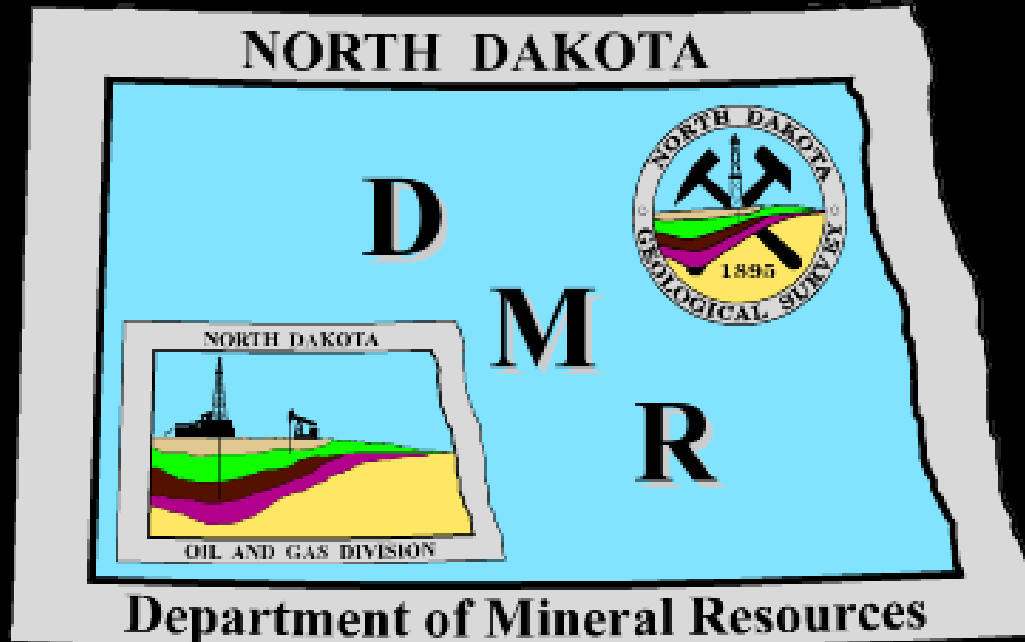


North Dakota Department of Mineral Resources



<http://www.oilgas.nd.gov>

<http://www.state.nd.us/ndgs>

600 East Boulevard Ave. - Dept 405

Bismarck, ND 58505-0840

(701) 328-8020

(701) 328-8000

BAKKEN BASICS

- Where are we?
- Where are we going?
- How did we get here?
- Challenges?
- What could change?

BAKKEN BASICS:

WHERE ARE WE?

- **Became #3 Oil Producing state in March**
(January figures, 546,000 bopd)
- **Became #2 Oil Producing state in May**
(March Figures, 575,000 bopd)
- **May production 19.8 million barrels of oil or 639,000 barrels of oil per day**
- **21.3 Billion cubic feet of natural gas or 687 million cubic feet per day**

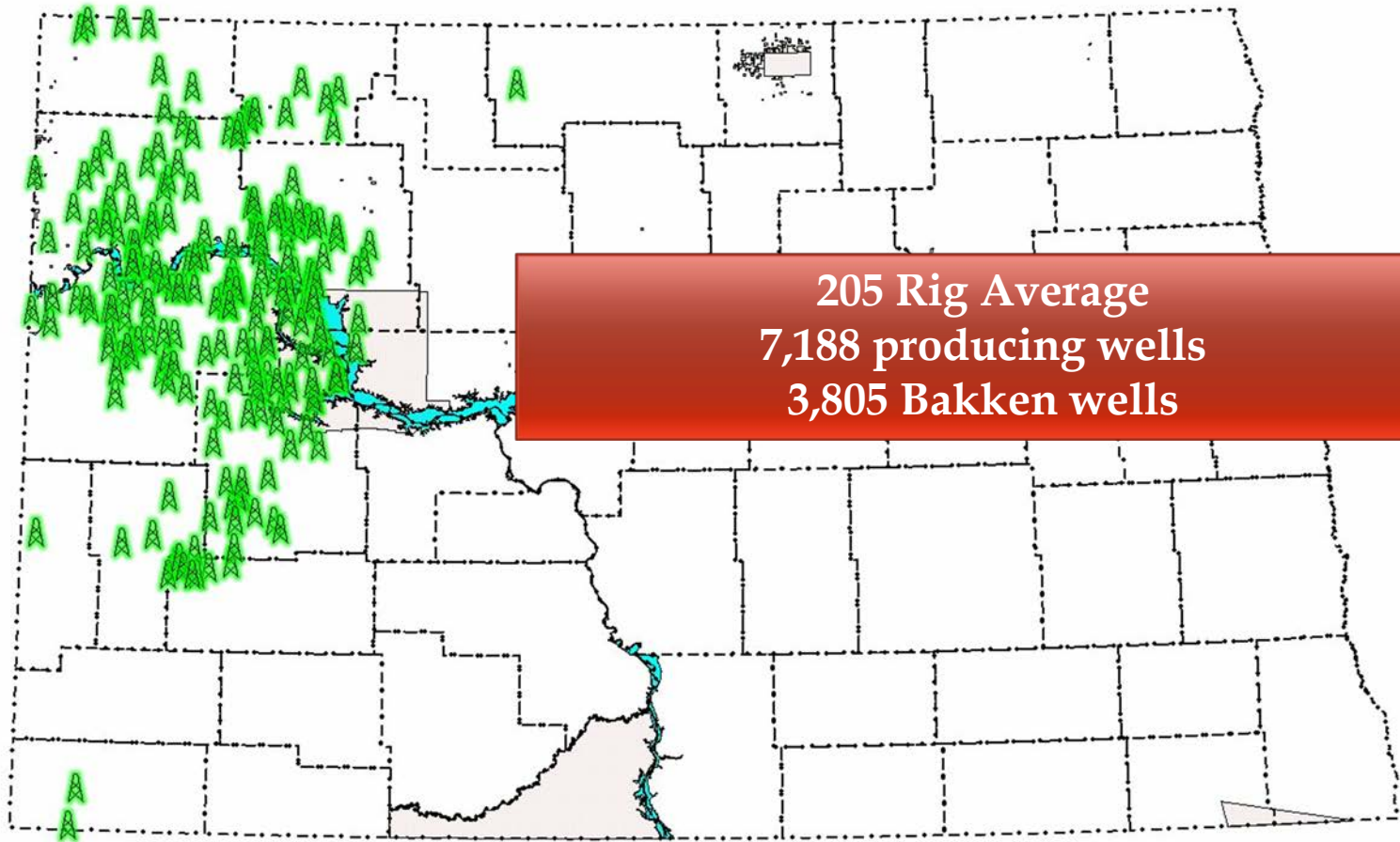
BAKKEN BASICS:

WHERE ARE WE?

- **2 Billionth barrel of oil produced in November 2011**
- **1 Billionth barrel of oil produced in October 1989**
- **First barrel of oil produced in April 1951**

BAKKEN BASICS:

WHERE ARE WE?



BAKKEN BASICS:

WHERE ARE WE?

What Does Every New Bakken Well Mean to North Dakota

A typical 2011 North Dakota Bakken well will produce for 29 years

If economic, enhanced oil recovery efforts can
extend the life of the well

In those 29 years the average 2011 Bakken well will:

Produce approximately 540,000 barrels of oil

Generate over \$20 million net profit

Pay approximately \$4,585,000 in taxes

\$2,200,000 gross production taxes

\$2,000,000 extraction tax

\$385,000 sales tax

Pay royalties of \$7,500,000 to mineral owners

Pay salaries and wages of \$2,100,000

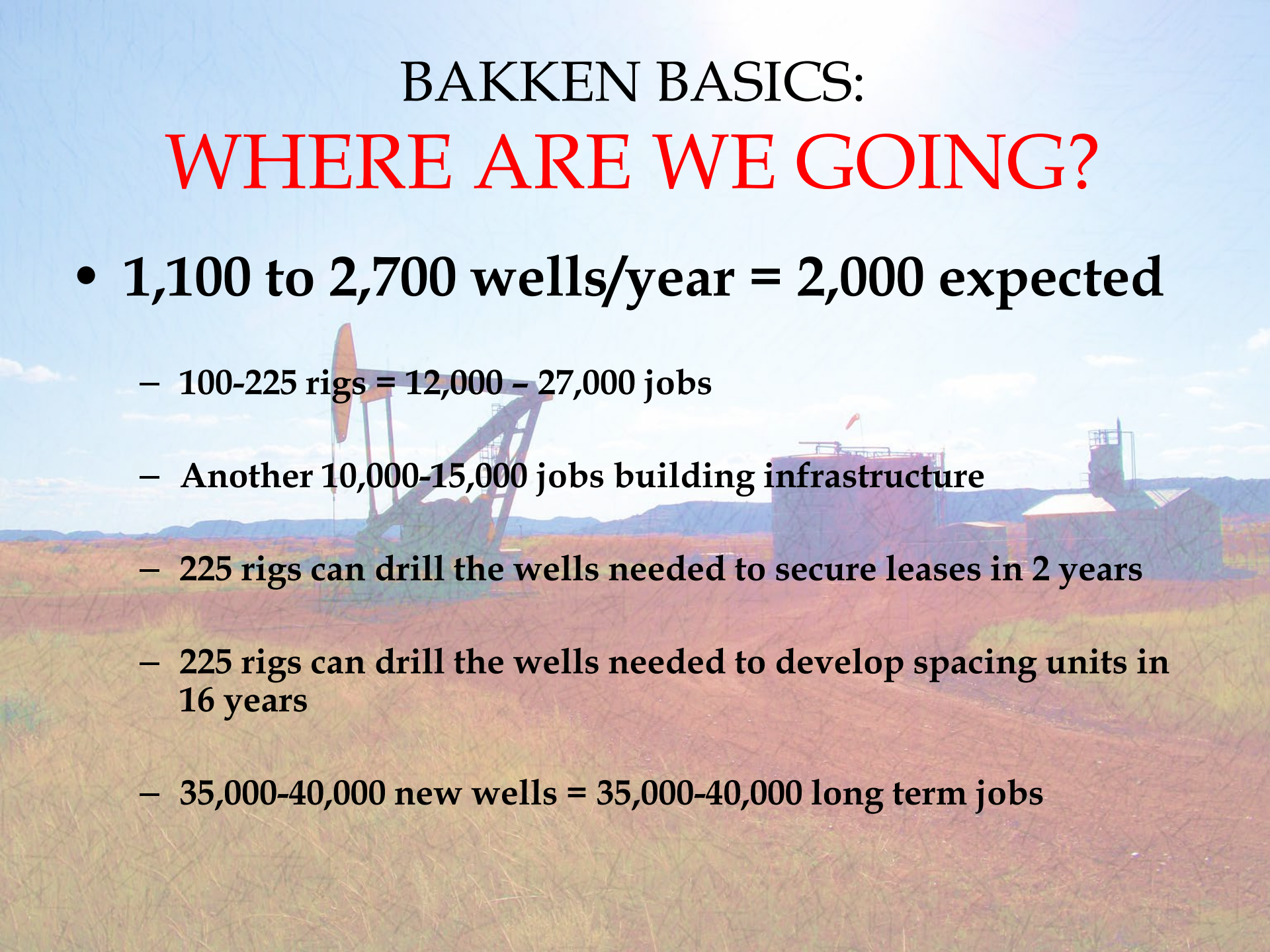
Pay operating expenses of \$2,300,000

Cost \$7,925,000 to drill and complete

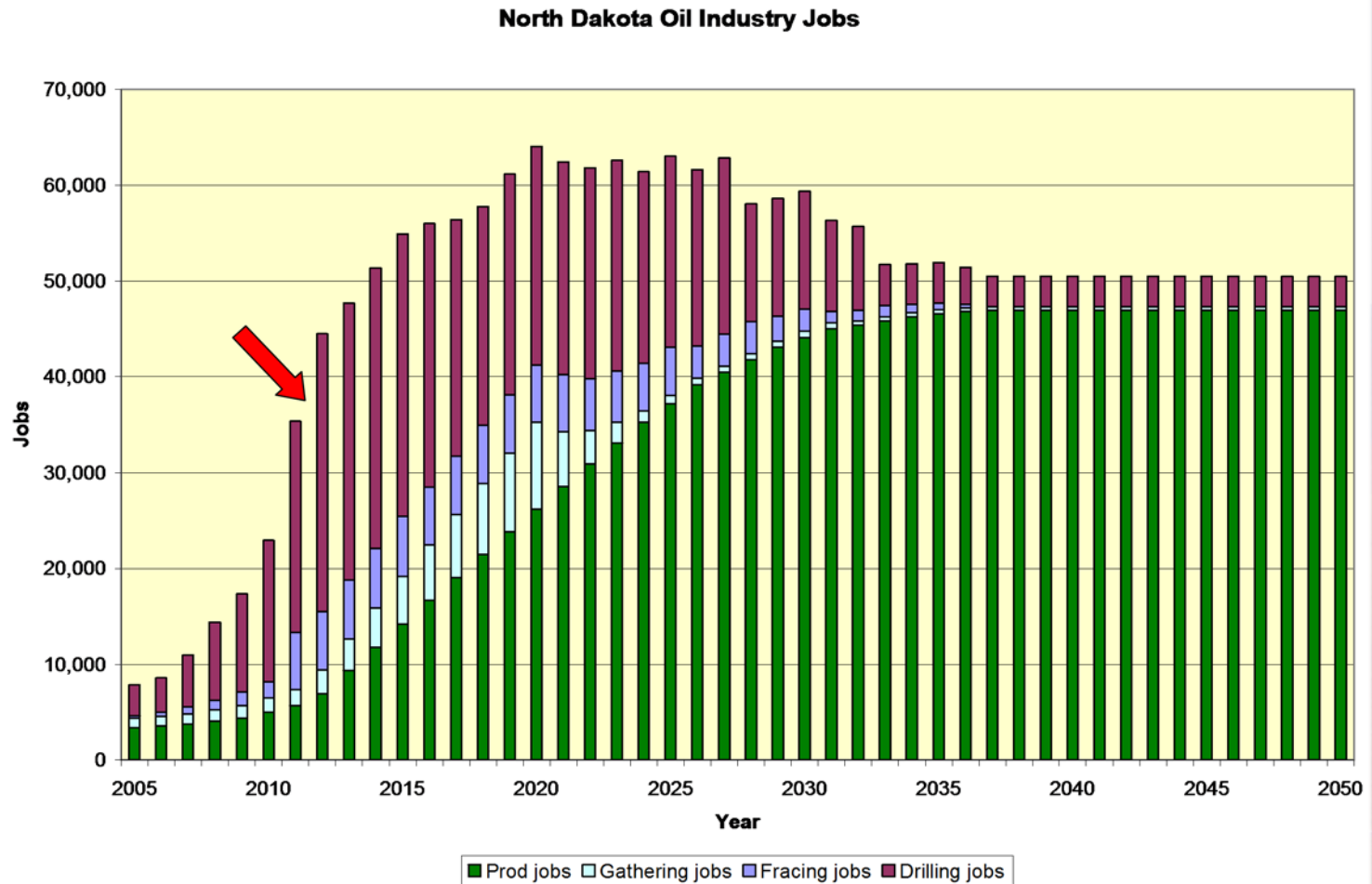
BAKKEN BASICS:

WHERE ARE WE GOING?

- **1,100 to 2,700 wells/year = 2,000 expected**
 - 100-225 rigs = 12,000 - 27,000 jobs
 - Another 10,000-15,000 jobs building infrastructure
 - 225 rigs can drill the wells needed to secure leases in 2 years
 - 225 rigs can drill the wells needed to develop spacing units in 16 years
 - 35,000-40,000 new wells = 35,000-40,000 long term jobs



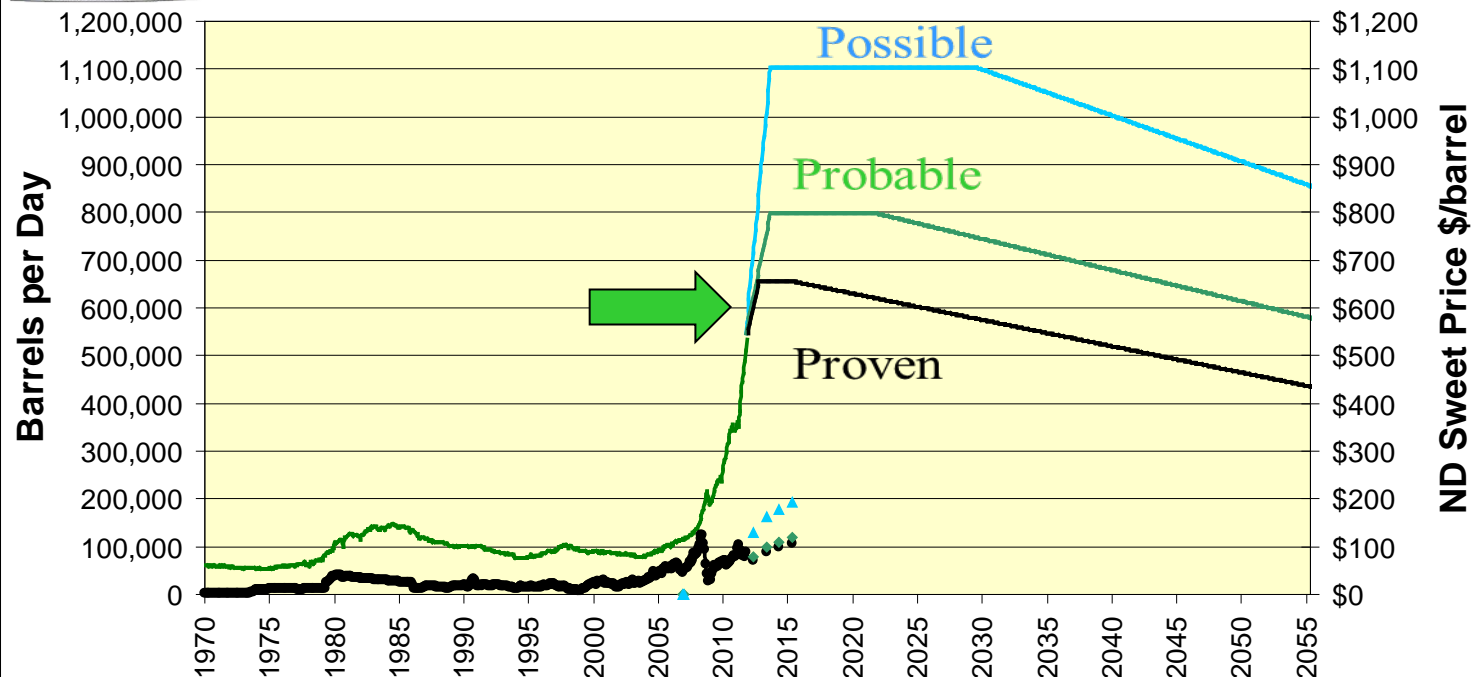
BAKKEN BASICS: WHERE ARE WE GOING?



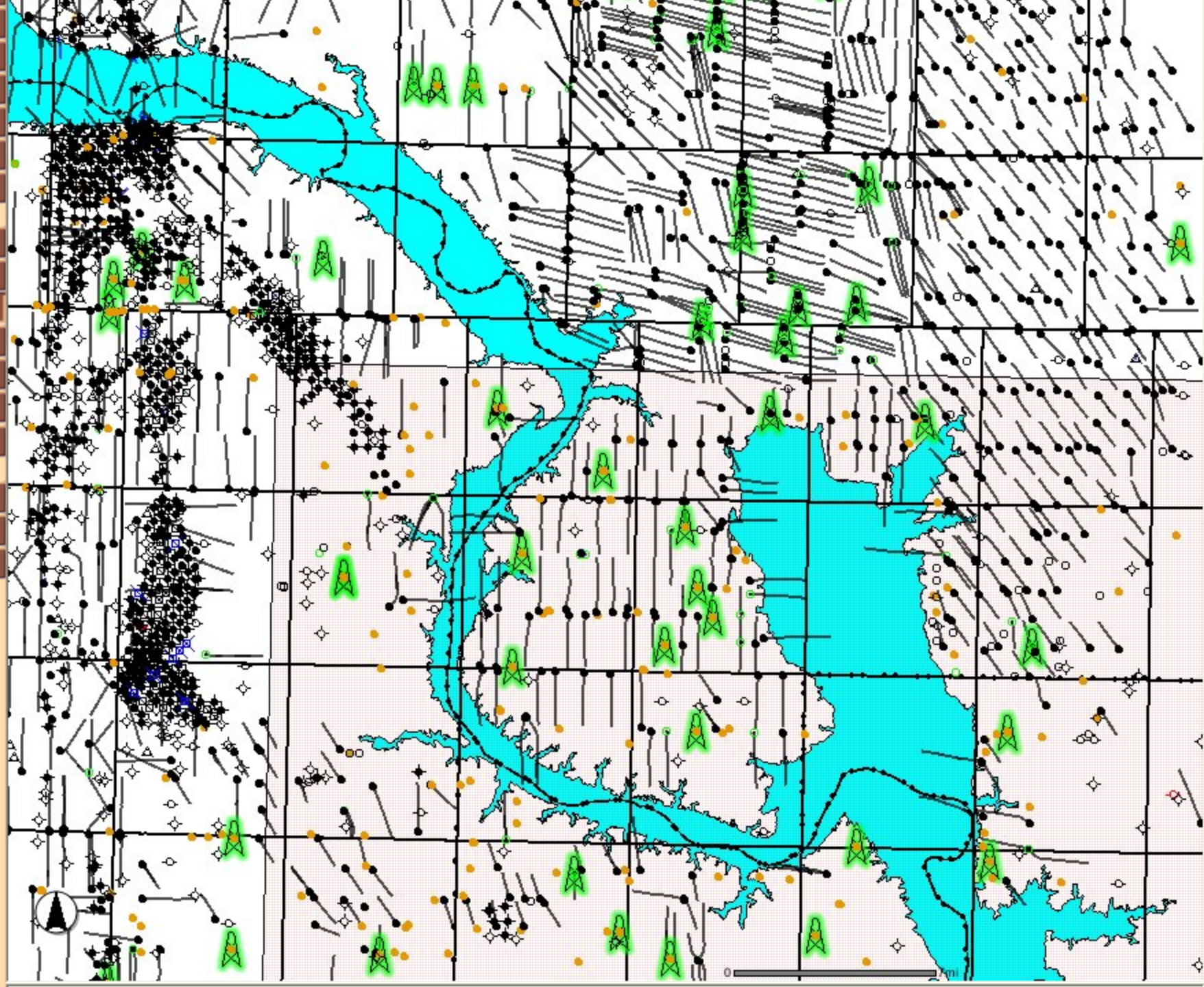
BAKKEN BASICS: WHERE ARE WE GOING?



North Dakota Oil Production and Price

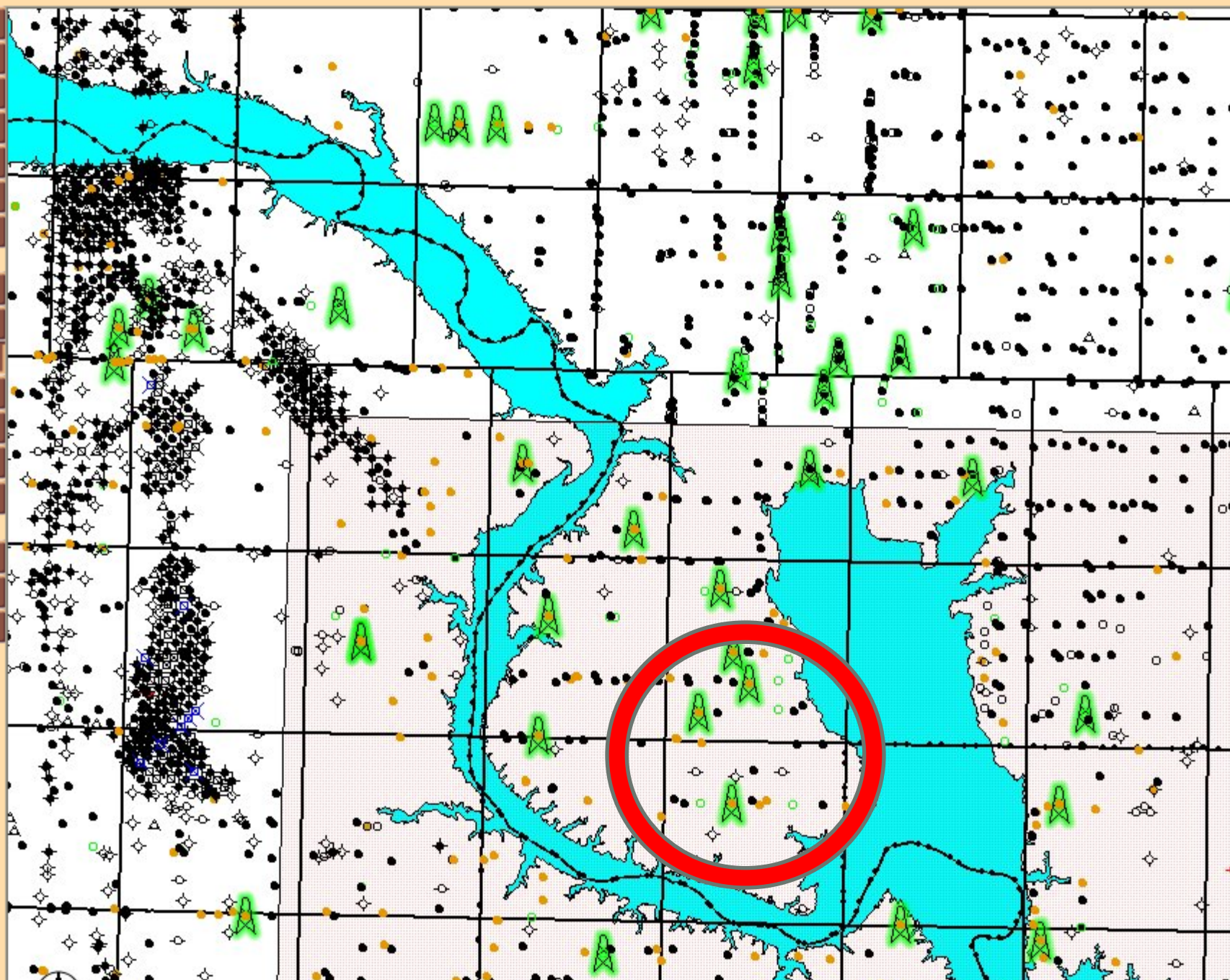


New Map
entire State
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Section



Oil and Gas : ArcIMS Viewer

- End / Layers
- Overview Map
- View Entire State
- Previous View
- Layer Selection
- Search
- Generate PDF
- Zoom In
- Zoom Out
- Pan
- Select Identify
- Select Object
- Buffer
- Distance
- Find Well
- Find Field/Unit
- Find Section

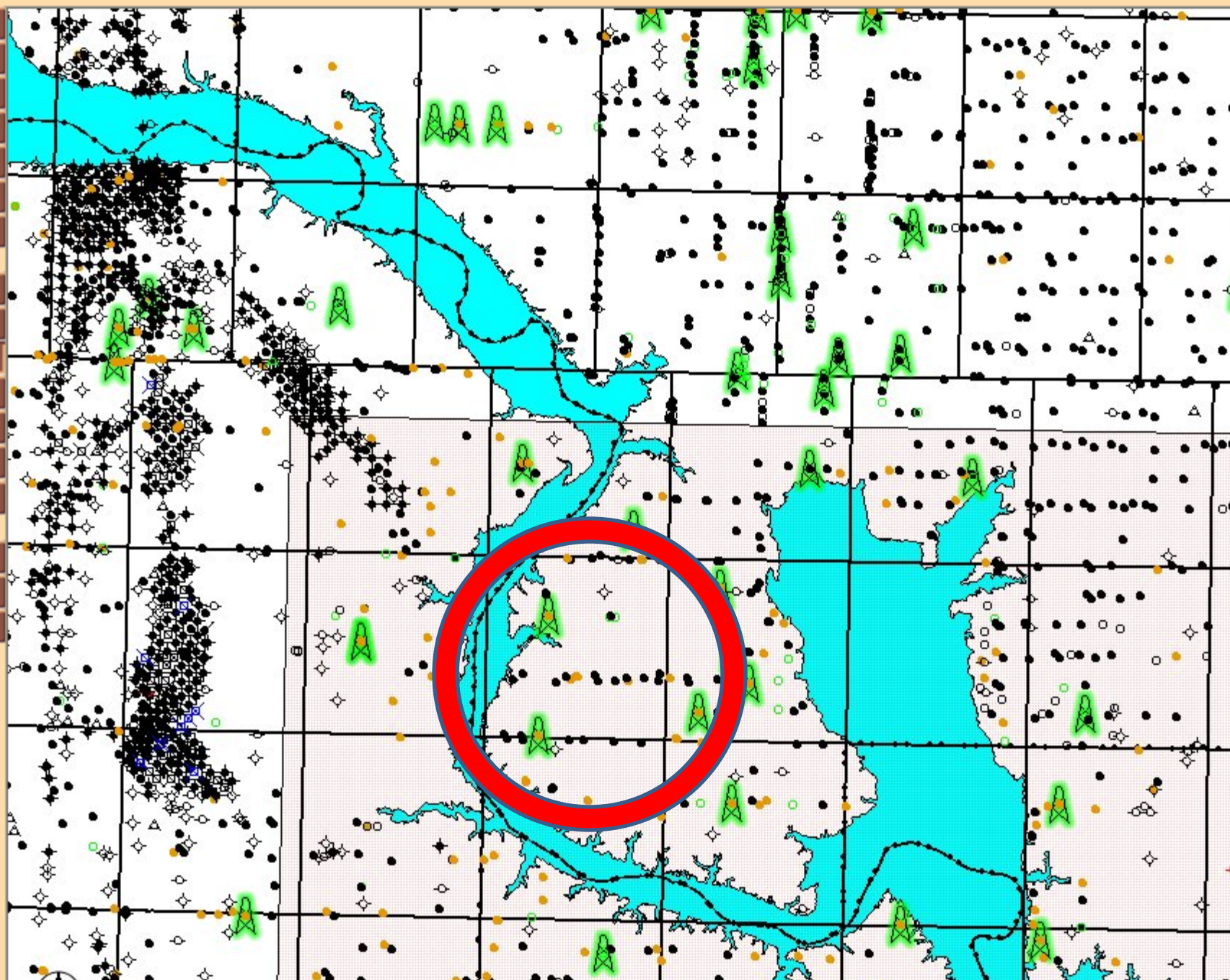




Vern Whitten Photography

Oil and Gas : ArcIMS Viewer

- End / Layers
- Overview Map
- View Entire State
- Previous View
- Layer Selection
- Search
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- Select Identify
- Select Object
- Buffer
- Distance
- Find Well
- Find Field/Unit
- Find Section





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Image USDA Farm Service Agency

Google earth
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Search

Fly To Find Businesses Directions

Fly to e.g., Hotels near JFK

sublette county wy

Sublette, Wyoming

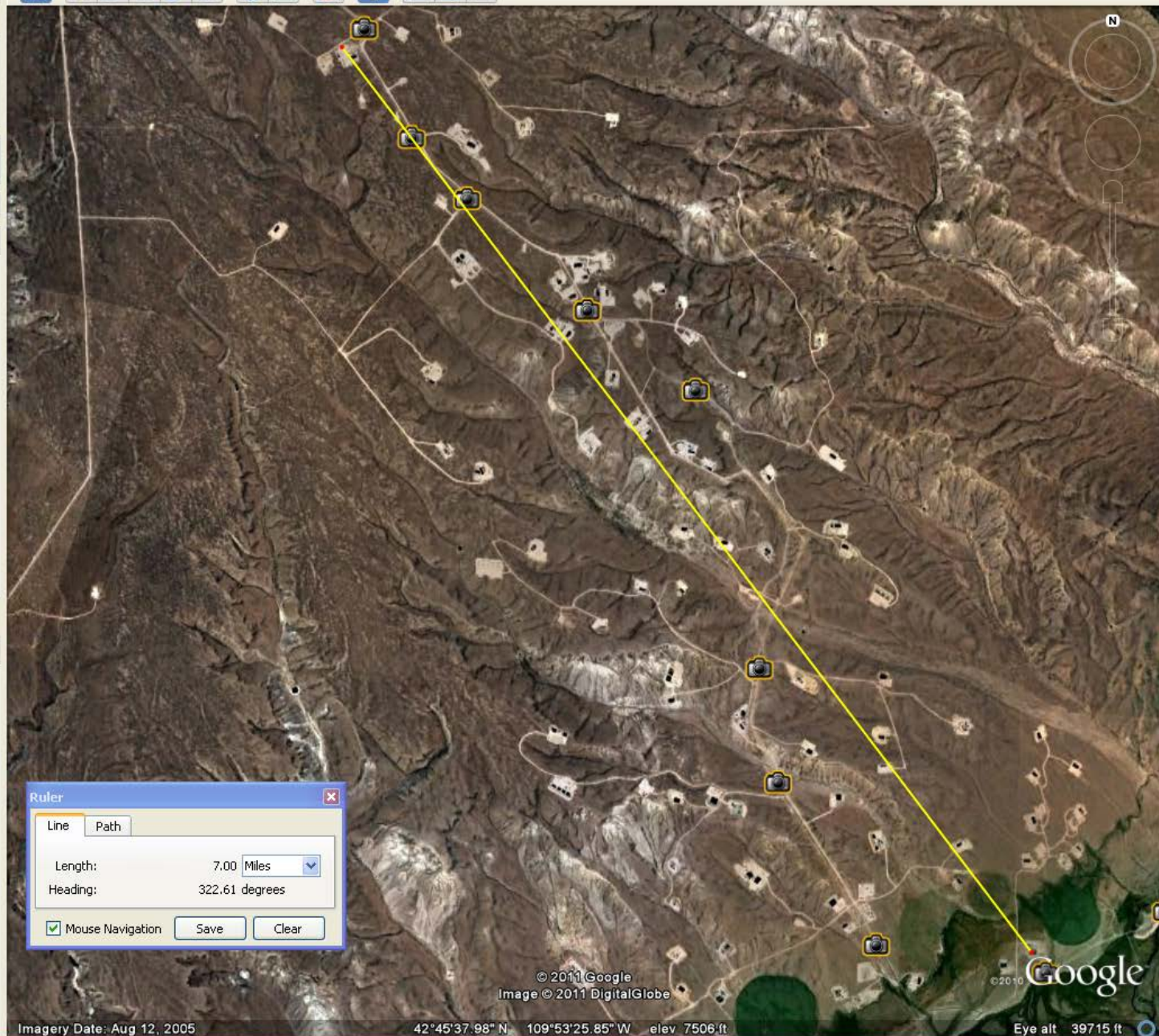
Places

- My Places
- Sightseeing Tour
Make sure 3D Buildings layer is checked
- Temporary Places

Layers

Earth Gallery >>

- Primary Database
- Borders and Labels
- Places
- Photos
- Roads
- 3D Buildings
- Ocean
- Street View
- Weather
- Gallery
- Global Awareness
- More



Imagery Date: Aug 12, 2005

42°45'37.98" N 109°53'25.85" W elev 7506 ft

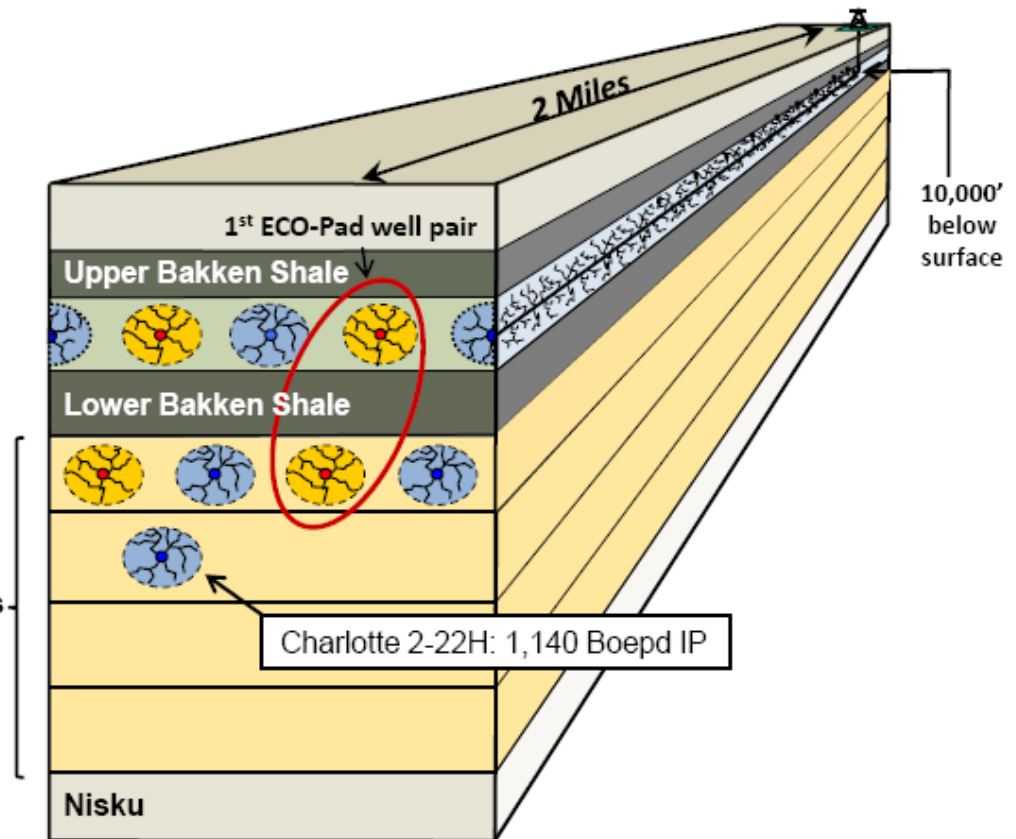
Eye alt 39715 ft

Bakken Development Plan

Original dual-zone development plan

- 8 wells per 1,280 acres – 4 MB, 4TF
- 603,000 Boe EUR per well (avg. 24.5 stages/completion)
- ECO-Pad® design: 2 wells south, 2 wells north

Additional Three Forks potential



Six Wells on a Single Pad



Vern Whitten Photography

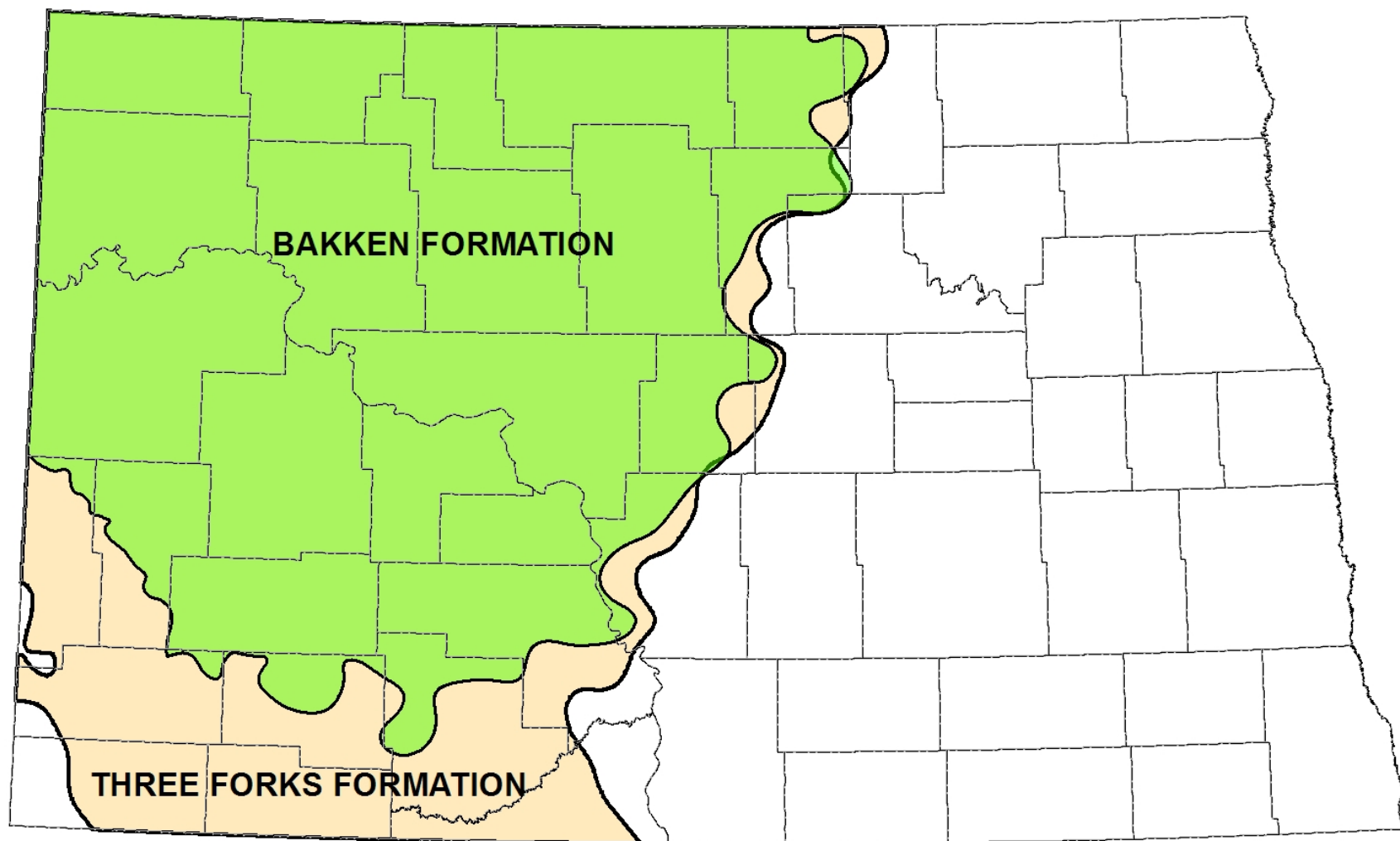
BAKKEN BASICS:

HOW DID WE GET HERE?



Resource Plays

- 1) **Large area of organic-rich source rock.**
- 2) **Heat, pressure, and time to mature** source rock.
- 3) **Expulsion** of hydrocarbons from source rocks into adjacent rocks.
- 4) **Trapping** of hydrocarbons in overlying and underlying reservoirs that are porous, but low permeability.
- 5) **Technology to extract** hydrocarbons using natural or artificial fractures to get economic amounts of petroleum production.



Bakken Formation

Three Forks Formation

upper shale

middle member

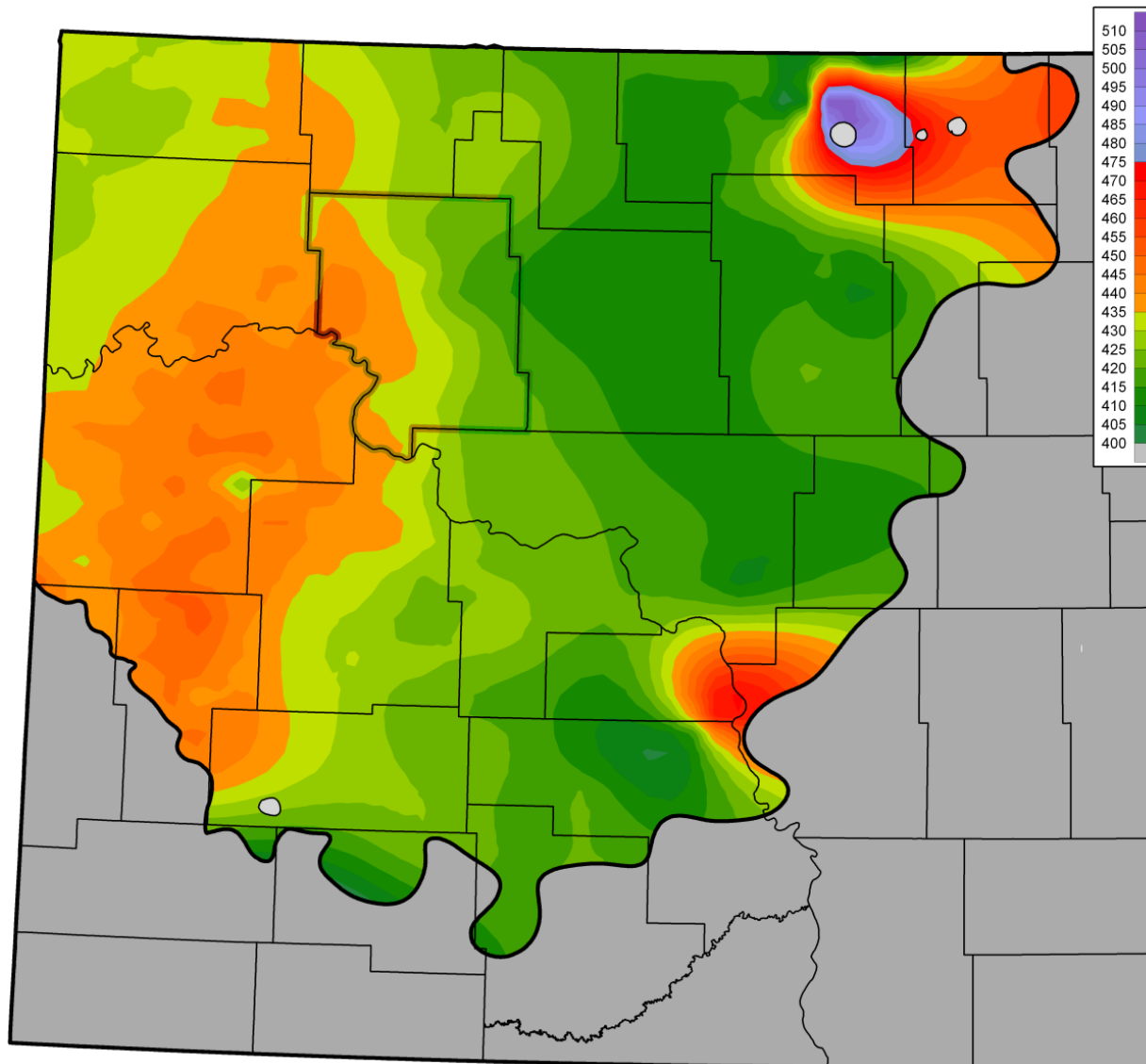
lower shale



Resource Plays

- 1) **Large area** of organic-rich source rock.
- 2) **Heat, pressure, and time to mature source rock.**
- 3) **Expulsion** of hydrocarbons from source rocks into adjacent rocks.
- 4) **Trapping** of hydrocarbons in overlying and underlying reservoirs that are porous, but low permeability.
- 5) **Technology to extract** hydrocarbons using natural or artificial fractures to get economic amounts of petroleum production.

2) Bakken T_{\max} : Maturation Index



Resource Plays

- 1) **Large area** of organic-rich source rock.
- 2) **Heat, pressure, and time to mature** source rock.
- 3) **Expulsion** of hydrocarbons from source rocks into adjacent rocks.
- 4) **Trapping** of hydrocarbons in overlying and underlying reservoirs that are porous, but low permeability.
- 5) **Technology to extract** hydrocarbons using natural or artificial fractures to get economic amounts of petroleum production.

Bakken Formation

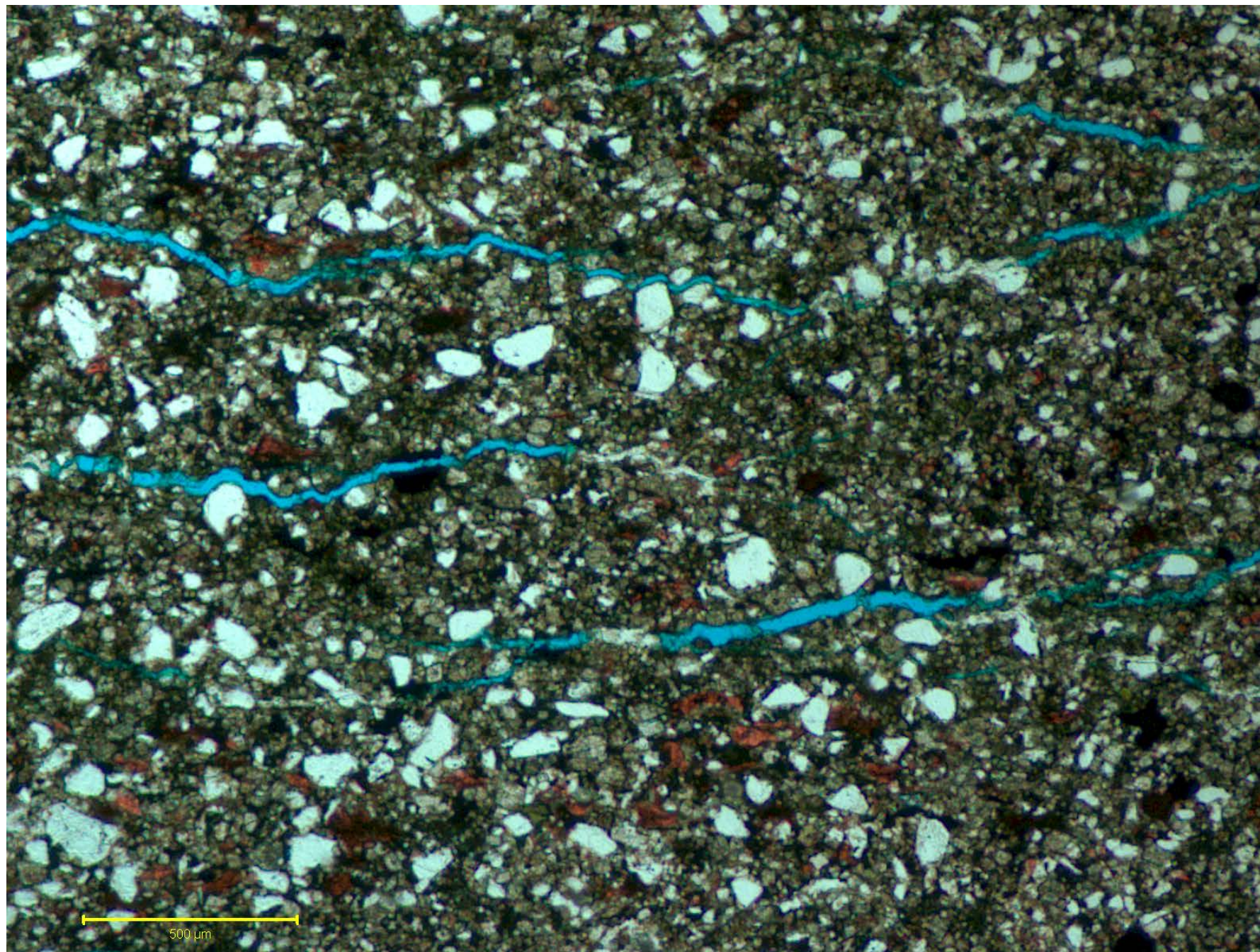
Three Forks Formation

upper shale

middle member

lower shale

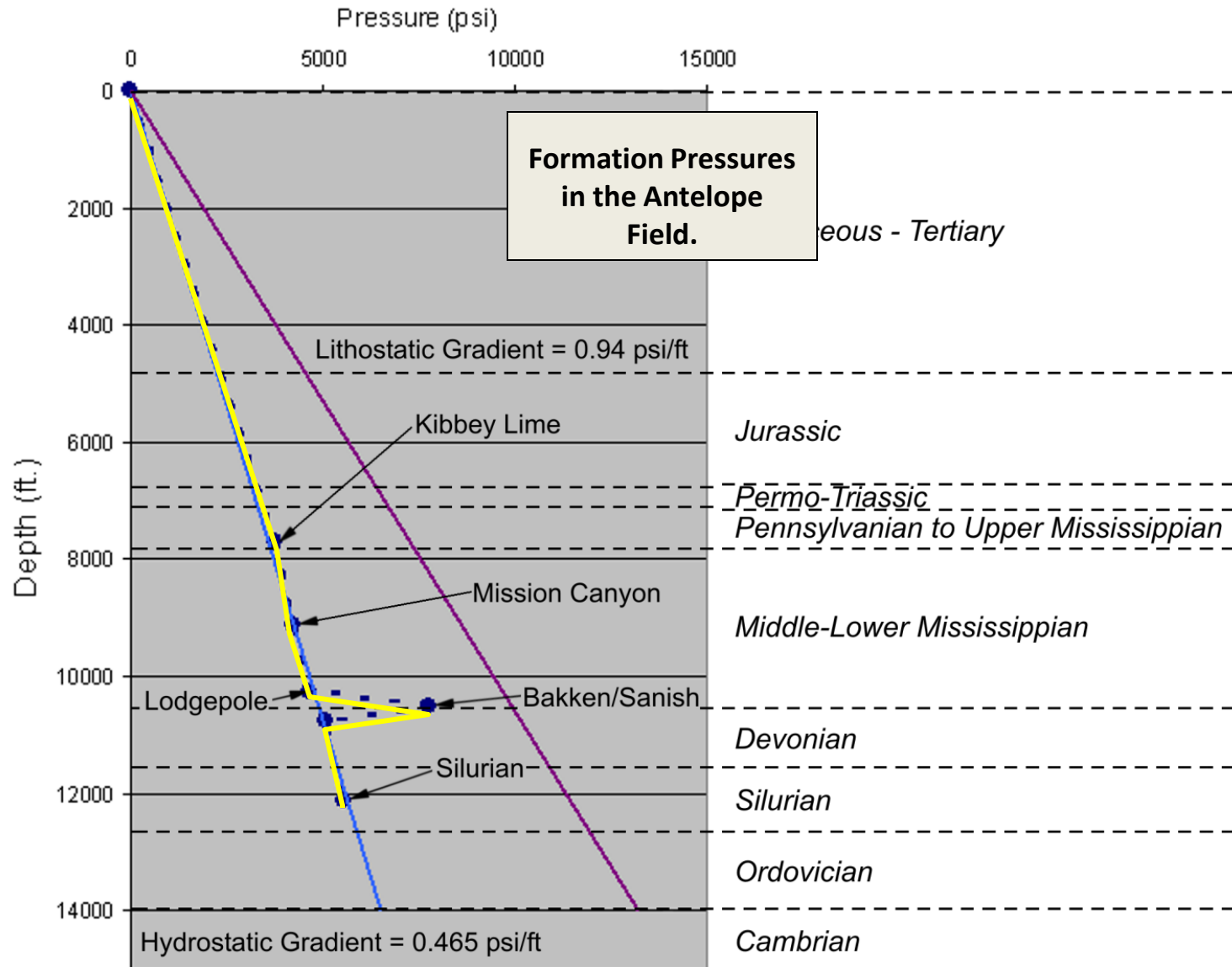




Resource Plays

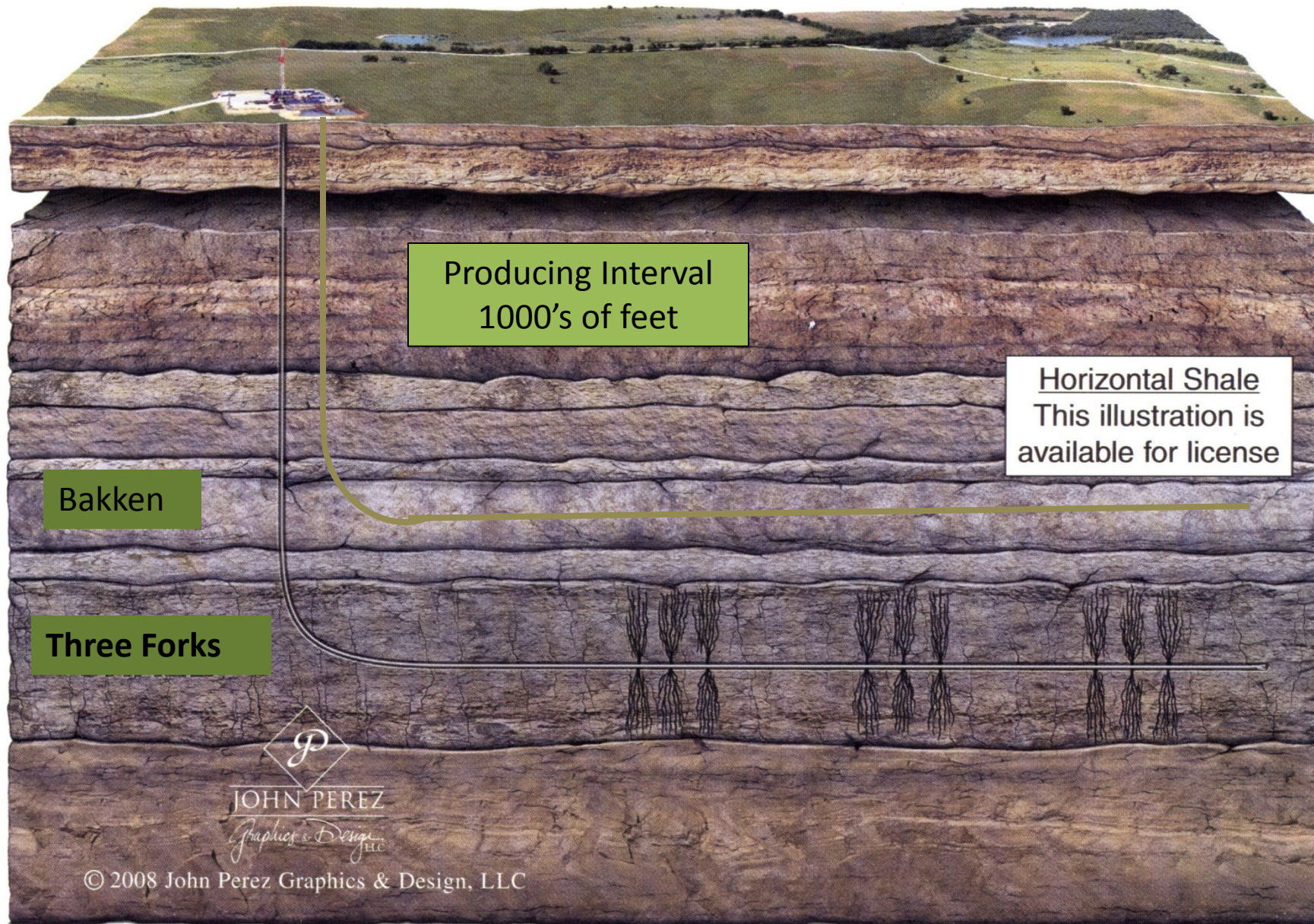
- 1) **Large area** of organic-rich source rock.
- 2) **Heat, pressure, and time to mature** source rock.
- 3) **Expulsion** of hydrocarbons from source rocks into adjacent rocks.
- 4) **Trapping** of hydrocarbons in overlying and underlying reservoirs that are porous, but low permeability.
- 5) **Technology to extract** hydrocarbons using natural or artificial fractures to get economic amounts of petroleum production.

4) Trapping → abnormally High Formation Pressure



Resource Plays

- 1) **Large area** of organic-rich source rock.
- 2) **Heat, pressure, and time to mature** source rock.
- 3) **Expulsion** of hydrocarbons from source rocks into adjacent rocks.
- 4) **Trapping** of hydrocarbons in overlying and underlying reservoirs that are porous, but low permeability.
- 5) **Technology to extract** hydrocarbons using natural or artificial fractures to get economic amounts of petroleum production.



Producing Interval
1000's of feet

Horizontal Shale
This illustration is
available for license

Bakken

Three Forks



JOHN PEREZ
Graphics & Design
LLC

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Drilling Voyager Oil Gas.flv



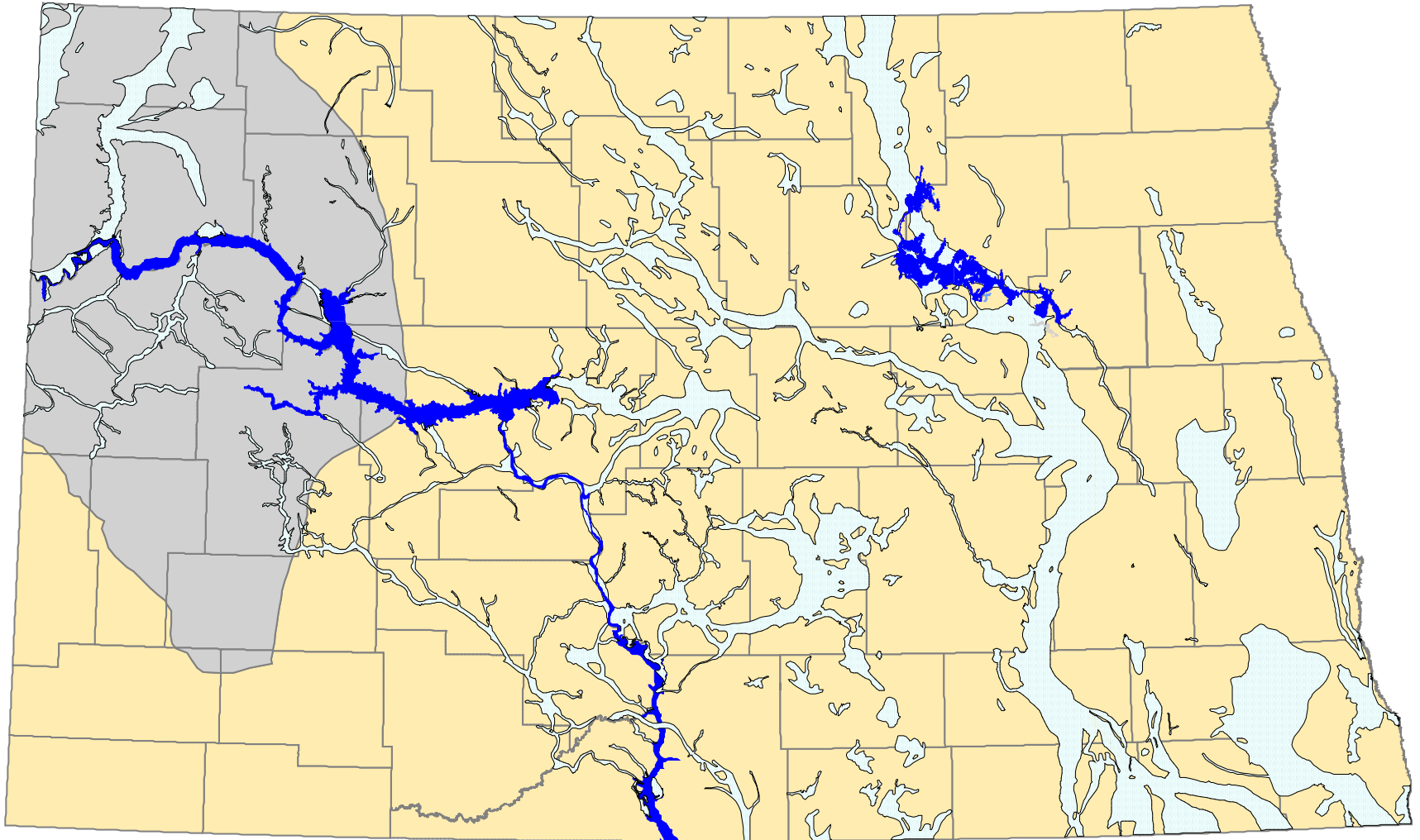
Performing hydraulic fracture stimulation south of Tioga

- all Bakken wells must be hydraulically fractured to produce
- 2-4 million gallons of water
- 3-5 million pounds of sand and ceramic
- cost \$2-5 million

Thirsty Horizontal Wells

- **2,000 - 3,000 wells / year**
- **15 - 25 years duration**
- **20 - 30 million gallons water / day**

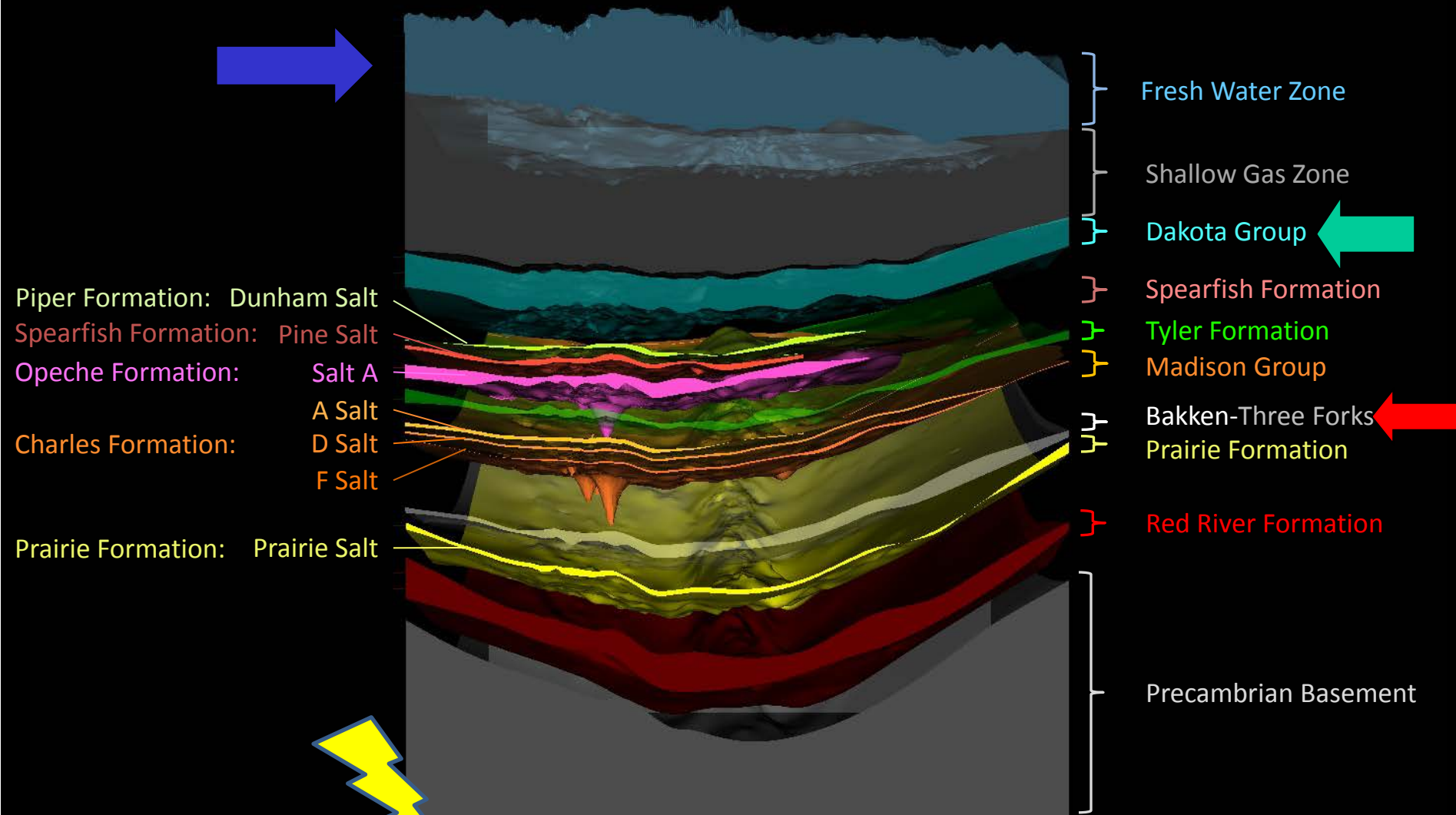
Glacial Drift Aquifers



FRAC WATER NEEDS

- **Lake Sakakawea (Missouri River) is the best water resource**
 - **one inch contains 10 billion gal water**
 - **30 million gallons per day for 1 year**

Significant Salt Intervals of Northwestern North Dakota



North Dakota
Geological Survey

North Dakota Depart.
of Mineral Resources



- **Compound**
 - **Purpose**
 - **Common application**
- Fresh **Water** – 80.5%
- Proppant – 19.0%
 - Allows the fractures to remain open so the oil and gas can escape
 - Drinking water filtration, **play ground sand**
- Acids - 0.12%
 - Help dissolve minerals and initiate fractures in rock (pre-fracture)
 - **Swimming pool cleaner**
- Petroleum distillates – 0.088%
 - Dissolve polymers and minimize friction
 - **Make-up remover**, laxatives, and candy
- Isopropanol – 0.081%
 - Increases the viscosity of the fracture fluid
 - **Glass cleaner**, antiperspirant, and hair color
- Potassium chloride – 0.06%
 - Creates a brine carrier fluid
 - Low-sodium **table salt substitute**
- Guar gum – 0.056%
 - Thickens the water to suspend the sand
 - **Thickener used in cosmetics**, baked goods, ice cream, toothpaste, sauces, and salad dressing
- Ethylene glycol – 0.043%
 - Prevents scale deposits in the pipe
 - Automotive **antifreeze**, household cleansers, deicing, and caulk



- Sodium or potassium carbonate – 0.011%
 - Improves the effectiveness of other components, such as cross-linkers
 - Washing soda, detergents, **soap**, water softeners, glass and ceramics
- Sodium Chloride – 0.01%
 - Delays break down of the gel polymer chains
 - **Table Salt**
- Polyacrylamide – 0.009%
 - Minimizes friction between fluid and pipe
 - **Water treatment**, soil conditioner
- Ammonium bisulfite – 0.008%
 - Removes oxygen from the water to protect the pipe from corrosion
 - Cosmetics, **food and beverage processing**, water treatment
- Borate salts – 0.007%
 - Maintain fluid viscosity as temperature increases
 - Used in laundry **detergents**, hand soaps and cosmetics
- Citric Acid – 0.004%
 - Prevents precipitation of metal oxides
 - **Food additive**; food and beverages; lemon juice
- N, n-Dimethyl formamide – 0.002%
 - Prevents the corrosion of the pipe
 - Used in **pharmaceuticals**, acrylic fibers and plastics
- Glutaraldehyde – 0.001%
 - Eliminates bacteria in the water
 - **Disinfectant**; Sterilizer for medical and dental equipment



Hydraulic Fracturing Stimulation is Safe










- **IOGCC survey—no contamination**
- **EPA survey – no contamination**
- **GWPC study verifies State's regs**
- **GWPC - IOGCC FracFocus Chemical
Registry**

Find a Well

 [Back To Search](#)

[Next Page](#)

Page of 5 [Go](#)

	API No.	Job Date	State	County	Operator	WellName	Well Type	Latitude	Longitude	Datum
	33-025-01132	4/13/2011	North Dakota	Dunn	XTO Energy/ExxonMobil	Alwin Federal 12X-19	Oil	47.627564	-102.967017	NAD83
	33-105-01913	4/18/2011	North Dakota	Williams	XTO Energy/ExxonMobil	Lonnie 31X-3	Oil	48.196639	-102.880264	NAD83
	33-105-01824	5/14/2011	North Dakota	Williams	XTO Energy/ExxonMobil	Allen 21X-17	Oil	48.254792	-103.058819	NAD83
	33-105-01825	4/28/2011	North Dakota	Williams	XTO Energy/ExxonMobil	Woodrow 34X-32	Oil	48.198603	-103.053617	NAD83
	33-053-03113	3/22/2011	North Dakota	Mc Kenzie	XTO Energy/ExxonMobil	101 Federal 21X-24	Oil	47.546178	-104.000694	NAD83
	33-105-01948	2/26/2011	North Dakota	Williams	XTO Energy/ExxonMobil	Normark 24X-31	Oil	48.460233	-103.008811	NAD83
	33-105-01899	2/17/2011	North Dakota	Williams	XTO Energy/ExxonMobil	Michael State 31X-16	Oil	48.167464	-103.031950	NAD83
	33-025-01165	5/9/2011	North Dakota	Dunn	Marathon Oil	Lucky Fleckenstien #34-20H	Oil	47.264306	-102.330608	NAD83
	33-025-01173	5/3/2011	North Dakota	Dunn	Marathon Oil	Wardner #24-35H	Oil	47.245872	-102.445641	NAD83

Find a Well

Map Search **Standard Search**

STATE: North Dakota COUNTY: Williams WELLS IN COUNTY: Choose a Well Name OPERATOR: Choose One

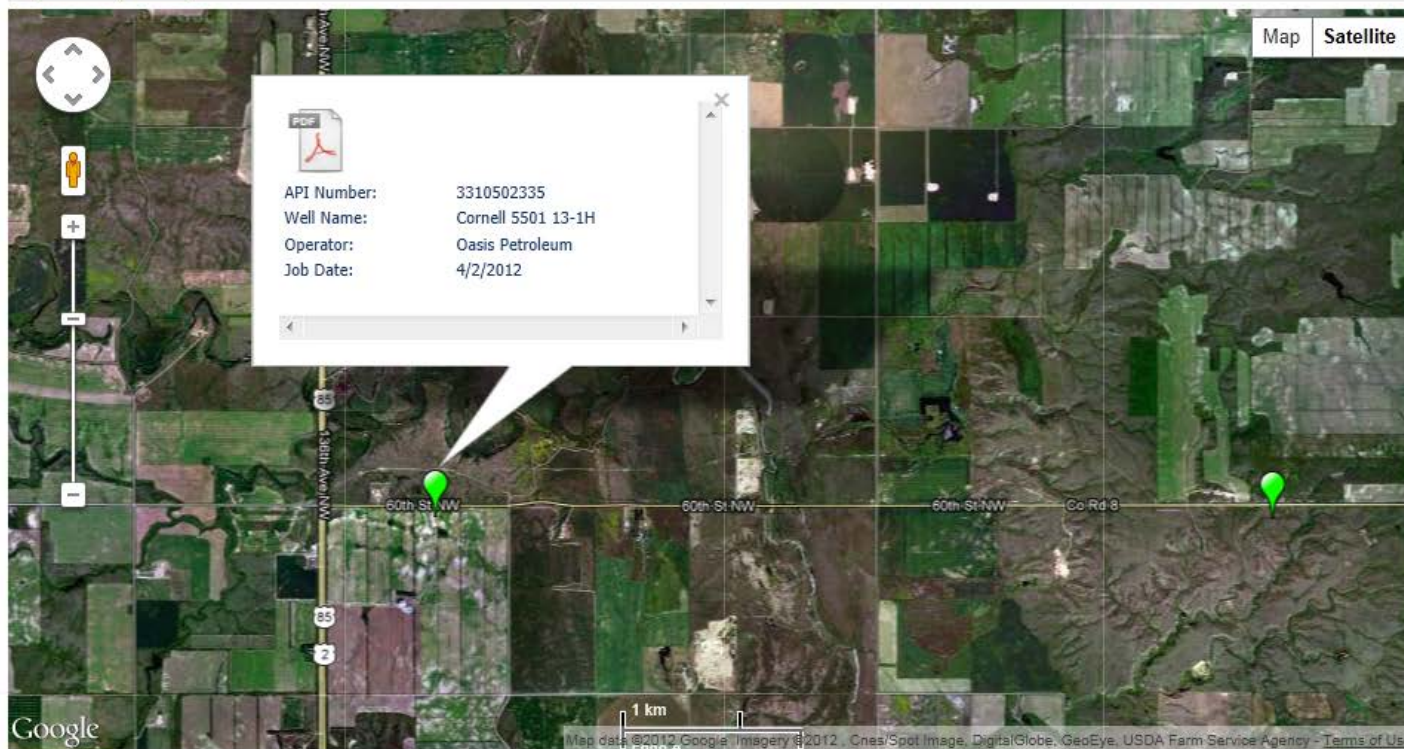
API WELL NUMBER:

WELL NAME:

Search

Reset

Not Seeing Map Markers? Please Click The "Reset" Button (left).



Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date:	04/02/2012
State:	North Dakota
County:	Williams
API Number:	33-105-02335
Operator Name:	OASIS PETROLEUM N AMERICA LLC
Well Name and Number:	Cornell 5501 13-1H
Longitude:	-103.612541
Latitude:	48.28361
Long/Lat Projection:	WGS84
Production Type:	Oil
True Vertical Depth (TVD):	9913
Total Water Volume (gal)*:	3328962

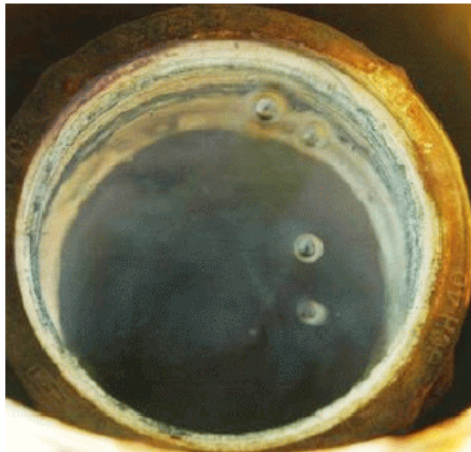
Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
XL-10	Superior Well Services	Cross-linkers	DI water	7732-18-5	Proprietary	Proprietary	
XL-10	Superior Well Services	Cross-linkers	Ethylene Glycol	107-21-1	30.00	0.010968	
XL-10	Superior Well Services	Cross-linkers	Glycerine	56-81-5	7.00	0.002559	
XL-10	Superior Well Services	Cross-linkers	Sodium Borate	XXXX-XX-X (Proprietary)	Proprietary	Proprietary	
XL-10	Superior Well Services	Cross-linkers	Sodium Hydroxide	1310-73-2	7.00	0.002559	
WFR-5W	Superior Well Services	Friction Reducer	Anionic Polyacrylamide	Proprietary	Proprietary	Proprietary	
WFR-5W	Superior Well Services	Friction Reducer	Ethoxylated alcohol blend	Proprietary	5.00	0.001218	
WFR-5W	Superior Well Services	Friction Reducer	Hydrotreated paraffinic solvent	64742-47-8	30.00	0.007308	
WFR-5W	Superior Well Services	Friction Reducer	Proprietary	Proprietary	Proprietary	Proprietary	
WFR-5W	Superior Well Services	Friction Reducer	Proprietary	Proprietary	Proprietary	Proprietary	
OB Breaker	Superior Well Services	Gel Breakers	Ammonium Persulfate	7727-54-0	100.00	0.000210	
OB-2	Superior Well Services	Gel Breakers	Ammonium Persulfate	7727-54-0	100.00	0.002641	
OB-2	Superior Well Services	Gel Breakers	Silica, crystalline quartz	7631-86-9	10.00	0.000264	
LSG-100	Superior Well Services	Gelling Agents	guar gum	9000-30-0	50.00	0.092391	
LSG-100	Superior Well Services	Gelling Agents	Petroleum Distillates	64742-47-8	60.00	0.110870	
LSG-100	Superior Well Services	Gelling Agents	Surfactant	68439-51-0	2.00	0.003696	

SHALLOW GAS PROJECT



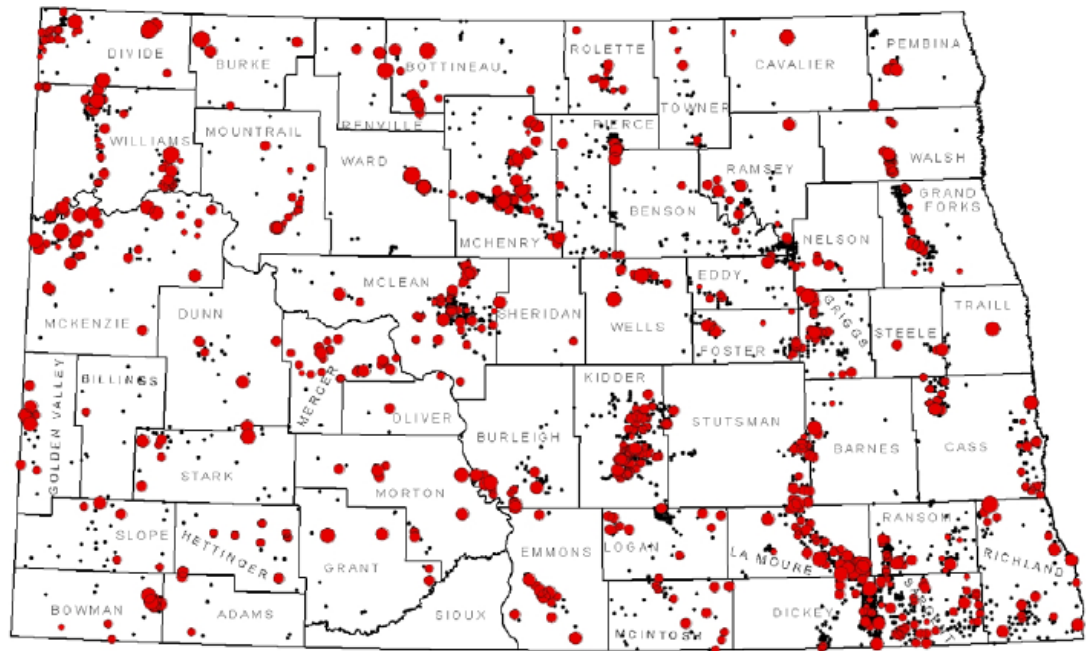
The Geological Survey tested 4,325 NDSWC monitoring wells for methane in 52 of the 53 counties in North Dakota from 2006-2010.



Methane bubbling to the surface in a two-inch NDSWC monitoring well.

The Geological Survey recently completed phase I of a study of shallow natural gas in North Dakota. We investigated 9,400 ND State Water Commission monitoring well sites, tested 4,325 wells, and detected methane in 905 wells. Approximately 20% of the wells contained detectable gas.

During the second phase of the project, thirty groundwater samples, primarily from eastern North Dakota, will be analyzed for dissolved gas composition, isotopes, and general chemistry. This will enable us to determine the source of the gas and identify chemical groundwater signatures that might assist the oil and gas industry in natural gas exploration.



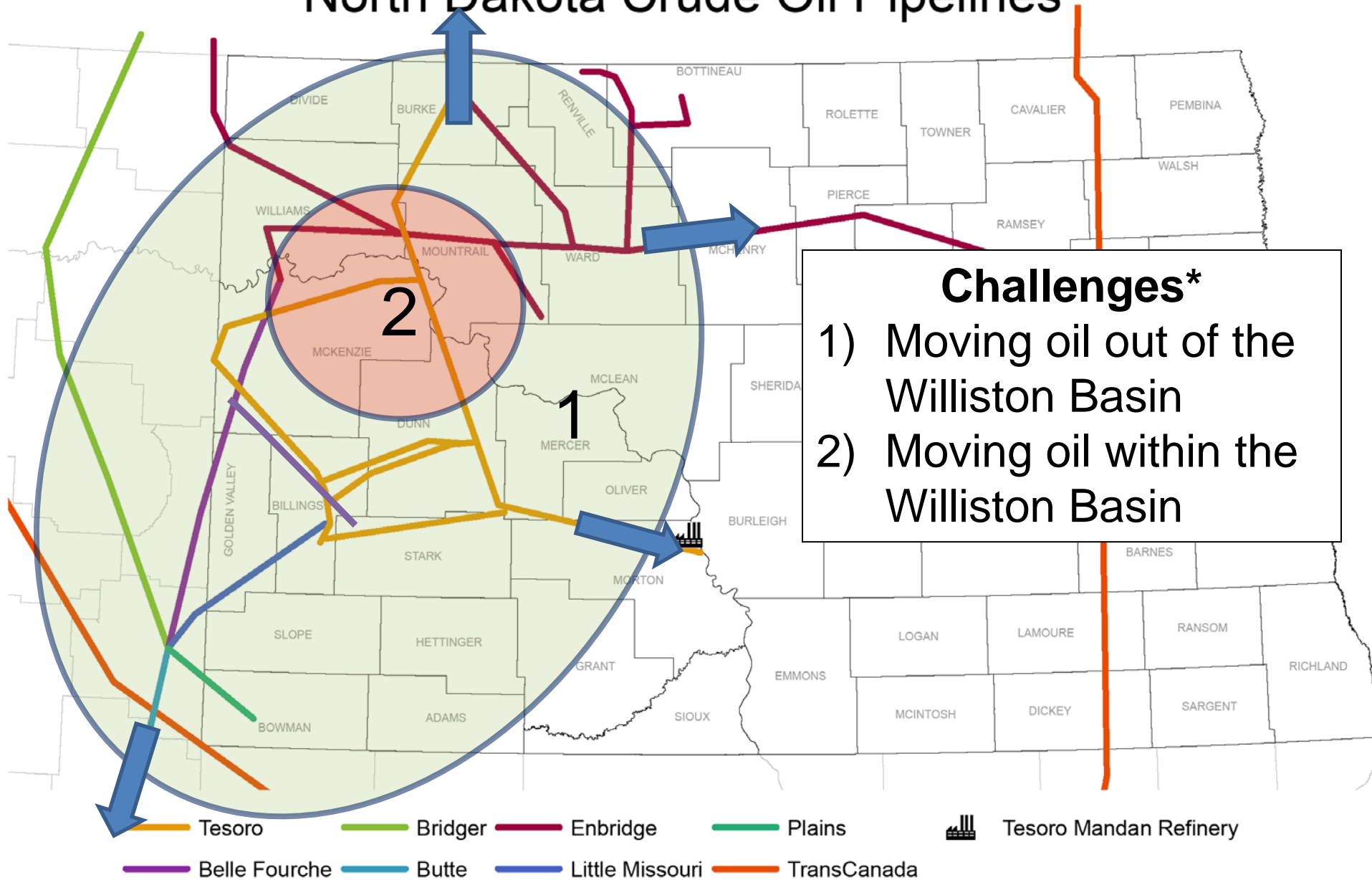
Monitoring wells that contained methane are indicated with red dots, black dots are wells that contained no detectable methane. The red dots are sized to reflect the concentration of methane -- the higher the concentration, the larger the dot.

BAKKEN BASICS:

- CHALLENGES?



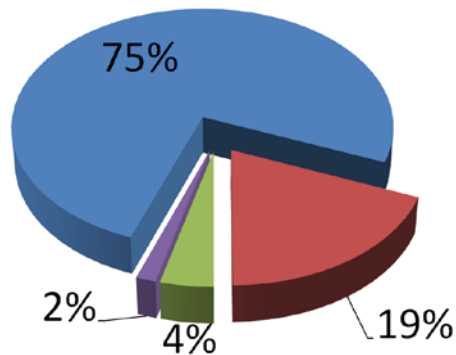
North Dakota Crude Oil Pipelines



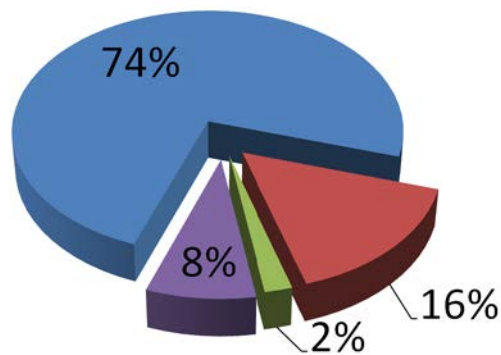
*Modified from Bridger and Belle Fourche Pipelines

Williston Basin Oil Transportation

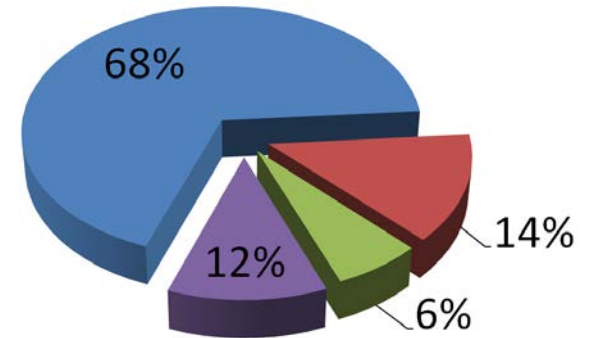
March 2009



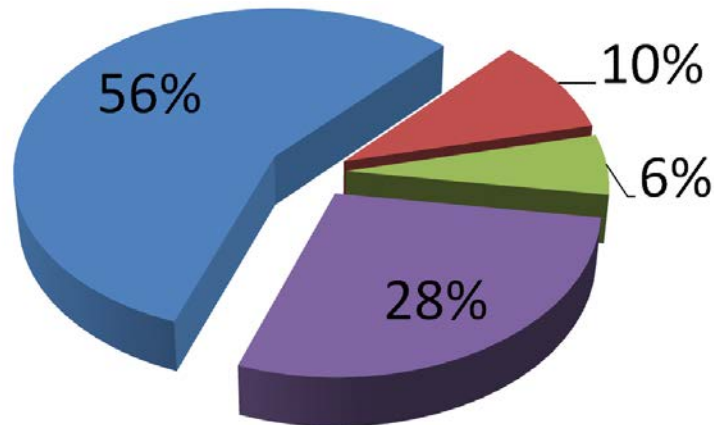
March 2010



March 2011



March 2012



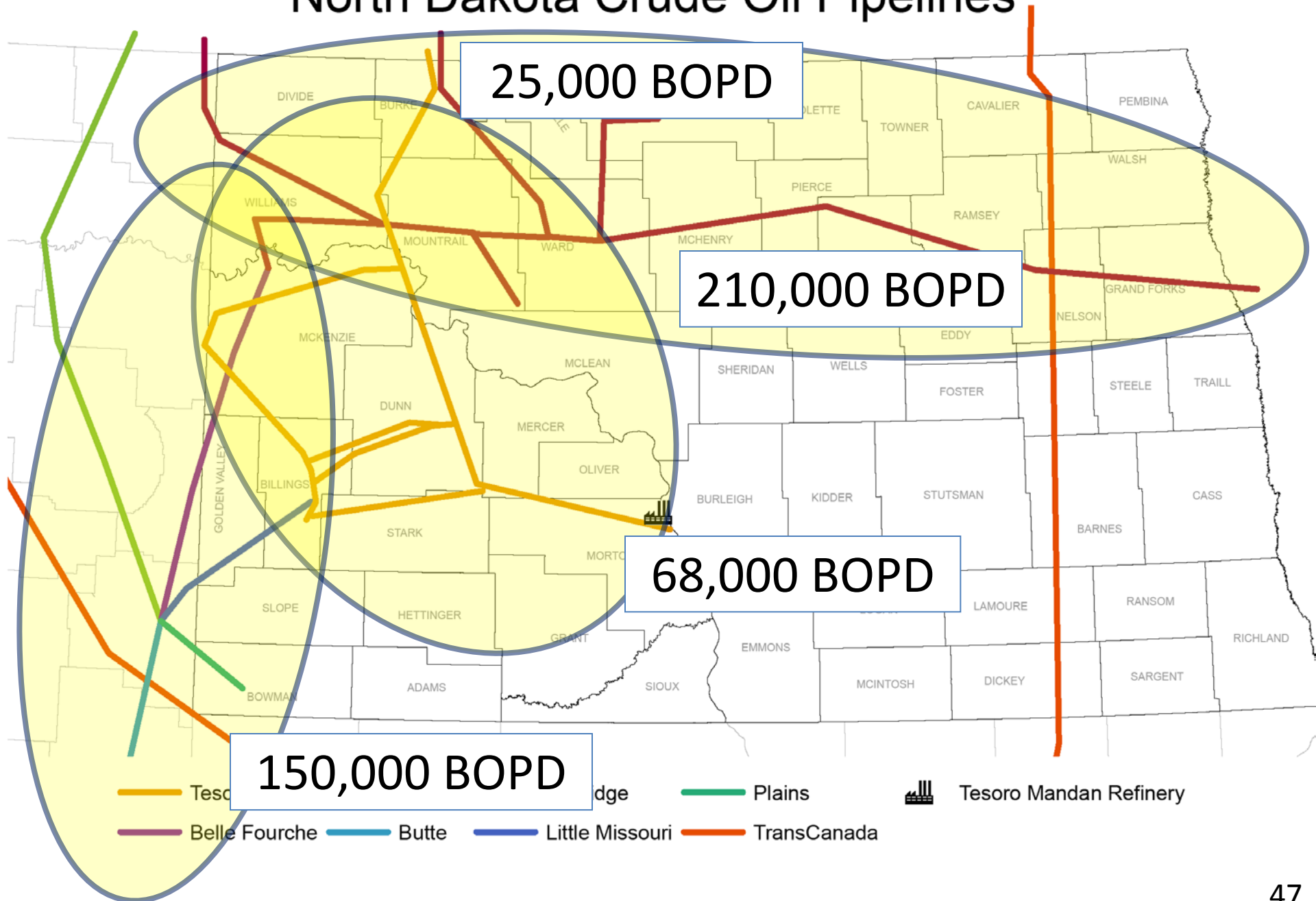
■ Pipeline Export

■ Tesoro Refinery

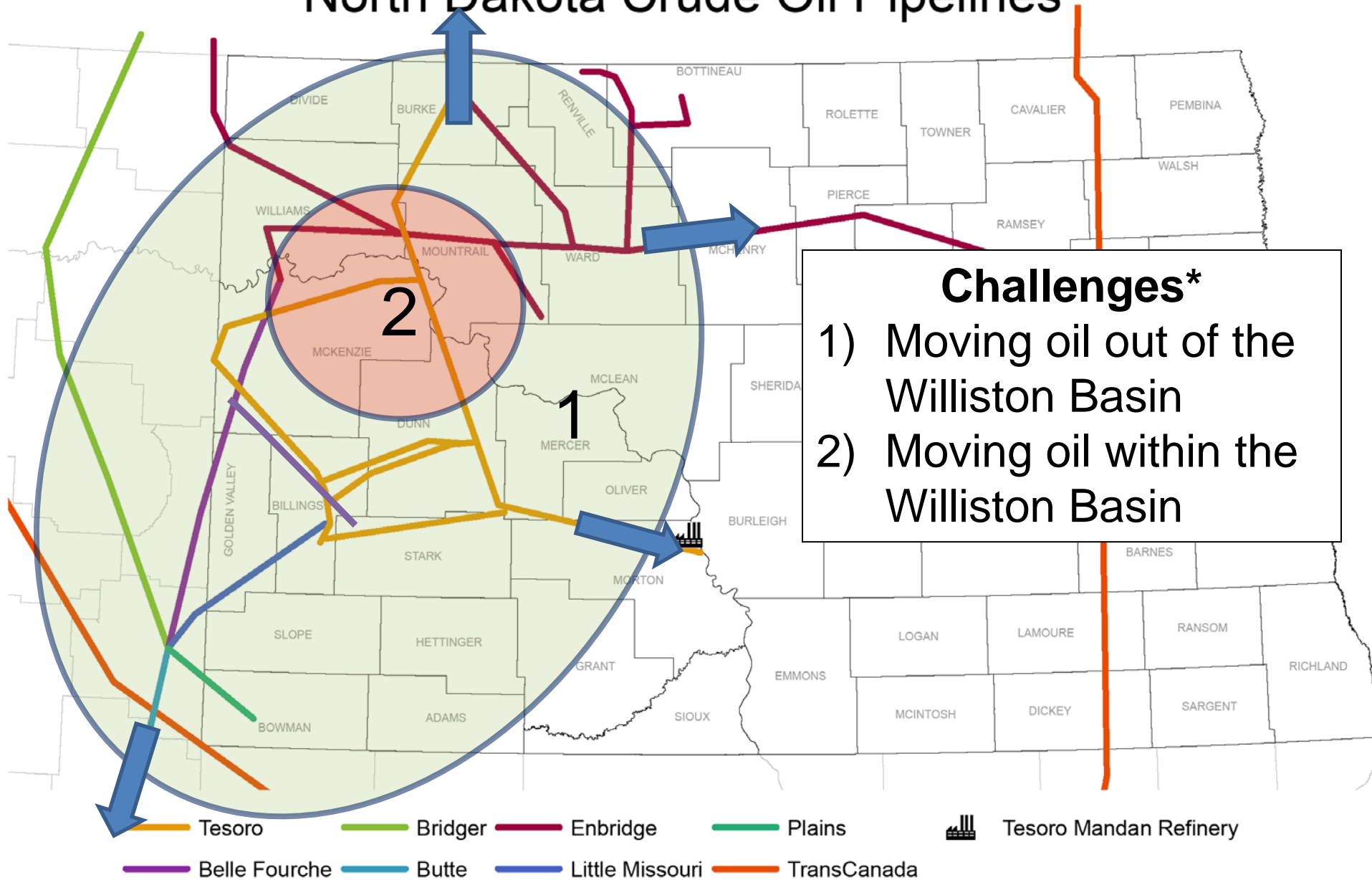
■ Truck to Canadian Pipelines

■ Estimated Rail

North Dakota Crude Oil Pipelines

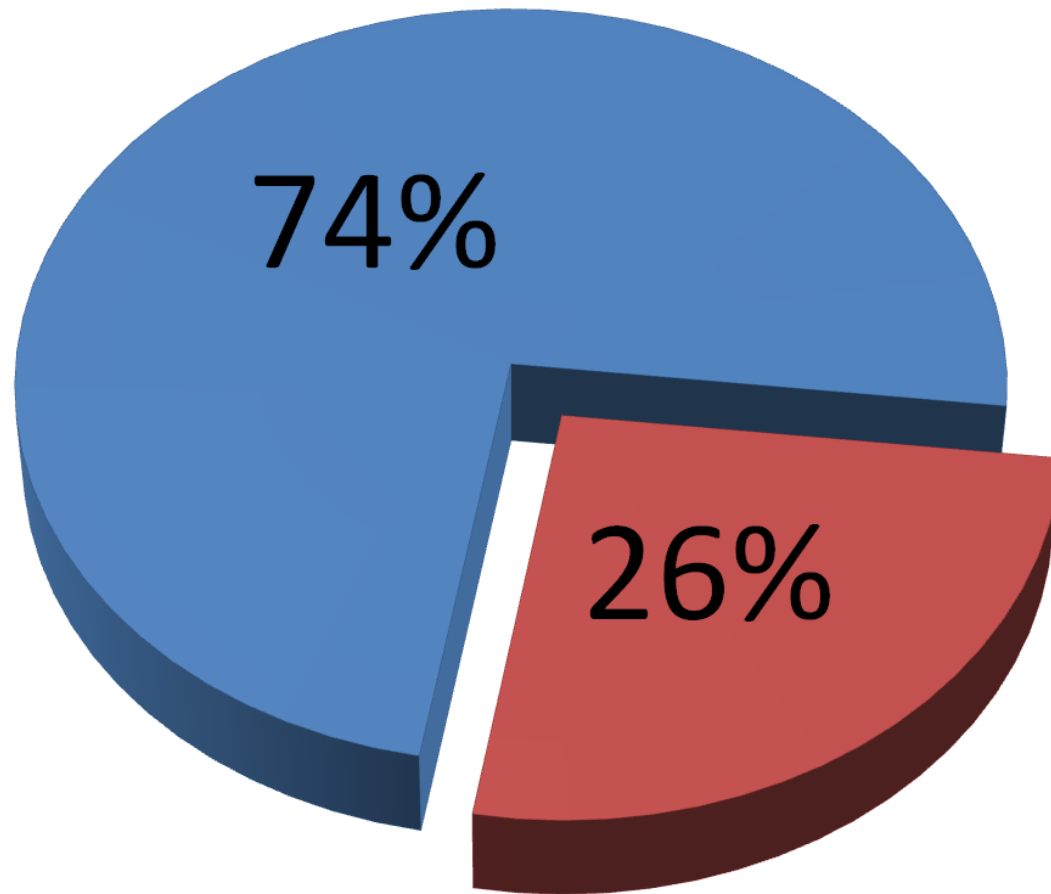


North Dakota Crude Oil Pipelines



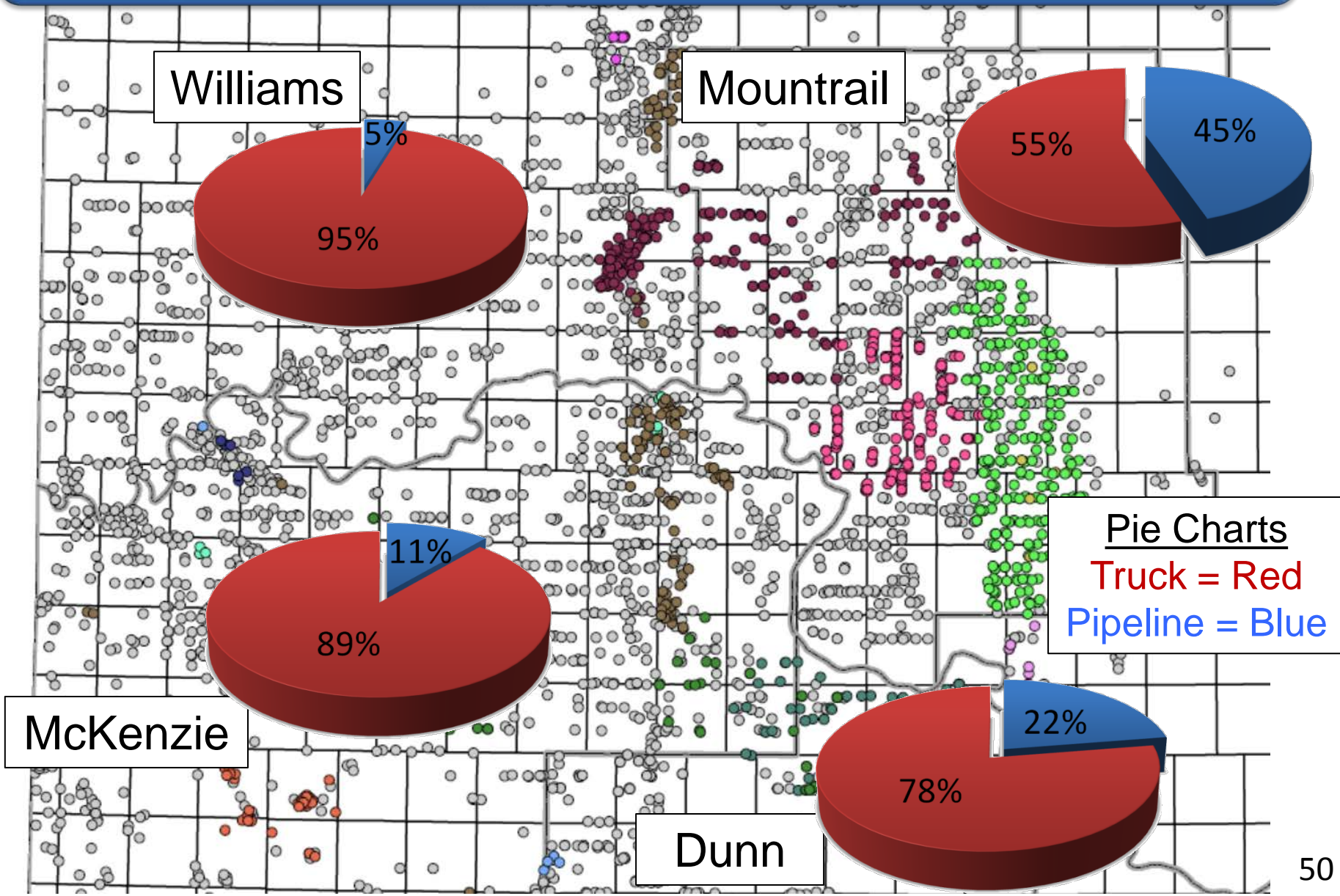
*Modified from Bridger and Belle Fourche Pipelines

North Dakota Crude Gathering



■ Truck ■ Pipeline

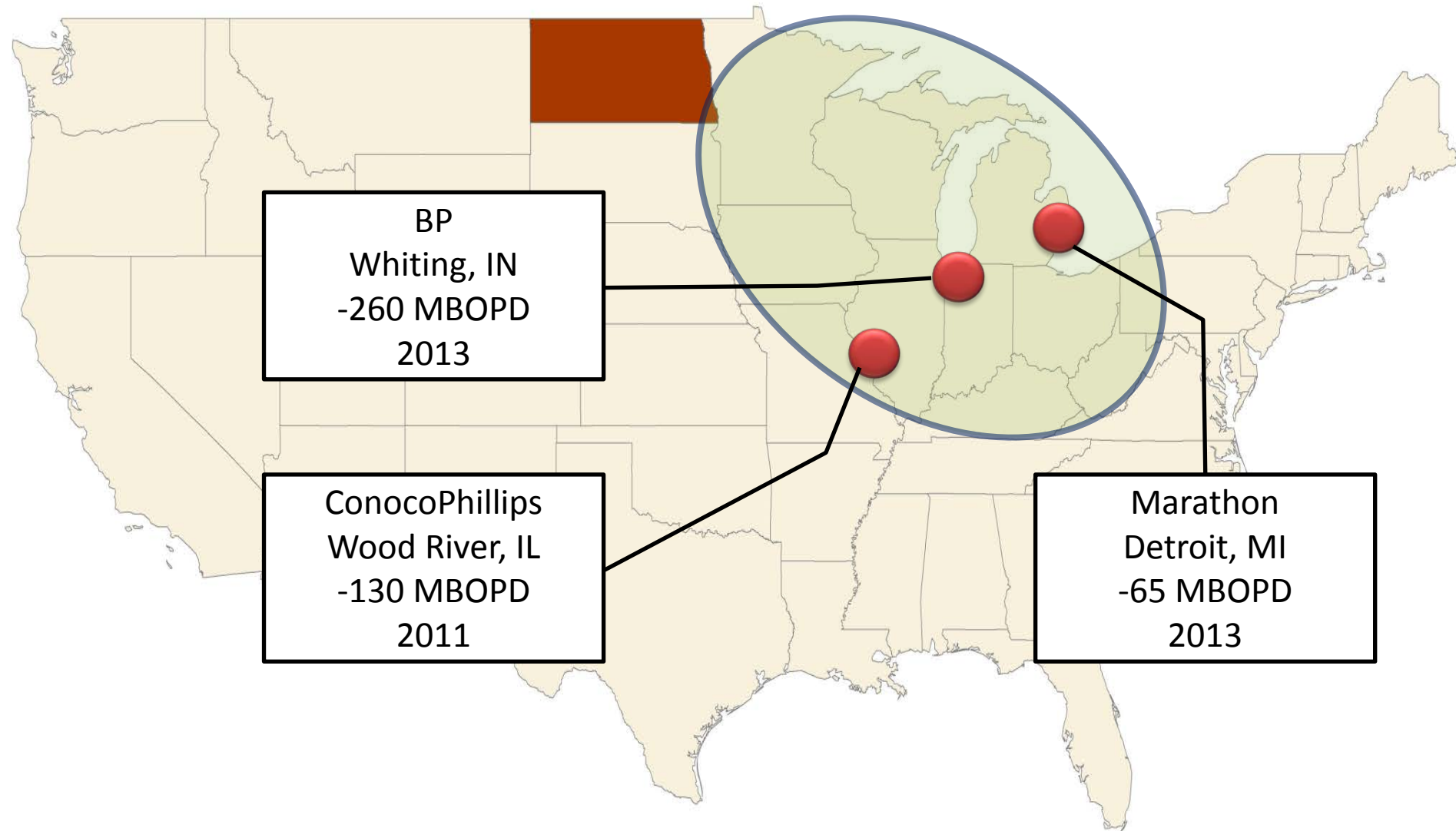
North Dakota Crude Gathering



Pipeline Challenge #3

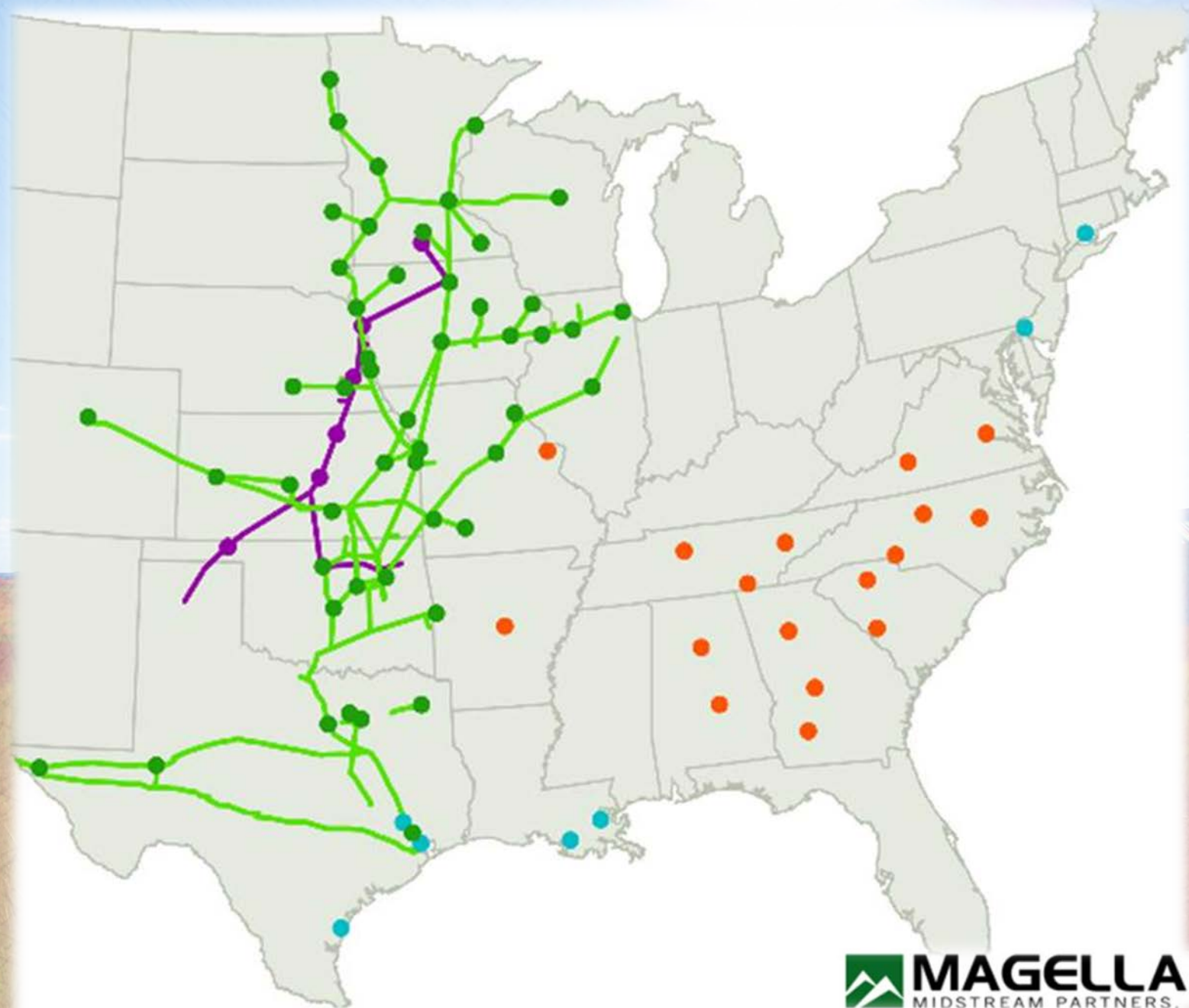


PADD II Decrease In Light Demand



Challenge #4???





Natural Gas Projects



BAKKEN BASICS:

WHAT COULD CHANGE?



Draft BLM Hydraulic Fracturing rule could double federal drilling permit approval time or worse. Comments due in September



Draft EPA guidance on diesel fuel in hydraulic fracturing could triple drilling permit approval time or worse.

Comments due 7/9/12



World and U.S. economies continue to struggle. If China joins the downward spiral oil price could fall enough to make some areas uneconomic



The future looks promising for sustained Bakken/Three Forks development

QUESTIONS?

- **Alison Ritter**
- **Department of Mineral Resources**
- **Public Information Officer**
- **amritter@nd.gov**
- **www.dmr.nd.gov/oilgas**
- **701-328-8036**