Where in New York are the Marcellus and Utica Shales??

How do they get to the gas resource and how do they get the gas out of the ground?

What are the concerns about this entire process and what can/should we do about it?

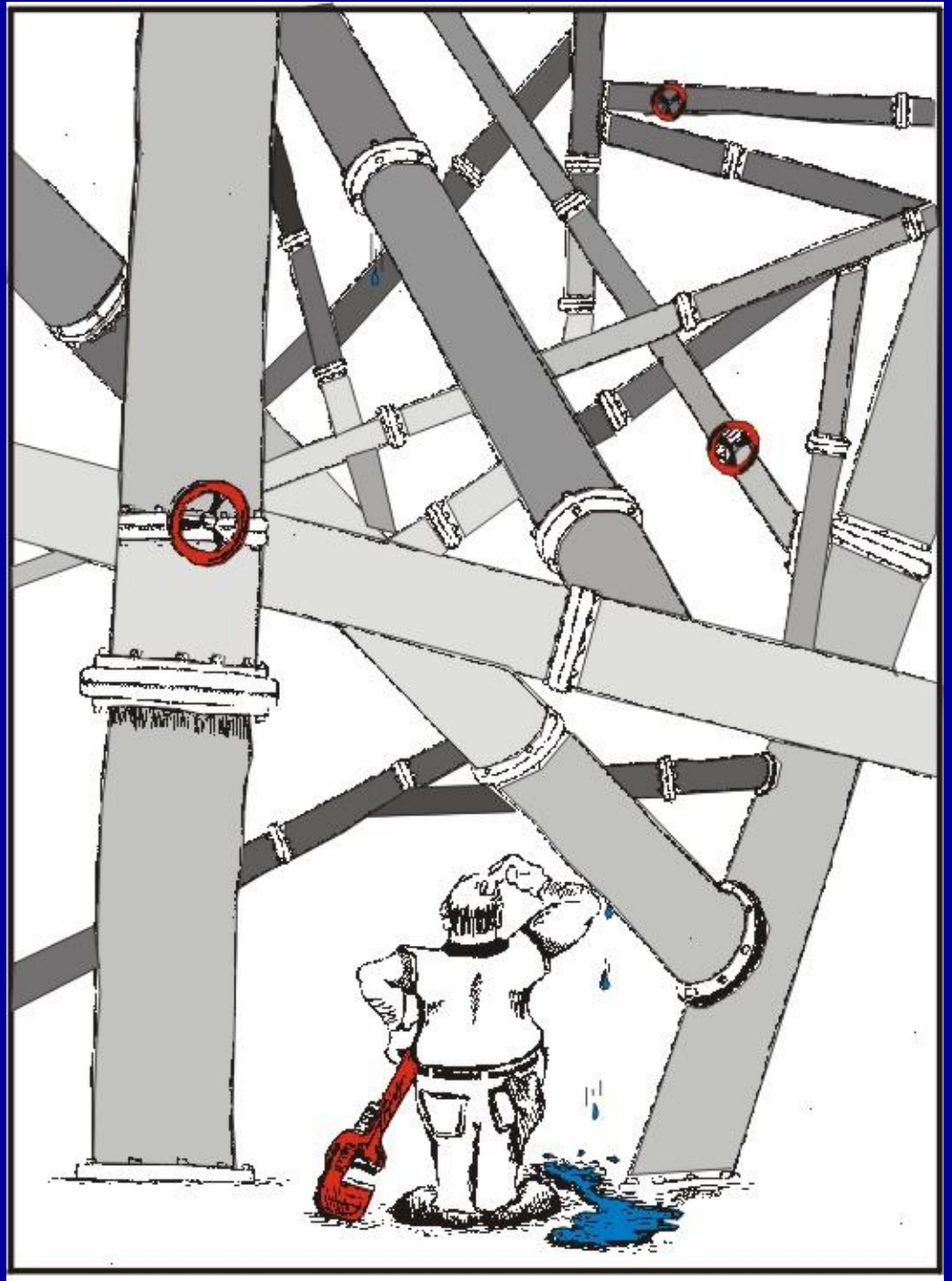
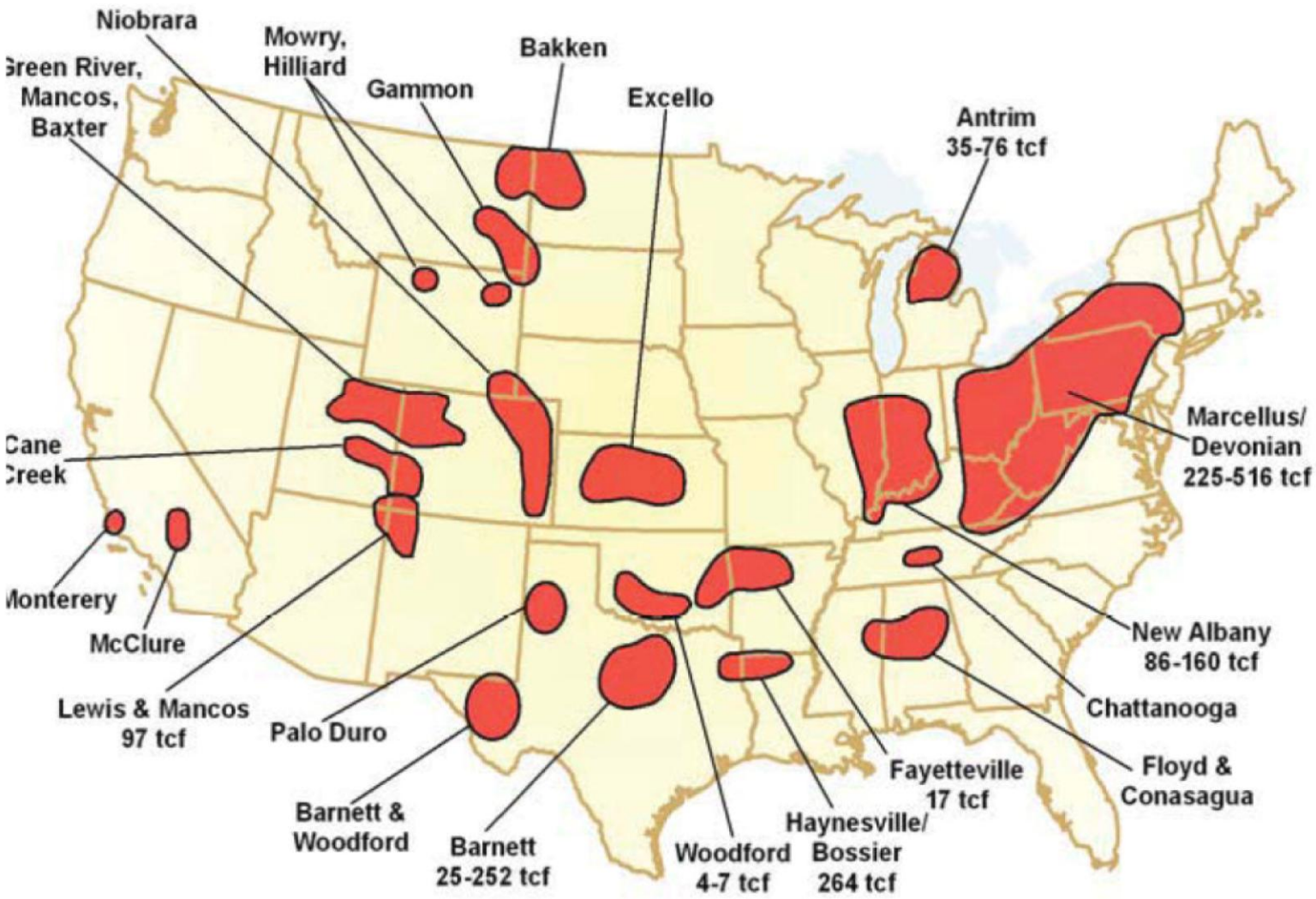
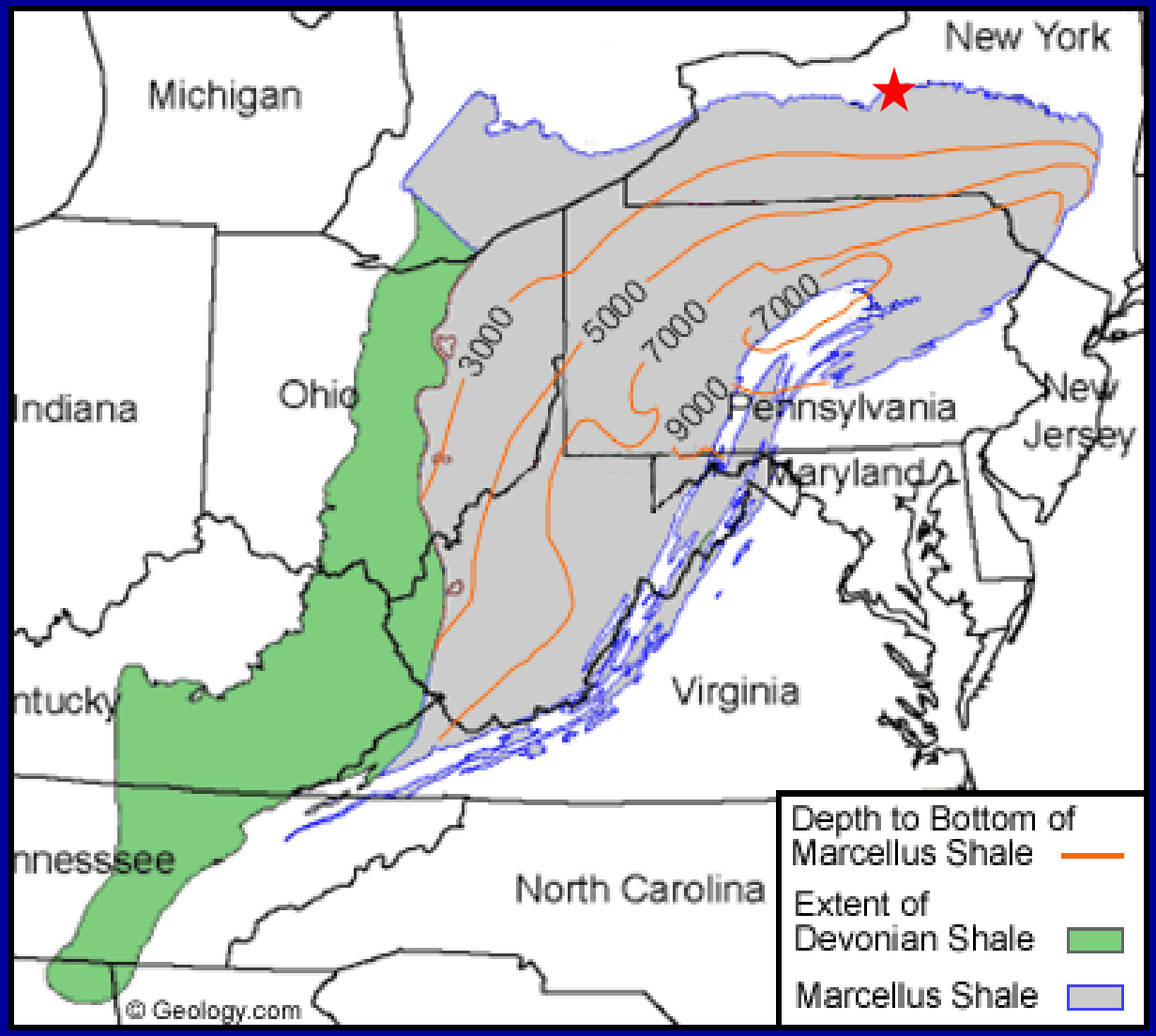


Figure 1: Gas Shale Basins of the United States

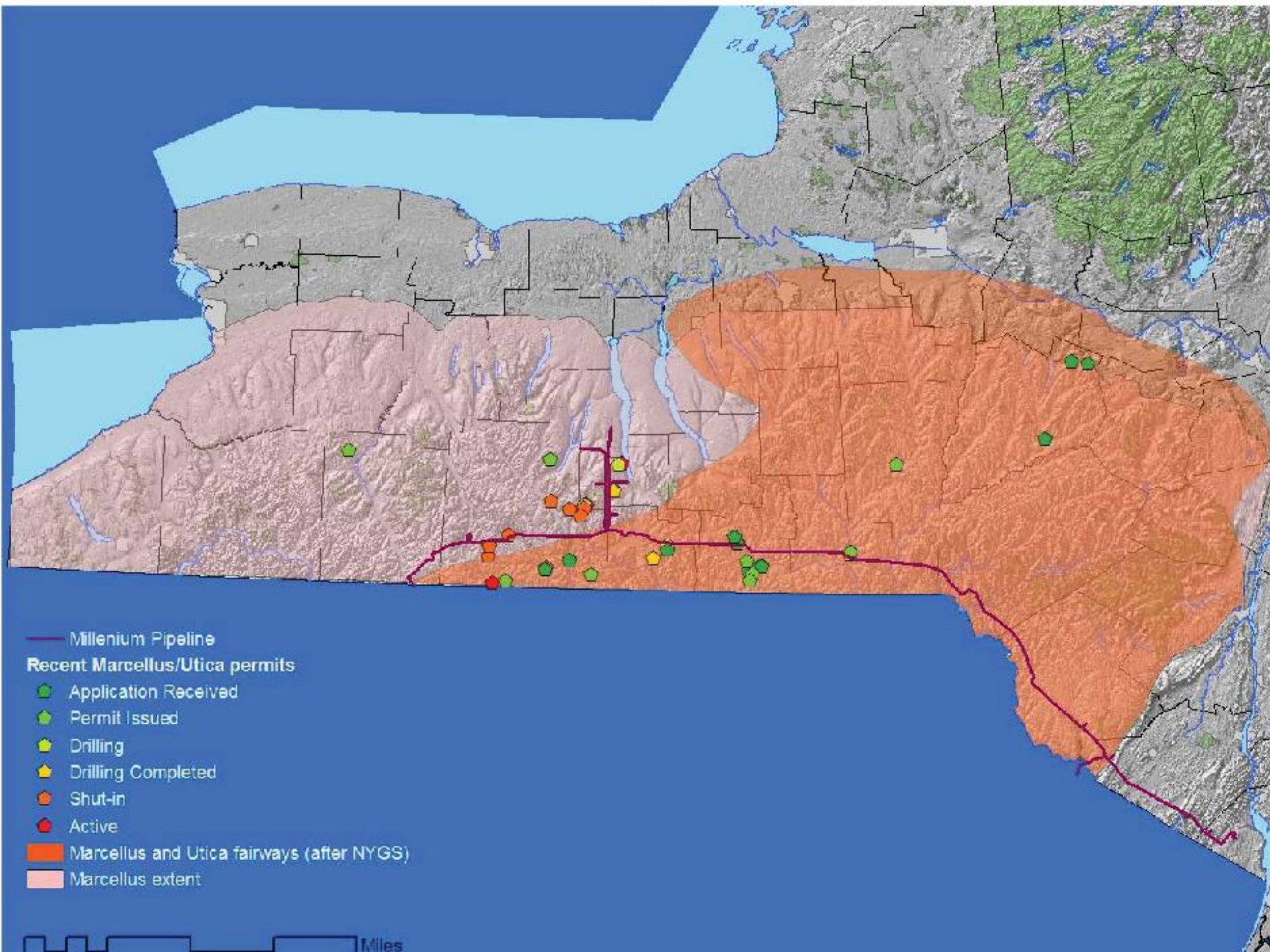


Schlumberger, Inc

Depth and extent of the Marcellus Shale



★ Marcellus, NY type section


Millenium Pipeline
Recent Marcellus/Utica permits
Application Received
Permit Issued
Drilling
Drilling Completed
Shut-in
Active
Marcellus and Utica fairways (after NYGS)
Marcellus extent
Miles

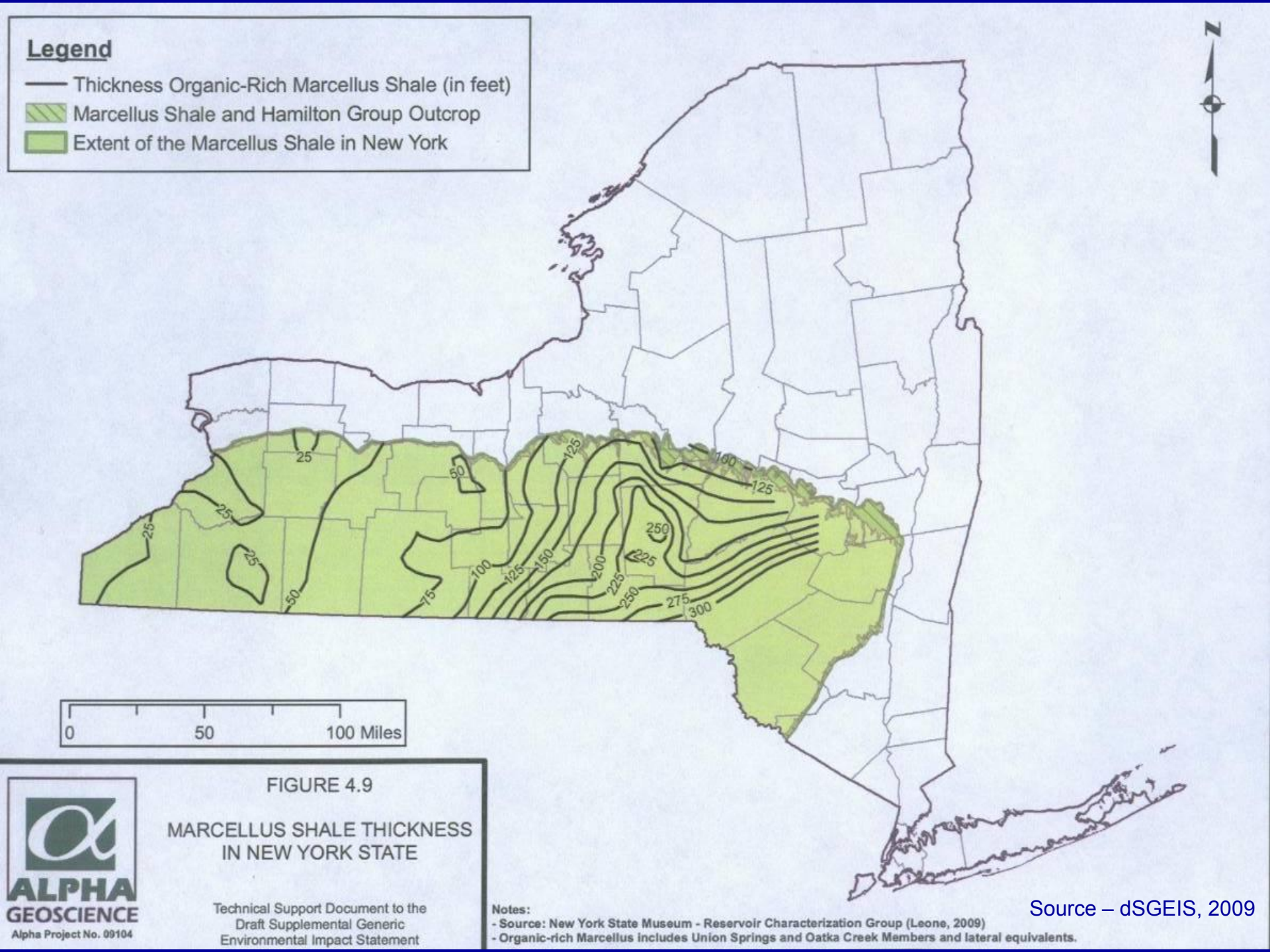


FIGURE 4.9

MARCELLUS SHALE THICKNESS IN NEW YORK STATE

ALPHA GEOSCIENCE
Alpha Project No. 09104

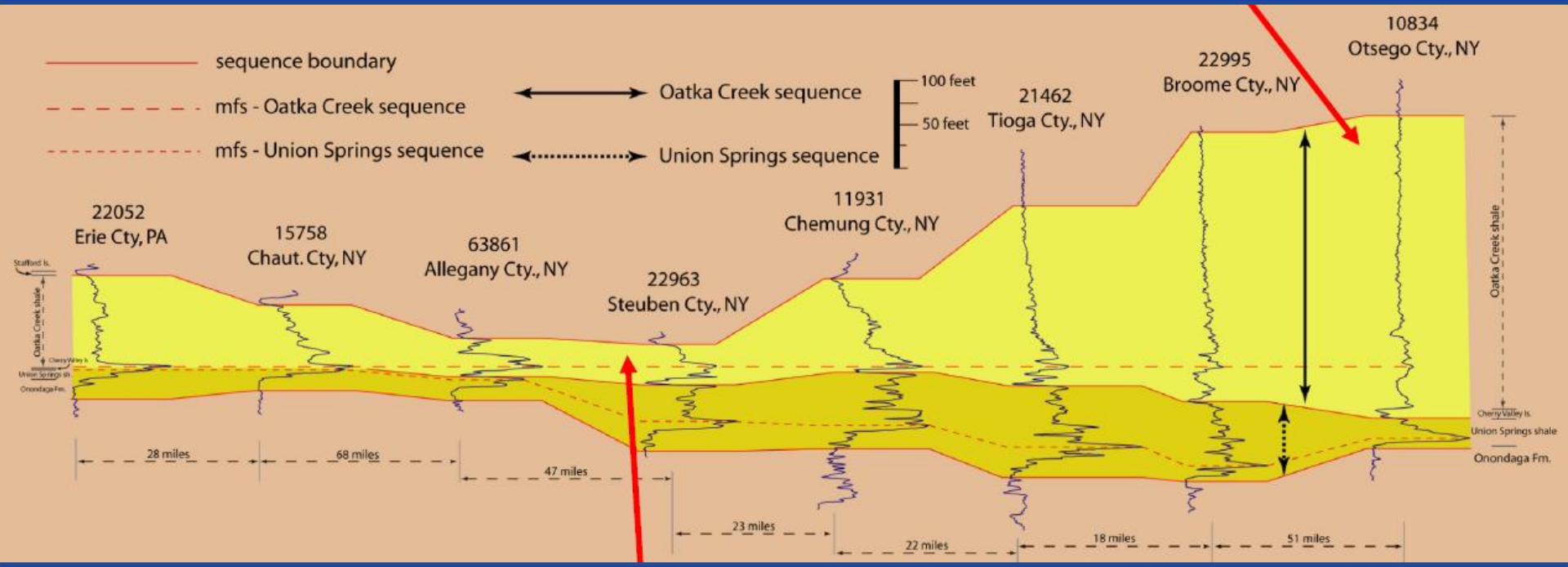
Technical Support Document to the Draft Supplemental Generic Environmental Impact Statement

Notes:
- Source: New York State Museum - Reservoir Characterization Group (Leone, 2009)
- Organic-rich Marcellus includes Union Springs and Oatka Creek Members and lateral equivalents.

Source – dSGEIS, 2009

East-West Geologic Section of the Marcellus Shale Across Southern New York

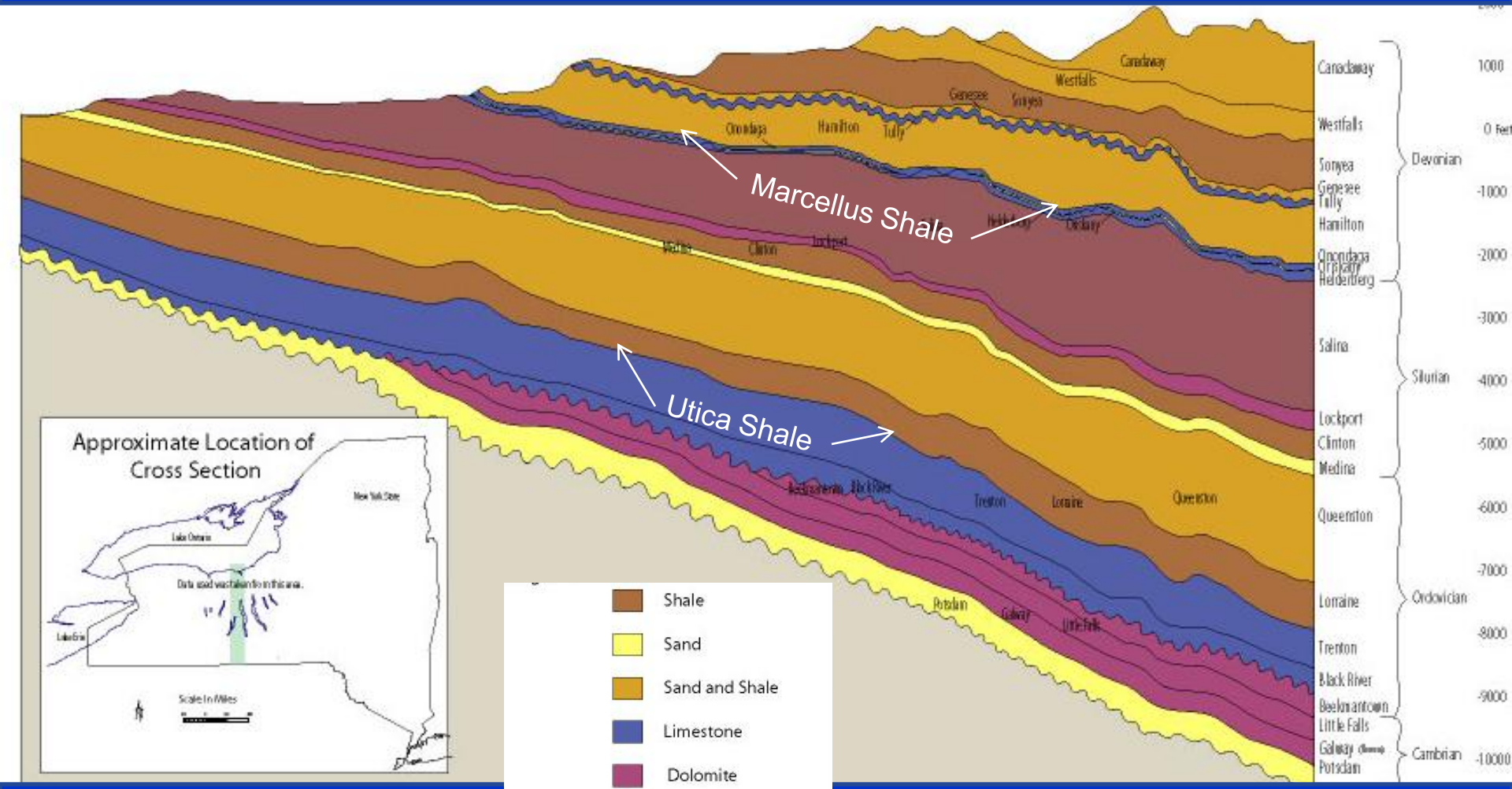
Thickening of Oatka Creek



Thinning of Oatka Creek
and Union Springs members

Lash and Engelder, 2009

North-South Geologic Section Across New York State



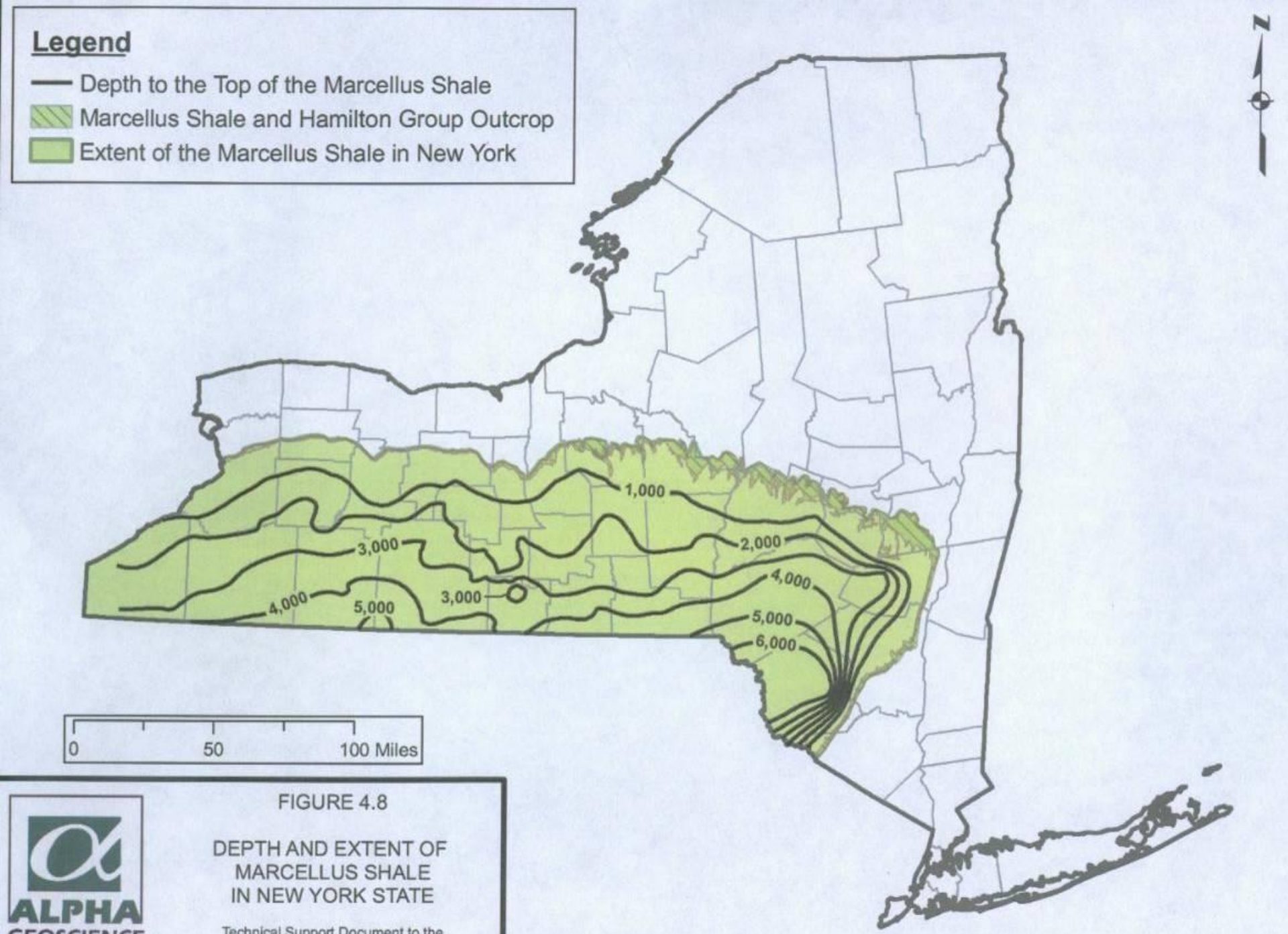


FIGURE 4.8

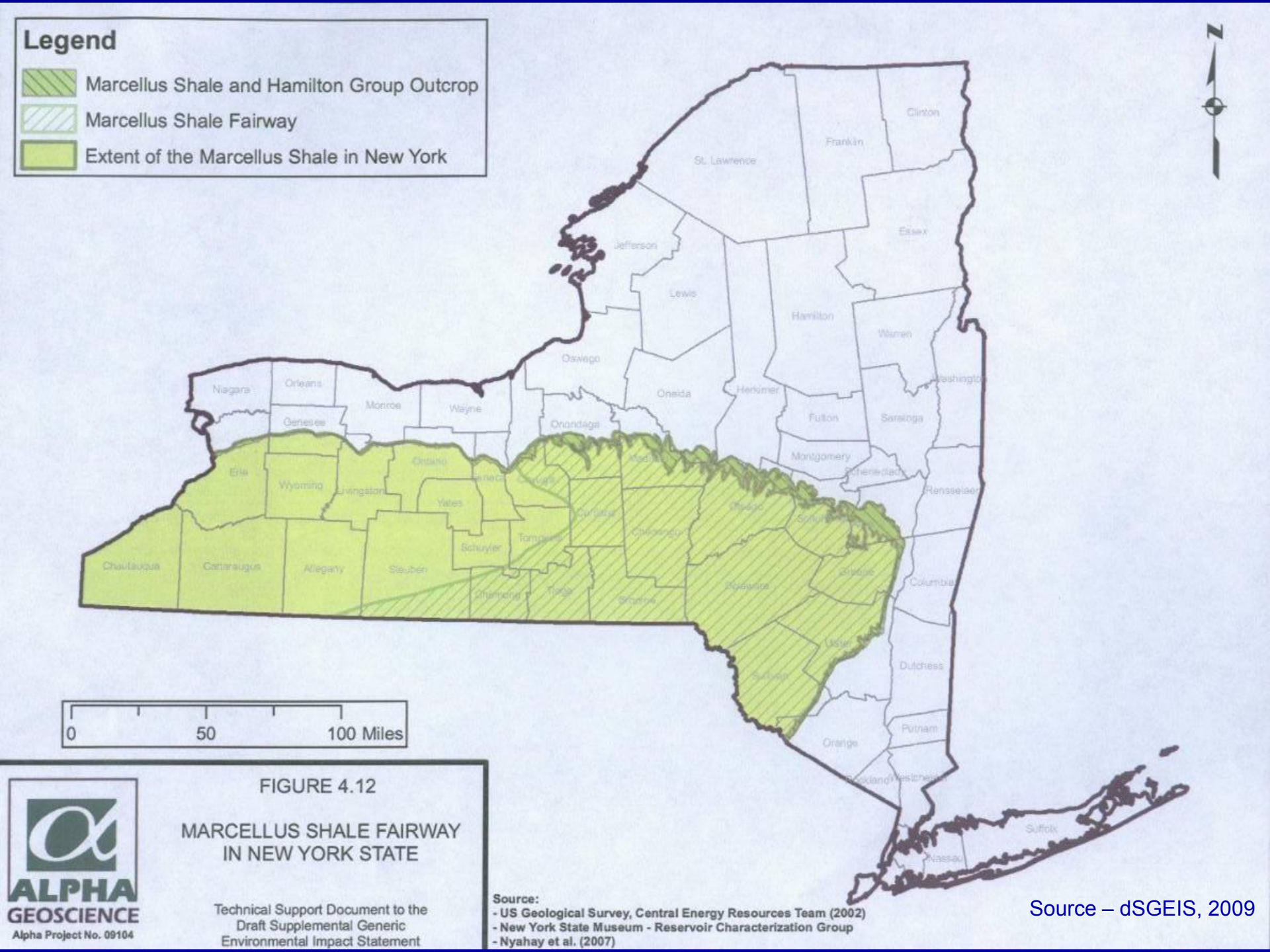
DEPTH AND EXTENT OF MARCELLUS SHALE IN NEW YORK STATE

Technical Support Document to the Draft Supplemental Generic Environmental Impact Statement

ALPHA GEOSCIENCE
Alpha Project No. 09104

Source:
- New York State Museum - Reservoir Characterization Group (Leone, 2009)

Source – dSGEIS, 2009



ALPHA GEOSCIENCE
Alpha Project No. 09104

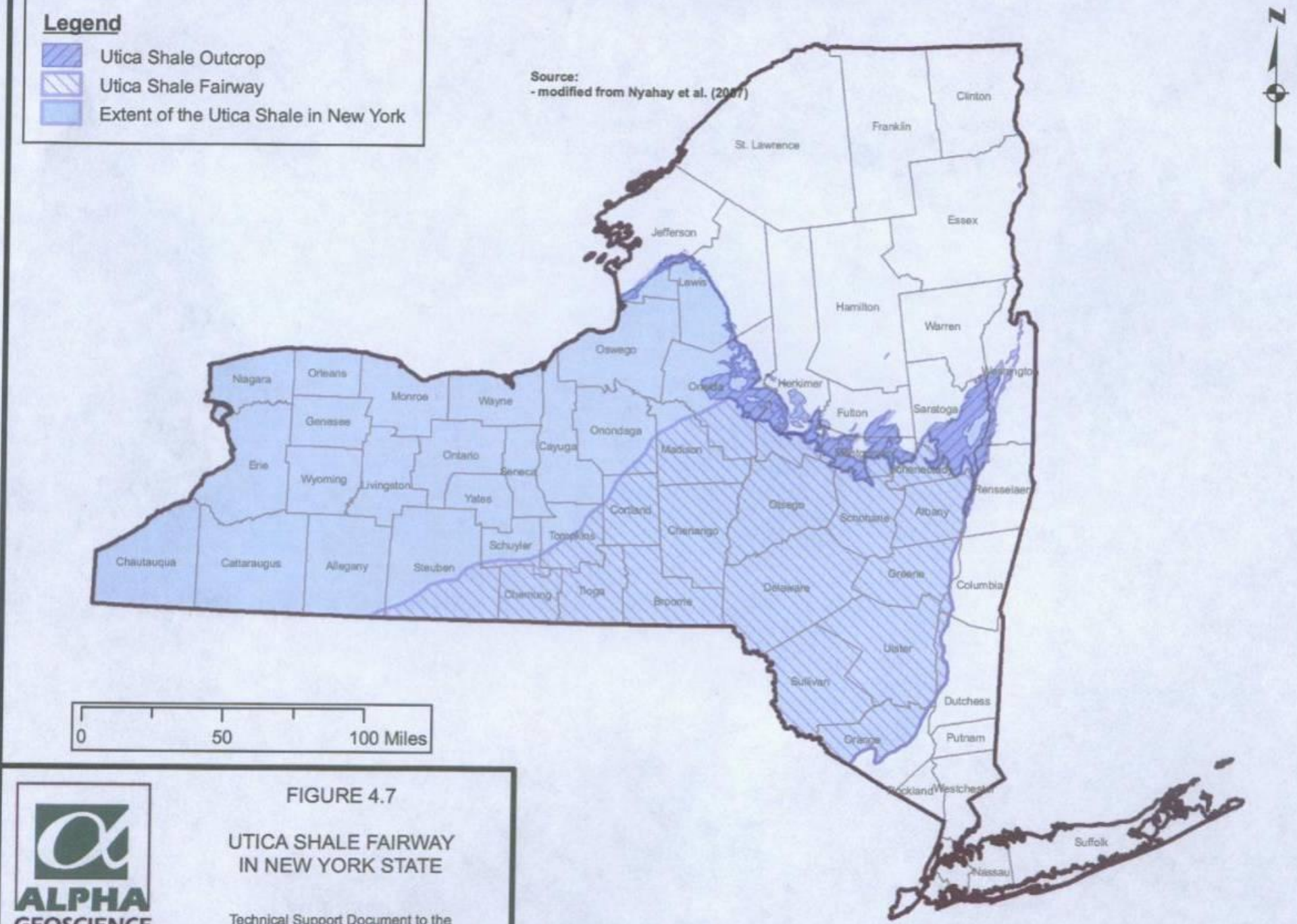
FIGURE 4.12

MARCELLUS SHALE FAIRWAY IN NEW YORK STATE

Technical Support Document to the Draft Supplemental Generic Environmental Impact Statement

Source:
- US Geological Survey, Central Energy Resources Team (2002)
- New York State Museum - Reservoir Characterization Group
- Nyahay et al. (2007)

Source – dSGEIS, 2009



ALPHA GEOSCIENCE
Alpha Project No. 09104

FIGURE 4.7

UTICA SHALE FAIRWAY
IN NEW YORK STATE

Technical Support Document to the
Draft Supplemental Generic
Environmental Impact Statement

New York State Stratigraphy

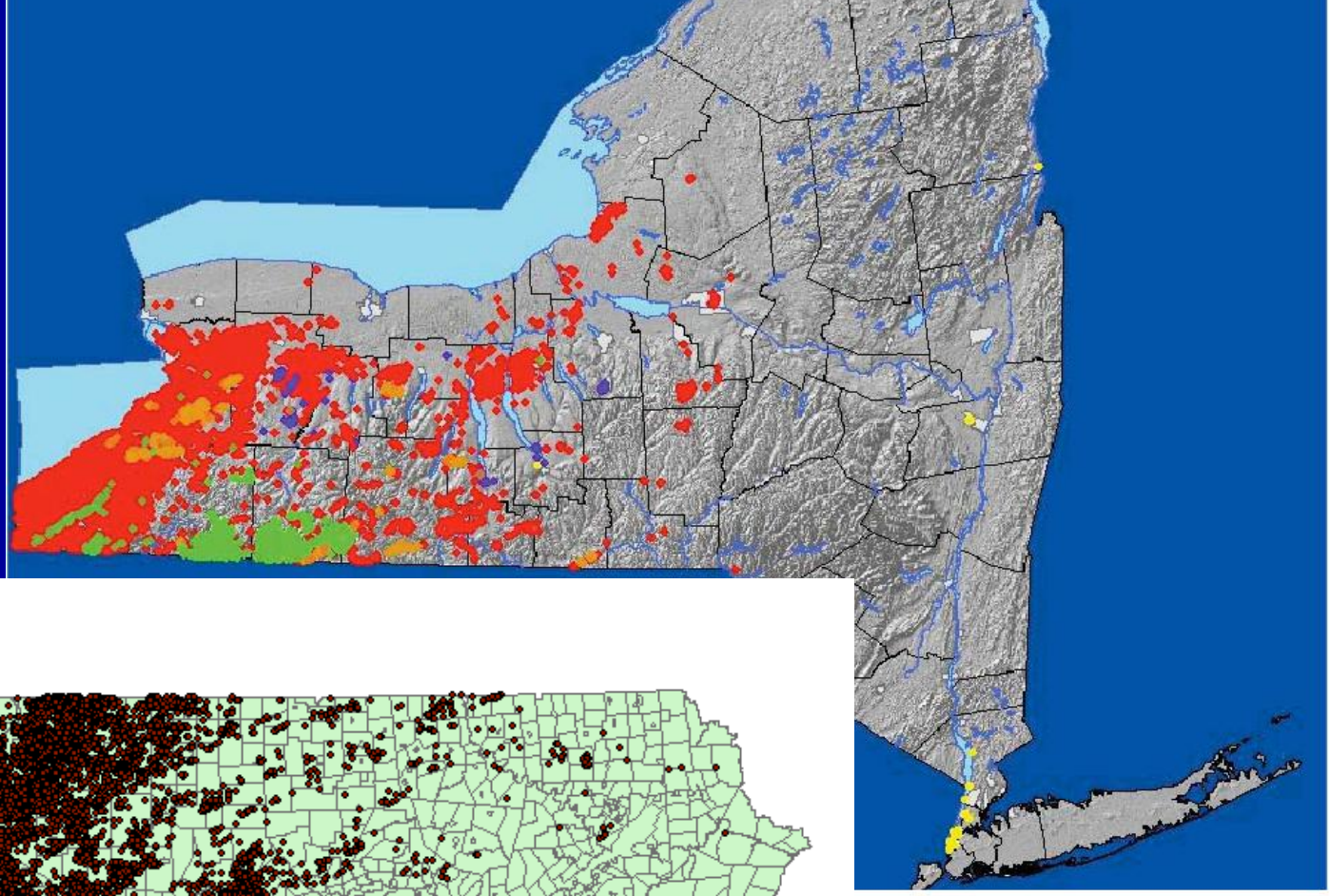
PERIOD		GROUP	UNIT	LITH.	THICKNESS	PRODUCTION
DEVONIAN	UPPER	Conewango	Riceville	Sh, ss, cgl	700'	
		Conneuat	Chadakoin	Sh, ss	700'	
		Canadaway	Undiff	Sh, ss	1100 – 1400	Oil, Gas
			Perrysburg - **Dunkirk**	Sh, ss		Oil, Gas
				sh		Gas
		West Falls	Java	Sh, ss	365 – 1250'	
			Nunda	Sh, ss		Oil, Gas
			Rhinestreet	Sh		
		Sonyea	Middlesex	Sh	0 – 400'	Gas
		Genesee	**Geneseo**	Sh	0 – 450'	
	?		Tully	Ls	0 – 50'	Gas
	MIDDLE	Hamilton	Moscow	Sh	200 – 600'	
			Ludlowville	Sh		
			Skaneateles	Sh		
			Marcellus	Sh		Gas
			Onondaga	Ls	30 – 235'	Gas, Oil
	LOWER	Tristates	Oriskany	Ss	0 – 40'	Gas
		Heldergerg	Manlius	Ls	0 – 10'	
			Rondout	Dol		
SILURIAN	UPPER		Akron	Dol	0 – 15'	Gas
		Salina	Camillus	Sh, gyp	450 – 1850'	
			Syracuse	Dol, sh, slt		
			Vernon	Sh		
		Lockport	Lockport	Dol	150 – 250'	Gas
		Clinton	**Rochester**	Sh	125'	Gas
			Irondequoit	Ls		
	LOWER		**Sodus**	Sh	75'	Gas
			Reynales	Ls		
			Thorold	Ss		
		Medina	Grimsby	Sh, ss	75 – 150'	Gas
			Whirlpool	Ss	0 – 25'	Gas
ORDOVICIAN	UPPER		Queenston	Sh		Gas
			Oswego	Ss	1100 – 1500'	
			Lorraine	Sh		
			Utica	Sh	900 – 1000'	
	MIDDLE	Trenton-Black River	Trenton	Ls	425 – 625'	Gas
			Black River	Ls	225 – 550'	
			Tribes Hill-			

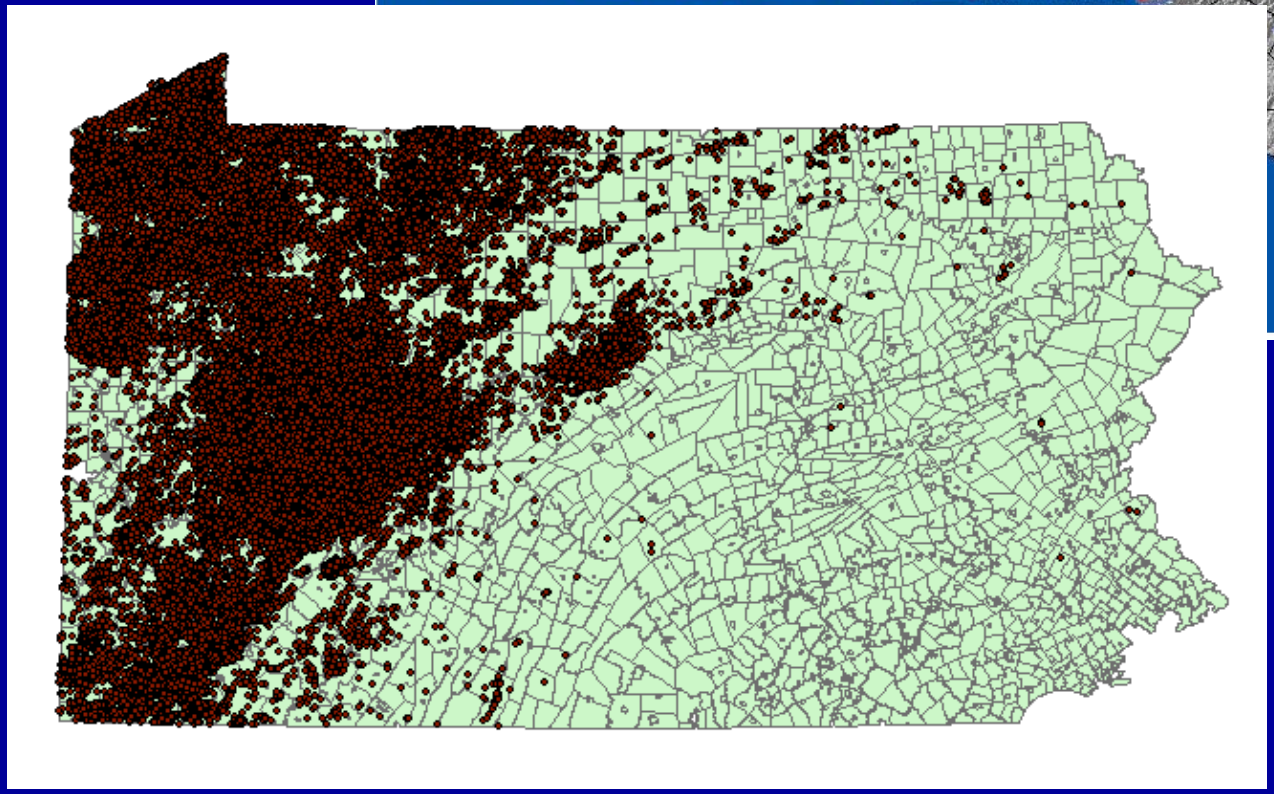
Primary Black/Gray Shales

- Dunkirk
- Rhinestreet
- Geneseo
- Marcellus
- Rochester
- Sodus
- Medina SS Central/ Western NY
- Lorraine
- Utica (estimated 4,500 ft. deep in vicinity of Dayton

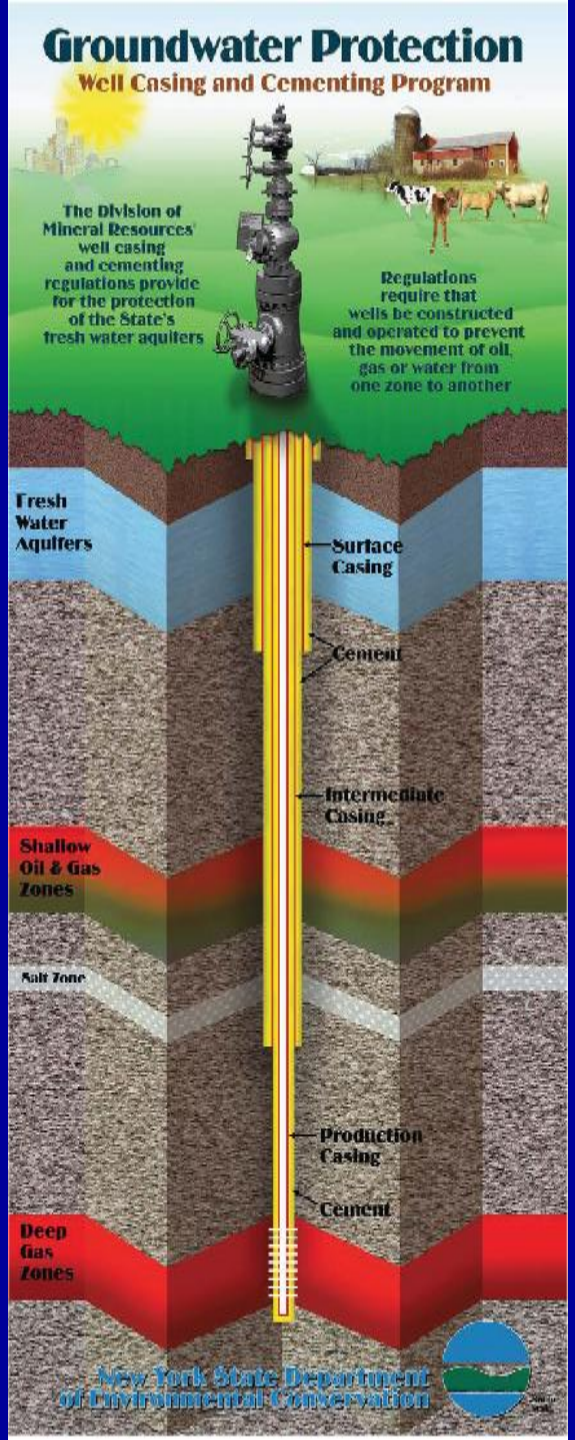
Marcellus Stratigraphy

Oil and Gas wells are not new in Pennsylvania and New York…….



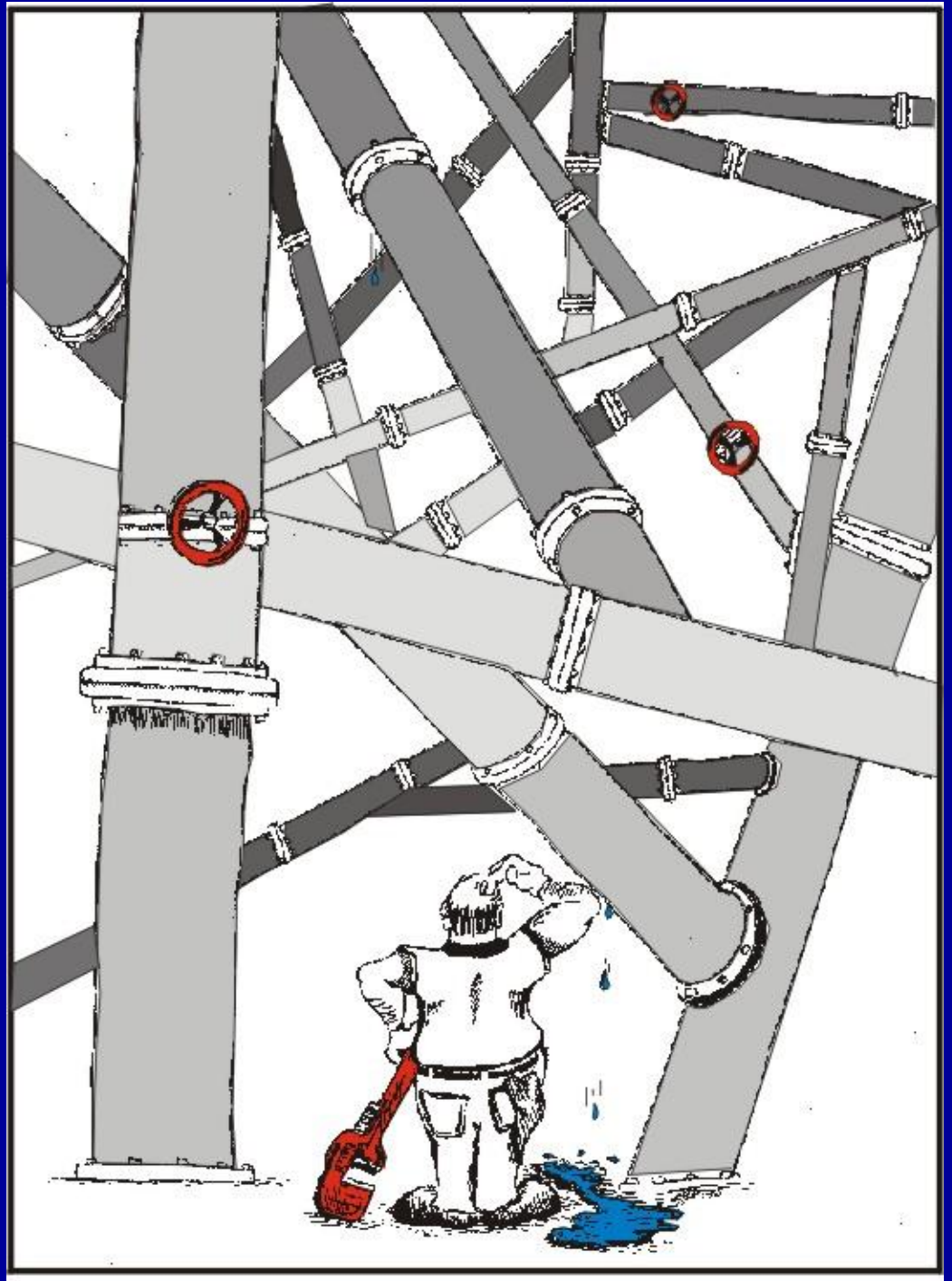


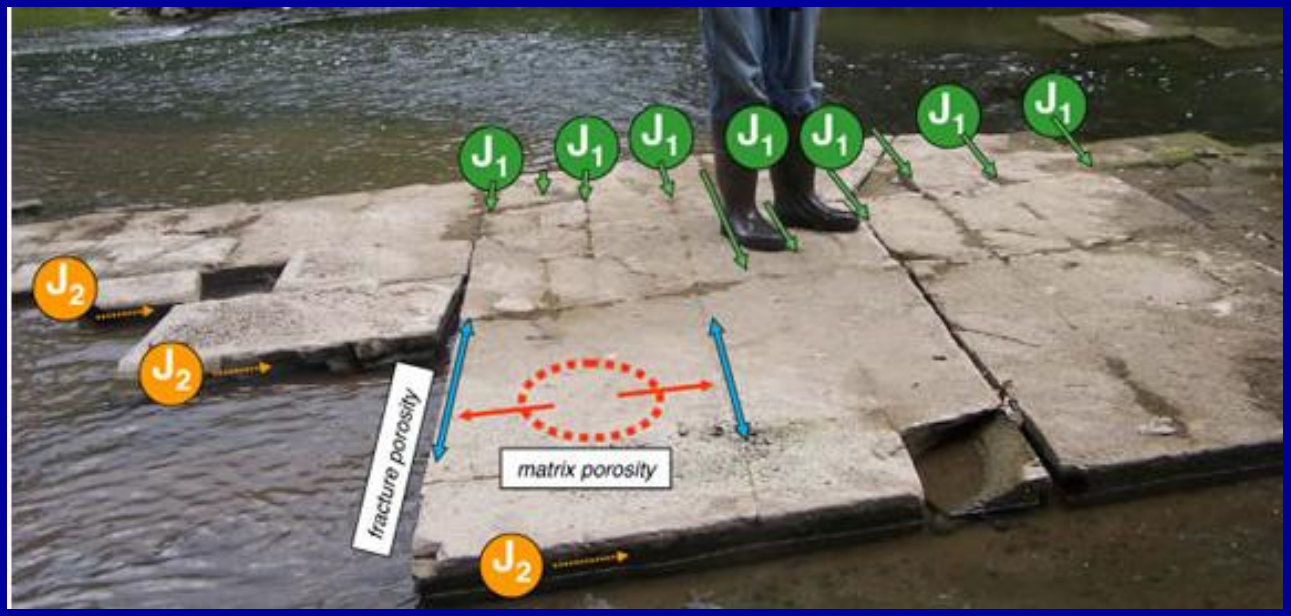
…and there are different regulations in and within each state.



Multiple steel casings
with high-strength cement
to isolate well from surrounding
aquifers and bedrock units.

What is different about Marcellus/Utica shale gas development?



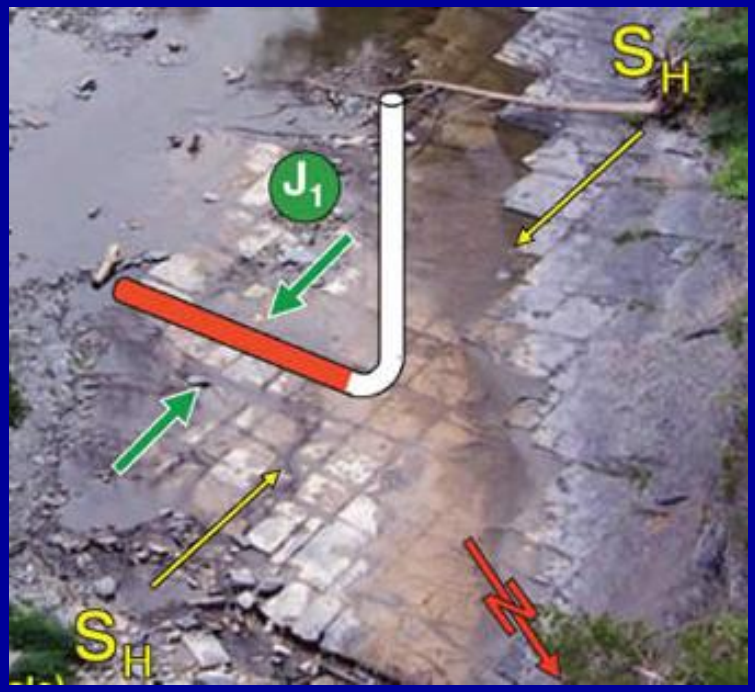


East-northeast trending J1 fractures more closely spaced and cross-cut by less well-developed, northwest-trending J2 fractures

Dual porosity gas reservoir where fractures drain rapidly and matrix drain slowly

Free gas and adsorbed gas in matrix

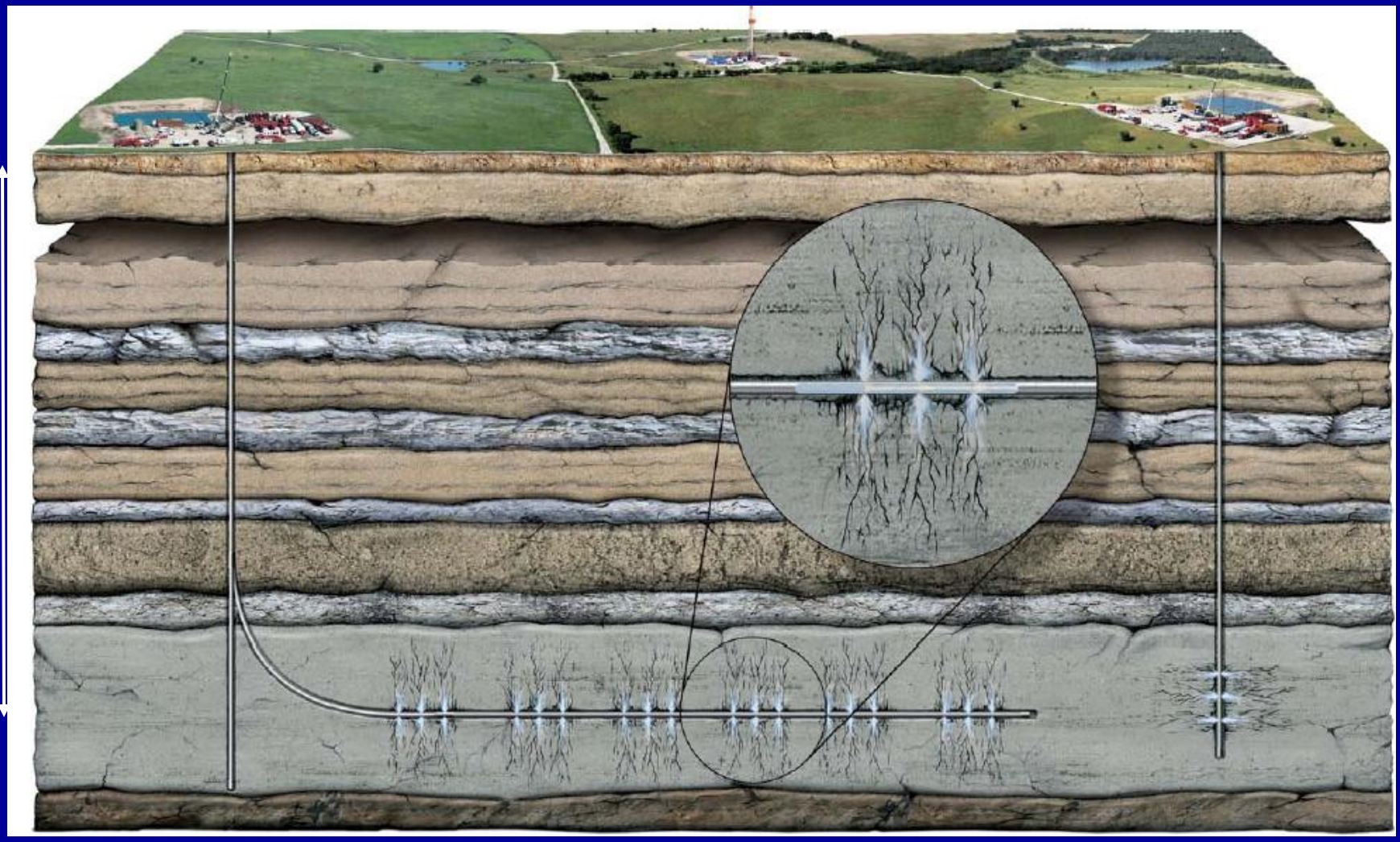
Connect matrix porosity to the wellbore by intersecting multiple J1 fractures



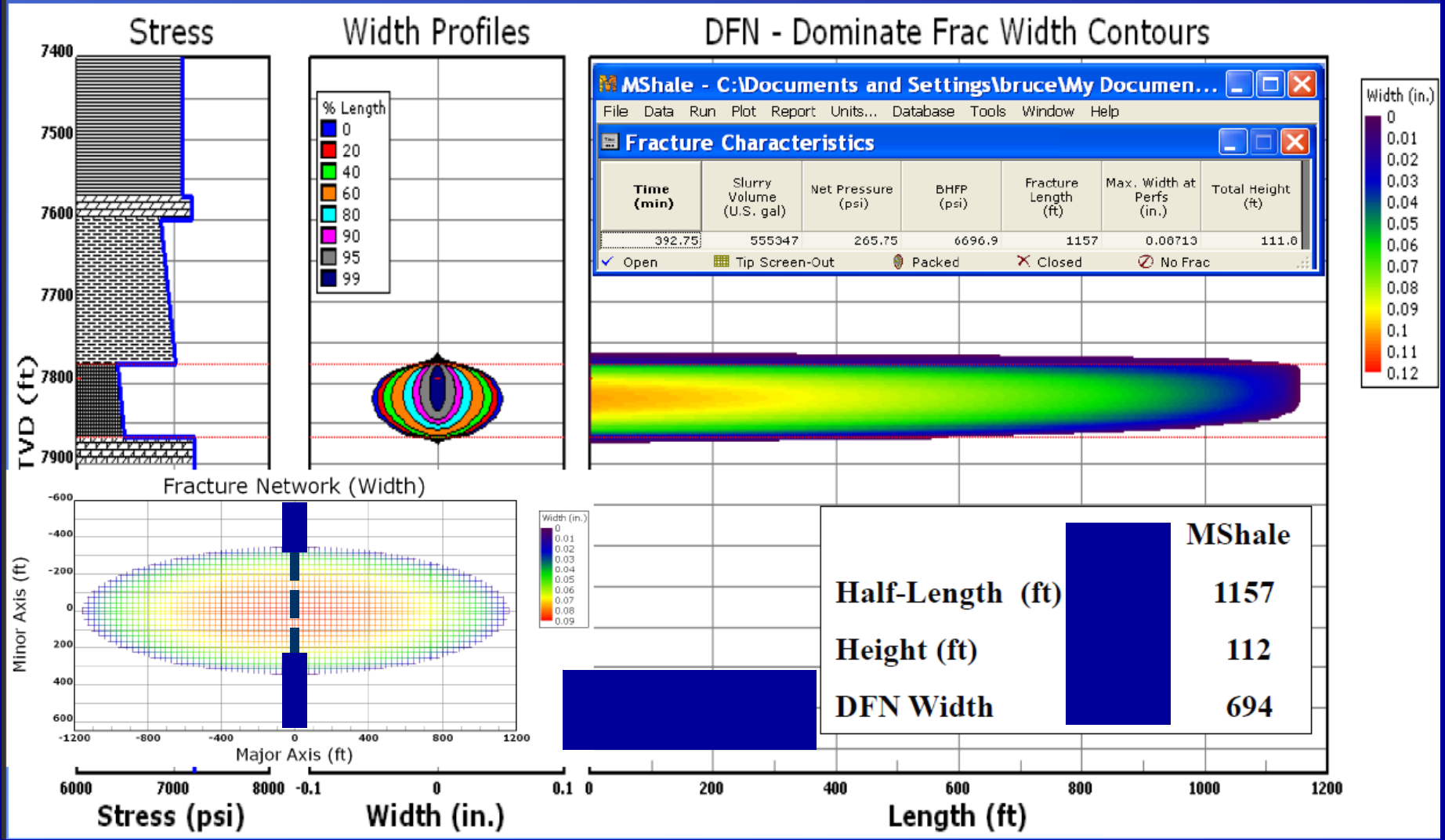
Drill horizontal wells to the north-northwest, or south-southeast that cross and drain densely developed J1 fractures

Marcellus Shale Gas Development

Horizontal Drilling in Black Shale with High-Volume Hydraulic Fracturing

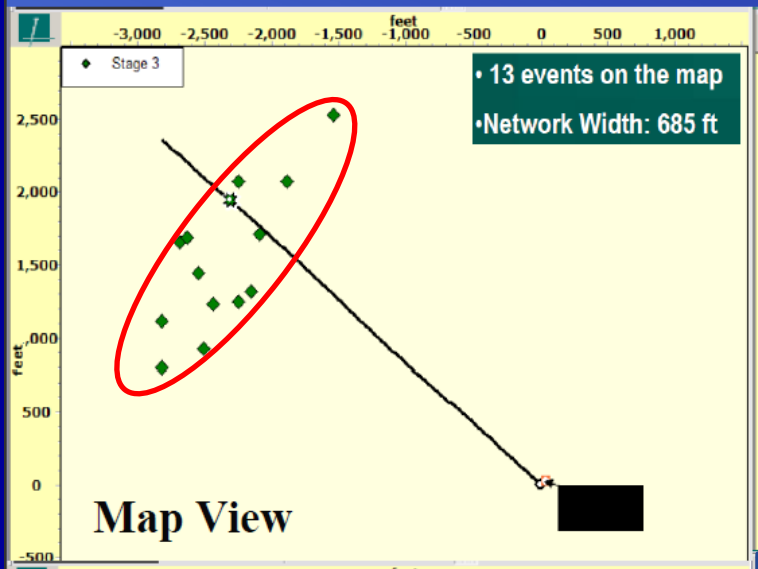


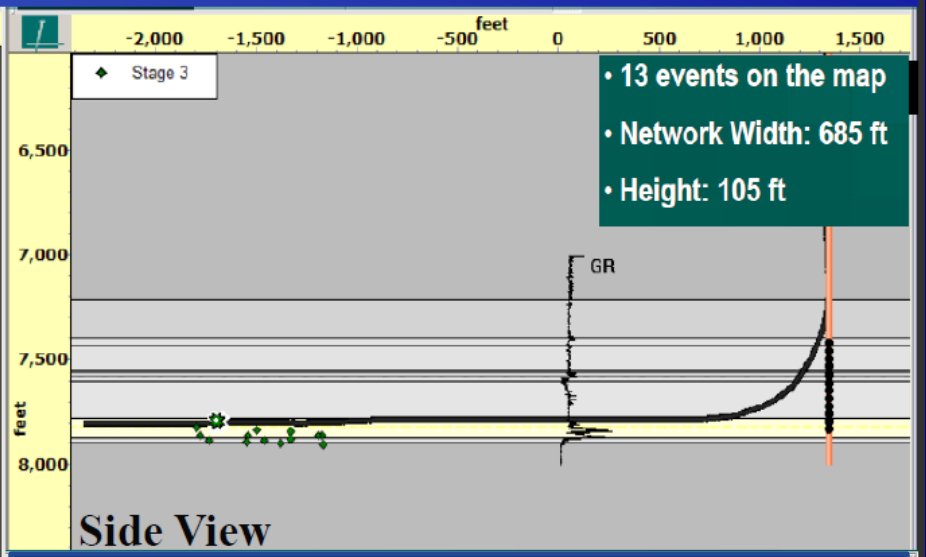
Marcellus Shale – Ex. 1 (Single Cluster)

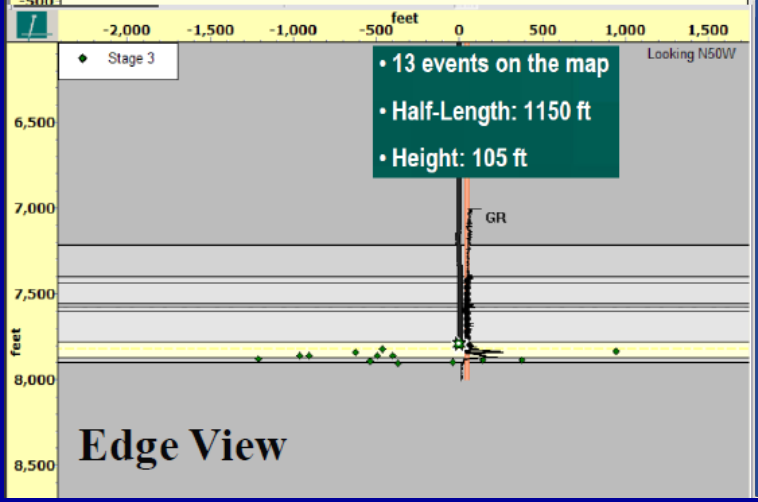


Meyer (2009)

Marcellus Shale (Ex. 1) – Microseismic

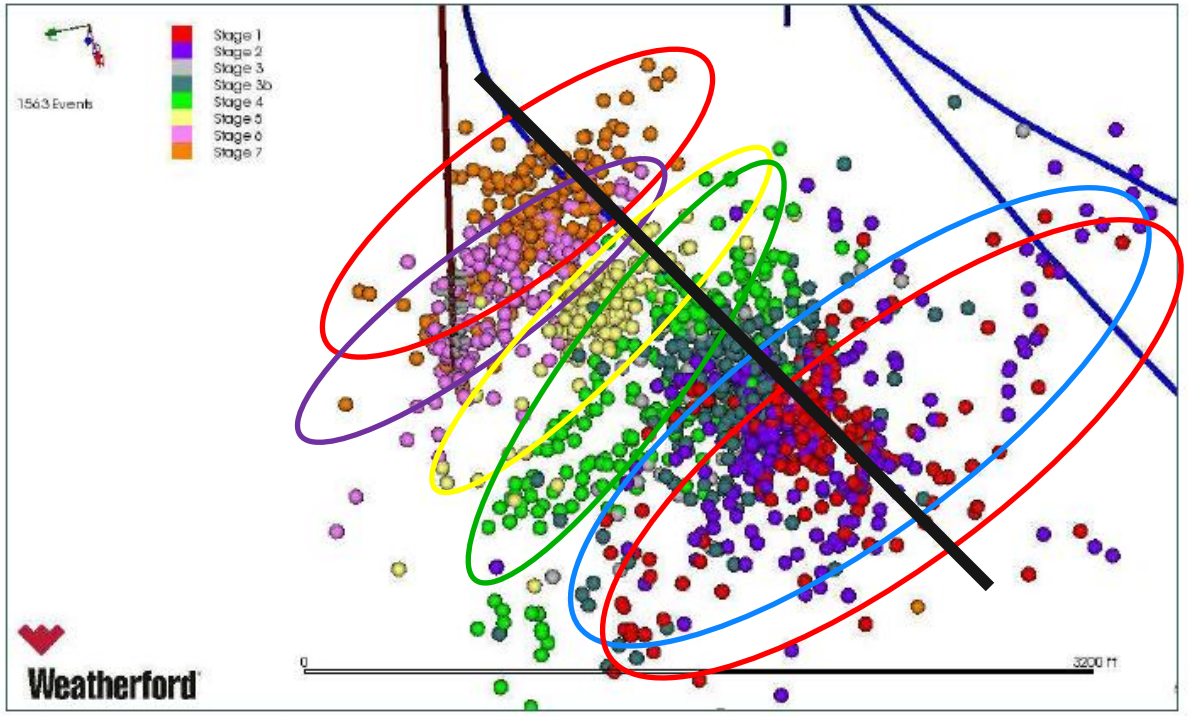






Meyer (2009)

Microseismic Monitoring of Hydraulic Fracturing



Horizontal well stimulation in plan view.

Horizontal well, multi-stage stimulation in shale indicates interaction and overlap between stimulation stages.

“Typical” Drillpad Design

Drilling Phase – drillrig, pumps, supplies, frack tanks

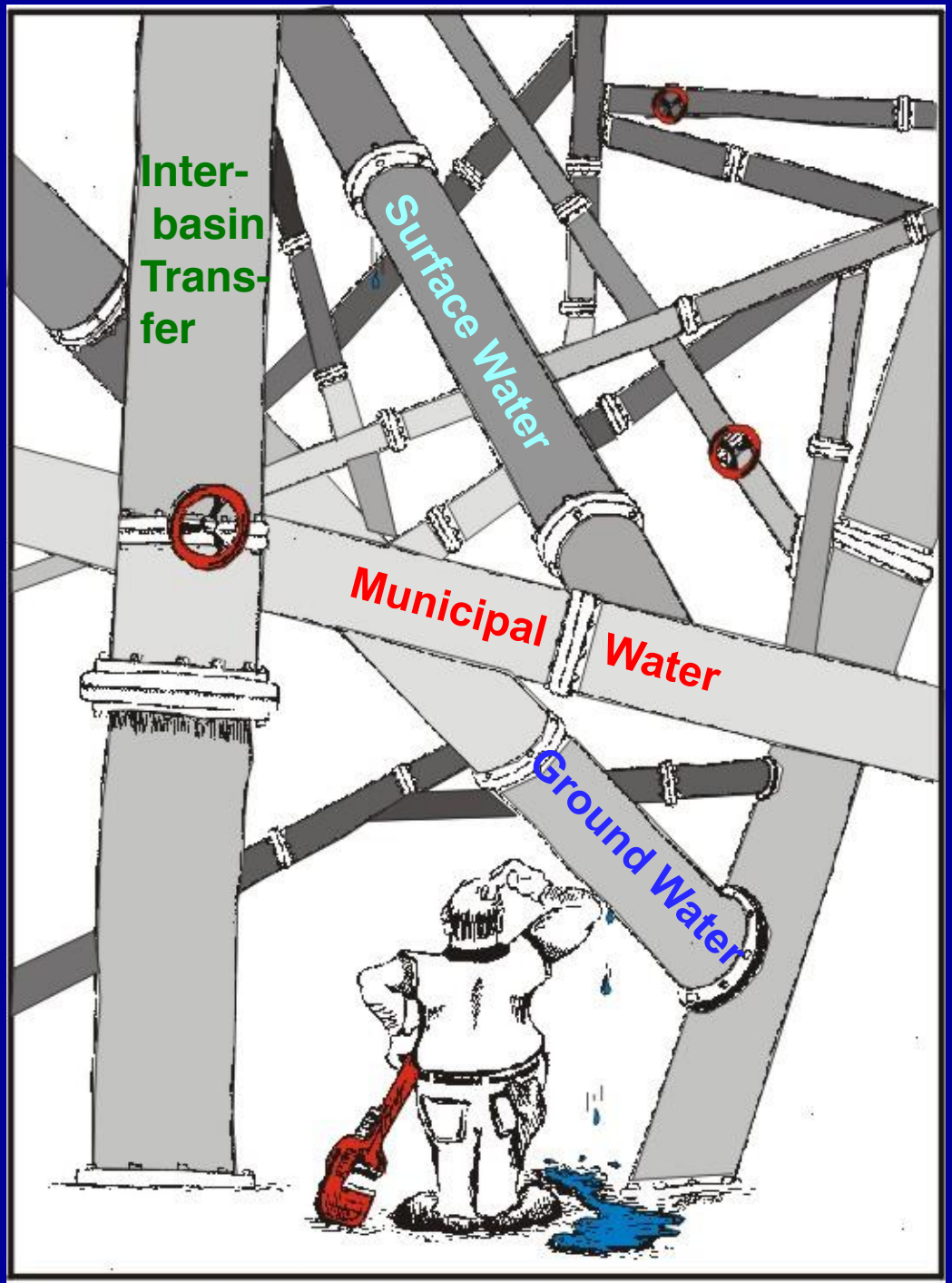
(a month or two)

Hydro-fracking Phase –
(a week or two)

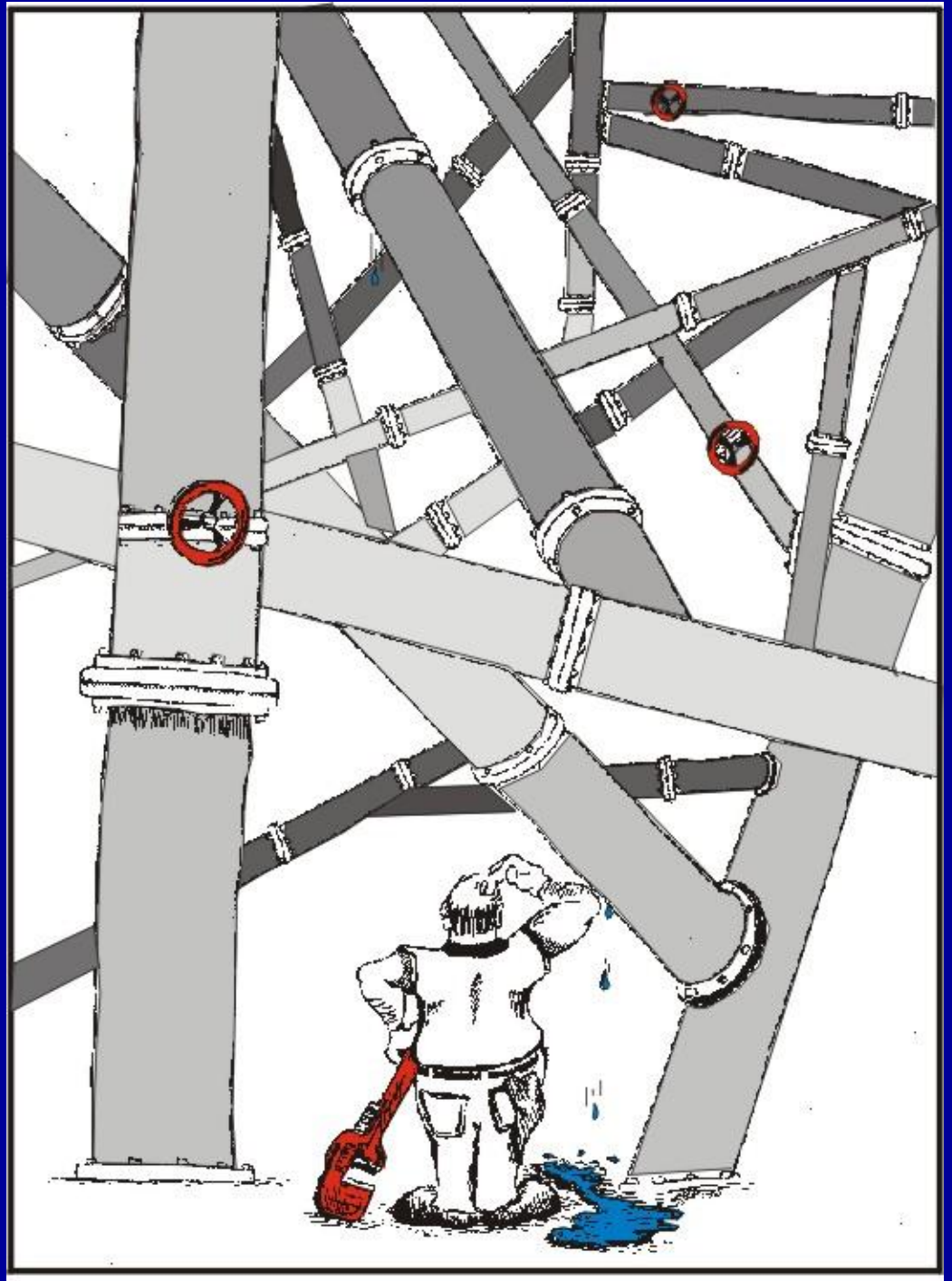
Injection pumps, supplies, and many frack tanks for fresh and flowback waters

Where do you get the water for fracking?

Each source has its own set of concerns…….

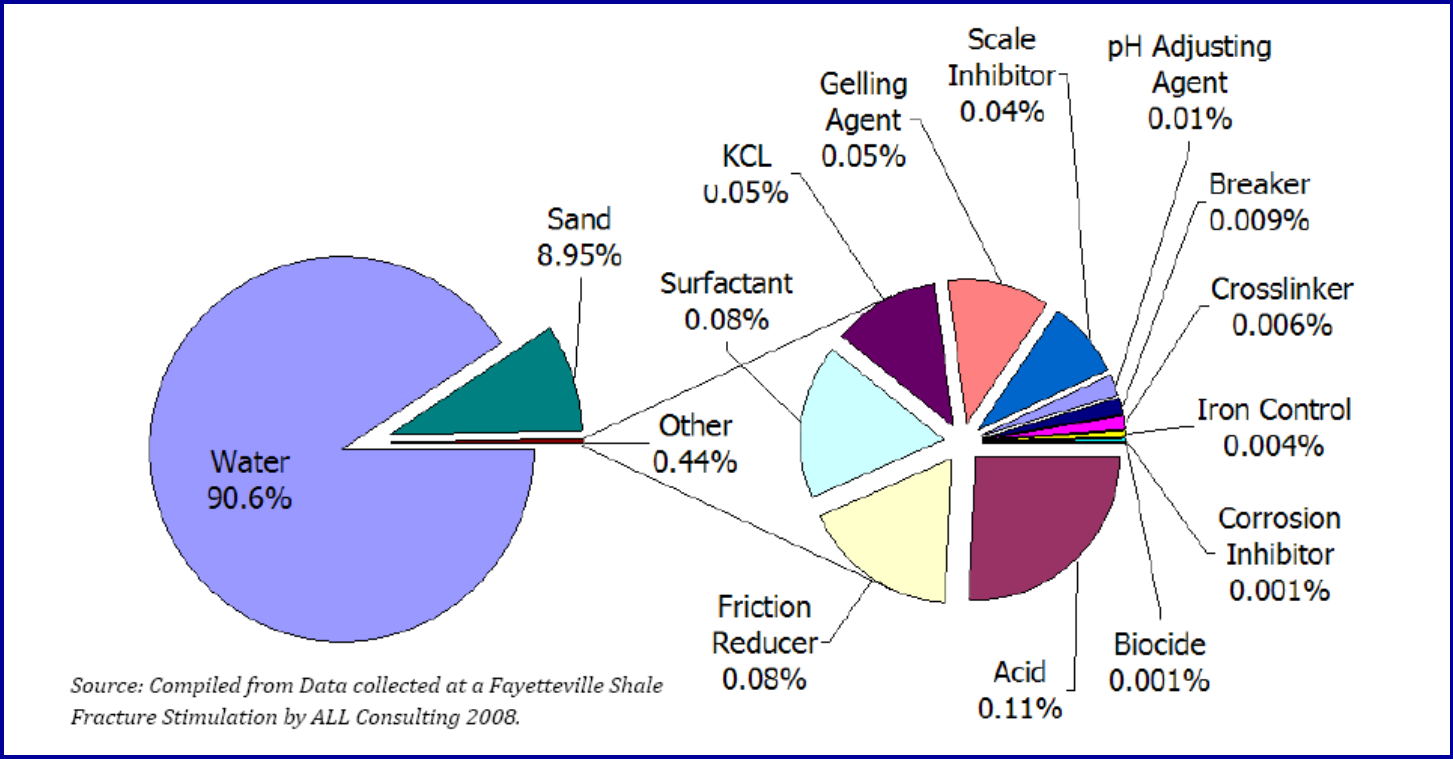


What is the quality of the frack and flowback water?



Typical Components of Frack Fluid

For a 1.5 million frack job, the 0.5 percent
is equivalent to 7,500 gallons of “chemistry”.



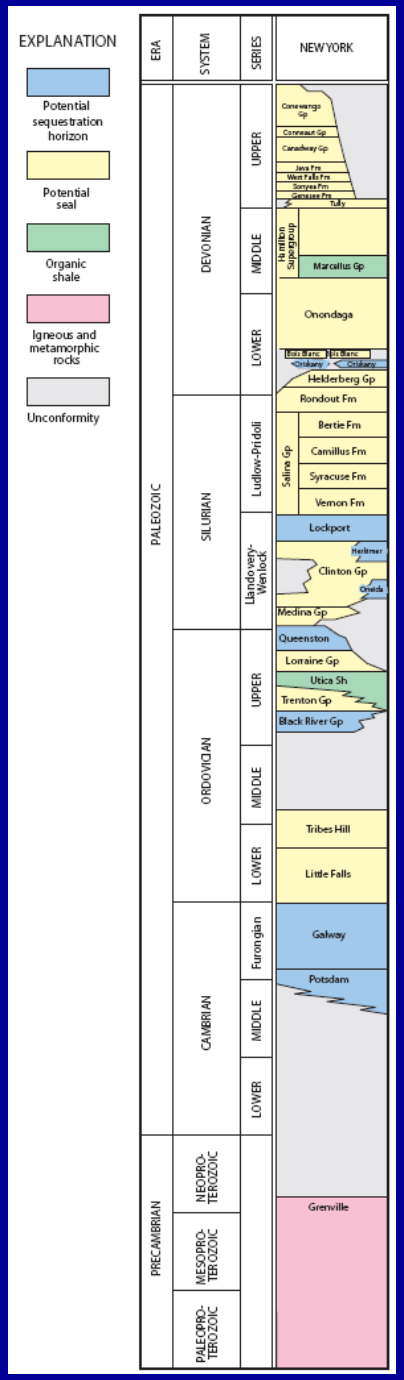
(Arthur, Bohn, Layne, 2008, ALL Consulting)
http://www.all-llc.com/shale/GWPCMarcellusFinal.pdf

What do we do with the **flow-back water** after the hydrofrac process is complete, and the **formation water** as gas is produced from the well?

Frack Water Return – (Flowback Water)
Total volume injected (1.5 million gal), returned over a 2-week period of time.

(From a well in SW Pennsylvania.)

Constituent	1st Third	2nd Third	Final Third	Units
Bromide	124	479	753	MG/L
Chloride	18,600	80,500	109,000	MG/L
Sulfide	<0.50	29.5	<2.5	MG/L
T. Dissolved Solids	34,578	133,620	192,000	MG/L
Temperature	29.3	29.4	25.3	Degrees C
Barium	668	6,100	8,730	MG/L
Iron, Total	23	31.3	71.9	MG/L
Magnesium	69.3	572	890	MG/L
Gross Alpha	1,159	22.41	18,950	pCi/L
Gross Beta	6,500	9.68	7,445	pCi/L
Radium 226	33	2.58	4.67	pCi/L
Radium 228	4.66	1.15	18.41	pCi/L
Manganese, Total	0.73	1.8	2.79	MG/L
Mercury, Total	<0.0002	<0.0002	<0.0002	MG/L
Molybdenum, Total	0.16	0.72	1.08	MG/L
Nickel, Total	0.03	0.07	<0.01	MG/L
Selenium, Total	<0.02	<0.02	<0.02	MG/L
Silver, Total	<0.01	<0.01	<0.01	MG/L
Thallium, Total	<0.02	<0.02	0.1	MG/L
Titanium, Total	0.06	<0.01	<0.01	MG/L
Zinc, Total	0.036	0.028	0.035	MG/L



DISPOSAL OF FRACK WATER BY DEEP WELL INJECTION

Marcellus Shale

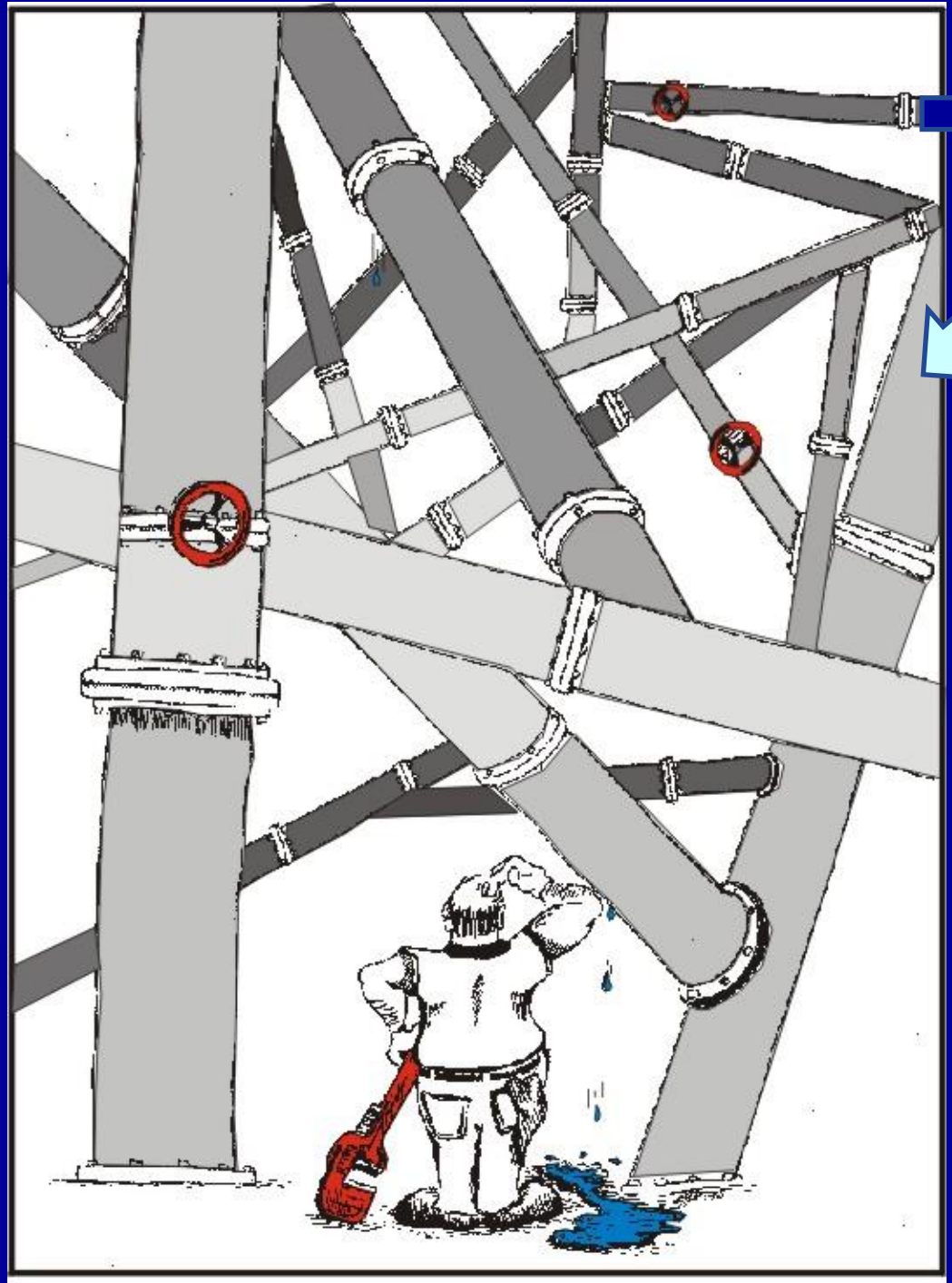
Utica Shale

Trenton-Black River carbonates

Potsdam sandstone

MRCSP

DISPOSAL OF FRAC WATER -
BY MUNICIPAL WASTEWATER TREATMENT PLANTS
AND DISCHARGE TO SURFACE WATER



Black Box

Proposed “Black box(es)” pretreatment systems to remove ‘constituents of concern’ prior to other treatment, reuse, or discharge

New Concepts to Reduce Flowback Volume

Reuse / Recycle the flowback

Reduce frack volumes
Use minimal frack volumes followed by a freshwater for application of frack pressures

Leave more frack fluid in the hole
Assumes down-hole gas will pass through the spent frack fluids

Use of liquefied propane instead of water
LP turns back to a gas and can be recovered for reuse.

Bottom Line – The gas industry wants to reduce the volume of water used.

Local Water-Resource Concerns

- Protection of surface water and groundwater during entire process
- Drill pad construction, storm runoff, chemical storage, and handling
- Drilling & hydro-fracturing process – cuttings and fluid handling
- Transportation of water & waste fluids to and away from site
- Flowback disposal -- Variable mineral and water-quality characteristics – Brines, oil & grease, heavy metals, radiochemicals, organics
- Site remediation when done

Bottom line – we need water-quality data prior to, during, and following drilling to determine the impact, or lack thereof, on the resources of NYS

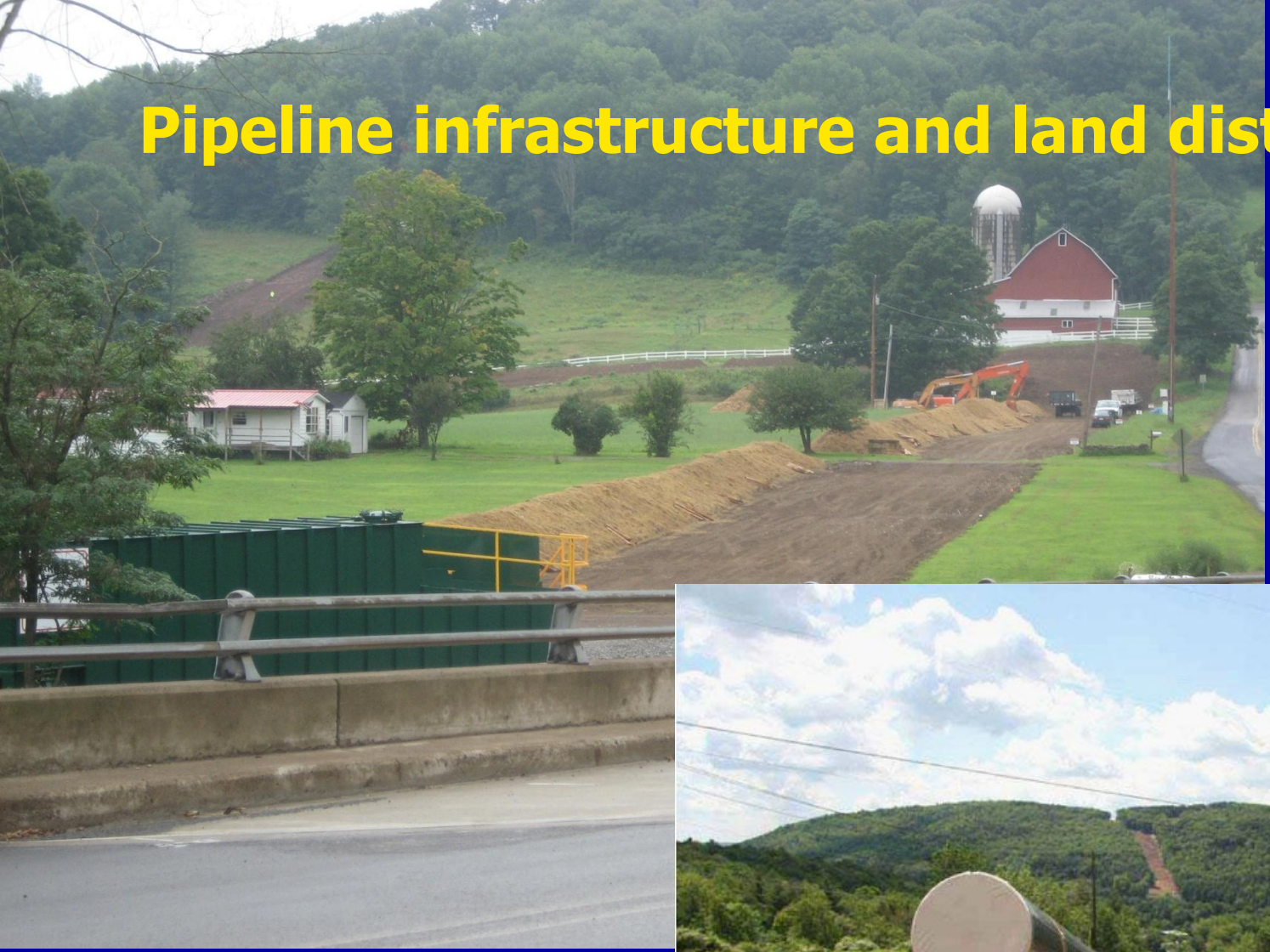
Regional Water-Resource Concerns

- What are the regional characteristics of black shale bedrock formations throughout the Marcellus, Utica, and other potential gas-bearing units?
  - Geologic nature – thickness of units, fracture tendencies, faults, etc.?
  - Geochemical nature – how variable are the mineral and water-quality characteristics?
  - Radiochemical nature – what radioisotopes are present and are they mobile, or made-mobile during drilling and fracking?

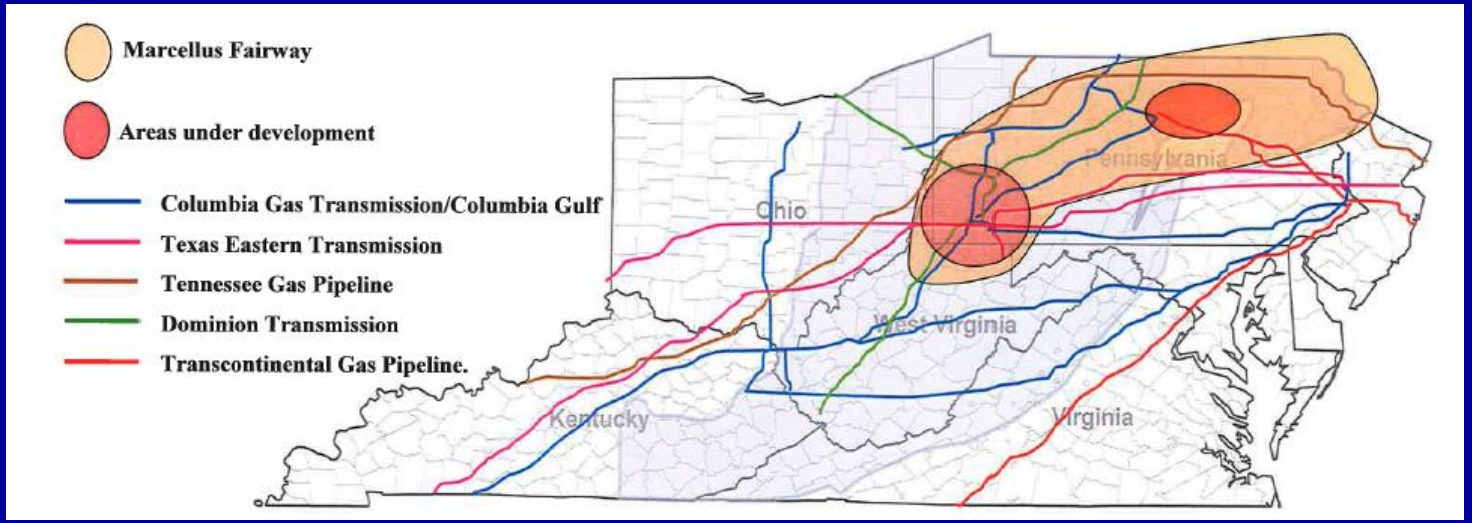
Proposed – A regional Marcellus Play database wherein data from across the play is entered into a USGS-maintained database and is available to be accessed by all.

Bottom line – We need to understand/document existing conditions prior and during the gas development/production process to assess and monitor our water, air, environmental resources.

Pipeline infrastructure and land disturbance

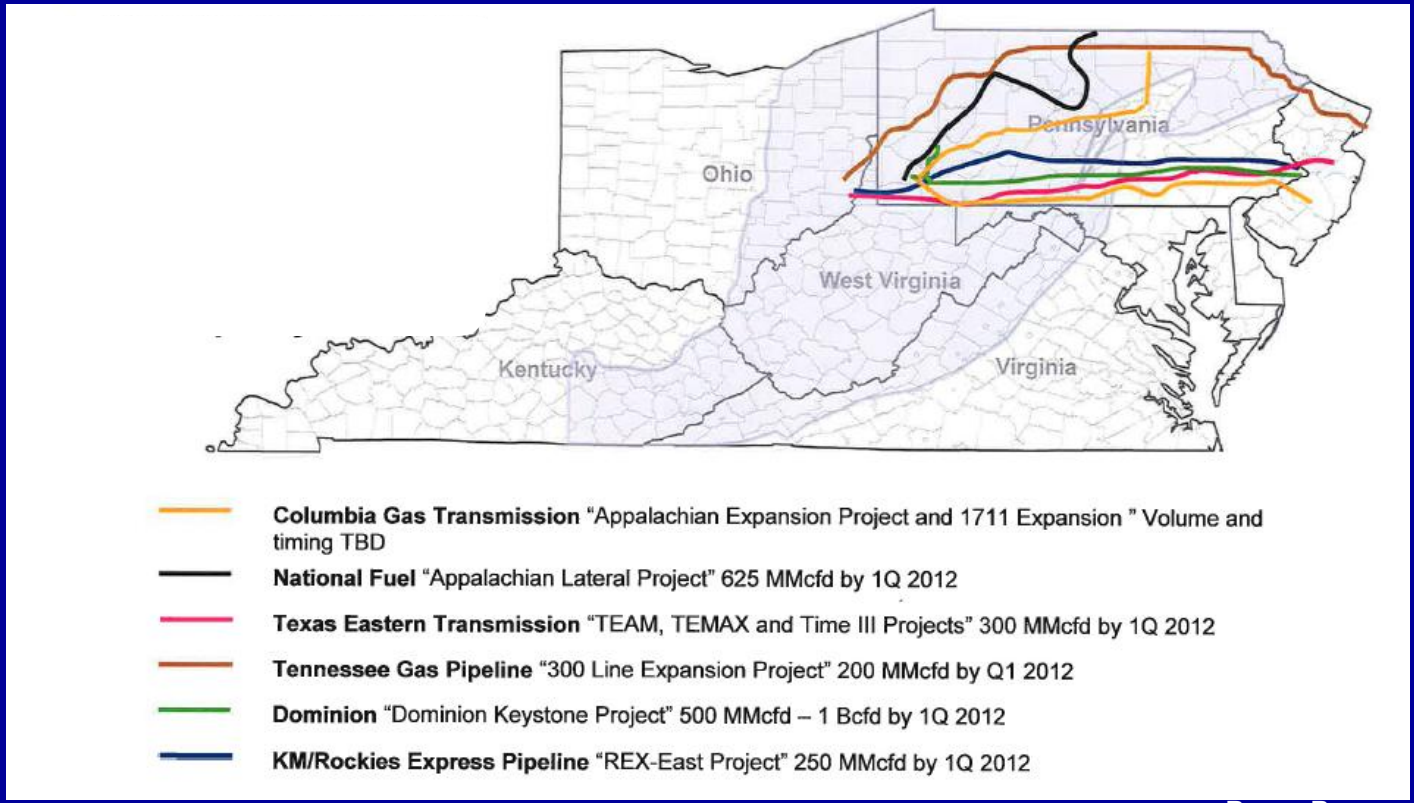


Existing Major Pipelines



Potential new pipelines in Pennsylvania

These are only the major transmission pipelines, not the gathering or intermediate pipelines



Range Resources, 2009

Considerations in relation to what a Village, Town, or County can and can't do in relation to shale-gas development within their jurisdiction.

Regulation of Oil, Gas, and Solution Mining Drilling and Production
Environmental Conservation Law (ECL), Article 23, Titles 1 to 13, Title 19
Regulation 6 NYCRR Part 550-559

New York's Oil, Gas and Solution Mining Law specifically supersedes all local laws or ordinances relating to the regulation of the oil, gas, solution mining, and brine disposal industries, but reserves to local governments jurisdiction over local roads and the rights of local governments under the Real Property Tax Law.

Under the Oil Gas and Solution Mining Law the jurisdiction can:

(this interpretation is by a hydrogeologist, not a lawyer – "Caveat emptor")

Table 15.1 - Oil, Gas, Solution Mining and Brine disposal Interagency Coordination

Regulate the use and bonding of local roads (with proper documentation)

Tax "property value" of production wells, (you need to check this one…..)

Regulate, to a degree, the location of new wells (DEC) and gas pipelines (PSC) near agricultural districts, wetlands, & water supplies through SEQRA reviews.

Regulate the use (sale) of municipal water (from that jurisdiction) for the drilling and hydrofracking processes.

Regulate the disposal (road spreading) of brine on roadways and use of the jurisdictions' wastewater treatment plant(s) to treat flowback/formation waters.

Follow-up on Oil and Gas complaints but only after County Health Department does their assessment – local jurisdiction has a secondary role.

Questions?