Fracking: Implications and Impacts on Illinois Highways

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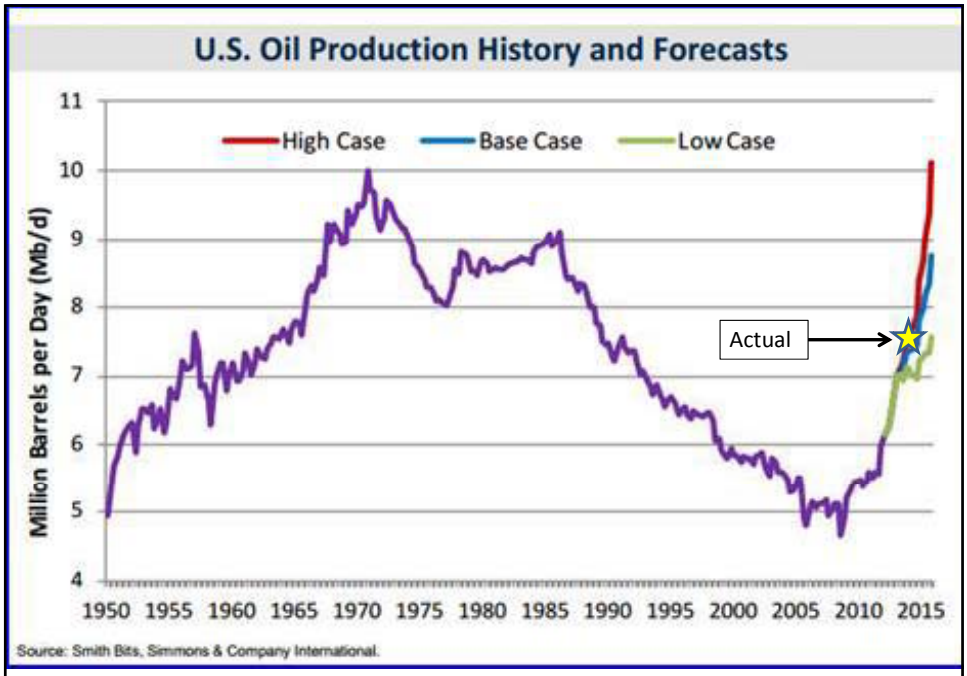
Illinois Department of Transportation

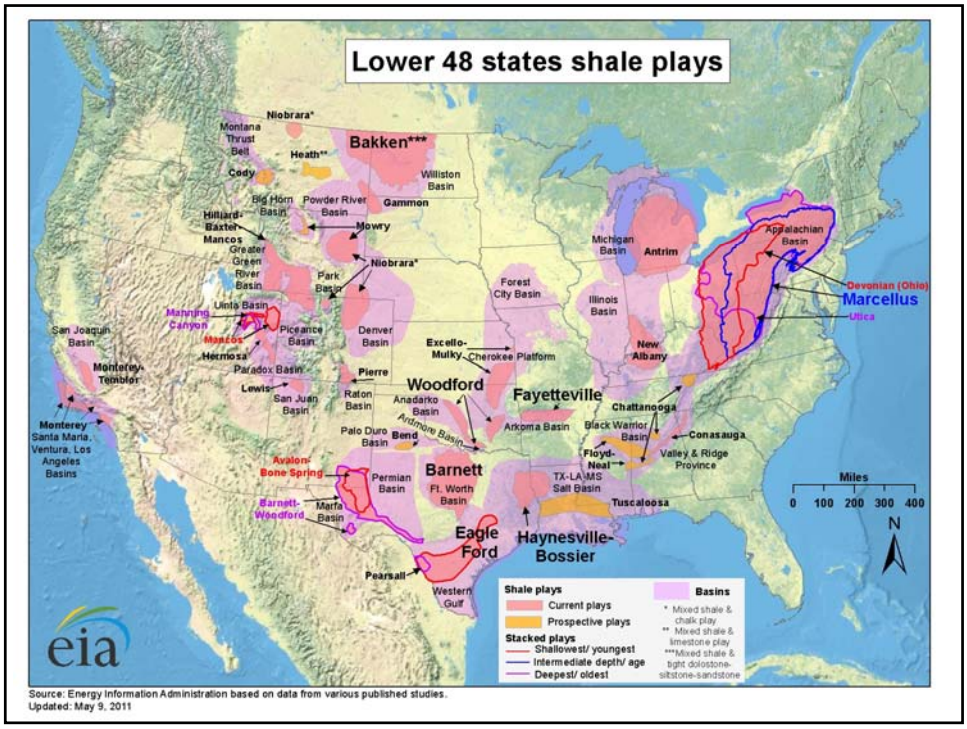
Fracking: Implications and Impacts on Illinois Highways

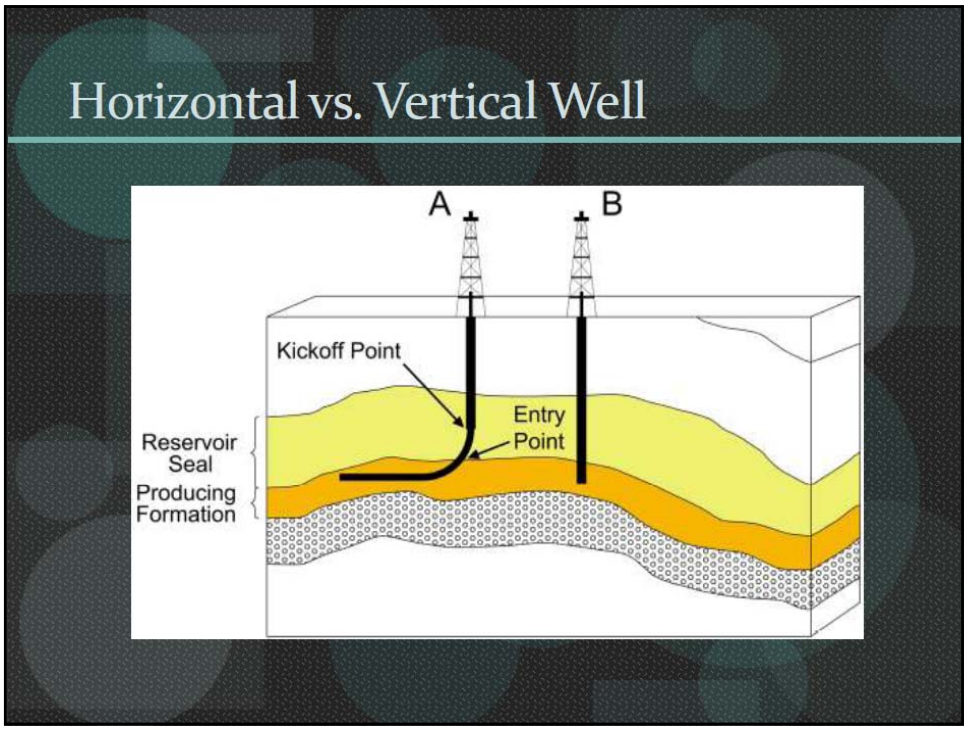
- Overview of fracking and horizontal drilling



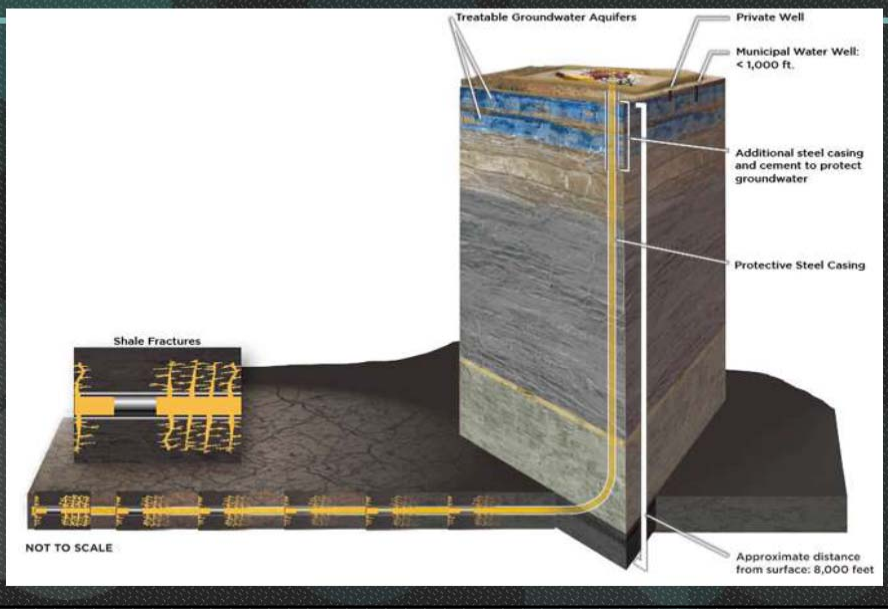
Why the Black Gold Rush?

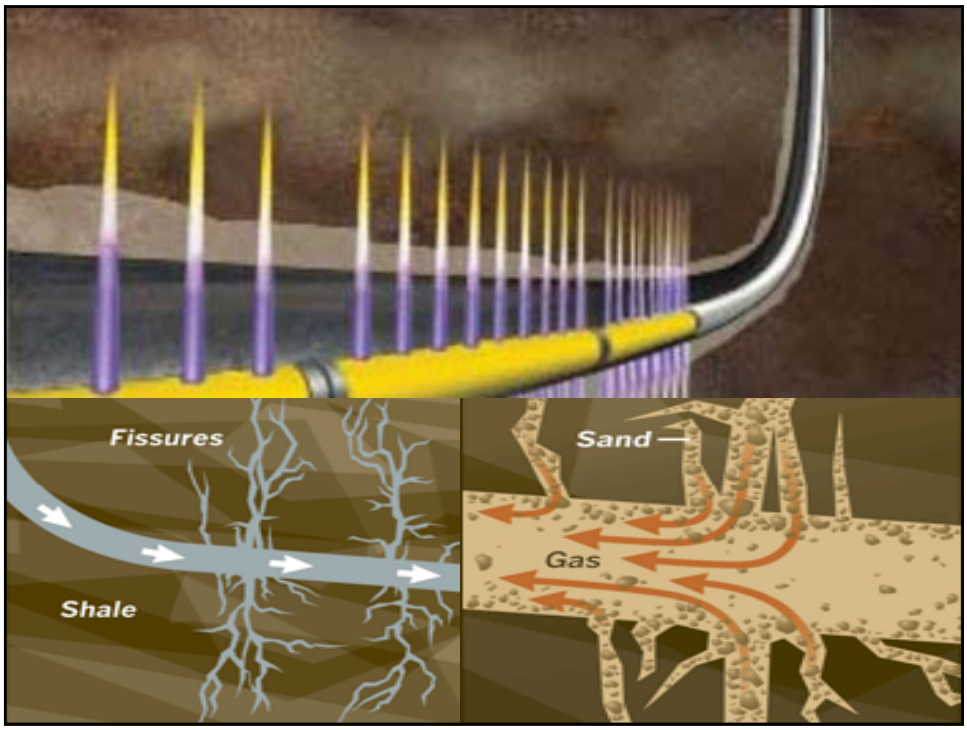
- Science of detecting oil bearing formations have greatly improved
- Combination of Horizontal Drilling (first in 1929) and Fracking (60 + year old technology)
- Techniques and economical production equipment (down hole and surface) fully developed in past 10+/- years
- Successful recoveries spur more use


Lower 48 states shale plays
Niobrara*
Montana Thrust Belt
Heath**
Bakken***
Cody
Williston Basin
Big Horn Basin
Powder River Basin
Gammon
Hilliard-Baxter-Mancos
Mowry
Greater Green River Basin
Niobrara*
Park Basin
Michigan Basin
Antrim
Appalachian Basin
Forest City Basin
Illinois Basin
Devonian (Ohio)
Marcellus
Utica
Uinta Basin
Mahogany Canyon
San Joaquin Basin
Piceance Basin
Denver Basin
Mancos
Hermosa
Excello-Mulky
Cherokee Platform
New Albany
Monterey-Temblor
Paradox Basin
Pierre
Lewis
Woodford
Fayetteville
San Juan Basin
Raton Basin
Anadarko Basin
Ardmore Basin
Chattanooga
Monterey
Santa Maria, Ventura, Los Angeles Basins
Palo Duro Basin
Bend
Arkoma Basin
Black Warrior Basin
Conasauga
Floyd-Neal
Valley & Ridge Province
Avalon-Bone Spring
Permian Basin
Barnett
Ft. Worth Basin
TX-LA-MS Salt Basin
Miles
0 100 200 300 400
N
Barnett-Woodford
Marfa Basin
Tuscaloosa
Eagle Ford
Haynesville-Bossier
Pearsall
Western Gulf
Shale plays
Current plays
Prospective plays
Stacked plays
Shallowest/ youngest
Intermediate depth/ age
Deepest/ oldest
Basins
* Mixed shale & chalk play
** Mixed shale & limestone play
***Mixed shale & tight dolostone-siltstone-sandstone
eia
Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011


Horizontal vs. Vertical Well
A
B
Kickoff Point
Entry Point
Reservoir Seal
Producing Formation

Horizontal Shale Gas Wells and "Multi-Stage" Fracs





Proppants

- Sands
  - Quartz
  - Silica
- Ceramics
- Needed properties
  - 4K to 8K crushing strength
  - Round to allow fluids/gasses to move around material
  - Specific sizes

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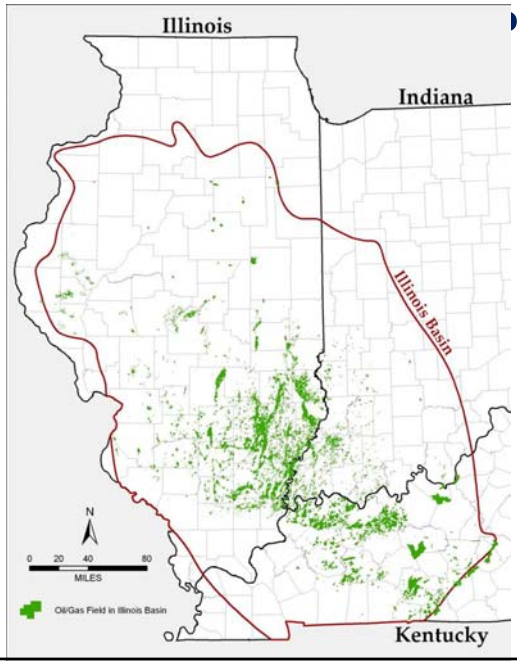
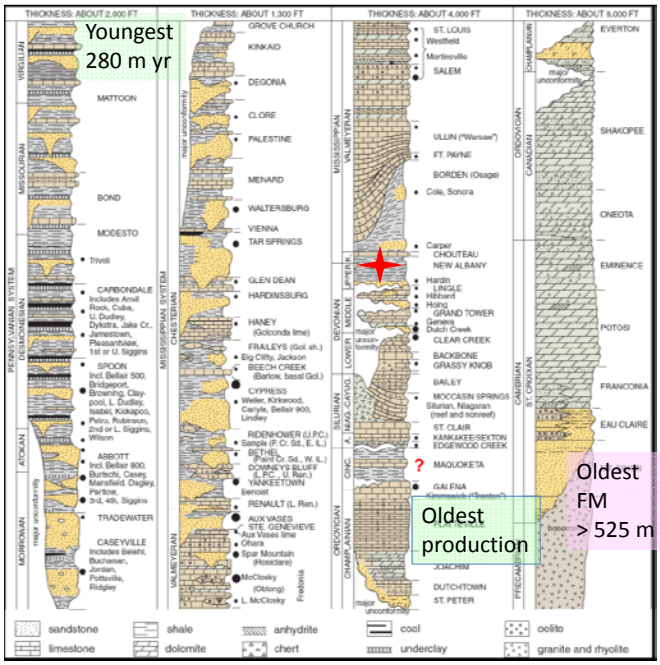
- Overview of fracking and horizontal drilling
- Illinois Oil and Gas resources

Where is the oil and gas in Illinois?



- >90,000 historic producing wells in Illinois (**green shapes**, includes gas storage fields.)
- **Over 3.4 Billion** barrels produced in IL, IN, KY. Majority of production from Illinois.
- 2006, ISGS estimated **14.1 Billion** Barrels total Illinois Basin Oil
- **Fracs** here for past 60 years.
- **Recent Leasing** Estimate: Over 250,000 acres have been leased, at a cost of $30 Million, *before* drilling a single new well.

STRATIGRAPHIC COLUMN, ILLINOIS OIL PAY ZONES



Paleozoic rocks produce in ILL. Upper Left are youngest rocks. Columns, looking left to right show older strata—you drill through glacial deposits and potentially all these formations to get to crystalline basement (Precambrian.)

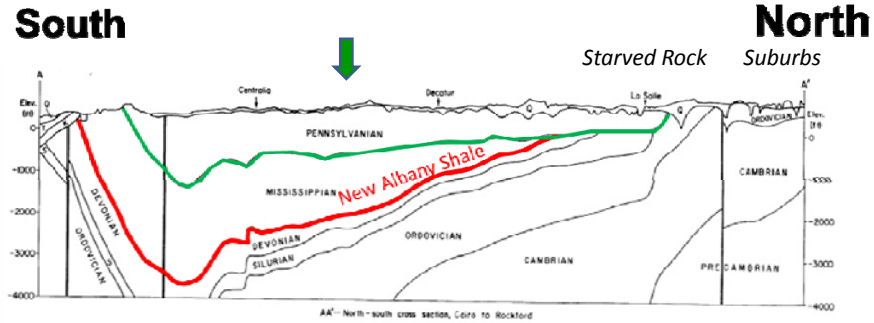
NEW ALBANY is source for about 95% of Illinois oil and gas.

Dots indicate oil productive rocks.

Glacial drift: thin blanket sediments from glaciers, covers most of the state.

Bedrock layers below dip down to the south, into the "basin."

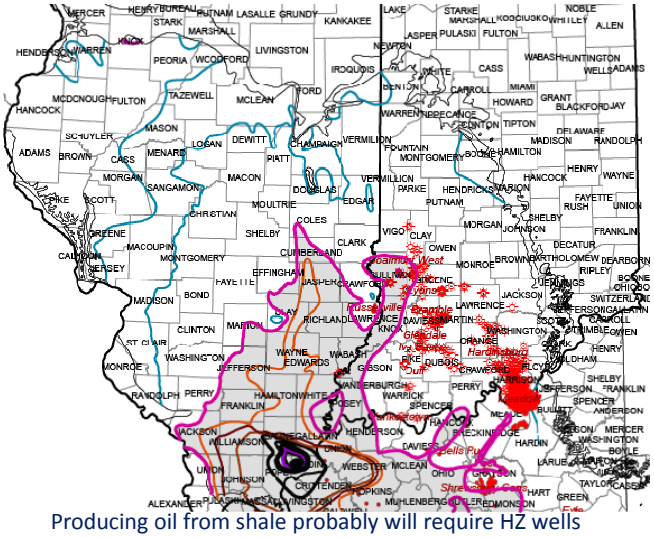
New Albany, our primary hydrocarbon source rock, is not interpreted to be matured into the oil window north of the **green arrow**. We do not think oil shale exploration will occur north of there.



However, not all horizontal drilling & fracking will be in the shale.

It might be considered in any oil or gas field in the state.

New Albany: A Horizontal Drilling, Frac Target? Map shows maturity of New Albany.



Producing oil from shale probably will require HZ wells and high volume hydraulic fracturing. It is a SPECULATIVE or UNCERTAIN "play" or model at this time.

Shaded area generally defines "oil shale play" boundaries. Better areas are inside orange contour, where shale is more mature, or "intense oil generation" is interpreted to occur. OIL is the target.

Red stars = gas wells, mainly shallow biogenically-altered shale; mostly in Indiana.

Map modified from GRI 2000.

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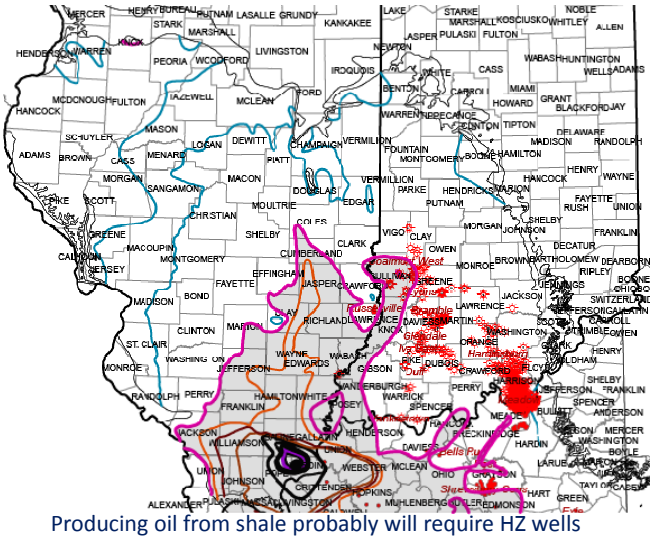

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Many people think the hunt is on for SHALE GAS in our New Albany Shale. Shale gas has received a lot of publicity lately in other areas. Research suggests that in the Illinois Basin, the main source rock is generally not matured enough to produce thermogenic gas (except in small area in purple in SE IL).

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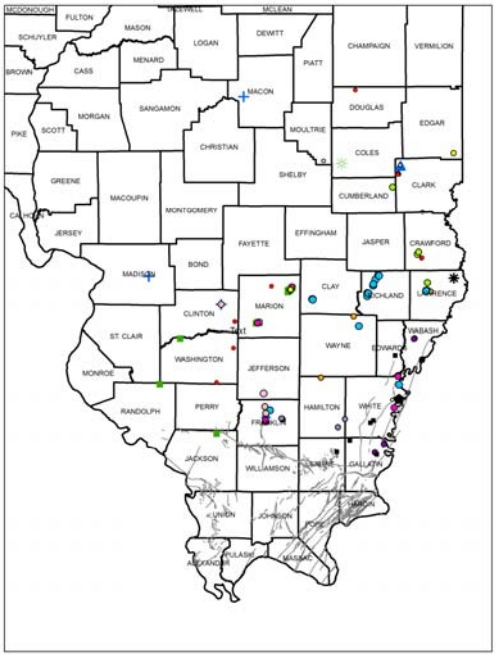


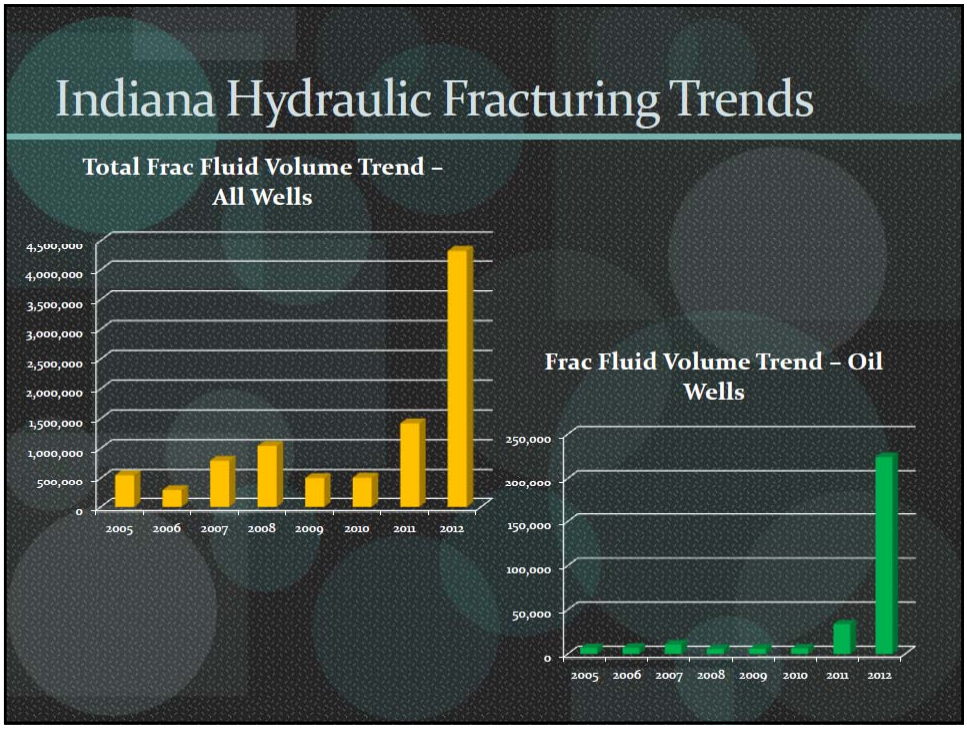
Horizontal Oil & Gas Wells in Illinois, December, 2012.
It's not all about shale!

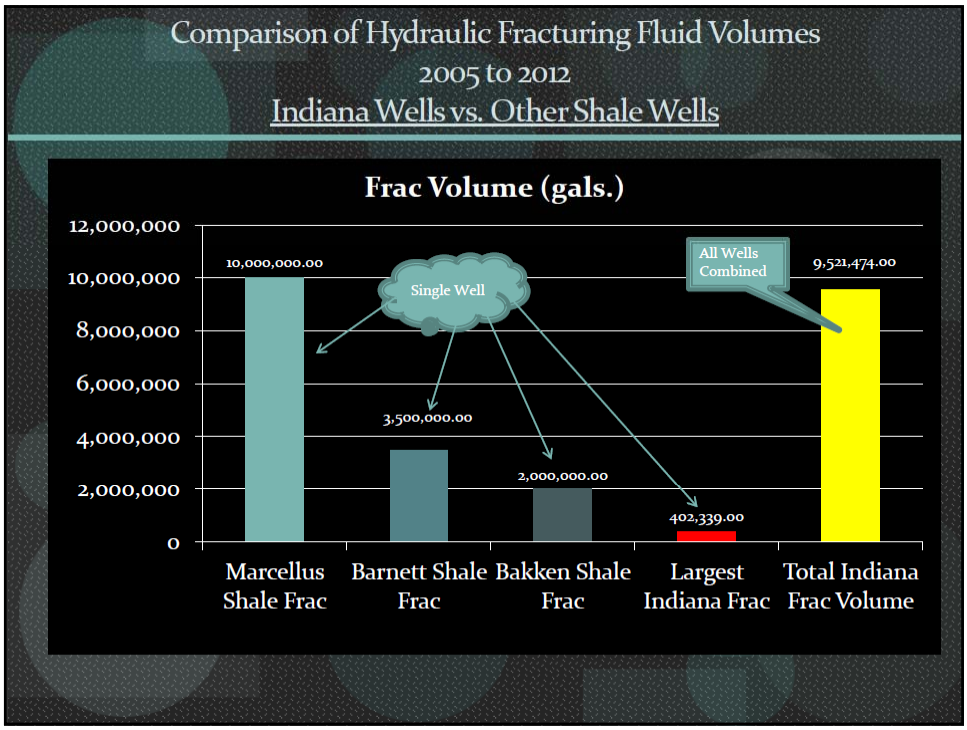
Count: 141 HZ wells, 12/2012.
Main pay zones:
19 Cypress
18 St. Louis
16 Trenton
15 Ullin-Warsaw
14 Devonian
11 Waltersburg
10 Ste. Genevieve
Single digits for all other pays.
Most horizontal production is from traditional sandstone or carbonate Reservoirs. Only 1 or 2 produce in shale.

Colors indicate producing or "pay" zones. Many horizontal wells do not use hydraulic fracturing method to stimulate production.

Imagine an oil reservoir: Stratigraphic Trap. Sandstone bar in a an ancient river system, pinches out to shale.

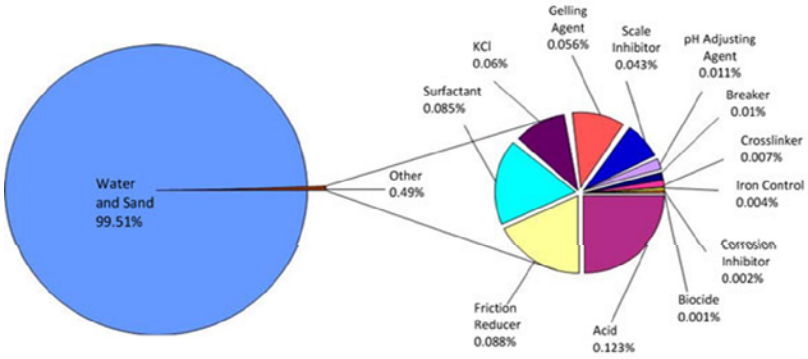
Imagine a **vertical well** here. It might have 10 feet of "pay," (usually oil & water mix,) then brine zone below. **Now imagine a horizontal well.** It could go hundreds of feet laterally within that "payzone," and produce a lot more oil or gas and water. Horizontal wells may "reach" hundreds to thousands of feet into the formation. Here: Reservoir boundaries: sand bar pinching out to shale on right.


Indiana Hydraulic Fracturing Trends
Total Frac Fluid Volume Trend – All Wells
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2005
2006
2007
2008
2009
2010
2011
2012
Frac Fluid Volume Trend – Oil Wells
250,000
200,000
150,000
100,000
50,000
0
2005
2006
2007
2008
2009
2010
2011
2012


Comparison of Hydraulic Fracturing Fluid Volumes
2005 to 2012
Indiana Wells vs. Other Shale Wells
Frac Volume (gals.)
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
10,000,000.00
Single Well
3,500,000.00
2,000,000.00
402,339.00
All Wells Combined
9,521,474.00
Marcellus Shale Frac
Barnett Shale Frac
Bakken Shale Frac
Largest Indiana Frac
Total Indiana Frac Volume

What goes in to frac water? A "cocktail," or mix.

Slickwater Hydraulic Fracturing Fluids
[example from a nine-stage treatment of a Fayetteville Shale (Arkansas) horizontal well.]



Make-up varies with each area and company. A number of compounds with similar function are available. Service companies proprietary formulations.

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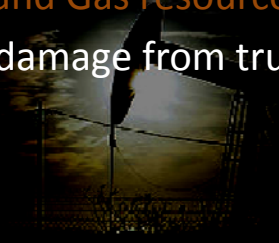
- Pavement damage from trucks

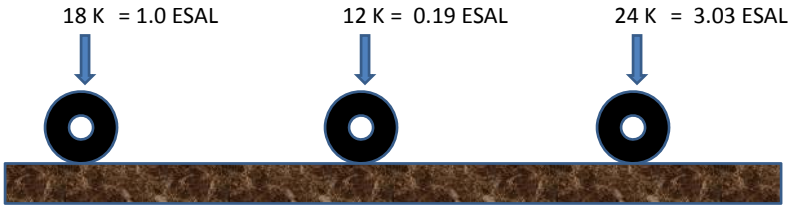


Why Is Oil Field Traffic a Concern?

- Amount of goods movement needed in states such as North Dakota has been phenomenal.
- Limited roadway infrastructure - so when new fields are developed very large increase in traffic on system not built to withstand large numbers of heavy trucks.
- Could same be true in Illinois?

18K Equivalent Single Axle Load (ESAL)

- Common Unit for pavement Damage
- Take mixed weight axles and convert to equivalent 18K axles



For Flexible Pavement: Follows approximately the 4th power rule….

$(12/18)^{4.0}$ = 0.20 ESAL

$(24/18)^{4.0}$ = 3.16 ESAL

Fully loaded Semi on Flex Pavement = 2.37 ESAL

Road Sections

Facility	Interstate	Primary	Local
Cross Section			
Material	**3.5" HMA Overlay 8" CR Concrete 4" Stabilized Base**	**2.5" HMA Overlay 9-6-9 Concrete**	**2-3" Built up Seal Coats or HMA 8-10" Aggregate Base**
Design ESAL	35,000,000	6,000,000	500,000
Pavement Cost/ESAL Mile	$0.086	$0.206	$1.021
$/Semi-Mile	$0.20	$0.49	$2.42

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- Estimated traffic generation from drilling

Estimated Illinois Well and Frack

- To well head
  - 1 Acre Aggregate Pad 8”
    - 2,940 tons - 82 loaded trucks
  - 1,000,000 Gal water
    - 4,165 tons - 175 loaded trucks
  - Sand
    - 500 tons - 21 loaded trucks
  - Equipment
    - 20 legal + 20 permit = 40 loaded trucks
  - Other (Casing, pipe, fuel, etc)
    - 50 legal
- From well head
  - Empty trucks and fully loaded trucks with “Back flow” fluids
- ESAL to well head = 872

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- Estimated traffic from production
- Compare with other users

Oil Production Traffic

Well Production Barrels/Day	Trucks/yr 80K Semis	10 year Truck Count	ESAL's over 10 yr Period (Flex)
5	14	140	332
50	140	1,400	3,320
150	405	4,050	9,600

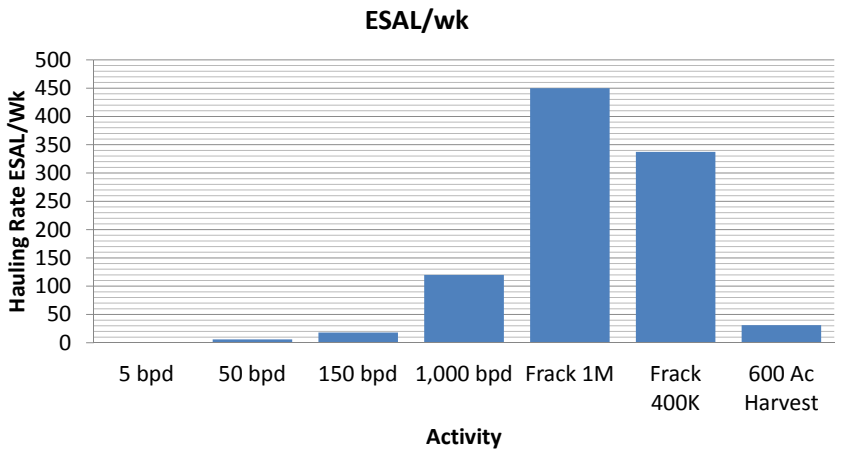
Frack Traffic

Trucks/Well 80K Semis	Time Period Weeks	ESAL's
368	2	872

Grain Harvest Traffic

Acreage	Trucks 80K Semis	Harvest Period Weeks	ESAL's
600	105	8	249

Hauling Rate ESAL/Wk



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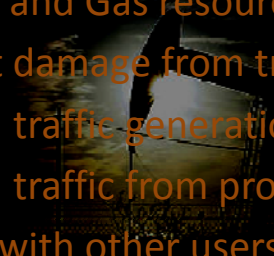

- Overview of fracking and horizontal drilling
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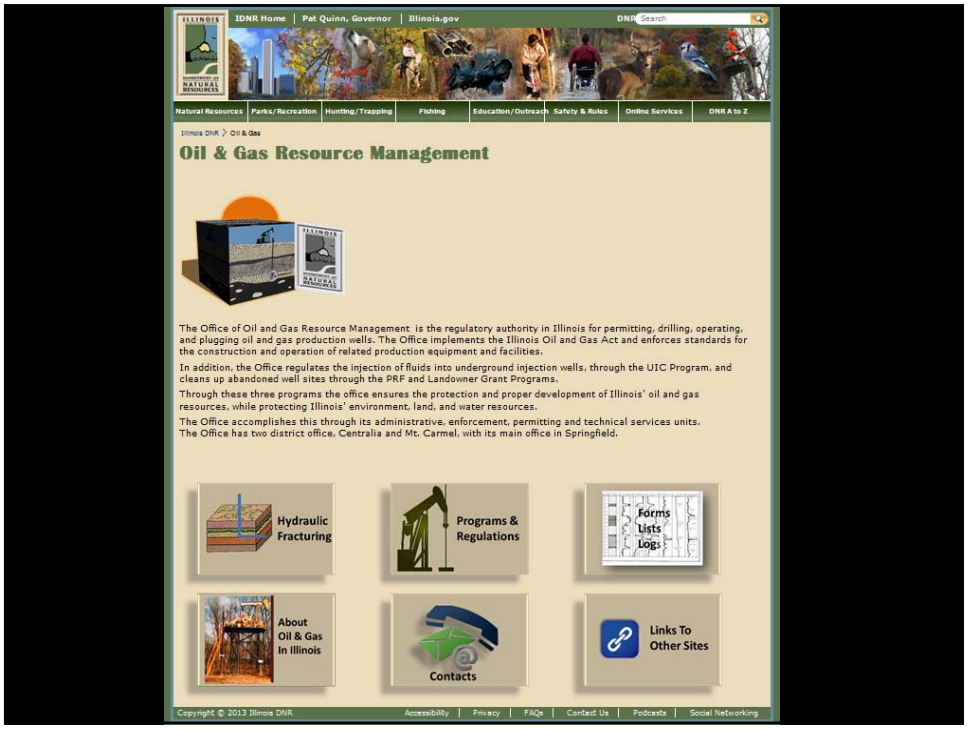
- Pavement damage from trucks
- Estimated traffic generation from drilling
- Estimated traffic from production
- Compare with other users
- DNR Rule making

DNR Rule Making

- DNR – Home Page:
  http://www.dnr.illinois.gov/Pages/default.aspx
- DNR Proposed Fracturing Regulation:
  - **http://www.dnr.illinois.gov/OilandGas/Documents/ProposedHydraulicFracturing62-245.pdf**



Rule Making Provisions

Article 245.210

15) Traffic Management Plan

A traffic management plan that is developed by the applicant, preferably in coordination with the impacted highway authorities (county, township, road district system, and municipal street system) to identify the anticipated roads, streets, and highways that will be used (Section 1-35(b)(15) of the Act) to facilitate the well site construction, drilling operations, high volume horizontal hydraulic fracturing operations, production, and continued operations of the well site. The traffic management plan shall include the following:

A) a scaled map of the proposed routes the applicant intends to use to construct the well site, perform high volume horizontal hydraulic fracturing operations, production and continued operations, for at least a 10 mile radius around the well site, identifying all the different highway jurisdictions;

B) anticipated well site construction and drilling operations start and end dates, high volume hydraulic fracturing operations start and end dates, and other high traffic operations start and end dates;

C) contact information for the applicant's representative with knowledge of the traffic management plan; and

D) contact information for a representative of each impacted highway authority;

UPCOMING HEARINGS

Tuesday, December 17, 2013
6:30pm-8:30pm (Doors open at 5:30pm)
Decatur Civic Center, Auditorium
#1 Gary K. Anderson Plaza
Decatur, IL 62523

Thursday, December 19, 2013
6:00pm-8:00pm (Doors open at 5:00pm)
Southern Illinois University at Carbondale (SIUC)
Student Center, Ballroom B
1255 Lincoln Drive
Carbondale, IL 62901

DNR Rulemaking

- Input via public hearings
- Written comments by mail received through Friday, January 3, 2014, at the DNR Headquarters in Springfield, or through an online submittal form.

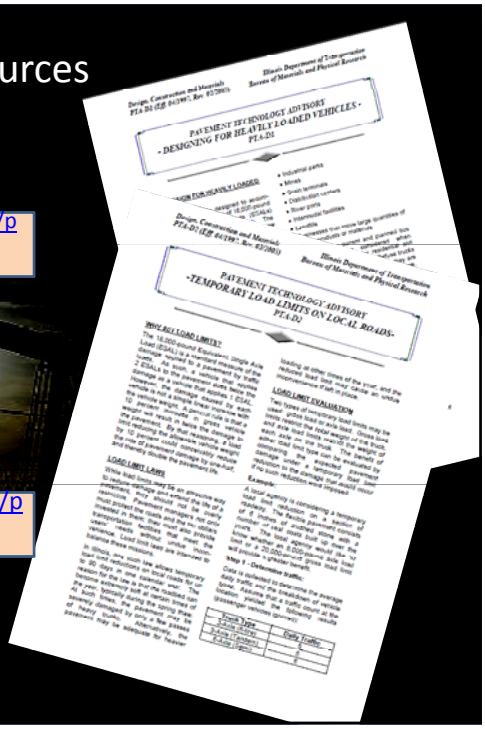
Conclusions

- From Indiana experience – Frack volumes likely under 1M gallons
- If Limited activities – Likely only local roads will have issues in isolated areas
  - Roadways able to support infrequent heavy trucks and harvest traffic may not hold up well to "hauling" to well heads over short periods
- If Wide spread success and Fracks routinely reach over 1M gallons
  - Issues for Township, County and State Roads
- Hearing and Comment Period Open

Resources

Designing for Heavily Loaded Vehicles
http://www.dot.il.gov/materials/research/pdf/ptad1.pdf

Temporary Load Limits on Local Roads
http://www.dot.il.gov/materials/research/pdf/ptad2.pdf



Thanks

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Questions?