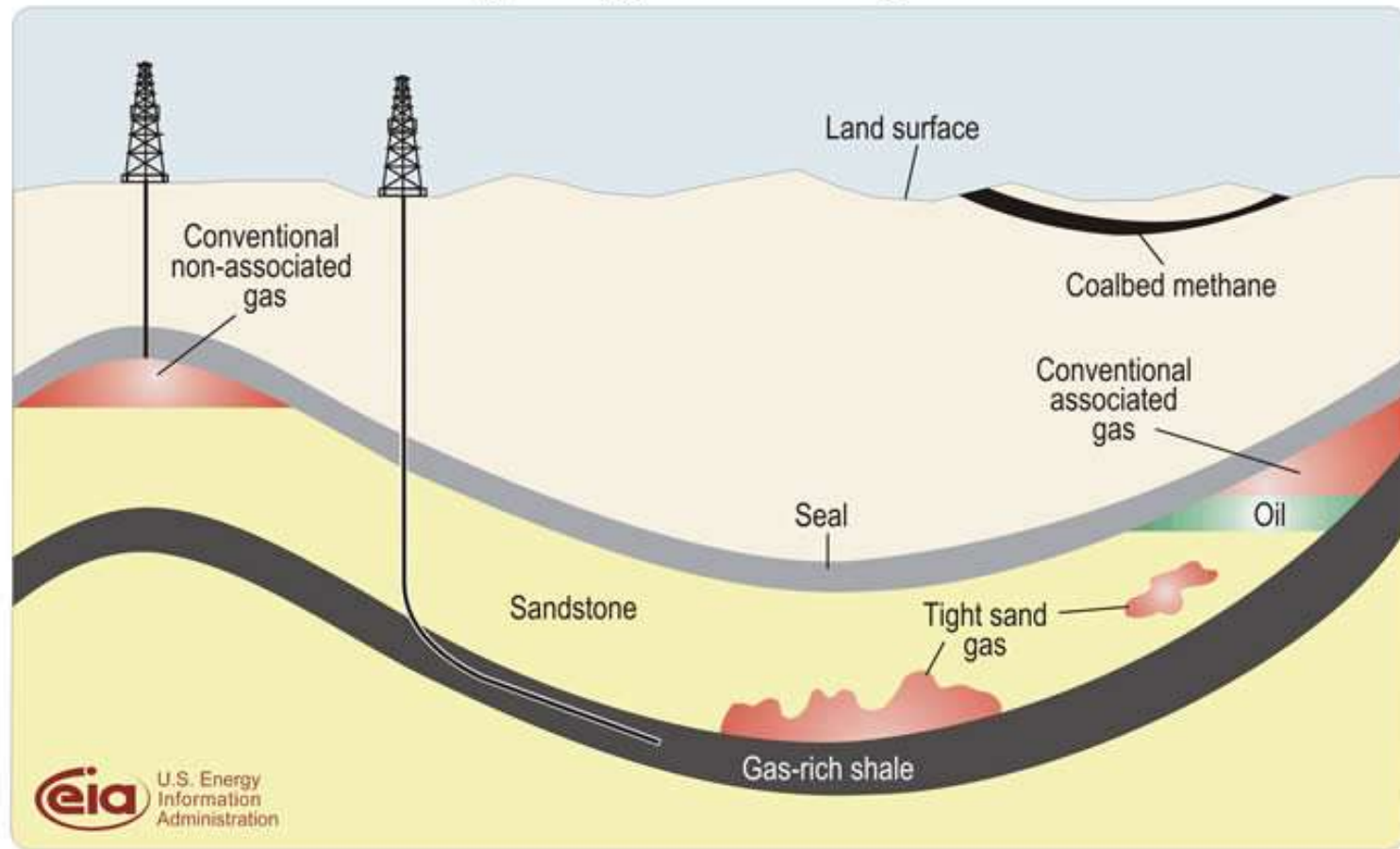
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April 11, 2011

www.chec.pitt.edu | www.fractracker.org

Conventional and Non-conventional Natural Gas Extraction Methodologies

Schematic geology of natural gas resources

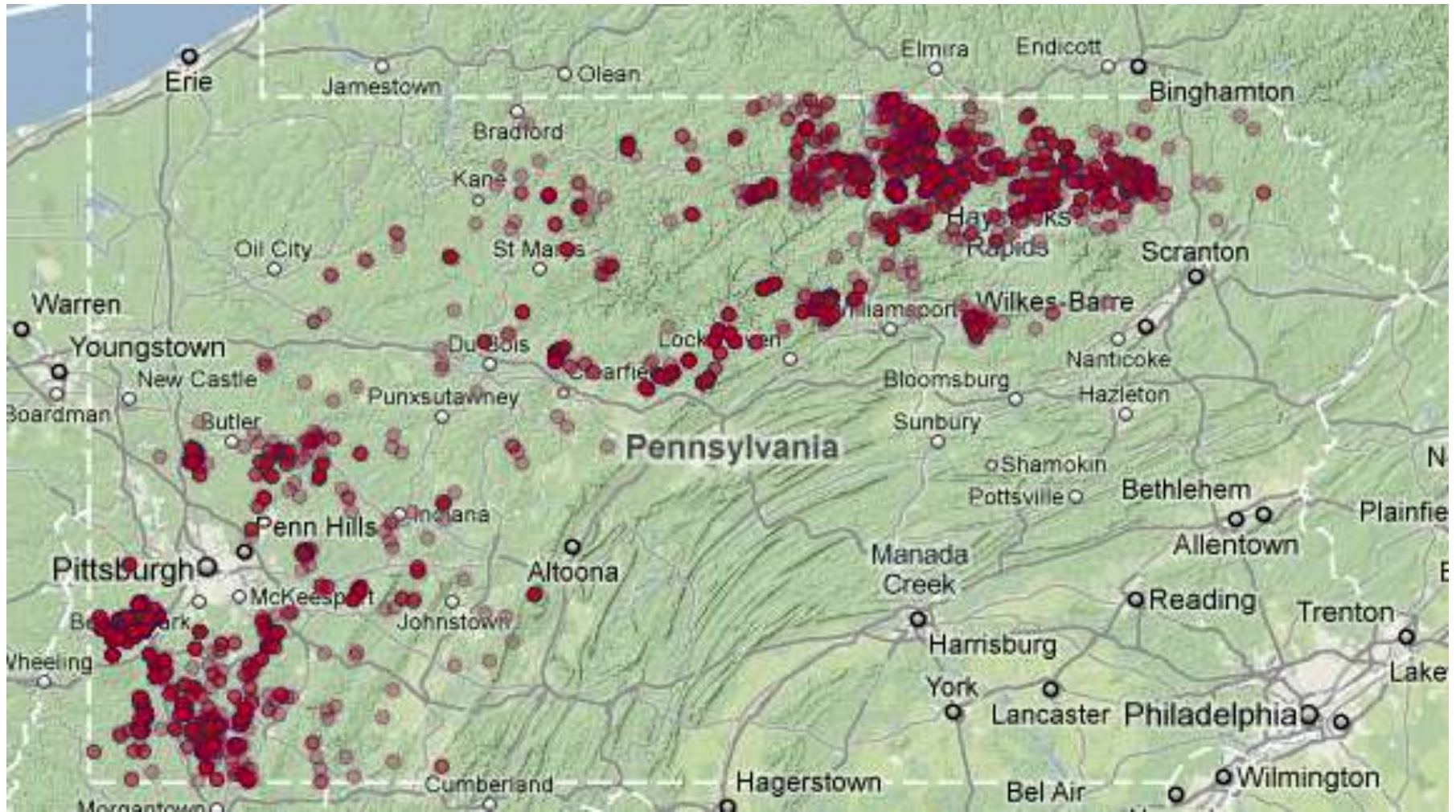


Marcellus Shale Range & Production Estimates



- 2008 – 50 TCF (trillion cubic feet) of estimated recoverable natural gas (Engelder and Lash, 2008)
- November 2008 – Based on Chesapeake’s production, estimate of recoverable gas from the Marcellus Shale raised to more than 363 TCF (Esch, 2008). Current estimates vary from 116 – 516 tcf
- U.S. uses about 23 TCF of natural gas per year (U.S. Energy Information Administration, 2010), so the Marcellus gas resource may be adequate to supply U.S.’s needs for roughly 15 years at current rates.

Marcellus drilling activity in PA to-date



Approximately 1,700 drilled Marcellus wells to-date (PA DEP, 2011). Map created using Data.FracTracker.org.

Natural Gas – nat·u·ral gas *noun*

Definition: combustible mixture of hydrocarbon gases

- Natural gas as we use it is almost entirely methane.
- But underground, it can be associated with a variety of other compounds and gases as well as oil and water:
 - Methane
 - Propane
 - Butane
- Natural gas transported through pipelines must meet purity specifications to be allowed in, so most gas processing is done at the well site.



Drilling Rig in Rural Upshur County, WV



Source: WWSORO, Modern Shale Gas Development in the U.S.: A Primer, (2009) U.S. Dept of Energy

Potential Public Health Problems Associated with Intense Marcellus Shale Gas Production

- Excessive groundwater and surface water usage (Each fracked well uses 3-8 million gallons of water) (Hazen and Swayer, 2009)
- Exposure to fracturing chemicals from leaks, spills, accidents, off gassing from frac-water pits
- Groundwater contamination from flowback and produced water - May contain toxic metals/elements, organic compounds (BTEX), and elevated levels of radionuclides from the shale formation itself
- Inadequate treatment and inappropriate disposal of brine water into surface water – May add toxic anions and cations and increases TDS levels in drinking water supplies
- Inhalation exposure from volatile organic compounds in frac water, and air contaminants from diesel usage, compressor stations and gas drying facilities
- Methane gas in air and water and explosion potential
- Community and behavioral health impacts



Water Testing

Can be expensive

Establish baseline

Choose certified lab

(<http://extension.psu.edu/water/resources/publications/water-pollutants/testing/thirdpartylabs.pdf>)

- Many residents have approached the CHEC as well as those advocating for safer gas drilling asking for advice on well water and municipal water testing.
- Well water testing is very important, but caution needs to be exercised because it is an expensive undertaking.
- It is important to negotiate water testing with gas company if leasing and have a baseline test paid by the gas company before drilling.
- The use of a certified lab is very important. Be careful in choosing a lab.



Water Testing – What is Important

Strontium

Barium

Manganese

Magnesium

Organics

- 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

Air Quality



- Gas drilling process, Compressors and Fracturing Ponds can emit volatile organic compounds (VOC) 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



Fracking Pond Fire – Hopewell Township, PA – April 1, 2010



Fracking Pond Fire – Hopewell Township, PA – April 1, 2010



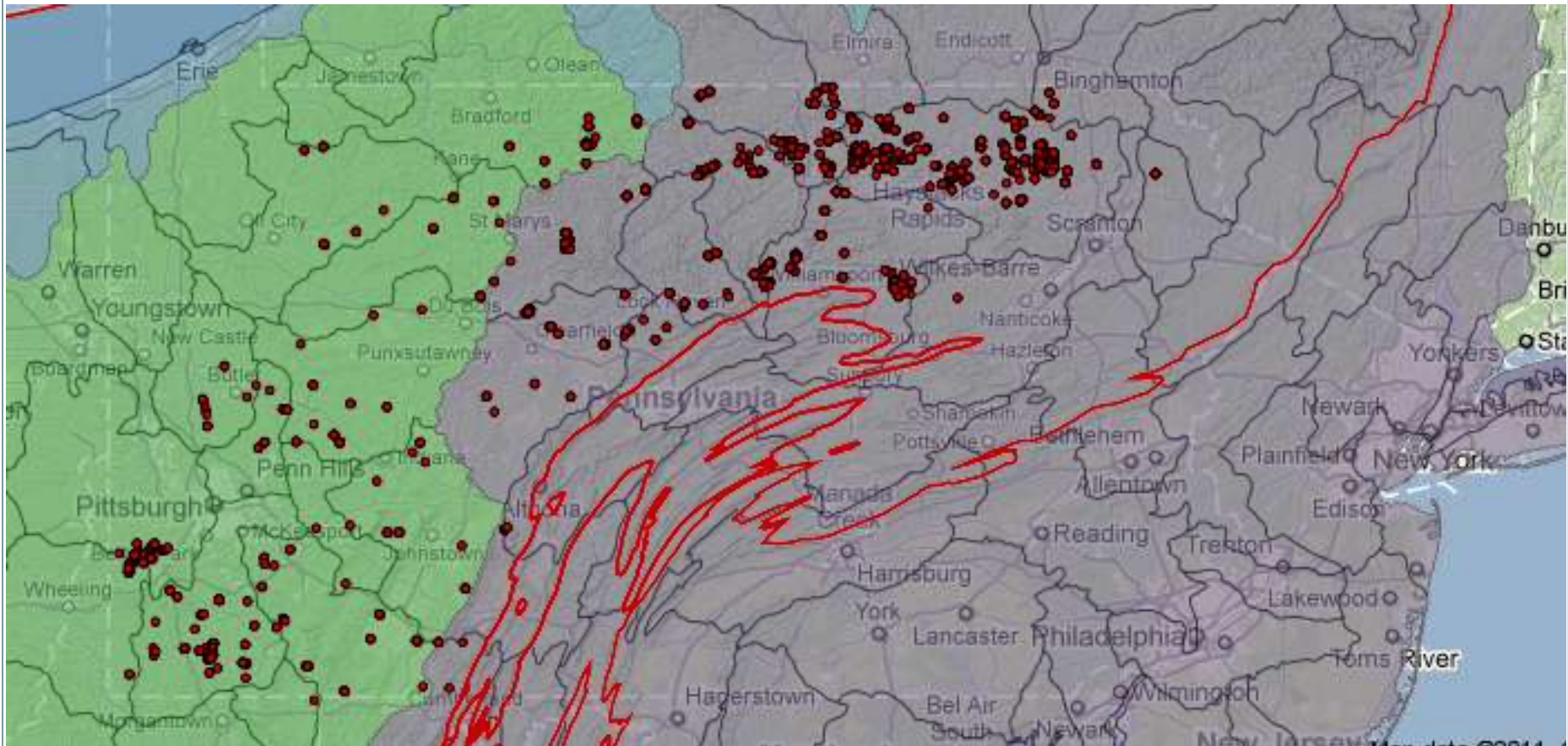
Impacts to Water from Gas Migration

Methane gas migration is not a new occurrence in PA, but has been associated with some Marcellus Shale gas extraction activities

DEP to Meet With Drilling Companies to Discuss Ways to Prevent Dangerous Gas Migration Situations, Safeguard Homes, Water Supplies

HARRISBURG -- Department of Environmental Secretary John Hanger announced today that he has called a meeting of oil and gas companies with permits to drill in the Marcellus Shale to discuss what steps the industry must take to prevent gas migrating from wells and polluting Pennsylvania's natural resources, which can create a public safety risk. The meeting will be held on May 13 in Harrisburg

Marcellus Shale Violations Issued by PA DEP and Watershed Outlines



Except for location information, this dataset was provided by a request to the Pennsylvania Department of Environmental Protection for violation information from 2007* to the present. There were 9,370 violations in that span from 3,661 unique wells. Of that total, there were 2,075 Marcellus Shale violations from 592 wells. The data is current as of September 30, 2010.

* Electronic violations data are only available since 2007 from the PA DEP

Government & Societal Challenges



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 adequate housing, may be unassimilatable without significant declines in quality of public services and community life.

Government & Societal Challenges Continued



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.

(Jacquet, 2009)

Impacts on Community Safety and Roads in Wetzell County, West Virginia

Below: Trucks parked along blind bend in road. (Hughes, Wade, and Renaud 2010)



Above: Slip below drill site closes road to ambulance.



Above : Road Disintegration from Truck Traffic

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 DATATOOL FOR TRACKING
IMPACTS OF SHALE GAS EXTRACTION**



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April 11, 2011

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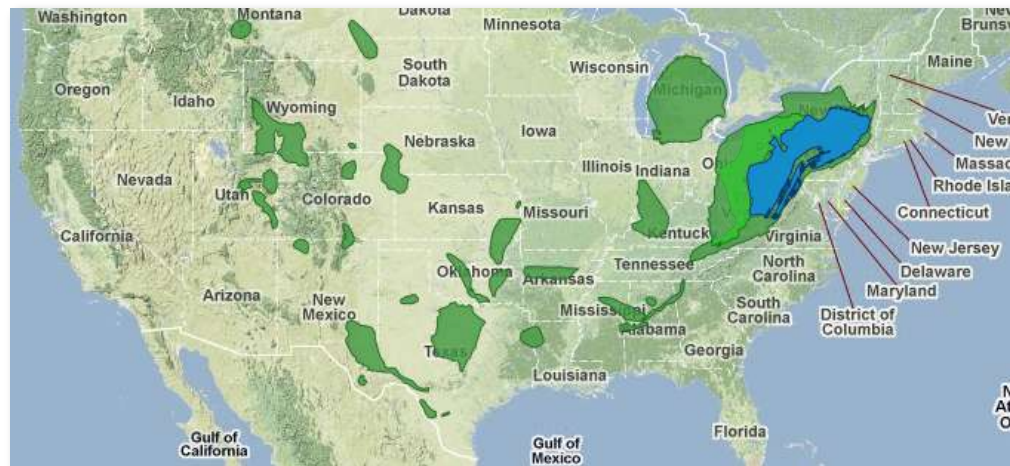
The Purpose



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



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 viewed 68 times
[Get this by email](#)

MOST RECENT
FRACTRACKER DATASETS
Community Impacts of

Register

Splash page (screen shot right)

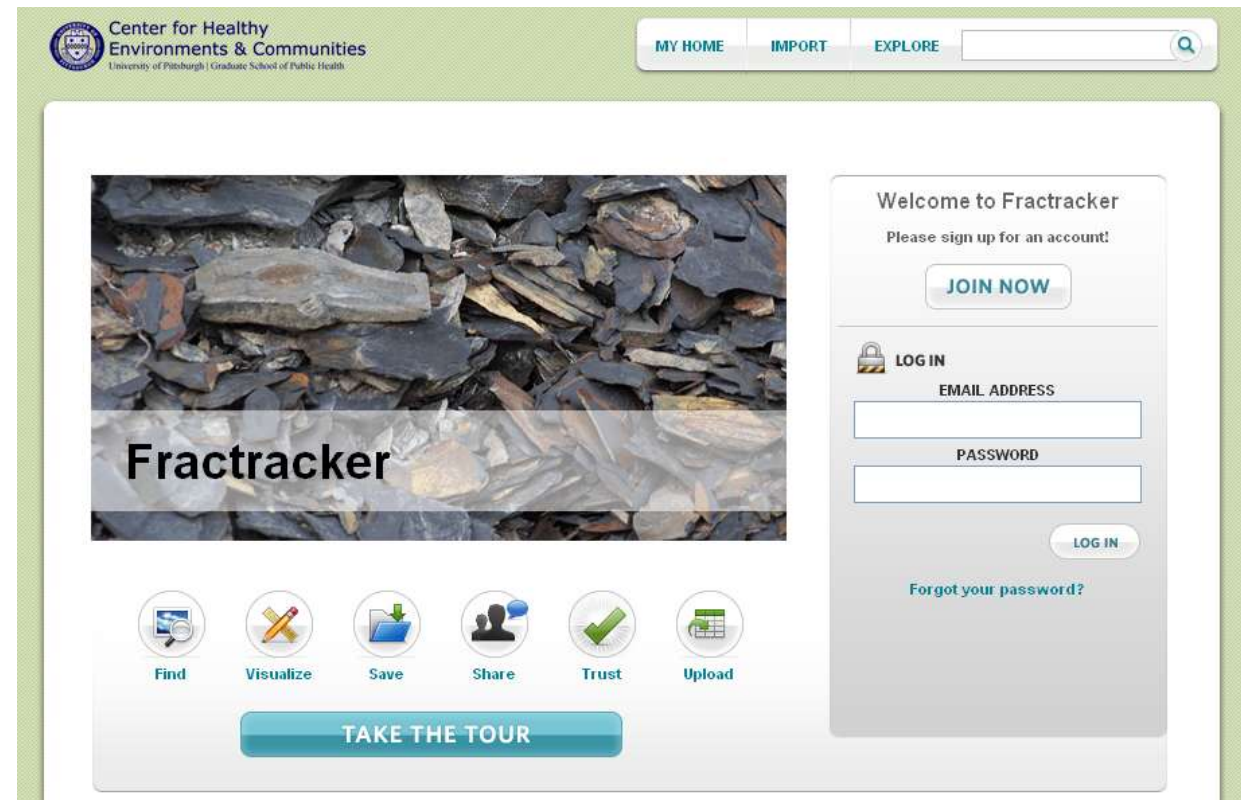
Free & automated using Rhiza tools (software developer)

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

The screenshot shows the user profile page for Samantha Malone. At the top, the site logo and name are visible. Below the navigation bar, the user's profile information is displayed, including their name, email, workgroups, position title, and organization. A table of statistics shows member since date, discussion comments, collections, datasets, and snapshots. There is also a section for email notifications and a rating system. At the bottom, a library of items is shown, with the first item being 'PA Oil and Gas Wastewater Facilities and Water Areas'.

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

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Everything is public.

Explore

Dashboard / summary of site's recent activity

Search / sort by datasets, snapshots, users, geographic area



My Home & Explore Pages

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MY HOME IMPORT EXPLORE

Explore Data, People, and Snapshots

Explore A Specific Geography
Click the button below to search for all the data in Fractracker 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 Fractracker.
Topic or Keyword [SUBMIT](#)
[Advanced Search](#)

Show Browse

80 Items SORT BY:

	Community Impacts of Marcellus Shale Drilling and M... xtraction Documentary Project Interviews (2010-08-24) 0 Comments	Originator: Kyle Ferrar Uploaded by: Kyle Ferrar on Aug 24, 2010	ACTIONS
	Asthma and Myocardial Infarction Rates of SW PA Counties in 2007 0 Comments	Originator: CDC's National Center for Health Statistics National Vital Statistics System Uploaded by: Drew Michanowicz on Aug 23, 2010	ACTIONS
	National Gas Transmission Pipeline Incidents 2010 to Present 0 Comments	Originator: USDOT - PHMSA Uploaded by: Drew Michanowicz on Aug 23, 2010	ACTIONS
	Marcellus Shale Drilled Wells in PA 0 Comments	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	0 Comments
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
CLASSIFICATIONS	Infrastructure	DOWNLOADED	0 Times
		USED IN	1 Snapshot
		RATING	Rate this item

VISUALIZE **DOWNLOAD**

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

Lat: 41.70573 Lon: -85.69336

National Gas Transmission Pipeline Incidents 2010 to Present

All records

+ all values view

POWERED BY Google

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. On the left, a 'Share this Snapshot' pop-up box is open, containing the following information:

- LINK:** <http://data.fractracker.org/cbi/link/WUjLbzNzNXC>
- EMBED:** `<iframe src="http://data.fractracker.org/cbi/snap" ...>`
- THUMBNAIL:** ``
- Options:** Include name & legend (large), Just the visualization (small)
- KML:** <http://data.fractracker.org/cbi/export/kml/Snapsho>

On the right, a sidebar titled 'ACTIONS' shows metadata for the snapshot:

- CREATED:** Aug 25, 2010
- DISCUSSION:** 0 Comments
- SAVED IN:** 1 Collection
- BASIS OF:** 0 Snapshots
- RATING:** 5 stars, with the text 'Rate this item'

The main area shows a map of the United States with numerous red markers indicating data points. The map is powered by Google and includes a legend at the bottom.

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.

References & Resources



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Thank You



QUESTIONS?

CHEC@PITT.EDU OR CALL 412-624-9379

FracTracker Partners:

- Center for Healthy Environments and Communities, University of Pittsburgh graduate school of public health
- Foundation for Pennsylvania watersheds
- The Heinz Endowments
- Rhiza labs