Natural Gas Development in Chenango County, New York

Bruce Selleck
Department of Geology
Colgate University
bselleck@colgate.edu
A Chenango resource finally gets tapped

By Frank Holtz

Chenango County stands up and takes notice of an exciting new discovery in 2008, and it was something right beneath our feet: the Marcello Shale.

The extensive natural gas reserves, long known to geologists, have been a part of Chenango since the beginning. The latest discovery, however, is bringing new interest and development to the region.

The Marcellus Shale, a major natural gas deposit, runs across Western Pennsylvania and New York, including Chenango County. The discovery of the Marcellus Shale in 2008 has led to increased interest in the area’s natural gas resources.

The Marcellus Shale is a thick layer of sedimentary rock that contains significant amounts of natural gas. The gas is trapped in the rock, and can be extracted through a process called fracking.

The development of natural gas resources has brought new opportunities for Chenango County. The Marcellus Shale is a rich resource, and the potential for economic growth is significant.

In addition to the economic benefits, the natural gas industry also brings new environmental concerns. The fracking process can have a significant impact on the surrounding area, and there are ongoing debates about the potential environmental effects.

Despite these concerns, the potential for economic growth in Chenango County is significant. The Marcellus Shale is a valuable resource, and the county is well positioned to capitalize on this opportunity.

---

**Testing Recommendations For Residential Wells Neighboring Gas Well Development Sites**

Water testing is necessary to ascertain the quality of new drinking water wells, and is further important to periodically evaluate existing well water quality. With the increase in gas well development sites in Madison County, concerned residents in proximity to such activities may also wish to conduct testing to determine if contaminants are present in their drinking water well.

The water quality parameters listed below may be useful if measured prior to and after the commencement of such gas drilling activity to assess possible impacts. It is typically recommended to conduct sampling for basic water quality parameters and for contaminants commonly found in groundwaters prior to the start of drilling to establish baseline indicators, and such analyses repeated along with testing for more specific contaminants are more likely to occur from such gas drilling activities after the drilling has been completed.

<table>
<thead>
<tr>
<th>Basic Parameter</th>
<th>Common Contaminants Found in Groundwater</th>
<th>Potential Gas Well Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Total Dissolved Solids (TDS)</td>
<td>Methane/3%</td>
</tr>
<tr>
<td></td>
<td>Turbidity</td>
<td>Methane/3%</td>
</tr>
<tr>
<td></td>
<td>Total Suspended Solids (TSS)</td>
<td>Volatile Organic Compounds</td>
</tr>
<tr>
<td></td>
<td>Hardness</td>
<td>Non-Hazardous</td>
</tr>
<tr>
<td></td>
<td>Iron</td>
<td>Non-Hazardous</td>
</tr>
<tr>
<td></td>
<td>Hydrogen Sulfide</td>
<td>Non-Hazardous</td>
</tr>
<tr>
<td></td>
<td>Arsenic</td>
<td>Non-Hazardous</td>
</tr>
<tr>
<td></td>
<td>Total App. Cost $70</td>
<td>Total App. Cost $100</td>
</tr>
<tr>
<td></td>
<td>Total App. Cost $500</td>
<td>Total App. Cost $250</td>
</tr>
</tbody>
</table>

This Health Department recommends testing for total coliform, which can indicate bacteriological contamination, in addition to testing for nitrate (total approx. cost $40), and conduct annually for anyone served by an individual water well. New residential wells should be tested for those recommended water quality parameters listed on Individual Water Supply Wells - Fact Sheet #3 prepared by the NYS Health Department (NYSDOH) and which is available from the following website:

http://www.health.state.ny.us/environmental/water/drinking/past5/appendixb/f63_water_quality.htm

All potable water samples should only be analyzed by a laboratory properly certified by the NYSDOH Environmental Laboratory Approval Program (ELAP). A current listing of ELAP certified laboratories is available at http://www.wadsworth.org/labinfo/elap.html or by contacting the local Health Department.

Note that each laboratory may approach baseline testing differently depending on area served and familiarity, and costs may vary accordingly.
• Geological framework
• Current developments
• Future expansion
  – Herkimer
  – Marcellus
  – Utica
  – Trenton?
• Environmental and infrastructure impacts
  - NYSDEC SGEIS
• Economic potential
This map depicts the distribution of gas and oil fields in New York State in 1980. Virtually all of the historical development has been in the western part of the state. No oil has been recovered from wells east of the Finger Lakes region, but there is considerable potential for natural gas.

All of the oil and gas in New York is found in Paleozoic sedimentary rocks which were deposited from 520 to 300 million years ago. Most of these rocks were laid down in a sedimentary basin - the Appalachian Basin – that stretched across eastern north America from Nova Scotia to Alabama.
What is ‘natural gas’?

‘Hydrocarbons’ are C-H compounds with C-H and C-C bonds.

Breaking of these bonds by oxidation (combustion) releases heat energy

Most common petroleum and gas hydrocarbons are alkanes, with the general formula - \( C_nH_{2n+2} \)

Natural gas has the lowest carbon footprint of any fossil fuel –

and is made up mostly of methane - \( CH_4 \),

with some ethane - \( C_2H_6 \), propane - \( C_3H_8 \) and butane - \( C_4H_{10} \)

‘Heavier’ alkanes - pentane, hexane, heptane, octane, etc - are liquid at surface temperatures and pressures

Liquid petroleum is a mixture of \( C_5 \) to \( C_{30} \) alkanes, plus aromatics (e.g. benzene) and alkenes

Methane is also produced by a variety of biological processes at the earth’s surface

methane from surface biological systems is rarely accompanied by ethane, propane or butane

methane from biological systems can be distinguished from petroleum system methane

Petroleum system natural gas may contain minor liquid hydrocarbons (wet gas with condensate)

Dry gas systems are most common in Central New York

Brine (formation water) is produced from most natural gas wells
Summary of Natural Gas Production in NYS and Chenango County – 2008 (DEC Data)

The common unit of measure for natural gas is the MCF

1 MCF = 1000 cubic feet of gas at surface temperature and pressure. This is approximately equal to 1,000,000 BTU of heat

1 Therm = 100,000 BTU --- 1 MCF is approximately 1000 Therm

A typical residence in the NE US consumes ~73 MCF for domestic heating in one year

New York State in 2008:

NYS consumed 1,190,341,000 MCF of natural gas
NYS produced 50,320,077 MCF of natural gas = 4.2% of consumption

7790 natural gas wells in NY had production reported

the top 100 producing wells accounted for 70% of NYS production

76 of the top 100 wells produced gas from the Trenton-Black River reservoir system

other producing formations in the top 100 – Theresa (5 wells); Oneida (5); Herkimer (4)

Chenango County in 2008:

427,609 MCF (=~ $3,000,000 at January 2008 wellhead price of $6.99/MCF)

18 wells – top producer at ~95,000 MCF is a Herkimer well
Subsurface exploration prior to drilling depends on seismic data. Modern seismic exploration technology allows developers to precisely target the highest-quality portions of reservoir formations. Grids of seismic data are used to construct 3-D subsurface seismic sections.

The map on the left shows routes for Vibroseis exploration in the towns of Lebanon, Smyrna and Plymouth.

2-D Seismic section (not from the Lebanon area)

http://openlearn.open.ac.uk/file.php/2292/S278_1_022i.jpg
Well logs are prepared during and immediately after drilling. The ‘log’ may consist of a number of remotely sensed parameters (density, gamma ray, neutron) and a lithologic log prepared from well cuttings or, more rarely, from cores. Well logs are used to characterize reservoirs, determine the geometry of ‘pay zones’ and direct further exploration and development. Well log data and well cuttings are available from the New York State Museum.
Drilling of a gas well requires construction of a drilling pad and access roads, and moving in and out of heavy equipment. Development of the well may involve installation of casing and cement sheath, and treatment of the producing formation to increase gas flow into the well. The above-ground equipment is not visually obtrusive; pipelines, valves and compressor facilities pose some safety risk. Properly designed and maintained wells do not offer significant environmental hazard.
Rock strata in central New York dip gently to the southwest. This cross-section exaggerates the dip and shows the sedimentary units and their ages. The oldest rocks in New York are the 1.1 billion year old metamorphic and igneous rocks of the Adirondacks. These ancient rocks contain no oil or gas, but host deposits of metals ores for iron, titanium, lead and zinc, and useful minerals like talc, wollastonite and garnet.

The red pattern indicates rock units that may serve as reservoir beds in central and western New York.
Utica Shale outcrop near Vanhornesville, NY
Utica Shale Gas Potential

Subsurface Utica Shale at reasonable reservoir depths

Utica Shale high probability fairway
Most gas wells in Chenango County tap reservoirs in the Oswego/Oneida/Herkimer sandstones. The Utica Shale that underlies the sandstone may be source bed for the gas. Minor fold structures in the sandstone help to trap the gas in commercial quantities. Wells in the Town of Smyrna are developed in a minor fold structure where the sandstone is unusually thick. The overlying Ilion Shale forms a seal on the reservoir sandstone. Wells are typically 2500-4000’ deep.

Deeper wells (greater than 10,000 feet) in the eastern Finger Lakes region have encountered large reservoirs in the Trenton-Black River Group trend. Trenton-Black River discoveries are related to deep fault structures and have proven difficult to locate, but very profitable when exploited.
Herkimer Sandstone outcrop near Jordanville, NY
Horizontal Well in Herkimer Sandstone Town of Lebanon, Madison County

- Marcellus
- Onondaga
- Helderberg
- Camillus
- Syracuse
- Vernon
- Lockport
- Willowvale
- Herkimer SS
Marcellus Shale outcrop near Chittenango, NY

2 meters
Marcellus Shale Gas Potential

Subsurface Marcellus Shale at reasonable reservoir depths.

Marcellus Shale high probability fairway
Natural gas production in Chenango County is almost entirely from the Oswego Sandstone-Herkimer Sandstone-Oneida Conglomerate interval.

While there has been much speculation about the potential for natural gas development from the Marcellus Shale, the most likely areas for development are where the Marcellus is at depths great enough (>1500 feet) to assure reasonable formation pressure and reservoir integrity.

The map on the left shows areas in southern Madison and Chenango County where the Marcellus Shale unit lies at depths great enough (red color contours) for likely development. Areas with green contours have Marcellus Shale at depths less than 1500 feet.

The Utica Shale, another potential shale gas target, underlies all of Madison and Chenango County. The Utica Shale potential may exceed that of the Marcellus in Chenango County.
Cross-section illustrates the schematic subsurface distribution of the Utica Shale, Herkimer Sandstone and Marcellus Shale.
Marcellus and Utica Shale Development – Why the controversy?

Development of high-yield shale wells that are economic requires **horizontal drilling and hydrofracturing**.

Hydrofracturing has been used for decades to increase gas, oil or water flows from tight formations. The process involves isolation of the target formation after the well is drilled, placement of downhole equipment, high-pressure pumping of fracture fluid, and subsequent flowback and well cleanout.

Horizontal drilling has also been used widely, and is currently used in Madison and Chenango Counties for Herkimer Sandstone well development.

Horizontal drilling and hydrofracturing has been used in coalbed methane wells in Wyoming and other states, and has been implicated as a source of groundwater contamination.

Horizontal drilling and hydrofracturing of shale wells in NYS are currently not permitted. The NYSDEC has issued a final draft of the SGEIS guidelines that will guide the permitting process for shale gas development.
Roughly 200 tanker trucks deliver water for the fracturing process.

A pumper truck injects a mix of sand, water and chemicals into the well.

Recovered water is stored in open pits, then taken to a treatment plan.

Natural gas flows out of well.

Natural gas is trucked to a pipeline for delivery.
Figure 6. A hydraulic fracturing stimulation in 2007 on a Marcellus Shale gas well showing the amount of equipment involved.
**Marcellus or Utica horizontal wells with hydrofracturing**

Highlights of new permit requirements:

*Planning and local coordination*
- EMO’s, fire departments
- Noise and visual impacts mitigation
- Testing of water wells pre- and post-drilling

*Site preparation and maintenance*
- Storm water control
- Fuel and other chemical storage

*Drilling, stimulation and flowback*
- Casing and cementing
- Hydrofracturing
- Steel containment for flowback water (not open pits)

*Reclamation*
- Limit of 45 days on open pits for drilling fluids
- Site restoration plan
What’s next?

**NYSDEC GEIS guidelines**
- Currently in comment period; possible legal challenges?
- Regulations issued – early 2010?
- Permitting of Marcellus horizontals – mid 2010?

**Drilling activity will ramp up through 2010** – increase in wellhead price
- Horizontal development Herkimer may attract other players
- New federal statues regulating shale gas development are unlikely
- US EPA may play a larger role in water quality monitoring in shale gas development areas
- Continued exploration for new Trenton-Black River fields
- Utica Shale tests will continue – Utica permits for horizontals?

**Land coalitions will play a role in leasing activity**, but fragile and subject to cherry-picking as Marcellus and other plays become more mature

**Local governments must continue to be informed and prepared**
Other issues on the horizon:

- Natural gas storage in depleted wells
- Carbon sequestration in depleted gas reservoirs
- Disposal injection of brine or drilling fluids
- Compressed air storage in depleted gas reservoirs
- Shutting-in of depleted wells
- Pipeline infrastructure expansion and maintenance
Energy development planning

Provide information
Leasing activity – data, maps, analysis
Development trends – data, maps, analysis
Environmental awareness – empowering the community
Legal framework – education and access to information
Communication strategies – cost, effectiveness, responsibility

Prepare for negative impacts
Road impact management - bonding, posting, driveway access
Communication with developers and EMO’s
Hazard planning and management – responsible agencies
Environmental impact planning – liaison with NYSDEC
Environmental and public health mitigation - DOH

Promote economic development
Regular and effective communication with developers
Encourage distribution systems
Support for new business that make use of NG
Strategic planning for a transitional energy economy