HANCOCK & THE MARCELLUS SHALE

Visioning the Impacts of Natural Gas Extraction Along the Upper Delaware

Prepared by the Columbia University Urban Design Research Seminar >> Spring 2009

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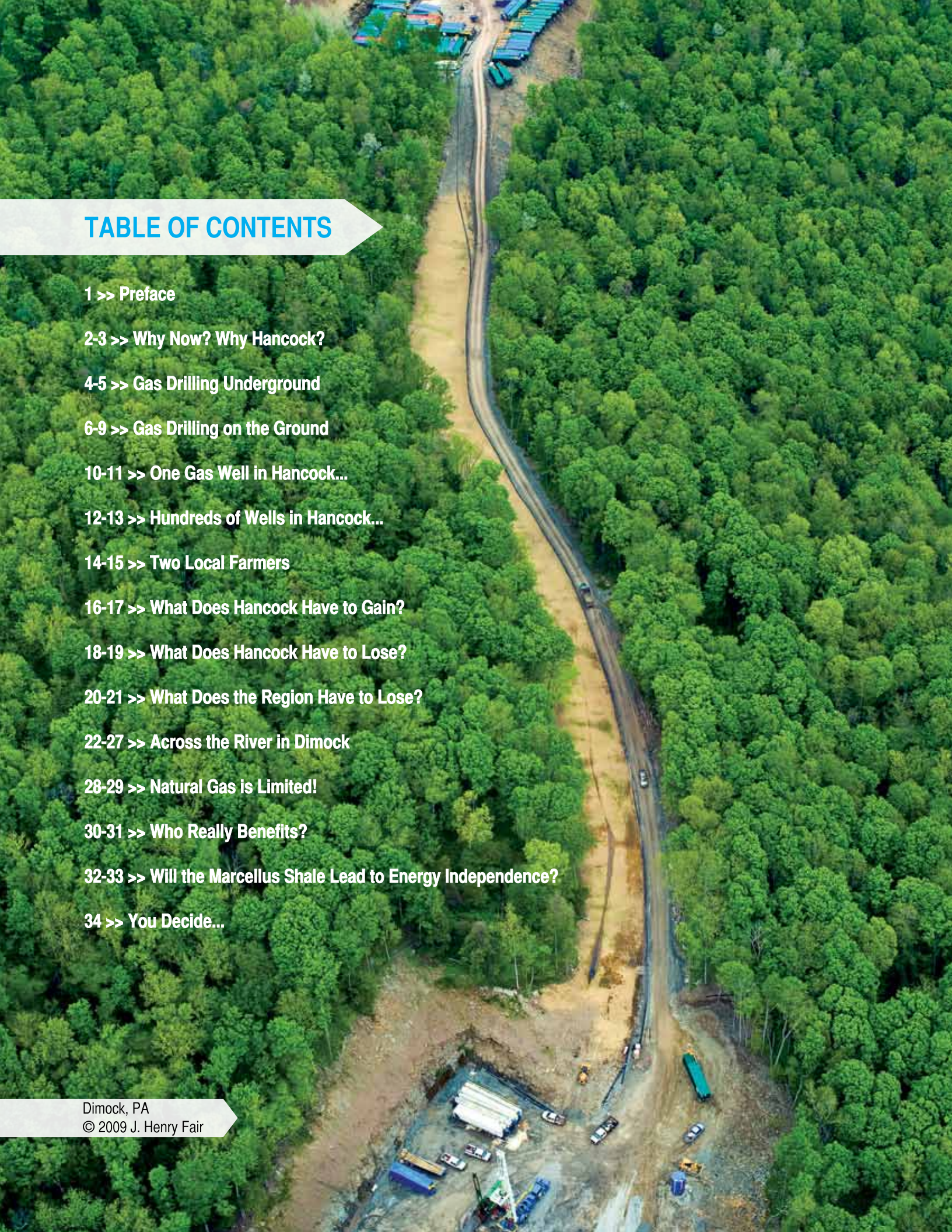

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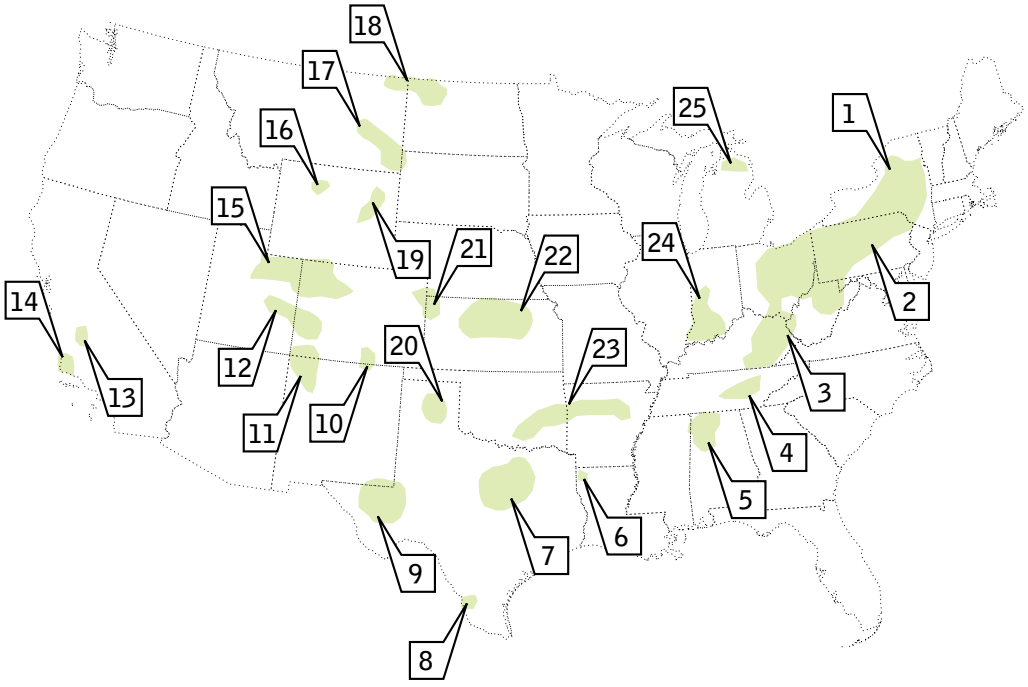

1 - Utica
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23 - Woodford/Caney/Fayetteville
24 - New Albany
25 - Antrim

GAS SHALE DEPOSITS IN THE U.S.

Schlumberger, http://www.slb.com/content/services/solutions/reservoir/unconventional_gas_4.asp (accessed May 2009)

PREFACE

This publication is the fourth such document to be produced by a graduate level seminar within the Urban Design Program at Columbia University. All have been focused on environmental issues facing the Upper Delaware River: the development potential of the Route 97 highway corridor (spring 2002)[1]; the impacts of the proposed NYRI power transmission line (spring 2007)[2]; the impacts of residential subdivision within the watershed (spring 2008)[3]; and now the impact of Marcellus Shale gas extraction (spring 2009). The importance of this year's topic is obvious. It is likely that throughout the history of the region, no other single developmental impetus has been so environmentally threatening and contentious and yet so devoid of local oversight. The letter below indicates the huge stakes in terms of impacts on Upper Delaware communities. Our choice of Hancock as the primary focus for this study is also obvious. For the gas industry, Hancock is an easy starting point, with its confluence of valuable infrastructure: river, roads, railroad, and gas pipeline. To date more than twenty-five percent of Hancock has been leased, creating the potential for hundreds of well sites with enormous cumulative environmental impacts concentrated in a relatively small area.

Among the communities of the Upper Delaware, perhaps nothing is more sacred than the practice of "Home Rule," with its legal guarantee of local control over land use. Historically, home rule has been a carefully guarded privilege throughout New York State and particularly in this region. Local town planning boards are routinely required by local, state and federal law to adhere to the State Environmental Quality Review Act (SEQRA) and consider micro-scale environmental impacts for even the smallest development projects. Unfortunately, in one devastating sweep, both the U.S. Energy Policy Act of 2005 and New York State's Environmental Conservation Law Article 23, altered municipal control by exempting natural gas activities from local oversight. Today, extracting natural gas from the Marcellus Shale, ultimately involving hundreds of cleared sites, miles of rural road impacts and millions of gallons of water, does not even receive the same level of review required by Hancock for a single residential dwelling plan where local, State and Federal criteria must be met regarding well, septic and adjacent wetland. This leaves the entire Upper Delaware region unprotected and slated for industrialization without compliance to historic local planning criteria and oversight. In Hancock the mayor's concern is understandable.[4]

Examining the planning consequences of natural gas extraction from Marcellus Shale is a useful contribution to the growing debate within the region. Our team focused on the gaps in local awareness of the comprehensive long-term impacts to the landscape and existing municipal infrastructure. Visualizing this impact was an important exercise for the seminar team, and an important component of this exercise. We hope that this document will be read by politicians and decision-makers who will determine the fate of natural gas extraction in the Upper Delaware Region; and by local citizens whose lives and livelihoods will be most effected by their decisions

Richard Plunz, Columbia University

Open Letter to the DRBC[4] **July 2009**

I'm taking this opportunity, together with the members of the village's board of trustees, to officially express our concern and ask that the Delaware River Basin Commission (DRBC) give due consideration to this request regarding the application by Chesapeake Appalachia, LLC to withdraw water from the West Branch of the Delaware River. It is to be hoped at this point in time that reasonable people and groups can work in cooperation for the betterment of mankind. With that thought in mind, I would like to go on the record with the DRBC with our request.

The site for water withdrawal is located in Pennsylvania less than a mile from the Village of Hancock, NY. One of the consequences of DRBC granting this permit would be that the water obtained by the applicant from this site and transported into New York State by way of the shortest route must travel on the Village of Hancock streets before reaching any town, county or state road.

In these tough economic times, it would be logical for the DRBC, if it were to give approval to the above docket, to make the actual issuing of the permit contingent on the applicant's (gas drilling company) previously entering into a legal agreement with the municipality for bonding its roads. This will address the potential of the applicant adversely affecting the public road right-of-ways. Bonding ensures that the road repair costs resulting from gas drilling company trucks, is placed on the company (applicant) where it belongs, and not the local taxpayers.

Celia Vazquez, Mayor of the Village of Hancock
Bill Schoonmaker, Dottie Picozzi, Karol Mech and Alice Hartz, Members, Village of Hancock Board of Trustees

1) K.J. Hutzel, K. Saul, eds., "Case Studies in Regional Environmental Design: Upper Delaware River Corridor," Columbia University Urban Design Research Seminar, 2002.
2) "A River Endangered. Proposed Power Transmission and Its Impact on Cultural History Along the Upper Delaware River," Columbia University Urban Design Research Seminar, Spring 2007.
3) "A Citizen's Guide to Residential Development. Western Sullivan and the Upper Delaware River Basin," Columbia University Urban Design Research Seminar, Spring 2008.
4) C. Vazquez, "Open Letter to the DRBC," *The River Reporter*, July 23-29, 2009.

WHY NOW? WHY HANCOCK?

"It's almost divine intervention. Right at the time oil prices are skyrocketing, we're struggling with the economy, we're concerned about global warming, and national security threats remain intense, we wake up and we've got this abundance of natural gas around us."

- Aubrey K. McClendon, Chairman and Chief Executive of the Chesapeake Energy Corporation

C. Krauss, "Drilling Boom Revives Hopes for Natural Gas," *New York Times*, August 24, 2008.


ENERGY CRISIS


ECONOMIC CRISIS


NEW FEDERAL LEADERSHIP


POLICY REVIEW

Americans have all too slowly come to understand the massive impacts that our energy consumption habits have had on this planet over the past century and a half. The seemingly limitless expenditure of non-renewable resources has created the current crisis in which we now find ourselves: political turmoil over America's dependence on foreign energy sources, volatile fuel prices exemplified by record-high gas prices in 2008, decimation of fragile ecosystems containing limited fossil fuel reserves, and increasing changes to our global climate. Combined with the global economic recession, we have no choice but to seek more affordable, efficient and environmentally-safe energy solutions to sustain life as we know it. On the national stage, we have gradually moved towards a new agenda of 'energy independence' by investing in research and development to both upgrade current energy infrastructure and explore new renewable energy technology. This has fostered a growing interest in natural gas which is a non-renewable yet relatively clean-burning fossil fuel. Such focus is due predominantly to the existing extensive infrastructure necessary to extract and distribute natural gas (i.e. pipelines, processing plants, transfer stations) and the numerous commercial applications (i.e. heating, appliance, and vehicle fuel sources).

In early 2008, geosciences professors Terry Engelder of Penn State University and Gary G. Lash of SUNY Fredonia, estimated that the Marcellus Shale Play running through West Virginia, Pennsylvania, Ohio, and New York, contains up to 500 trillion cubic feet of natural gas, far more than the USGS estimate of 1.3 trillion cubic feet in 2002.[1] Due to recently improved extraction processes and redesigned equipment, this cache of natural gas, previously inaccessible at 5,000 to 8,000 feet underground, was suddenly now within reach.

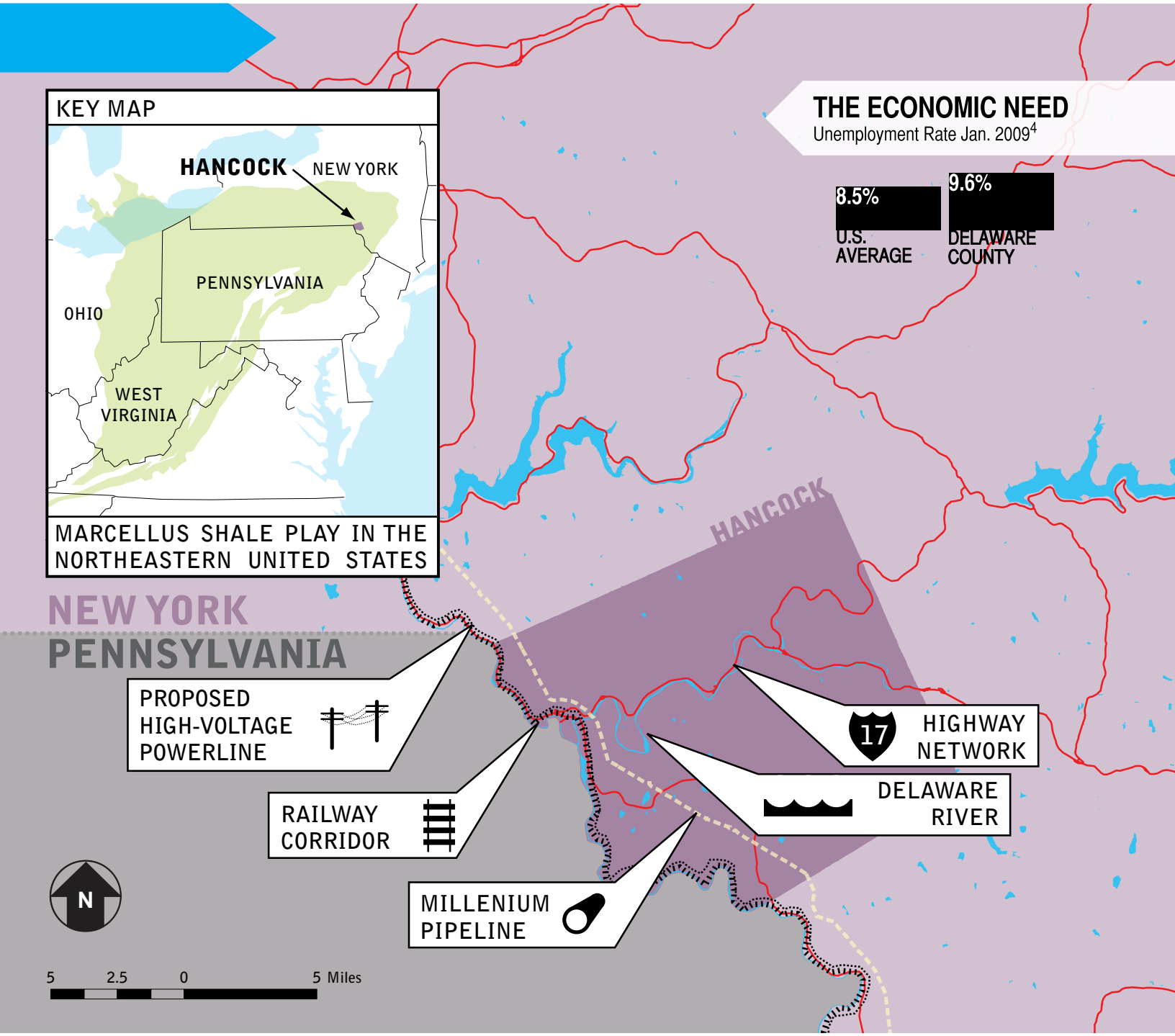
In July of 2008, New York Governor David Paterson signed a bill into law which facilitated denser drilling in the Marcellus Shale. At the same time, landowners throughout the Catskill region, including portions of the New York City watershed, were inundated with land men (representatives of gas companies) encouraging them to sign long term leases to allow for natural gas exploration, drilling and extraction. Like the millions of other homeowners throughout the country affected by the downturn of the financial market, local residents saw signing a lease as a viable source of much needed revenue: a means to support their families, pay bills and put food on the table.

However, New York State's regulatory matrix that governs natural gas drilling has not kept pace with these recent developments. The State's Department of Environmental Conservation (DEC) last established standards for natural gas extraction in 1992 when it issued a Generic Environmental Impact Statement (GEIS) which did not account for horizontal drilling technology or high water volume hydraulic fracturing.[2] As a result, in July 2008 the Governor ordered an update of the GEIS in a Supplemental Generic Environmental Impact Statement (SGEIS), described by DEC Commissioner, Pete Grannis, as follows:

> "The update will examine potential impacts from new horizontal drilling techniques, including potential impacts to groundwater, surface water, wetlands, air quality, aesthetics, noise, traffic and community character, as well as cumulative impacts. The update will occur as part of a public process that ensures that concerns raised by residents who could be affected by drilling activities are heard and considered...In addition, DEC is reviewing a variety of other areas, including staff resources, existing regulations, jurisdiction over water withdrawals, permit application fees and procedures, and legal and regulatory compliance, that could be implicated by increased drilling activity."[3]

On the advent of this DEC review, it is incumbent upon all of us - voters, landowners and municipal leaders - to take a closer look and better understand the costs and benefits of natural gas extraction through horizontal drilling and hydraulic fracturing. This report explores this 'transitional energy' source, the means by which we reach it and the impacts such processes have on our communities, our health, our land and our water.

1) T. Engelder and G. Lash, "Marcellus Shale Play's Vast Resource Potential Creating Stir In Appalachia," *The American Oil & Gas Reporter*, May 2008, http://www.aogr.com/index.php/magazine/cover_story_archives/may_2008_cover_story/ (accessed May 2009)
2, 3) A. Lustgarten, "Governor Signs Drilling Bill But Orders Environmental Update," *ProPublica*, July 23, 2008. http://www.propublica.org/article/governor-signs-drilling-bill-but-orders-environmental-update-723 (accessed May 2009)
4) "Geography of a Recession," *New York Times*, March 3, 2009, http://www.nytimes.com/interactive/2009/03/03/us/20090303_LEONHARDT.html (accessed May 2009)



Gas drilling companies have been extensively acquiring leases on privately owned lands throughout the Upper Delaware region in preparation for exploration and extraction of natural gas in the Marcellus Shale as soon as state regulations allow. The Town of Hancock in Delaware County, New York, with its own share of economic struggles, is at the epicenter with approximately 24,741 acres leased to gas drilling companies as of April 2009. The town sits above a dense portion of the Marcellus Play amongst a convergence of infrastructure necessary to facilitate major natural gas extraction and distrubution. This infrastructure and its potential value to drilling companies includes several components, the first and primary being the Delaware River, which could source some of the millions of gallons of water needed for hydraulic fracturing. Route 17, "The Quick Way", soon to be upgraded to Interstate 86, may be a potential transportation corridor for truckloads of water, construction materials, and waste. The existing major rail corridor could provide an alternate shipping option for water and site materials. The Millennium Pipeline, recently enlarged to a diameter of 30 inches, has the potential to serve as the primary gas distribution line. While its future remains unclear, the NYRI high-voltage power line proposal may also be an asset to gas companies as an electricity source for hydraulic fracturing and drilling operations.

GAS DRILLING UNDERGROUND

"The value of this science [horizontal drilling techniques] could increment the net worth of U.S. energy resources by a trillion dollars, plus or minus billions."

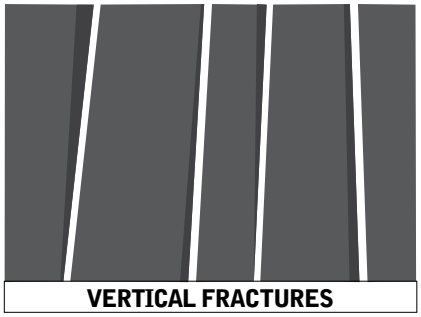
-Terry Engelder, Professor of Geosciences at Penn State University

Penn State Live, "Unconventional natural gas reservoir could boost U.S. supply," January 17, 2009, http://live.psu.edu/story/28116 (accessed May 2009)

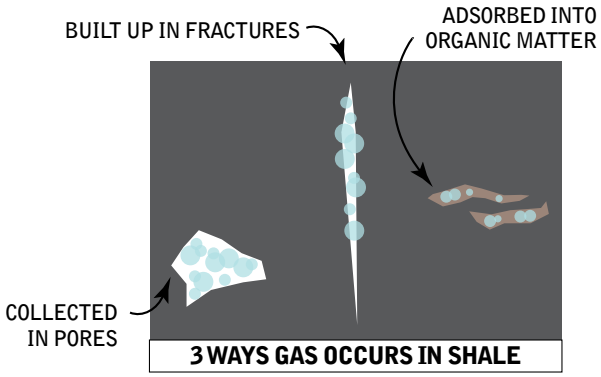
"When a pipe extends 8,000 feet below the earth's surface, there are numerous potential leak points along the way...well bore, natural fault or fracture..."

- Geoffrey Thyne, Hydrogeologist & Senior Researcher at University of Wyoming, Enhanced Oil Recovery Institute

A. Lustgarten, "Officials in Three States Pin Water Woes on Gas Drilling," *ProPublica*, April 26, 2009.

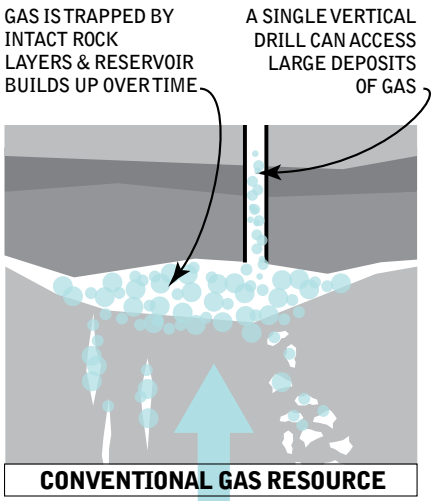


VERTICAL FRACTURES

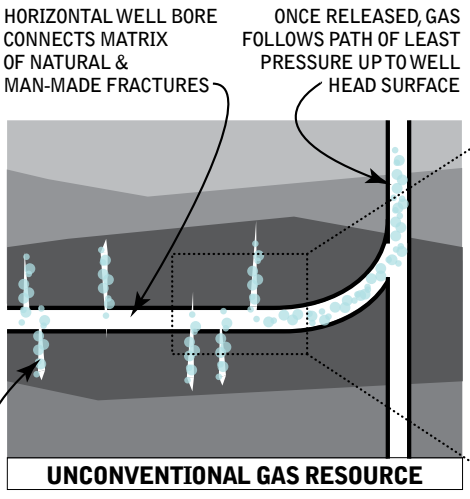


3 WAYS GAS OCCURS IN SHALE

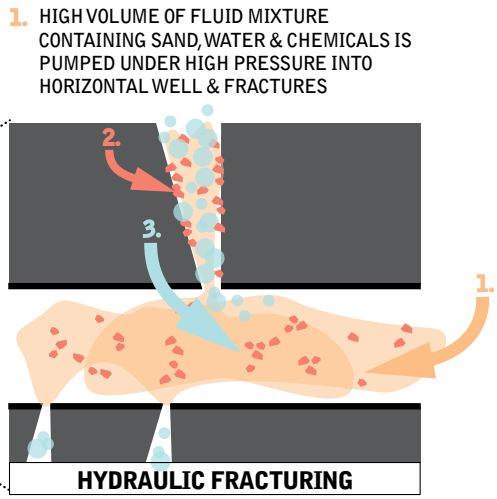
Each shale deposit across the United States is unique: formed with different varieties of organic matter, under different pressures, and over various time periods. As the organic matter decomposes, natural gas builds up in the shale. Over 350 million years ago layers of organic sediment collected, underwent tremendous pressure, and eventually formed the Marcellus during the Devonian period in the Northeastern US. The structure of the shale causes it to fracture vertically when stressed. As the earth shifts over time, gas travels through the fractures and collects in trapped underground pockets known as conventional gas reservoirs. When the permeability of the rock is so low that the gas cannot flow, or when the gas is tightly attached to organic matter in the formation, the deposit is referred to as unconventional. The majority of the gas potential in the Marcellus is unconventional, making it more challenging to extract relative to conventional reservoirs. Over its nearly 600 mile span across the Appalachian Basin, the characteristics of the Marcellus fluctuate. The eastern portion below Delaware County is particulary attractive to gas drilling companies because it is both deep and thick (there is high potential for technically recoverable gas) and probably dry (the gas is pure with very little precipitates requiring less costly processing after extraction). Because of the often microscopic pockets distributed unevenly throughout the shale, the industry conservatively estimates that only about 10% of the gas in place will be able to be extracted.[1] At this early stage, gas companies must experiment to develop site specific drilling techniques, leaving the location and productivity of each gas well highly speculative.



CONVENTIONAL GAS RESOURCE



UNCONVENTIONAL GAS RESOURCE



HYDRAULIC FRACTURING

1. HIGH VOLUME OF FLUID MIXTURE CONTAINING SAND, WATER & CHEMICALS IS PUMPED UNDER HIGH PRESSURE INTO HORIZONTAL WELL & FRACTURES
2. FLUID OPENS, CONNECTS & STABILIZES FRACTURES, SAND HELPS PROP OPEN FISSURES TO RELEASE GAS
3. GAS FLOWS OUTWARD THROUGH FLUID TO SURFACE

POTENTIAL CONCERNS

METHANE GAS MIGRATION

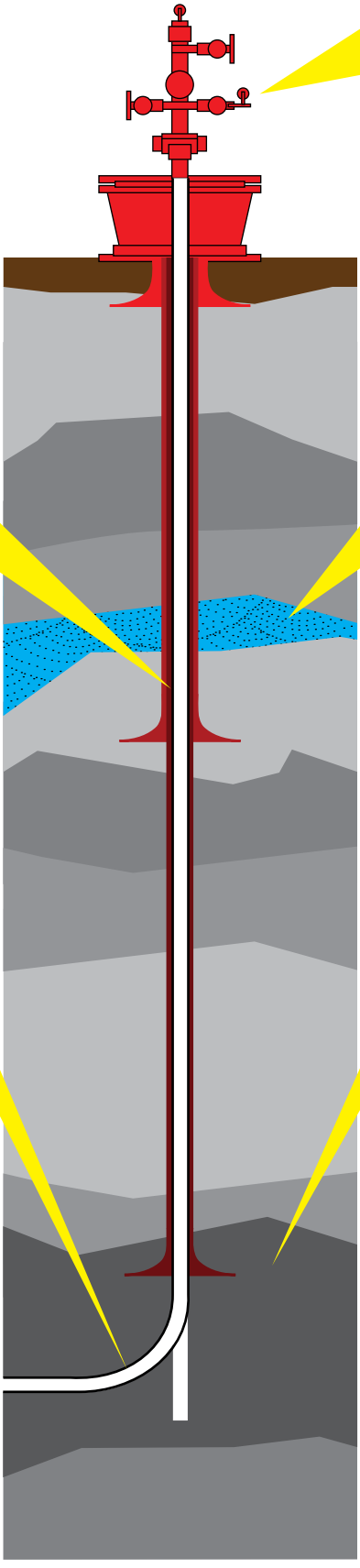
Methane can occur naturally or near an extraction site and can be difficult to detect because it is odorless. Signs of contamination include effervescent water, spurting faucet, or a bubbling noise in a well. A recent study of 200 private water wells in McKean County, PA, shows higher contamination rates for volatile organic compounds and other fracturing chemicals near deep gas wells.[2]

FRESHWATER PROTECTION STRING

In order to protect groundwater aquifers from the drilling fluids, a thick steel casing is cemented into place from the ground surface to below the deepest freshwater aquifer. Properly designed surface casings are critical due to the stresses of high gas and water pressure and the freeze/thaw cycles of the ground surface. Operators must monitor casing pressures throughout the well life to locate and correct leaks that may occur.[3]

RADIOACTIVE MATERIAL

Shales often contain low levels of naturally occurring radioactive material, as is the case for the Marcellus.[4] Radioactive material can reach the surface if radon gas is mixed with the natural gas and/or radioactive material is present in the fluids that are pumped out of the well. To ensure this is not a concern, monitoring of material brought to the surface and the regulation of waste storage and treatment are very important.



WELL PLUGGING

After the productive life of a well, typically a period of several years and in some cases up to a few decades,[5] much of the well casing is removed. The freshwater protection string remains in place, and the well is plugged with a low porous material.

HYDROGEN SULFIDE

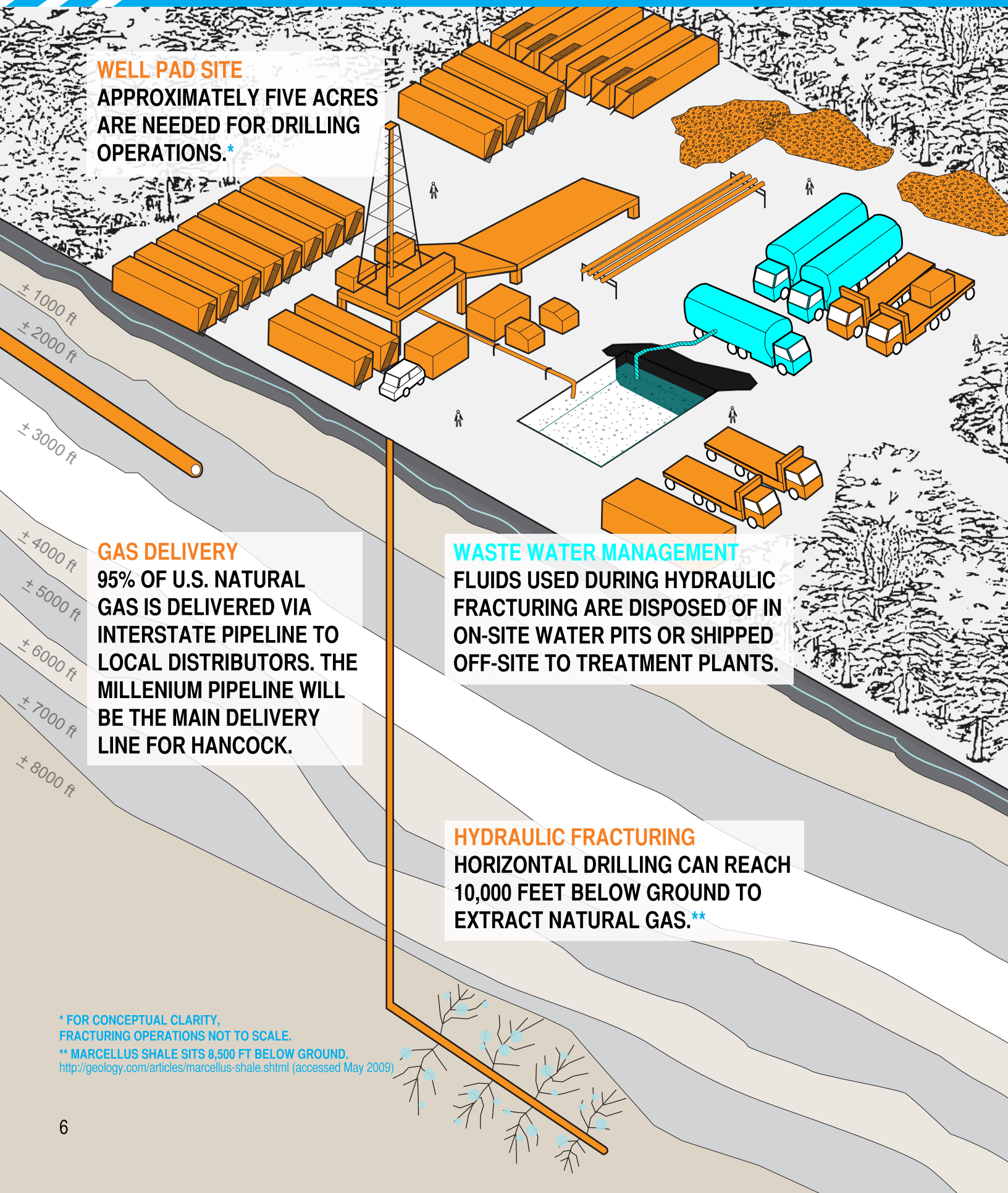
Hydrogen sulfide (H_2S), recognized by it's "rotten egg" odor, is a flammable and poisonous gas. It is naturally occurring, formed from decomposing organic matter, and is often present in wells drilled in shale or sandstone. H_2S was found in other Devonian shales in Ohio, Kentucky, and more specifically, in Derry Township, Pennsylvania which lies on the Marcellus Formation.[6]

ACID-PRODUCING MINERALS

Shales are also known to contain acid-producing minerals such as pyrite and sulfides. In 2003, pyrite was exposed in the Marcellus Formation in Mifflin County, PA.[7] Pyrite, when exposed to air and water, breaks down to form sulfuric acid and iron hydroxide. This acid can erode metals often found in black shales and contaminate soil and water resources. The US Geological Survey has confirmed high concentrations of arsenic, cobalt, chromium, molybdenum, nickel, vanadium, and zinc in stream sediments in close proximity to pyrite-rich Devonian black shale.[8]

1) Penn State Live, "Unconventional Natural Gas Reservoir Could Boost U.S. Supply," January 17, 2009, http://live.psu.edu/story/28116 (accessed May 2009)
2) Penn State University Natural Gas Webinar, "Water," Feb. 19, 2009.
3) K. Moss, "Potential Development of the Natural Gas Resources in the Marcellus Shale," National Park Service, US Dept. of Interior, December 2008.
4, 6, 7, 8) L. Sumi, "Shale Gas: Focus on the Marcellus Shale," The Oil & Gas Accountability Project / Earthworks, May 2008.
5) B. Swistock, "Water Facts #28, Gas Well Drilling and Your Private Water Supply," Penn State College of Agricultural Sciences, Rev: Sept. 15, 2008.

GAS DRILLING ON THE GROUND



WELL PAD SITE

APPROXIMATELY FIVE ACRES ARE NEEDED FOR DRILLING OPERATIONS.*

GAS DELIVERY

95% OF U.S. NATURAL GAS IS DELIVERED VIA INTERSTATE PIPELINE TO LOCAL DISTRIBUTORS. THE MILLENIUM PIPELINE WILL BE THE MAIN DELIVERY LINE FOR HANCOCK.

WASTE WATER MANAGEMENT

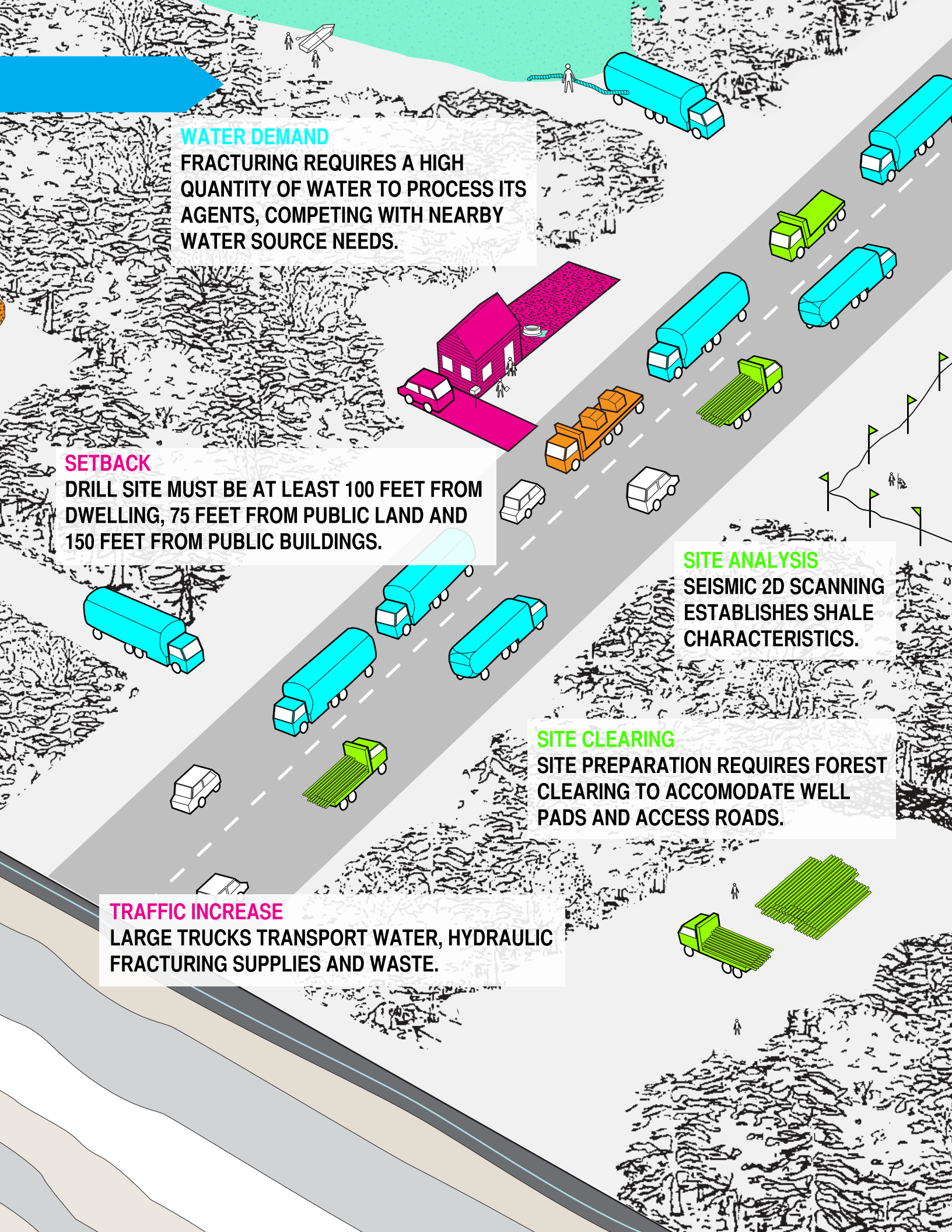
FLUIDS USED DURING HYDRAULIC FRACTURING ARE DISPOSED OF IN ON-SITE WATER PITS OR SHIPPED OFF-SITE TO TREATMENT PLANTS.

HYDRAULIC FRACTURING

HORIZONTAL DRILLING CAN REACH 10,000 FEET BELOW GROUND TO EXTRACT NATURAL GAS.**

* FOR CONCEPTUAL CLARITY, FRACTURING OPERATIONS NOT TO SCALE.

** MARCELLUS SHALE SITS 8,500 FT BELOW GROUND.
http://geology.com/articles/marcellus-shale.shtml (accessed May 2009)


WATER DEMAND
FRACTURING REQUIRES A HIGH QUANTITY OF WATER TO PROCESS ITS AGENTS, COMPETING WITH NEARBY WATER SOURCE NEEDS.
SETBACK
DRILL SITE MUST BE AT LEAST 100 FEET FROM DWELLING, 75 FEET FROM PUBLIC LAND AND 150 FEET FROM PUBLIC BUILDINGS.
SITE ANALYSIS
SEISMIC 2D SCANNING ESTABLISHES SHALE CHARACTERISTICS.
SITE CLEARING
SITE PREPARATION REQUIRES FOREST CLEARING TO ACCOMODATE WELL PADS AND ACCESS ROADS.
TRAFFIC INCREASE
LARGE TRUCKS TRANSPORT WATER, HYDRAULIC FRACTURING SUPPLIES AND WASTE.

GAS DRILLING ON THE GROUND

1. LEASING

Gas companies gain legal access to private property for the exploration and extraction of natural gas by signing lease agreements with willing landowners. Because of radically shifting market pricing, these offers are often made under pressure for a short-term turnaround.

>> HOW CAN LAND OWNERS PROTECT THEMSELVES FROM POTENTIAL HAZARDS AND LIABILITIES FROM HYDRAULIC FRACTURING?

2. SITE ANALYSIS

The exploration for natural gas begins with a series of geological surveys of the surface and sub-surface characteristics of the site. Geologists can then extrapolate a two- or three-dimensional seismic interpretation to identify which areas are best suited for gas extraction from the shale. Typically, this process may take up to four months.

>> WHO CONSIDERS PROXIMITY TO A HOME, A BARN, A WELL, AND RESULTING VISUAL AND AUDIAL IMPACTS?

3. SITE CLEARING

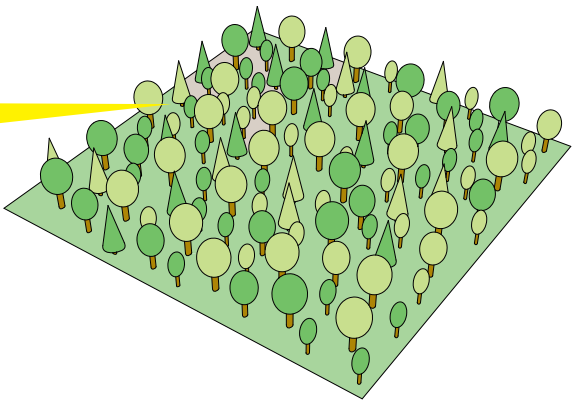
Once chosen, a site is prepaired by tree removal, earth-moving and road-grading. This allows for the delivery of heavy machinery and for transportation of water and gas during and after extraction. Consequently local traffic will increase on predominantly rural roads and deforestation may result in more frequent and severe incidents of erosion.

>> WHAT IMPACTS WILL SITE CLEARING HAVE TO HANCOCK'S RURAL LANDSCAPE AND HISTORIC WATER CONDITIONS?

TREE REDUCTION

1 acre of land sustains approximately **700 trees**, according to the Energy Act of 1992.

If one well pad site averages **5 acres**, about **3,500 trees** would be cut to clear maturely wooded terrain.



All Photos Dimock, PA

4. GAS PRODUCTION & DELIVERY

Once site preparation is complete, pad construction begins and drilling equipment is located. To initate horizontal hydraulic fracturing, the drill first runs vertically for a few thousand feet before turning horizontally to reach the Marcellus Shale which sits approximately 8,500 feet below the surface. This process will last several weeks to months. Wells drilled in the Marcellus may require repeated fracturings, which often require more water than the initial fracturing, to maintain productivity.[1] After the drilling, natural gas production and distribution occurs simultaneously. Pipelines are placed underground on-site and connected to the well through a feeder pipe, allowing gas to be transported to assigned distributors off-site. Ninetyfive percent of natural gas within the United States is distributed below ground via a network of interstate and intrastate pipe-works, such as the Millennium Pipeline.[2] Depending on the leasing company, extracted gas may be distributed above-ground, whereby the gas is liquified at a local plant and then trucked out to gas distribution source points.[3] This however is not a common practice unless the extracted gas is meant to be exported to a distant location.

>> HOW MUCH WATER WILL BE NEEDED, WHERE WILL IT COME FROM, AND WHERE WILL IT GO?

5. CLOSING

The lifespan of a well is anywhere from five to thirty years.[4] During this period, road maintenance, refracturing and additional site preparation will likely be necessary. Upon expiration of the lease, the inactive well should be closed and the site should be restored as per the terms and conditions of the lease. Many leases may allow for extensions but may not fully cover necessary remediation. A typical well closing may last for two weeks.

>> WHAT ARE THE LONG-TERM CONSEQUENCES OF HYDRAULIC FRACTURING TO LANDOWNERS, THE ENVIRONMENT, AND THE COMMUNITY?

1) L. Sumi, "Shale Gas: Focus on the Marcellus Shale," The Oil & Gas Accountability Project / Earthworks, May 2008.
2) United States Department of Energy, "Energy Efficiency and Renewable Energy, Current Technology, Natural Gas Reforming." http://www1.eere.energy.gov/hydrogenandfuelcells/production/natural_gas.html (accessed May 2009)
3) American Petroleum Institute, "Natural Gas Facts." http://naturalgasfacts.org/processing_and_delivery.html (accessed May 2009)
4) W. Lynn, "Drilling Companies Looking for Natural Gas," *The Progress Paper*, April 16, 2008. http://naturalgasfacts.org/processing_and_delivery.html (accessed May 2009)

ONE GAS WELL IN HANCOCK...

Natural gas exploration and extraction will impact the water, traffic and air in Hancock.

At minimum, horizontal wells use 62.5 times more water than traditional vertical wells

That's a minimum of 1.5 million gallons of water used during drilling[1]

That's enough water for everyone in the town of Hancock to take 17 ten-minute showers!

Average shower = 2.5 gallons per minute
25 gallons = 10 minute shower
Population of Town of Hancock = 3,449
according to the 2000 US Census

WATER WITHDRAWAL

"Water use is important, but an overblown issue."

-Mike Uretsky, Northern Wayne Property Owners Alliance

M. Uretsky, "Understanding and Fixing the Gas Exploration Paralysis: Building a Win-Win Situation, An Agenda for Change," Presentation dated January 12, 2009.

Horizontal fracturing requires a substantial consumption of water. A traditional vertical well uses an average of 80,000 gallons during its operating life, while horizontal wells that will be used throughout the Marcellus Shale will require anywhere from 1,500,000 gallons to 9,000,000 gallons of water during its 4 to 6 weeks of fracturing process.[1] This amount of water exceeds the volume required for vertical wells by more than 62.5 to 112.5 times.[2] That amount of water is approximately equivalent to every resident in Hancock taking between 60,000 to 360,000 ten-minute showers.[3]

Hancock's proximity to the Delaware River has encouraged extensive natural gas leasing in this area. The Delaware River is the main source of drinking water for many communities in the Catskills, as well as primary metropolitan areas such as Philadelphia and Trenton. According to the Delaware River Basin Commission (DRBC), approximately 36% of the Delaware Basin lies above the Marcellus Shale.[4]

For Delaware County and other municipalities that lack a centralized water system, the viability of gas development here will depend on the capacity of on-site wells to support drilling needs rather than the more costly shipment of water from off-site to the drilling location.[5] In addition to the challenge of finding enough water required for hydraulic fracturing, there is great concern regarding the the disposal of signficant amounts of waste water created by natural gas extraction. Questions remain as to how the water will be contained on-site following the fracturing process (i.e., in open pits or containers), whether municipal waste water treatment facilities can handle large quantities of large contaminated water, and how and where the water will be transported off-site if treatment cannot be provided locally.

All Photos Dimock, PA

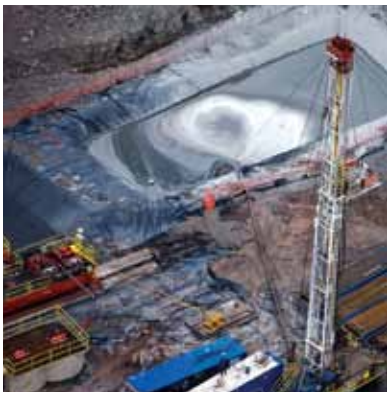
WASTE WATER & DISPOSAL

"...It's only sand and water, you have nothing to be afraid of..."

-Ron Gilius, Director of the Oil & Gas Management Division, Pennsylvania DEP

Deaware River Basin Comission, Meeting Minutes, West Trenton, New Jersey, March 11, 2009. http://www.state.nj.us/drbc/3-11-09_minutes.pdf (accessed August 2009)

Typically, 30 to 40% of the water used for drilling and fracturing returns to the surface highly contaminated. Pollutants include surfactants/ detergents, salt, metals, suspended solids, fracturing chemicals, oil, and grease.[6] However, municipalities in Delaware County do not have specialized treatment facilities with a capacity to handle industrial volumes of drilling waste water that contain salts and non-traditional chemicals. Instead, gas companies will likely pump waste water into on-site pits to evaporate in the open air. These pits are constructed with plastic liners, susceptible to punctures and often overflow during heavy rainfall. They must be frequently monitored during their construction and use to avoid any risk of contamination to soils and ground water. Using deep injection disposal wells, where millions of gallons of waste water are injected deep into the earth, is another on-site option but this process runs a very high risk of contaminating drinking water and requires permits from both the DEP and the EPA, regulated by the Underground Injection Control (UIC).[7] Containerized wastewater units on-site can also hold waste water on-site prior to shipment for off-site treatment but such must be included in a lease negotiated by the landowner.



AIR, NOISE & LIGHT

Portions of the chemicals used in fracturing fluid for natural gas extraction are converted into airborne toxins. Because many of the chemicals used by hydraulic fracturing companies are not of public record due to trade secret protection, it is difficult, if not impossible, to fully evaluate exposure risks. Of the documented health impacts associated with exposure to these chemicals, 94% result in eye and/or skin harm, 83% respiratory harm, 87% brain/neurological harm, and 93% gastrointestinal harm.[8] While gas workers are primarily affected by direct exposure to these chemicals, both air- and water-based dispersal of chemicals at pad sites impact those living in close proximity to fracturing operations. Thumper trucks, drilling, generators, and large trucks are all sources of noise and light pollution at varying frequencies and durations throughout surveying, 24-hour drilling, and fracturing operations.

TRAFFIC INCREASE

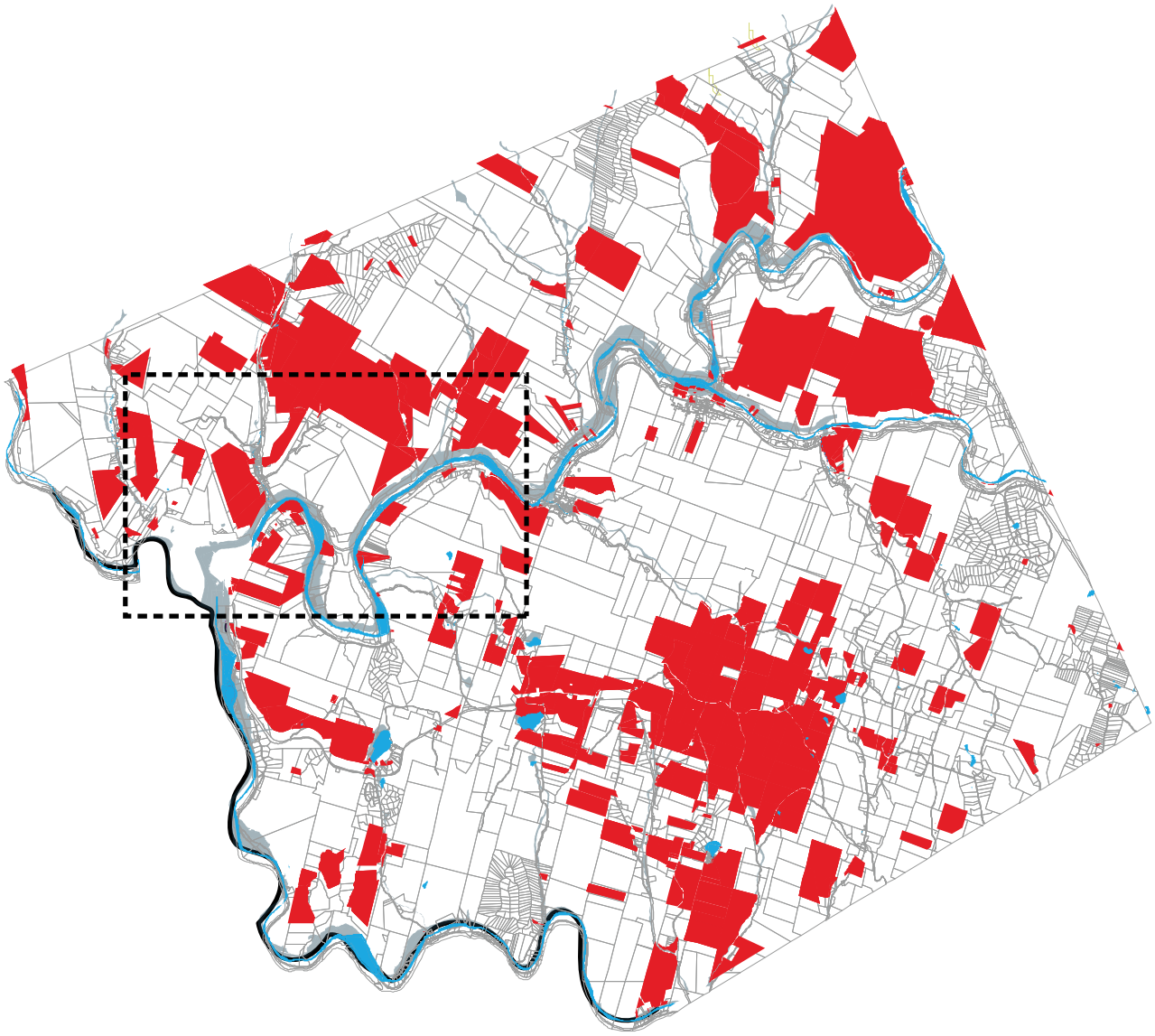
The increase of truck traffic for water transport associated with natural gas extraction has been studied at length. With three primary extraction phases - drilling which typically runs for 30 days, fracturing which typically takes anywhere from 14 days to a few months, and the ongoing operation and maintenance of the well site which can last for years - a tremendous amount of water is required. Sullivan County's study of the City of Denton, Texas, found that on average, for all three phases, approximately 592 one-way truck trips were made per well. Some individual vehicles weighed as much as 80,000 lbs when loaded with water and 100,000 lbs when loaded with rigging equipment.[9] The report clearly indicated that truck traffic associated with natural gas extraction increased vechicles on the road and also had a detrimental impact on the pavement life of municipal roads.[10]

COMPULSORY INTEGRATION

As large swaths of land are leased by gas companies, the future of any unleased land in close proximity remains in question. All drilling permits are subject to mandatory spacing units and as a result, some may encroach on unleased land as required by DEC. If the State grants such a permit, the property owner of that unleased land will receive a notice to elect, within 21 days, one of three choices of integration: as a participating owner, as a non-participating owner or as a royalty owner.[11] While participating owners must front non-refundable costs to the well operator which can be a risk if the well ends up producing little or no natural gas, a participating owner recieves lease payments as well as their full share of royalties. Non-participating owners do not front the cost of the well but are compensated by the well operator only after the reveneus from production cover the costs for the well and for a 200% risk penalty. Royalty owners, the default option, are not required to make any payments to the well operator. After the well goes into production, the owner will receive a royalty no less than one-eighth of the revenue received by the well operator for the share of production attributable to the owned acreage.[12]

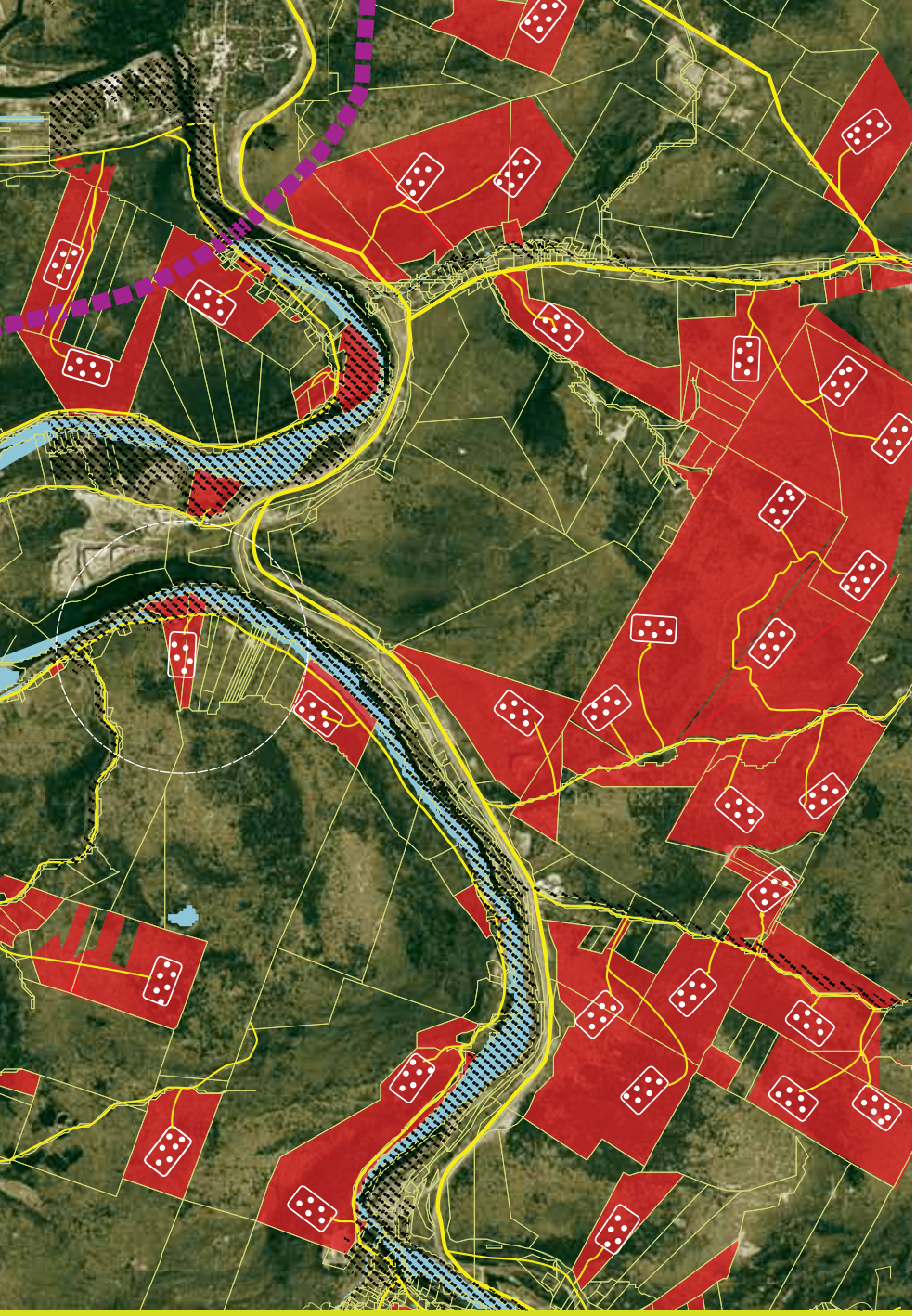
1, 4, 5) "Preparing For Natural Gas Development: Understanding Impacts And Protecting Public Assets," A Gas Drilling Research Task Force Report For Sullvian County, February 13, 2009.
2) Natural Resources Defense Council (NRDC), "Comments on Draft Scope of Work for Well Permit Issuance of Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs," December 15, 2008.
3) Based on average 10 minutes on 2.5 gallons per minutes shower head
6, 7) Penn State University Natural Gas Webinar, "Water," February 19, 2009.
8) "Products and Chemicals Used in Fracturing," Endocrine Disruption Exchange of Paonia, CO, February 2009. http://www.endocrinedisruption.com/chemicals.fracturing.php (accessed August 2009)
9, 10) "Preparing For Natural Gas Development: Understanding Impacts And Protecting Public Assets," A Gas Drilling Research Task Force Report For Sullvian County, February 13, 2009.
11) B. Field, "NYS DEC Program Policy DMN-1," Division of Mineral Resources, February 22, 2006. http://www.dec.ny.gov/energy/28013.html (accessed August 2009)
12) NYS DEC, "Landowner Option Guide," http://www.dec.ny.gov/energy/1590.html (accessed August 2009)

HUNDREDS OF WELLS IN HANCOCK...



As of April 2009 **25%** of Hancock has been leased to gas companies.[1]

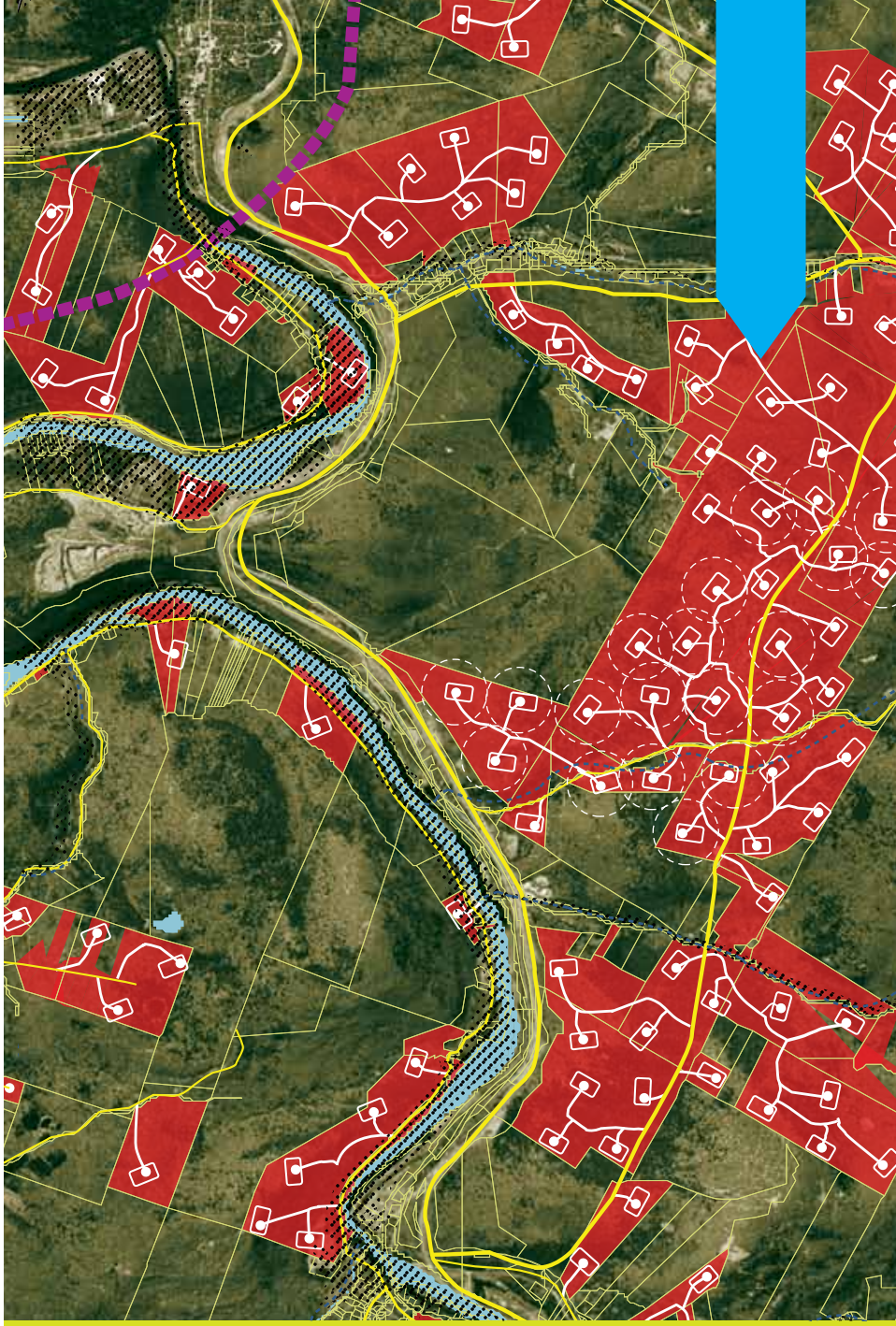
1. Based on research conducted by S.D. Root, Esq. of the Open Space Institute.



EXISTING ROADS
POTENTIAL BUILD OUT
MILLENIUM PIPELINE
100 YEAR FLOOD ZONE
LOCAL HYDROLOGY DISCHARGE

0 1.25 2.5 MI

N



HANCOCK, NY
Hypothetical Scenerio based
on April 2009 Lease Map
15 ACRE WELL PADS

5-6 WELL HEADS PER PAD
16 WELLS PER SQ. MILE

HANCOCK, NY
Hypothetical Scenerio based
on April 2009 Lease Map
5 ACRE WELL PADS

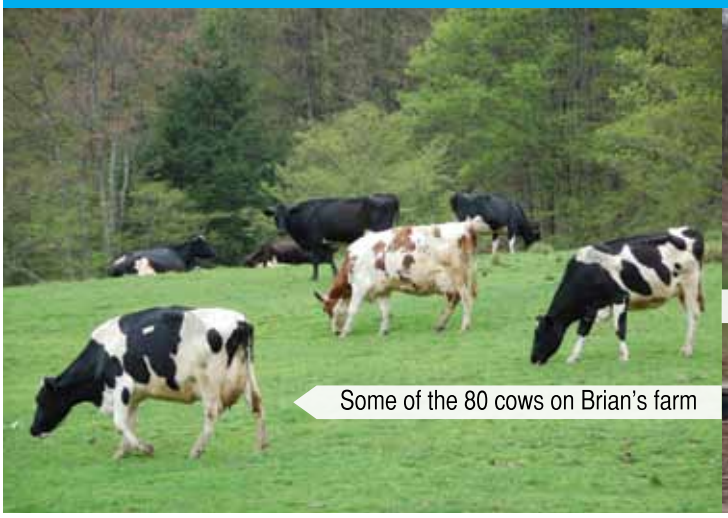
40-ACRE WELL SPACING
16 WELLS PER SQ. MILE

TWO LOCAL FARMERS

>> Brian Begeal

312 acre Dairy Farm
Owned for 5 generations, operated since 1982

After negoations with the gas drilling company, Brian, along with a group of land owners, signed a 5 year lease with an additional 3 year option.



Some of the 80 cows on Brian's farm

Millenium Pipeline adjacent to Brian's farm

All quotes Brian Begeal, interview by Emily Weidenhof, Vivian Ngo, Dongsei Kim and Wes Gillingham, Brian's Farm in Deposit, NY, May 5, 2009.
All photographs taken by Dongsei Kim on May 5, 2009.
Photographs and quotations published with individual's permission.

"...there is no stopping the gas...

"...this is all about the water...don't take it from the aquifers...it's also how you build the roads...this [gas drilling] is a disaster for water but doesn't have to be if DEC places protections..."

"...my farm is utterly dependent on my well water and spring pond..."

"...some lives better, some worse...my life will be worse with truck traffic and noise."

"...there are so many tired farmers out there, this is their chance now not to go to work..."

>> Mark Dunau

50 Acre Organic Vegetable Farm
Owned & operated since 1986

After attending lease contract meetings, Mark declined to lease his land to the gas company.

Spring pond on Mark's farm

Vegetable seedlings on Mark's farm

All quotes Mark Dunau, interview by Emily Weidenhof, Vivian Ngo, Dongsei Kim and Wes Gillingham, Mark's Farm in Hancock, NY, May 05 2009.
All photographs taken by Dongsei Kim on May 5, 2009.
Photographs and quotations published with individual's' permission.

WHAT DOES HANCOCK HAVE TO GAIN?

"Natural-gas extraction would create jobs, create wealth for upstate land owners and increase state revenue from taxes and landowner leases and royalties."

-Govenor Paterson's draft 2009 New York State Energy Plan

S. Isreal, "Gas Industry Prepares to Drill in Sullivan," *Times Herald-Record*, September 1, 2009.

"Unless you want all the land to end up in the hands of the wealthy, or go for back taxes to the county or see it developed, this [leasing land to gas company] is the way to go."

-Tom Shepstone, former planning adviser for the Town of Bethel

S. Israel and A. Bosch, "Sullivan Bracing for Enormous Rush by Natural Gas Companies: Big Money's at Stake," *Times Herald-Record*, July 06, 2008.

"Once we drill, we expect to be in a location for many decades. We come with the intention of being a long-term, positive influence."

- Jim Gipson, spokesman for Chesapeake Energy, a company leasing land in Sullivan County

S. Israel and A. Bosch, "Sullivan Bracing for Enormous Rush by Natural Gas Companies: Big Money's at Stake," *Times Herald-Record*, July 06, 2008.

"People don't realize what a huge economic boost this has been."

-Tina Schaeffer, bookkeeper at the Grandview Palace condominium resort in Loch Sheldrake, which rented 25 units to pipeline workers at up to $900 each per month

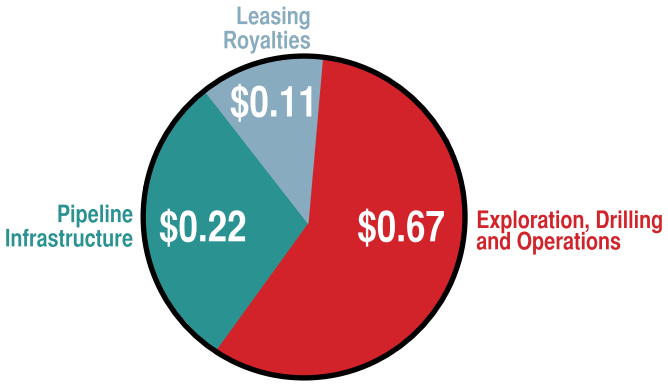
S. Israel, "Millennium Employees Gave Big Lift to Economy," *Times Herald-Record*, November 14, 2008.

Many industry experts predict that Marcellus shale is the next big opportunity for Appalachia, and oil companies have already invested hundreds of millions of dollars in the region. It is still too early to evaluate the full economic impact gas drilling will have on Hancock. However, we can draw some conclusions from the Barnett Shale region of north Texas where unprecedented wealth, employment jumps, and significant population increases have occurred. In an economic impact study by Perryman Group,[1] a Texas-based economic consulting group, three types of economic activities related to natural gas were identified in the Fort Worth Region: 1. Exploration, drilling and operations; 2. Leasing and royalties that go to landowners; and 3. Pipeline infrastructure.

Leasing and royalties income, which creates the most direct economic effect, actually accounts for a relatively small share of 11% in gross product, compared to 67% in exploration, drilling and operation, and 22% in pipeline infrastructure.[2] The report notes that the largest gain from the Barnett Shale went to the crude petroleum and natural gas industry, while retail, hospitality and other service sectors experienced some growth in income and employment. In the current economic crisis, these activities could potentially sustain Hancock's financial future while providing stable income for land owners who have signed leases.[3] It remains to be seen whether the additional income and jobs would create enough personal financial benefit to offset potential costs associated with effects of gas drilling on health care, home insurance and home value. Gas drilling activities in Hancock could also bring in tax revenue to the county and municipal governments. However, under the current Real Property Tax Law for New York, only gas-producing wells are being taxed. This means no tax goes to the local governments during exploring, drilling and fracturing or from abandoned and wells under the minimum production level. A productive well will only provide approximately 21% or $12,368 of tax revenue back to Hancock, while the remainder would be allocated to Delaware County and local schools.[4] Based on this scenario and figures, ten drilling sites with six producing wells each could bring to the town $742,208 in taxes. Because it has yet to be determined what the total costs would be associated with road repair and maintenance, emergency services and contamination clean up, it is not clear whether such income would be enough to cover these expenditures by Hancock as a result of natural gas exploration.

1, 5) The Perryman Group, "Drilling for Dollars: An Assessment of the Ongoing and Expanding Economic Impact of Activity in the Barnett Shale on Fort Worth and the Surrounding Area," 2008.
2) T. Kelsey, "Potential Economic Impacts of Marcellus Shale in Pennsylvania: Reflections on the Perryman Group Analysis from Texas," Penn State Cooperative Extension, http://naturalgaslease.pbwiki.com/f/Potential+Economic+Impacts+of+Marcellus+Shale.pdf (accessed July 2009)
3) "Economic Impact of the Oil and Gas Industry in Pennsylvania," Pennsylvania Economy League of Southwestern Pennsylvania, LLC, November 2008.
4) The Gas Drilling Task Force, "Preparing for Natural Gas Development: Understanding Impacts and Protecting Public Assets," February 11, 2009.
6) B. Begeal, interview by Emily Weidenhof, Vivian Ngo, Dongsei Kim and Wes Gillingham, Brian's Farm in Deposit, NY, May 05 2009.

FOR EVERY $1 GENERATED RELATED TO GAS DRILLING[5]:



LEASING BONUS + ROYALTIES = EARLY RETIREMENT

"There are so many tired farmers out there. For the folks around this area, this gas lease is like a lottery ticket. This is their chance to not have to work."

- **Mark Danau**, organic framer from Hancock
  M. Dunau, interview by Emily Weidenhof, Vivian Ngo, Dongsei Kim and Wes Gillingham, Mark's Farm in Hancock, NY, May 05 2009.

NEW BUSINESS FOR HOTELS AND RESTAURANTS

"For now, the men on the drilling crews seem to be mostly from Texas, and they are providing steady business to hotels and restaurants."

- **Rick Adams**, Houston, PA mayor and cafe owner
  M. Levy, "Marcellus Shale Drilling Offers Hope," *Times Leader*, November 28, 2008.
  http://www.timesleader.com/news/hottopics/shale/Marcellus_Shale_drilling_offers_hope_11-27-2008.html (accessed May 2009)

NEW JOB OPPORTUNITIES

"Employment of 26,500 individuals in full and part-time jobs. For every oil and gas industry job, an additional 1.52 full and part-time jobs are generated in Pennsylvania. Indirect or induced employment, related to oil and gas, includes industries such as health care, legal services and the management of companies and enterprises."

- **Report by the Pennsylvania Economy League of Southwestern Pennsylvania**
  Allegheny Conference on Community Development, "Pennsylvania's Oil and Gas Industry Generates $7.1 Billion in Statewide Economic Impact Annually, New Report Finds," November 17, 2008. http://www.alleghenyconference.org/PDFs/ACCDPress/PR08OilGasIndustryReport111708.pdf (accessed June 2009)

IT'S ALL ABOUT ECONOMIC BOOM

"With the signing bonus I can retire now.... I am tired of working 100 hours a week."
-Brian Begeal, as he points towards a future gas drilling site[6]

Photograph by Dongsei Kim

WHAT DOES HANCOCK HAVE TO LOSE?

"It's a heated subject, and it makes us get angry with one another. And we shouldn't. We should find common ground and move it forward. To stop the drilling is an exercise in futility. ...[W]e're property owners and voters who reside here and we favor responsible development, including gas drilling, which is going to take place."

-Marian Schweighofer, Northern Wayne Property Owners Alliance

S. Long, "Natural Gas Hot Topic at UDC Meeting," *River Reporter*, June 11-17, 2009. http://www.riverreporter.com/issues/09-06-11/head2-udc.html (accessed July 2009)

"Gas companies will try and cheat a landowner in 1,000 different ways. It all comes down to the lease."

-James Leonard, an Endicott Accountant specializing in the gas industry

S. Israel, "Gas-drilling forum draws 300 people in Sullivan," *Times Herald-Record*, August 19, 2008.
http://www.recordonline.com/apps/pbcs.dll/article?AID=/20080819/NEWS/80819035/-1/rss01 (accessed July 2009)

"We're all poor people around here. We thought this was going to be great for us. But we didn't expect explosions."

-Norma Fiorentino, referring to the local gas development and after her water well exploded in Dimock Township, PA

L. Legere, "DEP Probes Blast in Gas-Drilling Region," *Scranton Times-Tribune*, January 03, 2009.

As our midwestern and Pennsylvania neighbors can attest, increased costs associated with hydraulic fracturing borne by a town and its school districts can be significant. From road damage and repair to added burdens from contamination cleanup costs, the impact on local coffers can be devastating. In Hancock, all drilling, fracturing and extraction processes will require extremely heavy truck traffic on rural roads not designed for such capacity and the seven bridges in Hancock will undoubtedly experience unprecedented levels of use.[1] If the Town of Lebanon, New York is any indication, Hancock's costs to repair and maintain its road infrastructure would negate any benefit from tax revenues generated by gas production. With 1,340 residents, this small Madison County town had an annual local road repair budget of approximately $60,000 but following the introduction of natural gas drilling, and associated transport needs, the cost for road repair has risen to more than $550,000 in the past two years.[2]

All industrial sites carry a high risk of chemical spills and fire. Such risks place burdens on rural emergency services and in Hancock, additional training for emergency personnel on toxic chemicals and flammable gas significantly will be critically necessary.[3] Moreover, cleaning up contamination during fracturing, extraction and capping of wells could further drain local tax revenues because current bonding levels collected from the gas companies by the town for potential contamination cleanup are still set at the 1960 rate.[4] Since this will not be sufficient to cover current capping costs, it will likely be the tax payers who will subsidize the town's effort to clean and cap abandoned gas wells.

Individual landowners may also face increased costs for home and health insurance costs. In most cases, a property leased for gas exploration would constitute a "business" exposure with a greater risk of injury, requiring additional liability clauses and a higher insurance rate.[5] Impacts on the health of landowners, their children and their livestock from the noise and air pollution generated by a 24-hour drilling operation may likely increase health insurance premiums or may not even be covered by certain policies.

Because of the unknown nature of gas drilling's physical impact on Hancock, any prediction of economic results, whether a gain or loss, is entirely speculative. Policy makers, as well as residents, should be aware of all potential impacts from natural gas extraction that could affect the health and economy of Hancock and its residents.

1) G. Scott, "Truck Traffic Blamed for Damaged Roads," *Weatherford Democrat*, June 20, 2007.
2) J. Goldstein, "Lebanon Supervisor Comments on Recent Natural Gas Article," *The Madison County Courier*, July 22, 2009.
3) Headwaters Economics, "Fossil Fuel Extraction as a County Economic Development Strategy Are Energy-focusing Counties Benefiting?", Bozeman, Montana, September 2008. http://www.headwaterseconomics.org/energy/HeadwatersEconomics_EnergyFocusing.pdf (accessed May 2009)
4, 10) D. Pace, "Taxpayers May Be Liable for Oil Cleanup,"*Associated Press*, December 27, 2004.
5) DGK Insurance and Financial Services, "If I Sign a Gas Lease, How Will Coverage for Liability Issues be Addressed Under Either Homeowner's or Farm Owner's Insurance Policy?", http://www.dgkinsurance.com/faq.htm#gaslease (accessed August 2009)
6) U.S. Department of Education, "New York." http://www.ed.gov/rschstat/eval/disadv/2002indicators/new_york/edlite-new_york.html (accessed August 2009)
7) U.S. Environmental Protection Agency, "Evaluation of Impact to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs," June 2004.
8) A. Mall, "Oil and gas impacts on livestock health?", NRDC, Boulder, Colorado, May 5, 2009.
http://switchboard.nrdc.org/blogs/amall/oil_and_gas_impacts_on_livesto.html (accessed July 2009)
9) "Preparing For Natural Gas Development: Understanding Impacts And Protecting Public Assets," A Gas Drilling Research Task Force Report For Sullvian County, February 13, 2009.
11) L. Legere, "DEP Probes Blast in Gas-Drilling Region," *Scranton Times-Tribune*, January 03, 2009.
12) A. Bosch, "Farmers Hope Gas Drillers Hit Paydirt," *Times Herald-Record*, July 13, 2008.
http://www.recordonline.com/apps/pbcs.dll/article?AID=/20080713/NEWS/807130330 (accessed May 2009)

SCHOOL COSTS

CURRENT PER PUPIL EXPENDITURES $9,344[6]

MEDICAL & EMERGENCY SERVICE COSTS

SOME INGREDIENTS IN THE FRACTURING FLUID IN UNDILUTED FORM CAN CAUSE **KIDNEY, LIVER, HEART, BLOOD, & BRAIN DAMAGE** THROUGH PROLONGED OR REPEATED EXPOSURE.[7]

LIVESTOCK HEALTH

REPRODUCTIVE CHANGES, INCLUDING UNEXPLAINED, DRAMATIC INCREASES IN BIRTH DEFECTS, STILLBIRTHS, AND REDUCED FERTILITY, ACCORDING TO MEDICAL TESTING. ONE HOG FARMER ESTIMATES HIS **LOSSES AT MORE THAN $50,000.**[8]

ROAD REPAIR & MAINTENANCE

ON AVERAGE, ALL THREE PHASES YIELD ABOUT **592 ONE-WAY TRUCK TRIPS PER WELL** WITH SOME INDIVIDUAL VEHICLES WEIGHING UP TO 80,000 LBS. WHEN LOADED WITH WATER.[9]

CONTAMINATION CLEAN UP

$1 BILLION TAX EXPENSE; SINCE REQUIRED BONDS ARE COLLECTED FROM OIL AND GAS COMPANY AT A RATE SET IN 1960, TAX PAYERS MUST SUBSIDIZE GOVERNMENT EFFORTS TO CLEAN AND CAP ABANDONED GAS WELLS[10]

INSURANCE PREMIUMS

JUST BEING NEAR A DRILLING SITE MAY CAUSE YOUR INSURANCE TO INCREASE.
IF THERE IS AN EXPLOSION IN YOUR NEIGHBORHOOD AS HAS HAPPENED IN DIMOCK, PA,[11] YOU MAY NOT BE ABLE TO GET HOMEOWNERS' INSURANCE AT ALL.

IT'S ALL ABOUT LONG TERM

Photograph by Dongsei Kim

"Their trucks are up and down here all day. You ought to hear it at..."
-Ray, an auto mechanic in Dimock, whose voice is drowned out by a passing truck.[12]

WHAT DOES THE REGION HAVE TO LOSE?

"You can't do a large amount of drilling and have zero impact.....We are absolutely focused on protecting our water"

-John Hanger, Secretary of Pennsylvania's Department of Environmental Protection

J. Hurdle, "Pennsylvania Says Natgas Drilling Risks Inevitable," *Reuters,* March 20, 2009. http://www.reuters.com/article/environmentNews/idUSTRE52J6AP20090320 (accessed August 2009)

"The gas companies tell us it's impossible for the water to become contaminated... But it's increasingly common... We have no idea what to protect ourselves from."

-Lisa Bracken, resident of Silt, Colorado, who draws her drinking water from Divide Creek.

A. Lustgarten, "Does Natural-Gas Drilling Endanger Water Supplies?", *Business Week*, November 11, 2008. http://www.businessweek.com/magazine/content/08_47/b4109000334640.htm (accessed August 2009)

"As in 1981, the physical behavior of the Delaware River system can still be compared to that of a single pool. Changes in one region can affect circumstances in another. The replenishment of both surface and ground waters is linked to weather and precipitation, soil and geology, human use and transport."

-The Delaware River Basin Commission

State of the Delaware River Basin Report 2008, "Category 1, Basin Hydrology," December 2008. http://www.state.nj.us/drbc/SOTB/index.htm (accessed August 2009)

As millions of people, plants, and wildlife species depend on the high quality and quantity of water in the Delaware River, one of the most important considerations for policy makers and landowners is the impact natural gas extraction will have on the regional water network of the Delaware River Basin. To best understand the scale of this impact, we look to the number of people depending on this hydrological system and its vulnerability to a drastic change in use patterns.

Every day, over 8.7 billion gallons of water are consumed in the Delaware River Basin[1] by nearly 16 million people.- thats one out of twenty Americans. Of the four states sharing the Delaware River Basin, Delaware has the highest percentage of water consumption from this source (81.5%), followed by Pennsylvania (42%), New York (35%), and New Jersey (34%).[2] The potable water supply of the Delaware River Basin is composed of surface water diversions (rivers, streams, and reservoirs) and groundwater withdrawals (aquifers). Surface water sources constitute one third of the resources provided by the Delaware River and are directly related to the condition and use of the area's landscape. The remaining two thirds of the water is fed by groundwater sources. The upper region of the basin where Hancock is located depends mostly on groundwater sources (80%), specifically domestic wells.[3]

New York City's water supply depends almost entirely on the well-being of the Catskill/Delaware System. The Catskill/Delaware watershed, located on the eastern edge of the Marcellus Shale, is the main source of water for over 9 million New York City residents. It constitutes 90% of the total water consumption in the city and is one of the rare water supply systems in the world that does not require an expensive filtering process or a mechanical pumping system to reach its consumers. The other 10% of the water is provided by the Croton Watershed, for which the city is currently building a water filtration plant that will cost more than $3 billion.[4]

Recent records of gas drilling activity in the U.S. collected from at least nine states have shown that water contamination, fracturing fluid spills, and water theft[5] have been consistent issues in communities where local residents are competing for water with gas drilling operations from a common river or reservoir system.

J. HENRY FAIR

Observing the landscape from a larger scale, photographer J. Henry Fair visions the regional environmental impacts of industry in his recent work "Industrial Scars". "My work is a response to my vision of society", Henry says, "I see our culture as being addicted to petroleum and the unsustainable consumption of other natural resources, which seems to portend a future of scarcity." Henry's latest project catalogs the burgeoning gas drilling operations in Dimock, PA. Shown in the adjacent map, Dimock shares similarities in its geology, landscape, and communities with Hancock. Henry's photographs on the following pages share valuable lessons from just across the river.

1, 2, 3) The Delaware River Basin Commission, "State of the Delaware River Basin Report 2008," December 2008. http://www.state.nj.us/drbc/SOTB/index.htm (accessed August 2009)

4, 5) Manhattan Borough President Scott M. Stringer Report, "Uncalculated Risk: How Plans to Drill for Gas in Upstate New York Could Threaten New York City's Water System," February 2009. http://www.mbpo.org/uploads/UncalculatedRisk.pdf (accessed August 2009)

Sources: The Delaware River Basin Comission. State of the Delaware River Basin Report 2008. U.S. Census Bureau, 2008 Population Estimates.

ACROSS THE RIVER IN DIMOCK

Only 35 miles west of Hancock, across the Delaware River, sits what has been considered to be the "ground zero for America's energy future"[1] and an example of what gas drilling in the Marcellus shale would bring to New York State. The township of Dimock, Pennsylvania, currently has 20 drilling rigs operated by Cabot Oil & Gas Co. As of April 2009, the 1,382 residents[2] are dealing with 9 cases of private water wells contaminated with high levels of methane and 2 diesel fuel spills (100 and 800 gallons) due to drilling operations. Next year, the Houston TX based company will be drilling 63 new wells in Dimock in light of facing a DEP Notice of

Violation (NOV) on charges of contaminating fresh groundwater.[3] The most infamous drilling related incident took place on New Year's Eve of 2009. A several thousand pound concrete slab covering a drinking water well exploded due to the accumulation of methane in the water. Without acknowledging responsibility, Cabot Oil & Gas Co. began a voluntary supply of water to at least five homes in Dimock.[4] The following aerial photographs were taken by J. Henry Fair in collaboration with LIGHTHAWK: Flight & Areal Services. These drill sites, photographed in late winter and early spring of 2009, are located in Dimock Township in Susquehanna County, PA.

All Photos Dimock, PA

ACROSS THE RIVER

"The water has to go somewhere...The thing is it's not water. It's like you're taking 5 million gallons of fresh water, and you're contaminating it intentionally. You're leaving half of it in the ground, and then you're looking for a place to dispose of the other half."

-Steve Penningroth, co-founder of the Community Science Institute

B. Duncan, "An Unearthed Resource," *The Ithacan*, April 23, 2009. http://theithacan.org/am/publish/news/200904_An_unearthed_resource.shtml (accessed August 2009)

"If these formulas were to become available to other companies, it is possible that we could lose our competitive advantage to those companies"

-Diana Gabriel, Halliburton spokesperson

A. Lustgarten, "Does Natural-Gas Drilling Endanger Water Supplies?", *Business Week*, November 11, 2008. http://www.businessweek.com/magazine/content/08_47/b4109000334640.htm (accessed August 2009)

All Photos Dimock, PA

ACROSS THE RIVER

"You have to evaluate which is more important, the money or the water...The economy is so tough. Suppose you could stop drilling – no one wants Cabot to go away."

-Dimock resident, owner of a leased property who declined to be named

A. Lustgarten, "Officials in Three States Pin Water Woes on Gas Drilling," *ProPublica*, April 26, 2009. http://www.propublica.org/feature/officials-in-three-states-pin-water-woes-on-gas-drilling-426 (accessed August 2009)

1) B. Duncan, “An Unearthed Resource,” *The Ithacan*, April 23, 2009. http://theithacan.org/am/publish/news/200904_An_unearthed_resource.shtml (accessed August 2009)
2) U.S. Census Bureau, 2007 Population Estimates
3) S. Long, “Contaminated Wells Spark Controversy,” *The River Reporter*, March 19-25, 2009.
4) A. Lustgarten, “Officials in Three States Pin Water Woes on Gas Drilling,” *ProPublica*, April 26, 2009.
http://www.propublica.org/feature/officials-in-three-states-pin-water-woes-on-gas-drilling-426 (accessed August 2009)

All Photos Dimock, PA

NATURAL GAS IS LIMITED!

"It's well accepted that the 2005 Energy Bill was the Dick Cheney lobbyist energy bill. It was written by lobbyists. It was championed by Dick Cheney. It wasn't just the green light that it gave to more nuclear power. It had enormous giveaways to the oil and gas industries."

-Hillary Clinton, during the primaries in 2008, at the democratic debate in Las Vegas

On The Issues, "Hillary Clinton on Energy & Oil," http://www.issues2000.org/Cabinet/Hillary_Clinton_Energy_+_Oil.htm (accessed August 2009)

"This bill will strengthen our economy, and it will improve our environment, and it's going to make this country more secure."

-George W. Bush, after signing the Energy Policy Act in 2005 in Albuquerque, NM

R. Stevenson, "Bush Signs an Energy Bill That Had Been a Longtime Priority," *New York Times*, August 9, 2005.

Though natural gas is considered an alternative source of energy, it is not renewable. According to the most optimistic scientific estimations[1] and even if it was possible to extract all the gas from the ground, the natural gas reserves from the Marcellus Shale could supply the U.S. for a little less than three years based upon current consumption rates.[2] While the most easily accessible gas has already been extracted in the United States, the natural gas reserves in the Marcellus Shale have remained untouched. Known of for decades, the Eastern Gas Shales Project (EGSP), a multi state initiative funded by the U.S. Department of Energy that was formed subsequently to the oil crisis in 1973, concluded that the Marcellus reserves were not likely to be exploited until its pricing would support the development of advanced technology to access it.[3] Located approximately 8,500 feet below the earth's surface, the Marcellus Shale was not a feasible reserve for cultivation. But more than thirty years later, as gas prices steadily increased,[4] Halliburton developed a combined horizontal drilling and fracturing technology[5] to extract natural gas trapped in subsurface geological formations. This technology, common to the Midwestern states such as Colorado, New Mexico, Arizona, Wyoming and southern states such as Texas has just made its way to the Northeast making access to the Marcellus Shale in Virginia, Pennsylvania and New York possible.

With supportive policy regimes at the federal, state, and local levels, gas drilling remains an economically viable pursuit. Following the energy crisis of the 1970s, President Carter implemented energy conservation and renewable energy policies[6] which resulted in a drop in consumption of both natural gas and oil. But as some of these regulations were repealed by subsequent administrations in the 1980s, both consumption and therefore also production rates stepped up again.[7] Not only is gas consumer activity influenced by policy but government subsidies and incentives influence the behavior of gas companies (see following page).

The 2005 Energy Policy Act offered significant subsidies that guaranteed gas companies profit, even if they didn't discover gas or did not pursue extraction after the initial drilling and fracturing had been completed. The 2005 Energy Policy Act[8] also exempts gas drilling techniques from the Safe Drinking Water Act of 1974.[9] As a result, profit margins for gas drilling and technology companies have further increased while additional tax burdens are indirectly being imposed on local municipalities. Current conditions have also supported the natural gas industry. Since the early 1970s, the average yield of a gas well has consistently diminished.[10] At the same time, however, fossil fuel supplies are becoming ever more scarce keeping natural gas drilling a worthwhile investment for gas companies today.

1) Based on estimates by the Department of Environmental Conservation, http://www.dec.ny.gov/energy/46288.html, assuming that total reserves in the Marcellus Shale amount to a maximum of 516 trillion cubic feet (accessed April 2009)
2) Energy Information Administration (EIA), http://www.eia.doe.gov/emeu/aer/natgas.html (accessed February 2009)
3) J. Harper, "The Marcellus Shale – An Old New Gas Reservoir in Pennsylvania," Bureau of Topographic and Geologic Survey, in Pennsylvania Geology, Vol 38, No. 1 http://www.dcnr.state.pa.us/topogeo/pub/pageolmag/pdfs/v38n1.pdf (accessed April 2009)
4) Energy Information Administration (EIA), http://tonto.eia.doe.gov/dnav/ng/hist/n9190us3m.htm (accessed April 2009)
5) Information brochure by Halliburton, http://www.halliburton.com/public/shale/pubsdata/H06377.pdf (accessed April 2009)
6) Energy Information Administration (EIA), http://www.eia.doe.gov/emeu/aer/natgas.html (accessed February 2009)
7) U.S. Department of Energy (DOE), Energy Timeline from 1971 to 1980, http://www.energy.gov/about/timeline1971-1980.htm (accessed April 2009)
8) Energy Information Administration (EIA), http://www.eia.doe.gov/emeu/aer/natgas.html (accessed February 2009)
9) Energy Policy Act (EPA), http://www.epa.gov/oust/fedlaws/publ_109-058.pdf (accessed April 2009)
10) Energy Policy Act (EPA), http://www.epa.gov/oust/fedlaws/publ_109-058.pdf, Subtitle C – Production, Sec. 322, Hydraulic Fracturing, accessed 04/23/2009
11) NATURAL GAS http://www.naturalgas.org/regulation/history.asp#dereg (accessed May 2009)
12) NATURAL GAS http://www.naturalgas.org/environment/technology.asp#advances (accessed May 2009)
13) J. Harper, "The Marcellus Shale – An Old New Gas Reservoir in Pennsylvania," Bureau of Topographic and Geologic Survey, in Pennsylvania Geology, Vol 38, No. 1 http://www.google.de/url?sa=t&source=web&ct=res&cd=1&url=http%3A%2F%2Fwww.dcnr.state.pa.us%2Ftopogeo%2Fpub%2Fpageolmag%2Fpdfs%2Fv38n1.pdf&ei=Kj-QSZ2CFo-ctwe00OmmCw&usg=AFQjCNETklUTg3J4SV-RUKSiszOGJoU4EA&sig2=NxSJlz6du3jirKXEKud4MQ (accessed May 2009)
14) ENERGY POLICY ACT http://www.epa.gov/oust/fedlaws/publ_109-058.pdf (accessed May 2009)

EFFECTS

TECHNOLOGY

POLICY

1973 1st ENERGY CRISIS
OPEC OIL EMBARGO

1979 2nd ENERGY CRISIS

FUTURE WHAT DOES THIS MEAN?

1970s FRACTURING TECHNIQUES
CO2-SAND / FLUID FRACTURING [12]

1980s HORIZONTAL DRILLING
TO GROUP SEVERAL WELL HEADS [12]

1970s & 80s "EASTERN GAS SHALE PROJECT" [EGSP] BY U.S. DEPT. OF ENERGY

STUDY OF DEVONIAN SHALES, MAPPING, EXPLORATION OF NEW TECHNOLOGIES [DIRECTIONAL DRILLING, FRACTURING TECHNIQUES] TEST WELLS IN IL, MI, OH, PA, NY

RESULT: MARCELLUS SHALE NOT ATTRACTIVE UNTIL GAS PRICES RISE &TECHNOLOGY ADVANCES [13]

2005 ENERGY POLICY ACT [EPA]

TAX INCENTIVES & LOAN GUARANTEES FOR ENERGY PRODUCTION GAS PRODUCTION EXEMPT FROM SAFE DRINKING WATER ACT REQUIREMENTS [14]

THE EPA SCANDAL

The National Energy Policy Development Group, who prepared the EPA in 2001, refused to release information as to who was involved and what was discussed, violating the open meetings law.

Hydrofracing technology was developped by Halliburton; the firm will earn royalties from gas drilling in NY State.

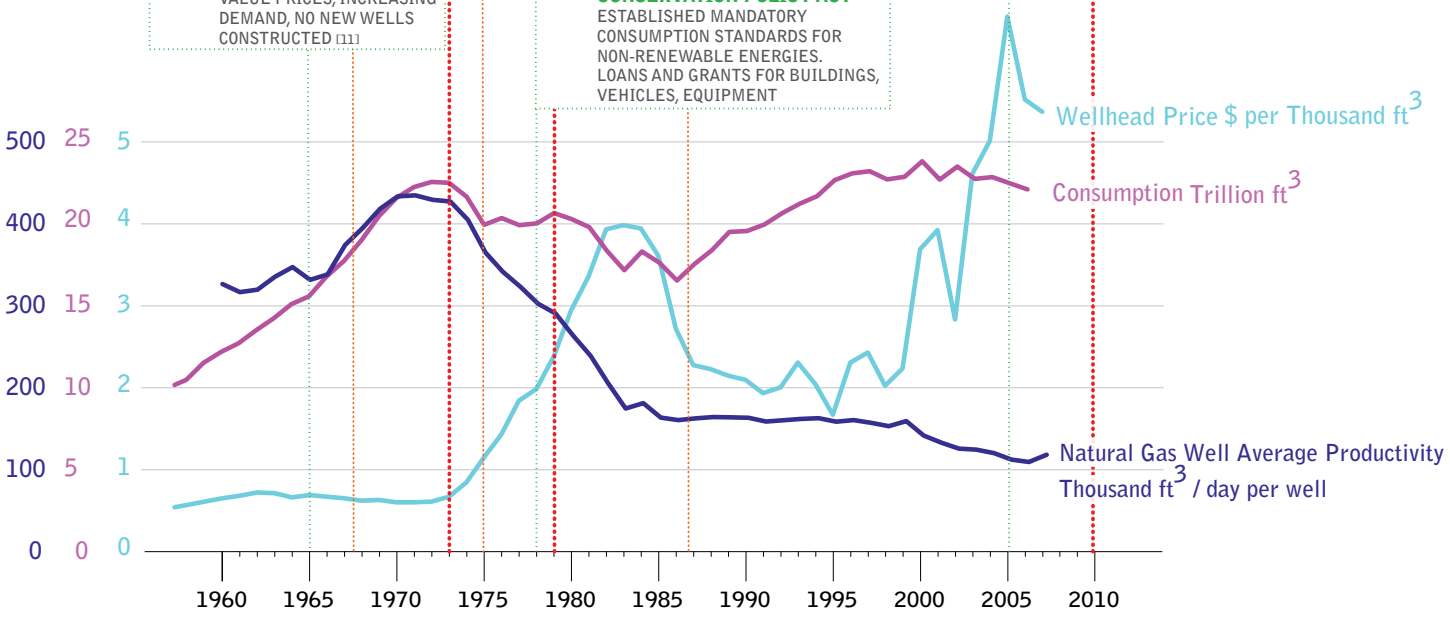
Former U.S. Vice President Cheney, the CEO of Halliburton from 1995 - 2000, received $211.465 from the firm in 2005, after urging Congress to **EXEMPT FRACING FROM THE SAFE DRINKING WATER ACT** as part of the EPA.

1960s & 70s FEDERAL POWER COMMISSION [FPC] SETS PRICE RATES FOR INTERSTATE PIPELINES

RESULT: BELOW-MARKET VALUE PRICES, INCREASING DEMAND, NO NEW WELLS CONSTRUCTED [11]

1978 NATURAL GAS POLICY ACT
DEREGULATION, AS A REACTION OF SHORTAGES, LED TO PRICE INCREASE AND DEMAND DECREASE [11]

1978 NATIONAL ENERGY CONSERVATION POLICY ACT
ESTABLISHED MANDATORY CONSUMPTION STANDARDS FOR NON-RENEWABLE ENERGIES. LOANS AND GRANTS FOR BUILDINGS, VEHICLES, EQUIPMENT



HISTORY OF NATURAL GAS IN THE U.S.

THE MARCELLUS SHALE CONTAINS APPROX. 500 TRILLION CUBIC FEET OF NATURAL GAS, THOUGH IT IS ESTIMATED THAT ONLY 10% IS RECOVERABLE.

THE UNITED STATES WILL CONSUME AN ESTIMATED 230 TRILLION CUBIC FEET OF NATURAL GAS IN THE NEXT 10 YEARS.

10% OF THE MARCELLUS SHALE WILL SUPPLY THE USA WITH 2 YEARS OF NATURAL GAS AT CURRENT CONSUMPTION RATES.

NATURAL GAS IS A NON-RENEWABLE RESOURCE

WHO REALLY BENEFITS?

"The oil and gas industry has been given exemptions to the regulations that apply to everyone else...this is not an accident."

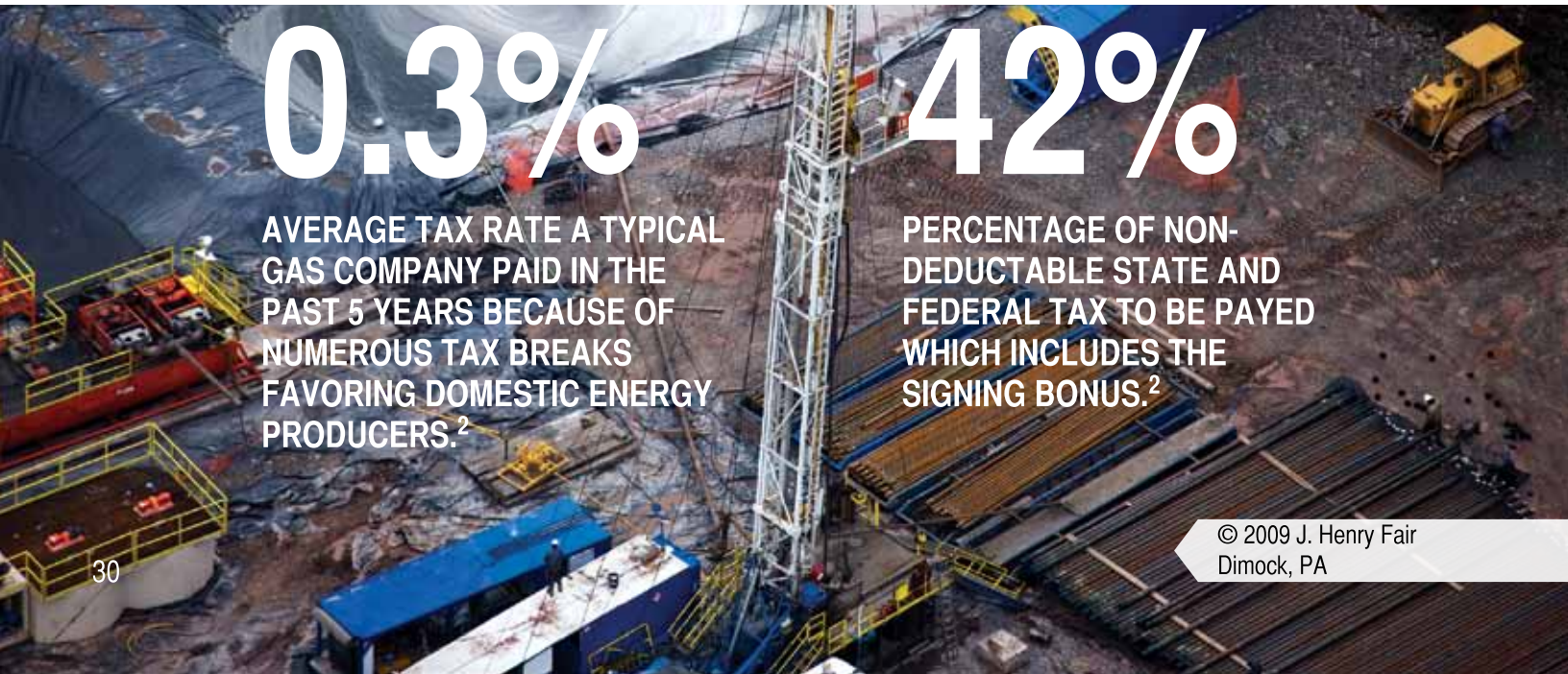
-James Barth, a resident of Beach Lake, Pennsylvania

S. Long, "Natural Gas Hot Topic at UDC Meeting," *River Reporter*, June 11-17, 2009. http://www.riverreporter.com/issues/09-06-11/head2-udc.html (accessed August 2009)

In order to boost domestic production of fossil fuel, the energy industry and United States Congress have promoted large subsides for fuel exploration in the U.S. The Energy Policy Act of 2005, authorized subsidies to incentivize domestic harvesting in order to obtain energy independence.[1] These numerous tax breaks favoring domestic energy producers were staggering; a typical gas company paid only 0.3% on their profit, compared to the standard 35% stated corporate tax rate.[2] This lower tax rate could be justified if it was proven to assist with the domestic production of energy but there is a strong possibility that extracted U.S. natural gas will be exported to overseas .

Most of the subsidies provided to corporate gas companies apply to the exploration phase of natural gas extraction, rather than production.[3] Since taxes and royalties are not paid to townships and residents until gas production reaches a minimal level, gas companies have nothing to lose in leasing, exploration and drilling. It also means that abandoning drilled wells without remediation can be a possibility. Due to the recent economic global crisis and severe cutbacks on all levels of public and private spending, prices of natural gas have fallen dramatically. Many energy companies no longer see profit in natural gas drilling and have been shutting down wells all across the US. Companies are not only drilling less but also deciding not to pump from wells already drilled. Even in the highly active Barnett Shale field, drilling operations have reduced significantly. "The big bonanza is over," said Jay Ewing, the completion and construction manager for Devon Energy in the Barnett Shale, where so far in 2009 his company has brought its rig count from 35 to 8. With the energy prices so volatile, any landowner or community considering natural gas exploration and extraction should investigate other options for a more financially secured future.

1) S. Lazzari, "Oil and Gas Tax Subsidies: Current Status and Analysis," CRS Report for Congress, February 27, 2007. http://price.house.gov/issues/uploadedfiles/energy2.pdf (accessed May 2009) Joint Committee on Taxation, "Renewable Energy and Energy Conservation Tax Act of 2007," Annual Tax Expenditure Reports, June 19, 2007. http://www.house.gov/jct/x-36-07.pdf and http://www.house.gov/jct/x-59-05.pdf (accessed May 2009)
2) Money Central, "Companies With the Fattest Tax Breaks," *Business Week*, December 4, 2007. http://articles.moneycentral.msn.com/Investing/Extra/CompaniesWithTheFattestTaxBreaks.aspx (accessed August 2009)
3) "Analytical Prospects, Budget of the United States Government Fiscal Year 2009" http://www.whitehouse.gov/omb/budget/fy2009/pdf/spec.pdf (accessed July 2009)
4) Friends of the Earth, "Big Oil, Bigger Giveaways," July 2008. http://www.foe.org/pdf/FoE_Oil_Giveaway_Analysis_2008.pdf (accessed August 2009)



$5.9 Billion

OIL AND GAS PERCENTAGE DEPLETION ALLOWANCE[1]

EPA ALLOWS INDEPENDENT COMPANIES TO DEDUCT 15 PERCENT OF THEIR SALES REVENUE IF THEIR AVERAGE DAILY PRODUCTION FALLS BELOW A CERTAIN MINIMUM.

this means: **gas companies get subsidies even if the wells don't yield any products and no royalities need to be paid[4]**

$3.5 Billion

MANUFACTURING TAX DEDUCTION[1]

A 2004 LEGISLATION RECLASSIFIED OIL AND GAS AS A MANUFACTURED GOOD, ALLOWING COMPANIES TO CLAIM BILLIONS OF DOLLARS OF ADDITIONAL TAX DEDUCTIONS.

this means: **tax payers subsidizing costs of oil production[4]**

$3.5 Billion

INTANGIBLE DRILLING COSTS[1]

INTEGRATED COMPANIES ARE ALLOWED TO IMMEDIATELY DEDUCT 70 PERCENT OF INTANGIBLE DRILLING COSTS (WAGES, SUPPLIES, SITE PREPARATION, ETC) AND SMALL INDEPENDENT COMPANIES 100 PERCENT.

this means: **tax payers pays for 70%-100% of equipment, supplies, etc costs for drilling[4]**

$522 Million

NATURAL GAS DISTRIBUTION LINES[1]

EPA 2005 ALLOWS COMPANIES CAN DEDUCT THE COSTS OF NATURAL GAS DISTRIBUTION OVER 15 YEARS OF DEPRECIATION TIME.

this means: **almost free gas distribution[4]**

$133 Million

PASSIVE LOSS[1]

OWNERS AND INVESTORS CAN USE LOSSES FROM THE OIL AND GAS BUSINESS TO SHELTER OTHER INCOME.

this means: **subsidizing gas companies if they lose money on drilling[4]**

$10 Million

NATURAL GAS GATHER LINES[1]

EPA 2005 ALLOWS COMPANIES TO DEDUCT THE COST OF NATURAL GAS GATHERING LINES OVER A 7-YEAR DEPRECIATION RECOVERY PERIOD.

this means: **almost free gas pipelines[3]**

WILL THE MARCELLUS LEAD TO ENERGY INDEPENDENCE?

"We applaud...elected leaders from both political parties who understand the once-in-a-lifetime opportunity we have to strengthen our Commonwealth's economy and energy independence by supporting the development of the Marcellus Shale."

-The Marcellus Shale Committee, The Independent Oil & Gas Assoc. of Pennsylvania, and The Pennsylvania Oil & Gas Assoc.

"Marcellus Shale Committee Applauds State Elected Leaders for Pro-Jobs Position," *Reuters*, April 16, 2009. http://www.reuters.com/article/pressRelease/idUS207651+16-Apr-2009+PRN20090416 (accessed August 2009)

"We believe Marcellus easily holds a 10- to 20-year supply of natural gas - that's for the nation, based on current consumption."

-Dave Spigelmyer, Spokesman for Equitable Resources Inc.

K. Leonard, "Marcellus Gas Estimate Swells," *Pittsburgh Tribune-Review*, November 1, 2008. http://www.pittsburghlive.com/x/pittsburghtrib/business/s_596250.html (accessed August 2009)

"All this for 10 years worth of natural gas? Pollution on this scale is not easily remedied, future generations will surely scoff at the idea of severely impacting a heavily populated 575 square mile area to obtain a 10-year supply of gas. The 'more petroleum at any cost' philosophy may keep our economy going for now, but it will be the key to our eventual undoing. Until we can shift into an economy based on the sustainable exploitation of our planet's resources, we will increasingly poison ourselves and our environment."

-David Austin, Benzene Leukemia Law Blog

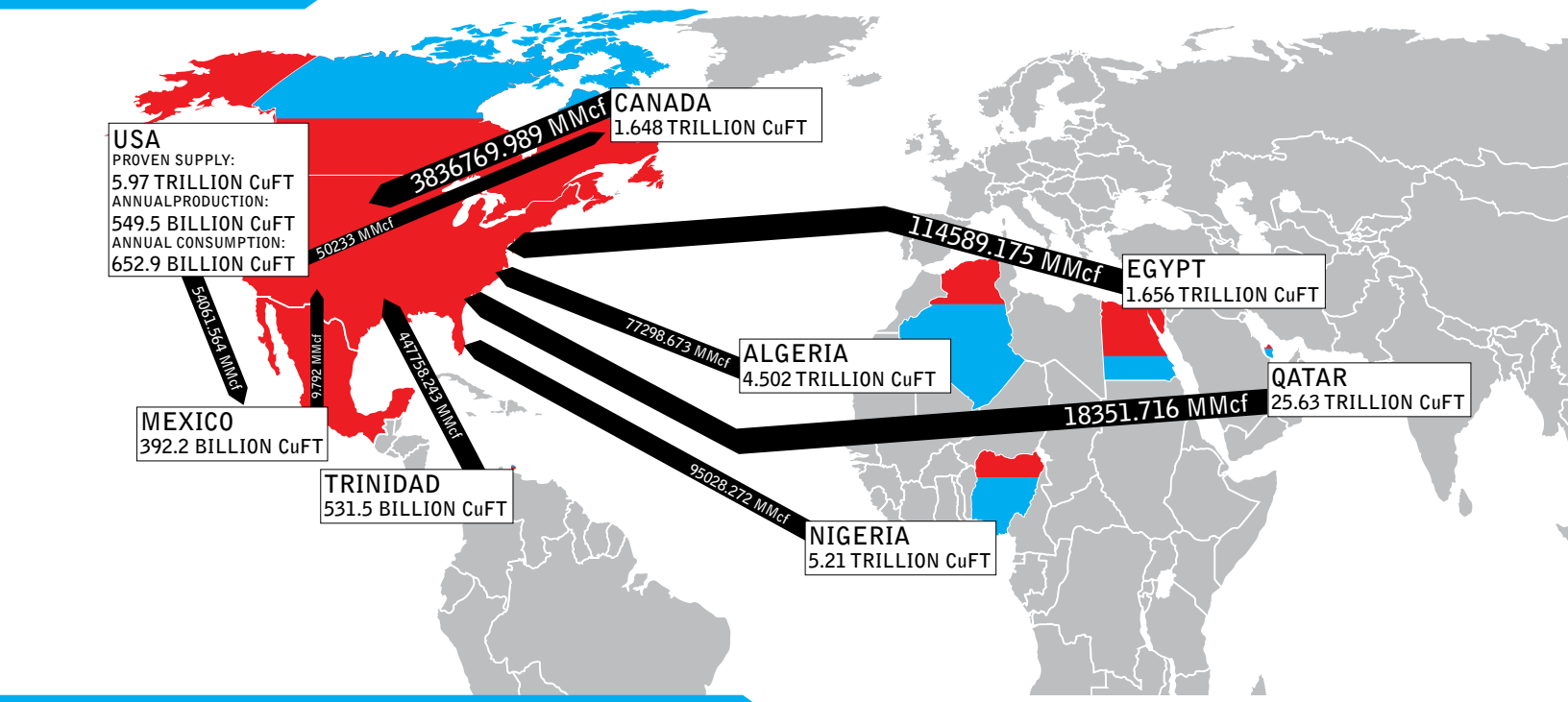
D. Austin, "Natural Gas Drilling Pollution Debate Heats Up Around Marcellus Shale," Benzene Leukemia Law Blog, Burke & Eisner, P.A., May 13, 2009. http://www.benzeneleukemialawblog.com/2009/05/articles/benzene/informationnews/natural-gas-drilling-pollution-debate-heats-up-around-marcellus-shale/ (accessed August 2009)

The term "energy independence" was conceived in the United States during the energy crisis of the 1970's, where national security was clearly at risk due to a dependence on foreign oil. While very little has changed since then, the term "energy independence" has become a politically popular saying, especially in light of the climate change impacts we are now experiencing from increased reliance on petroleum products. During the 2008 presidential campaign, the expression was seen as a rally cry for candidates of both parties resulting in two very different visions on accomplishing this goal. The Democratic candidates saw investment in renewable energy, such as wind and solar power, as the answer whereas the Republican Party tended to focus on increasing domestic production of existing energy resources.

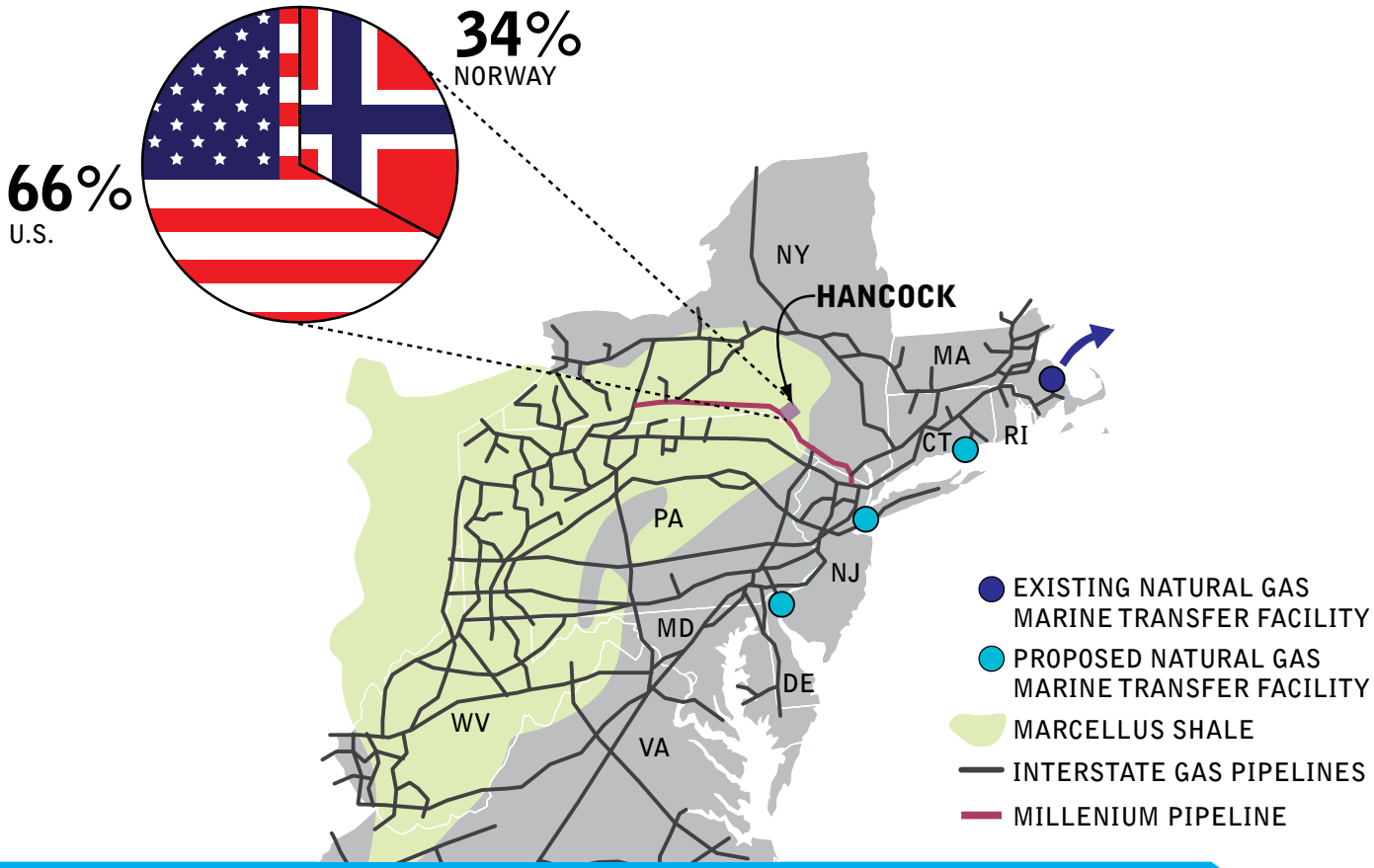
Desipte consuming more natural gas than it produces domestically,[1] the United States still exports a portion of its supply of natural gas to international markets. At the same time, we still import from other countries to fulfill our internal demand. When considering the Marcellus Shale in the context of this global trade network, it appears as a feasible source for gas export as the infrastructure necessary to bring natural gas to a marine transfer station for distrubution abroad is available thorugh the Millenium Pipeline. Exportation of natural gas produced in the Marcellus Shale may also be influenced by the fact that Chesapeake Energy, one of the major investors thus far in the Marcellus Shale, has sold a 32% share of its leases in the region to the second largest European natural gas distribution company, StatoilHydro[2] from Norway. This transaction may imply that the development of the Marcellus Shale is again not solely for America's "energy independence" but is another source for the global gas trade network.

Accordingly, while geologic research has shown that the Marcellus Shale would create a new domestic source for natural gas, there is no guarantee that this will further American independence from foreign oil or even be sold within the U.S. market. There are still many who argue that the there is great danger in the American import of international energy resources to fulfill its demand as it sends billions of dollars out of the country to governments that are not "U.S. friendly". However, the USEIA reports that in 2007 the U.S. imported 16% of its natural gas to fulfill domestic consumption with 90% of this import coming from Canada, making this ally the main supplier of both oil and natural gas to the United States.[3]

1) The Central Intelligence Agency World Factbook. https://www.cia.gov/library/publications/the-world-factbook/geos/us.html (accessed April 2009)
2) "Chesapeake Teams Up with Norway Supplier," *Toronto Star*, November 12, 2008. http://www.thestar.com/Business/article/535150 (accessed August 2009)
3, 4, 5) The United States Energy Information Administration, "U.S. Natural Gas Imports by Country." http://tonto.eia.doe.gov/dnav/ng/ng_move_impc_s1_m.htm (accessed April 2009)



U.S. NATURAL GAS TRADE NETWORK[4]



U.S. NATURAL GAS TRANSPORT NETWORK: OPTIONS FOR THE FUTURE[5]

YOU DECIDE...

Natural gas hydraulic fracturing has the capacity to alter lifestyle and landscape at a scale not seen in the Catskills since the creation of the New York City Watershed system. Requiring almost a million gallons of water (with chemical additives) per day for each operating well, the impacts to the quantity and quality of water in the Upper Delaware region are clearly at risk, whether simply by diversion or as a result of contamination. Increased truck traffic, wastewater treatment needs and gas distribution pipelines will burden already-stressed municipal infrastructure, from rural road networks to local fire departments. And the alteration of a once bucolic landscape will affect the community character of an historic region that draws millions of recreational visitors a year.

However, natural gas leasing appears to be a viable solution to the many that are suffering in this difficult economic climate. While not clearly a 'stable' commodity, revenue from gas leasing and potential income from royalties can offer relief to landowners on the brink of losing their property and their way of life. Such funds would allow for mortgages to be paid off, children to go to college and lifelong dreams to be realized. As such, we are poised at a difficult juncture – to drill or not to drill.

At a time when there is incontrovertible evidence that our climate will deteriorate dramatically unless we move immediately towards sustainability in global energy production and use, the natural gas debate in Hancock, New York becomes an evermore important venue for cooperative resolution. Localities, like never before, have an ability to influence the direction of regional, national and even global policy on energy. Given the jurisdiction they exercise over land use and planning, as well as the design and construction of buildings and other municipal services, local governments are a critical partner of state and federal governments to resolve energy issues to prove that ground-breaking strategies really can work. Natural gas hydraulic fracturing presents an historic opportunity for localities to seek scalable solutions that are transferrable to larger geographies.

This report aims to accomplish two goals: to inform broadly and to induce involvement. Seeking and implementing strategies in the Catskills that support both sustainable economic development and preservation of invaluable natural resources can only be accomplished with the support of the individual citizen, elected local officials and regional policy makers. These will be legal, political and scientific solutions that require the work of several generations to undo our past "era of procrastination". Instead, in this "period of consequences", where there is both severe urgency and great optimism, we are charged with - and capable of - solving our energy problems in our own backyard. Be a critical contributor – get the facts and then decide on whether or not to drill.

Jennifer Grossman, Open Space Institute

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URBAN DESIGN LAB
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

Open Space Institute

UPPER DELAWARE udpc Preservation Coalition, Inc.