

DEP Briefing to the NYC Water Board on the Natural Gas Impact Assessment Project

September 25, 2009



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Environmental Engineers & Scientists



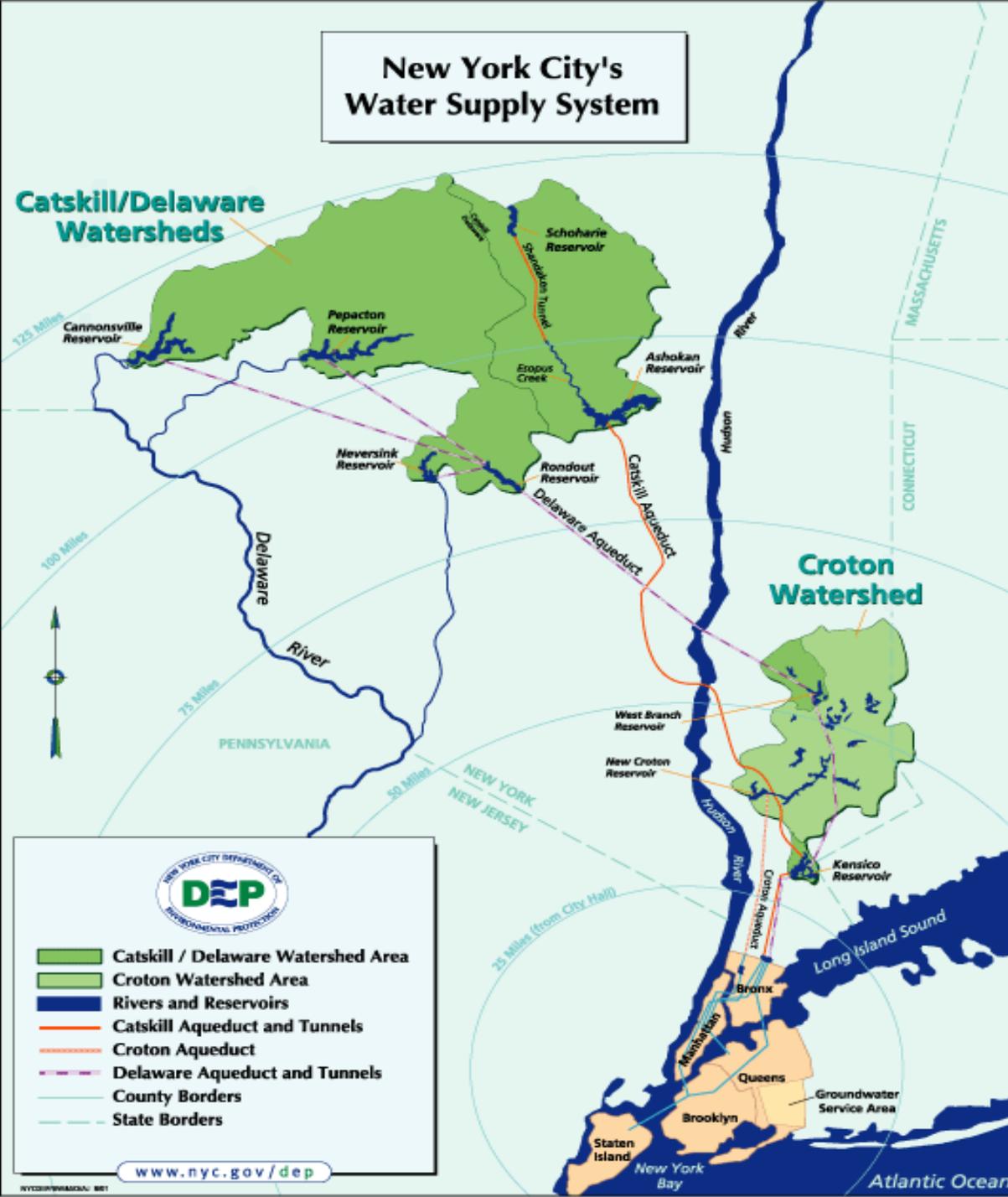
*Impact Assessment of Natural Gas Production
in the New York City Water Supply Watershed*

Presentation Overview

- NYC Watershed and Natural Gas Development
- Natural Gas Impact Assessment Project
 - Project status
 - Assessment Components
 - Highlights of Results
 - Future Planned Work
- Site Visit to Bradford County, PA

New York City Water Supply

- Primarily a surface water supply with 19 reservoirs & 3 controlled lakes
- System Capacity: 550 billion gallons
- Serves 9 million people (1/2 of population of New York State)
- Delivers approx. 1.1 billion gallons per day to the City
- Source of water is a 2,000 square mile watershed in parts of 8 upstate counties

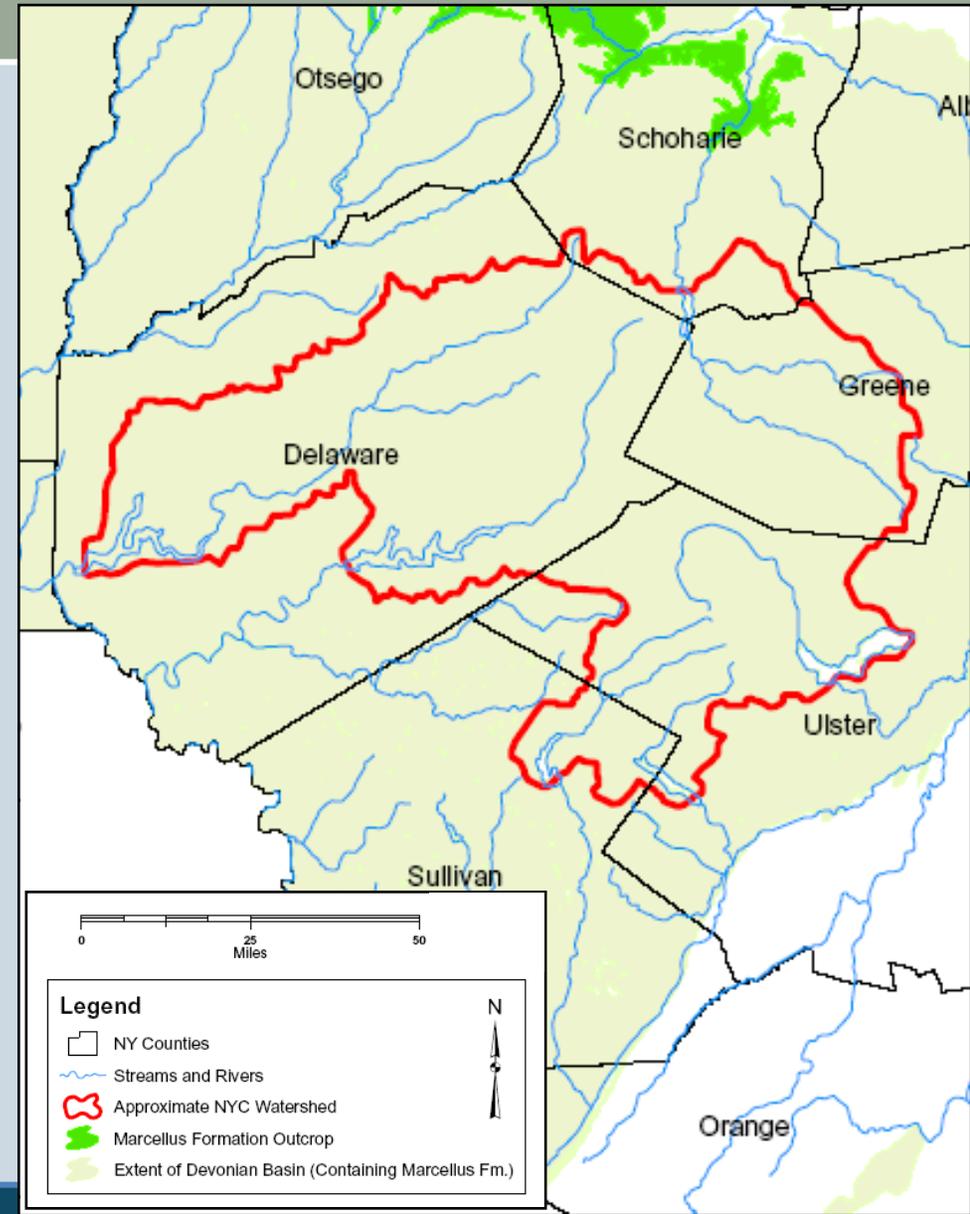


Natural Gas Exploration

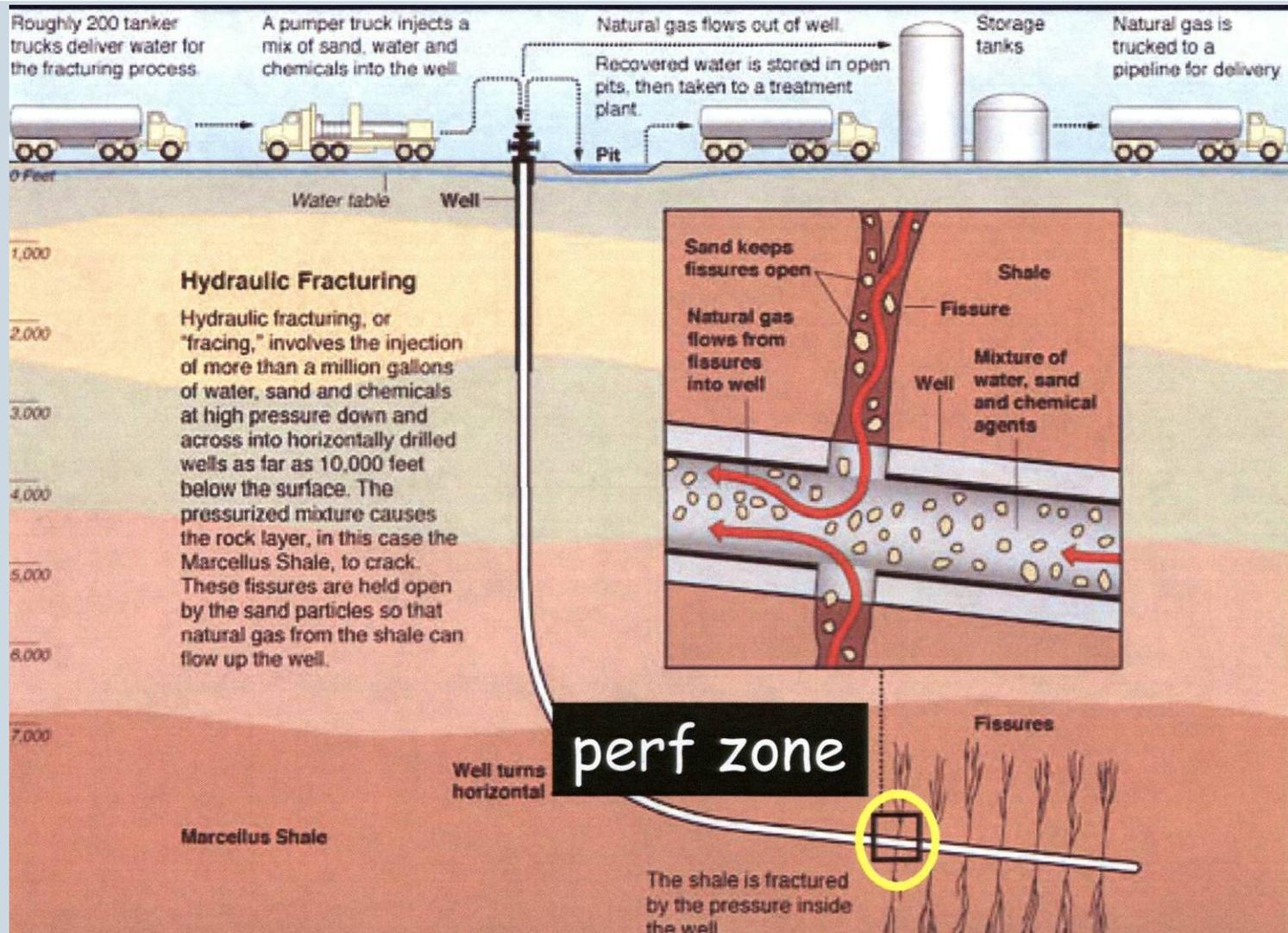
- **Recent interest in natural gas exploration in the NYC watershed**
 - Combination of proximity to the Millennium Pipeline, improved drilling technology and higher prices makes shale drilling more feasible
 - Target formation is the Marcellus Shale
- **Natural gas production is not new to NYS**
 - ~13,684 active oil and gas wells which produced 50.32 bcf (billion cubic feet) of gas and 397,060 barrels of oil in 2008
 - Total market value of the oil and gas produced in New York in 2008 is estimated at \$486 million

Natural Gas and the Marcellus Shale

- The Marcellus Shale formation underlies the entire NYC WOH watershed and is the shallowest of several potential gas producing formations
- It is a “non-conventional source rock” meaning the gas is distributed across the formation (i.e., bubble wrap)
- Base of the Marcellus occurs ~3,000 - 7,000 ft. underground



Hydrofracing Process



Natural Gas Development Activities/Impacts – Estimated Quantities

- Two to five acres of disturbance per site, not including access roads
- 500 to 800 truck trips per well (18-wheeler and tanker trucks)
 - Equipment, chemicals, water, proppant, waste, etc.
- 2-9 million gals. of stimulation water per well, additional volume needed for rehabilitation
 - 1% to 5% of volume are chemicals
 - 100,000 to 300,000 lbs of proppant
- Average of 15,000 gal./yr. of produced water



Joint Venture Project – H&S/LBG

- In January 2009, Water Board hired Hazen and Sawyer/Leggette, Brashears and Graham (Joint Venture) to conduct an assessment of potential impacts to the NYC watershed from natural gas drilling (DEP is managing the project)
- The assessment focuses on potential impacts to water quality, water quantity, and water supply infrastructure
- **Scope of Work:**
 - Assessment Component – phased approach; rapid and final assessment reports
 - Technical Assistance Component – SGEIS and on-demand technical assistance

Contract Progress and Deliverables

- **Reports**

- Rapid Impact Assessment Report
- Final Impact Assessment Report – due by 12/31/09

- **DEC SGEIS**

- JV reviewed and provided comments on the scope for the SGEIS
- Awaiting release of the draft SGEIS – originally expected Spring 2009
- Once draft SGEIS is released, City will comment as part of public comment process

Rapid Impact Assessment - Components

- **The Rapid Impact Assessment was designed to quickly provide DEP with basic information on all potential impacts**
 - Policy development and emergent issues
 - Focus more detailed investigations on critical impacts
- **Assessment included:**
 - Evaluation of natural gas development activities and their impacts
 - Analysis of regional hydrogeology and potential water quality signatures
 - Review of available data on drilling and fracturing fluids
 - Review of natural gas issues and regulations in other states
 - Preliminary risk evaluation for DEP major infrastructure

Rapid Impact Analysis Highlights

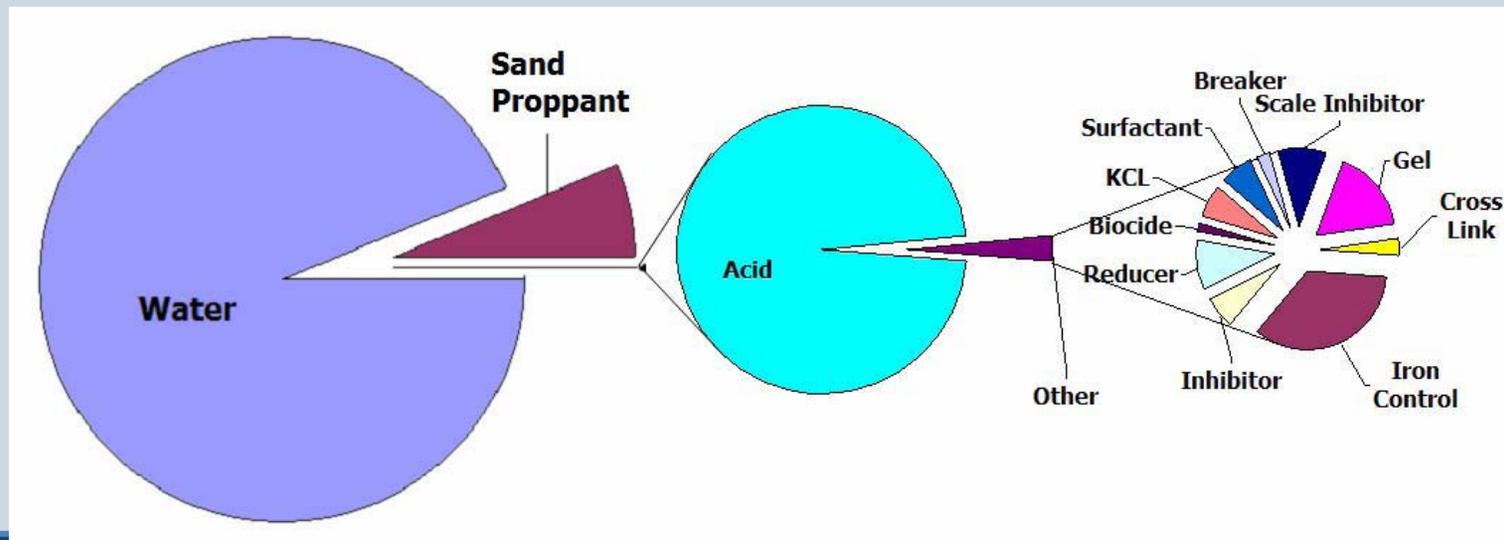
Water Quality

- **All the activities required for natural gas drilling involve some risk to the water supply. Many are similar to construction sites but the chemical and wastewater risks are unique to the industry.**
- **Level of impacts in the watershed would be related to rate and magnitude of natural gas development**



Rapid Impact Analysis Highlights Hydrofracing Chemicals

- **Developed a database of potential chemicals:**
 - Over 430 products; over 350 individual chemicals
 - Original TedEx database was expanded to include fate and transport, analytical methods, regulations, etc.
- **Additives range from food-grade substances (sucrose, xanthan gum, etc.) to potentially hazardous compounds (BTEX, heavy metals, biocides, etc.)**



Rapid Impact Analysis Highlights

Water Quantity

- **Impacts would depend on location, timing, source, and magnitude of withdrawals**
 - Excessive withdrawals can result in operational impacts due to reduced reservoir inflow or altered flow or quality in regulated streams (e.g., Esopus Creek)
 - Groundwater flow regimes could be altered by natural gas development, potentially impacting baseflow
- **Particular concern in the Catskill watershed**
 - Lack of withdrawal permitting authority and basin-level planning framework provided in the Delaware watershed by DRBC

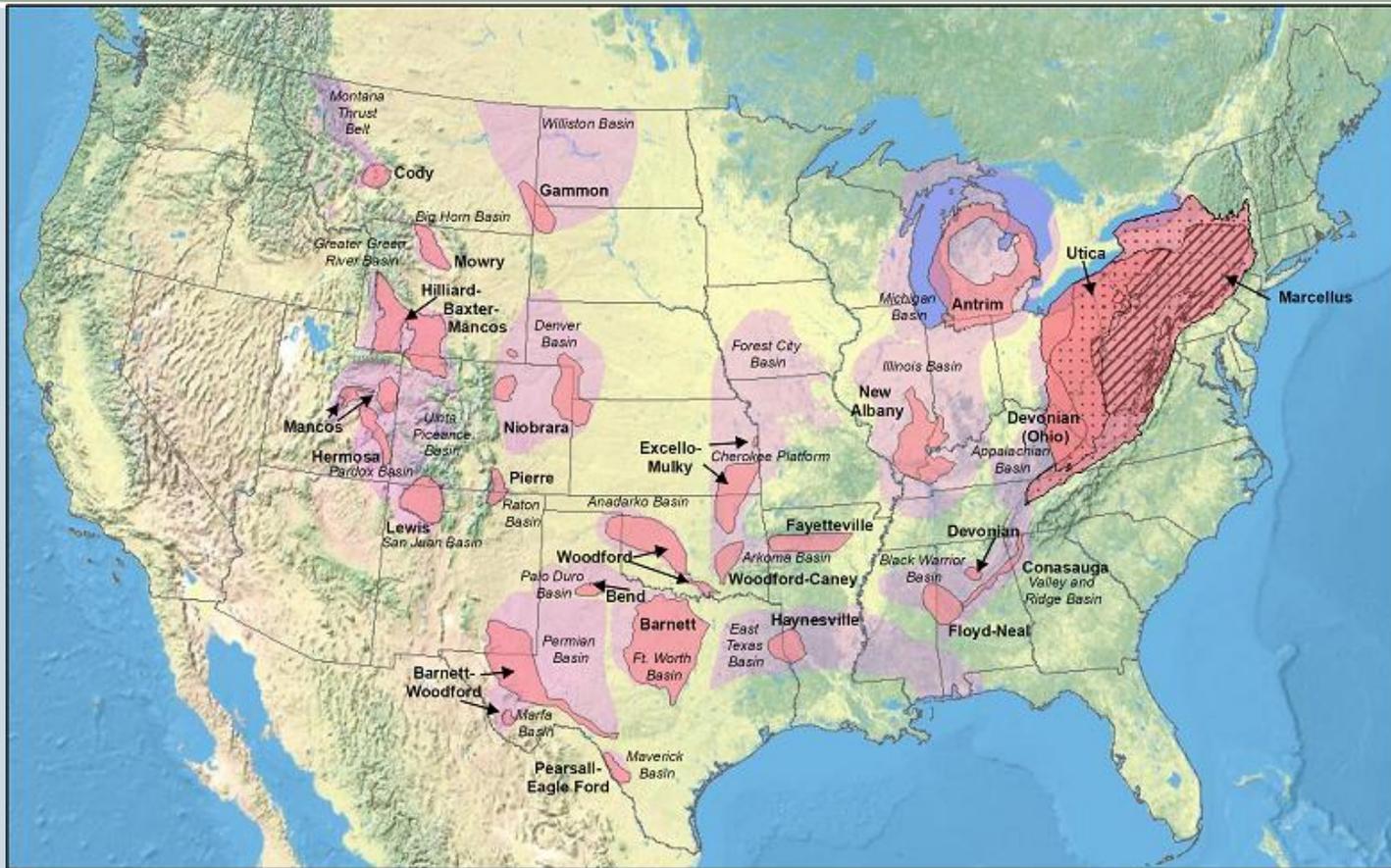


Rapid Impact Analysis Highlights Infrastructure

- **Assessment is using data compiled from record drawings, geologic reports, etc. and evaluating:**
 - Location and separation distance with respect to all possible gas-bearing units
 - Potential paths through rock formations that could allow the transmission of contaminants (e.g., faults or joints)
 - Structural condition of the infrastructure
- **Drilling and hydraulic fracturing operations in close proximity to critical NYC infrastructure could potentially lead to structural impacts**
- **There is also a risk of influxes of poor quality groundwater and/or natural gas under certain conditions**

Natural Gas Case Studies and Failures

Shale Gas Plays in the US



United States Shale Gas Plays

www.eia.doe.gov
eia Energy Information Administration
 Office of Oil and Gas

Shale Gas Plays
 Basins

Stacked Appalachian Plays

- Marcellus
- Utica
- Devonian (OH shale)

November 2008

Miles
 0 150 300 600

Rapid Impact Analysis Highlights

Case Studies

- Failures compiled from eight formations/states (PA, LA, TX, AR, WY, NM, CO, KY) focused on analogous shale formations
- Isolated failures occurred for all activities. Human error was a leading cause when a cause is determined
- Systemic failures generally related to lack of regulation (e.g., use of unlined wastewater pits)
- Many states have recently revised or are in the process of revising their regulations

Final Impact Assessment Components

- **Infrastructure Risk Technical Memo**
 - Complete the analysis of the Delaware Tunnels and develop proposed drilling set-backs
- **Watershed Risk Technical Memo**
 - Develop a few, key “what-if” scenarios
 - Identify any strategies for minimizing the risks to the watershed
- **Final Impact Assessment Report**
 - Will be geared toward non-technical audience and contain a brief synopsis of all components, including those completed for the Rapid Impact Assessment

Conclusions of Rapid Impact Assessment

- The site preparation on the surface is likely to increase erosion and run-off into the reservoirs.
- The wellbore, which acts as a conduit between geological formations, can allow previously isolated contaminants to flow into shallow groundwater or surface water.
- The stimulation of the well introduces hazardous chemicals into the watershed.
- Water withdrawals for hydrofracing may have direct water supply operational impacts.
- The hydrofracing process creates enormous volumes of industrial wastewater that cannot be effectively treated by conventional processes.

Next Steps

- **Rapid Impact Assessment Report has provided a thorough overview of potential impacts to water quality, water quantity, and DEP infrastructure**
- **Work to date supports a level of concern about potential water supply impacts**
- **Remaining work will focus on what will be most useful to DEP given the inherent uncertainties**
 - e.g., buffer distance around aqueducts and facilities

Site Visit to two Chesapeake Natural Gas Drilling Sites in Bradford County, PA

- **Chesapeake Energy provided the opportunity to see active natural gas drilling operations.**
- **On July 1st, DEP and JV staff traveled to Bradford County, PA to see:**
 - ▣ Judd Well Site (vertical drilling phase)
 - ▣ Evanchick Well Site (producing phase)
 - ▣ Gas pipeline under construction

Site 1: Judd Well Under Construction



Drilling Platform and Block



Mud Pit



Mud Recycling



Stormwater and Erosion Control



Pumps, Generators, and Compressors



Chemical Storage



Evanchick Site - Gas & Produced Water Collection Facilities



Chesapeake Pipeline Under Construction



Chesapeake Pipeline Under Construction



Questions?

