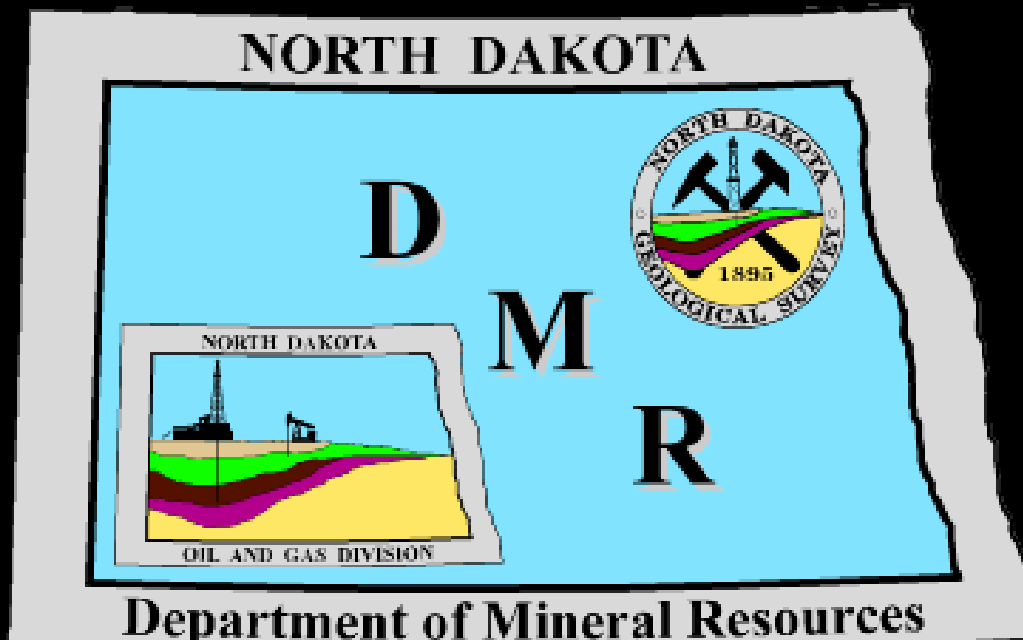


# North Dakota Department of Mineral Resources



*<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*

# Topics for Today

- Resource Plays
- Development History & Intervention Points
- Activity

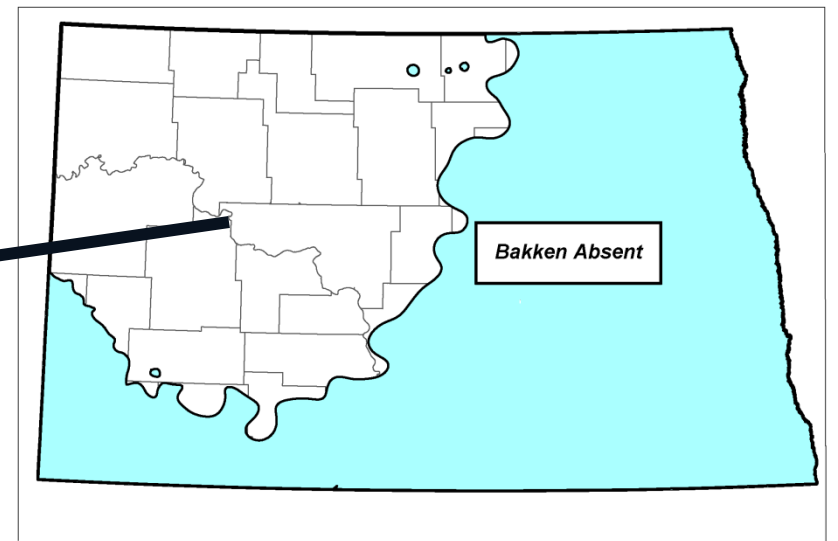
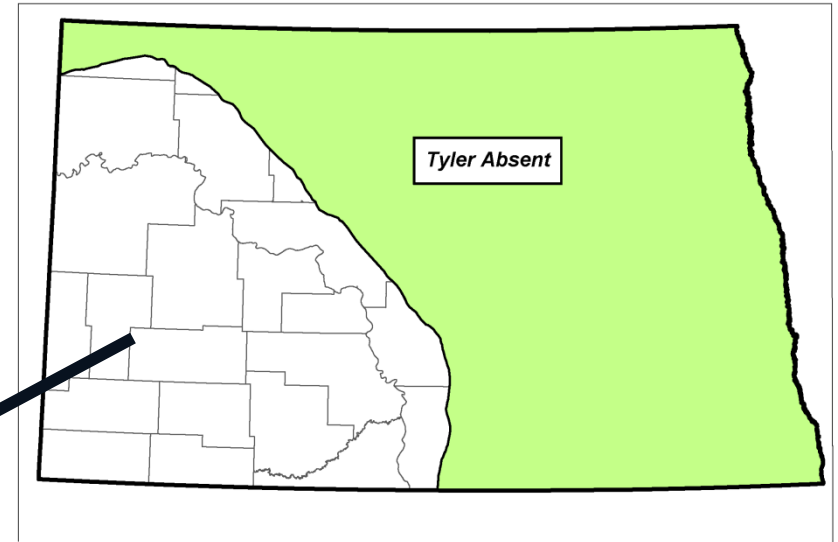
# Resource Plays

- 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.

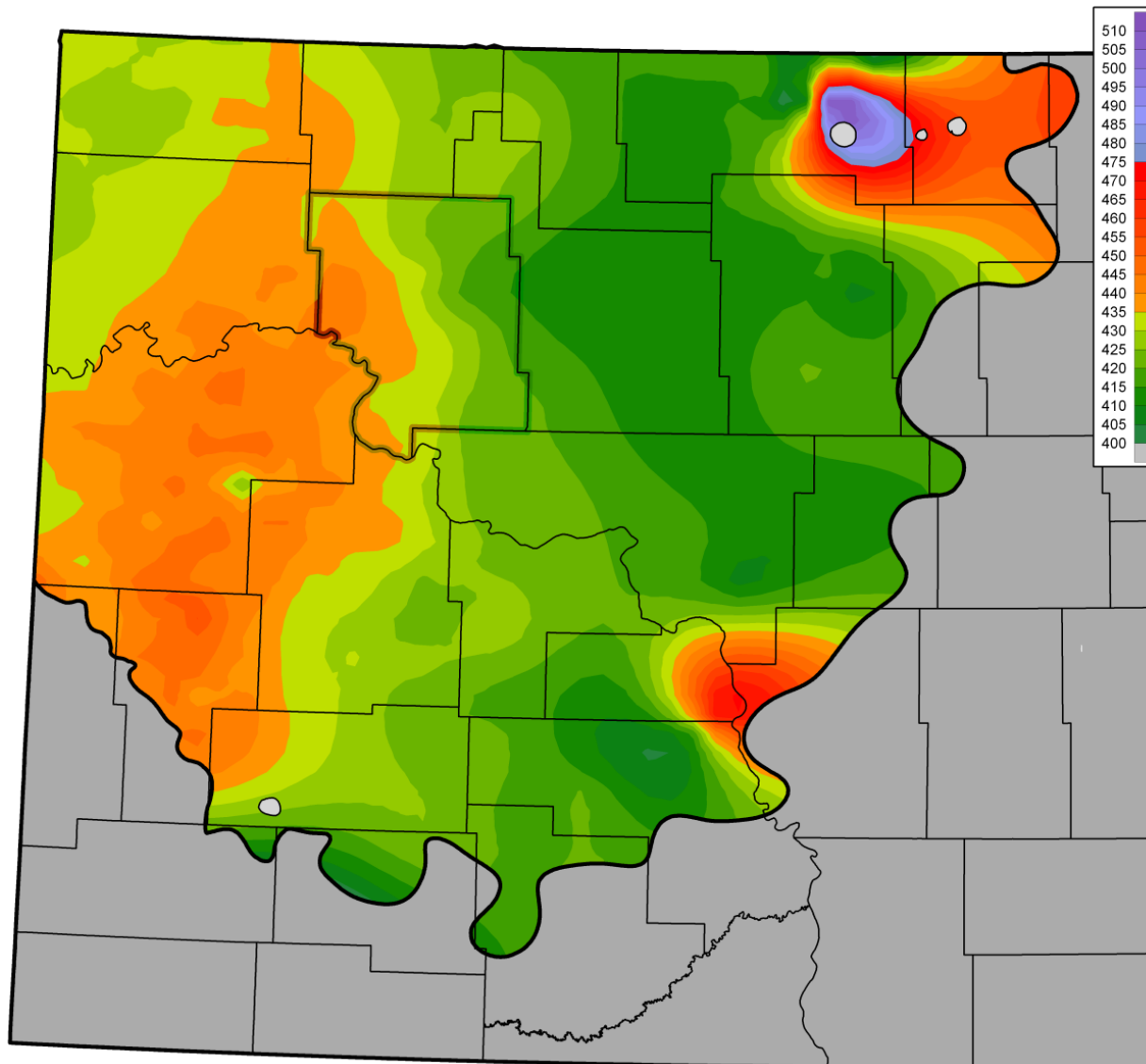
# 1) Regional Extent Tyler and Bakken

**NORTH DAKOTA STRATIGRAPHIC COLUMN**

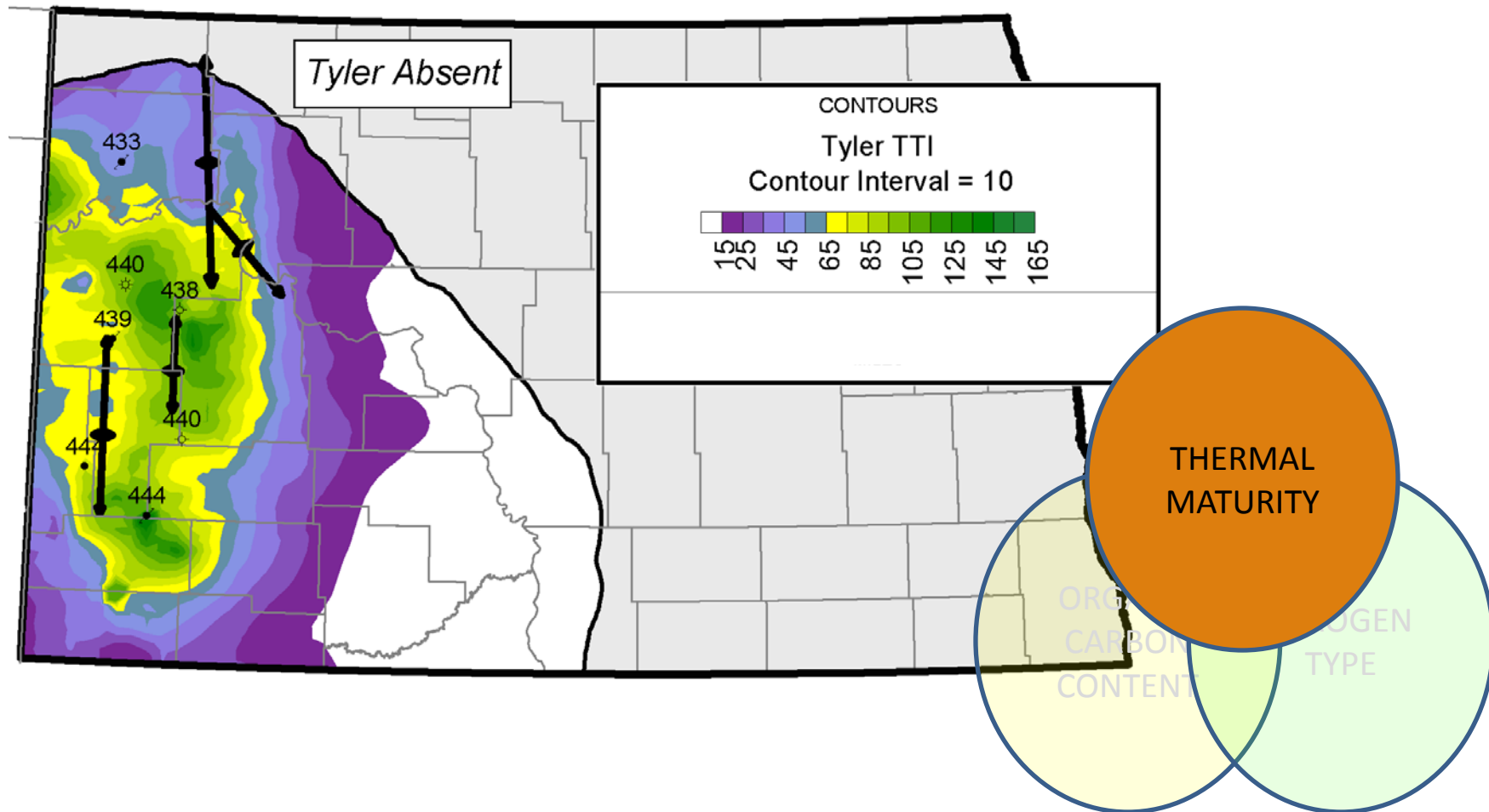
SYSTEM	ROCK UNIT	ROCK COLUMN	LITHOLOGY, DEPOSITIONAL ENVIRONMENTS, AND OTHER ATTRIBUTES
CENOZOIC	Quaternary	Quaternary	Recent deposits, including alluvium, glacial drift, and recent sediments.
	Pleistocene	Pleistocene	Glacial drift, alluvium, and recent sediments.
	Pliocene	Pliocene	Glacial drift, alluvium, and recent sediments.
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	Pliocene	Pliocene	Glacial drift, alluvium, and recent sediments.
MESOZOIC	Upper Cretaceous	Upper Cretaceous	Shale, sandstone, and siltstone.
	Lower Cretaceous	Lower Cretaceous	Shale, sandstone, and siltstone.
	Lower Cretaceous	Lower Cretaceous	Shale, sandstone, and siltstone.
	Lower Cretaceous	Lower Cretaceous	Shale, sandstone, and siltstone.
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	Lower Cretaceous	Lower Cretaceous	Shale, sandstone, and siltstone.
	Lower Cretaceous	Lower Cretaceous	Shale, sandstone, and siltstone.
PALEOZOIC	Carboniferous	Carboniferous	Shale, sandstone, and siltstone.
	Carboniferous	Carboniferous	Shale, sandstone, and siltstone.
	Carboniferous	Carboniferous	Shale, sandstone, and siltstone.
	Carboniferous	Carboniferous	Shale, sandstone, and siltstone.
	Carboniferous	Carboniferous	Shale, sandstone, and siltstone.
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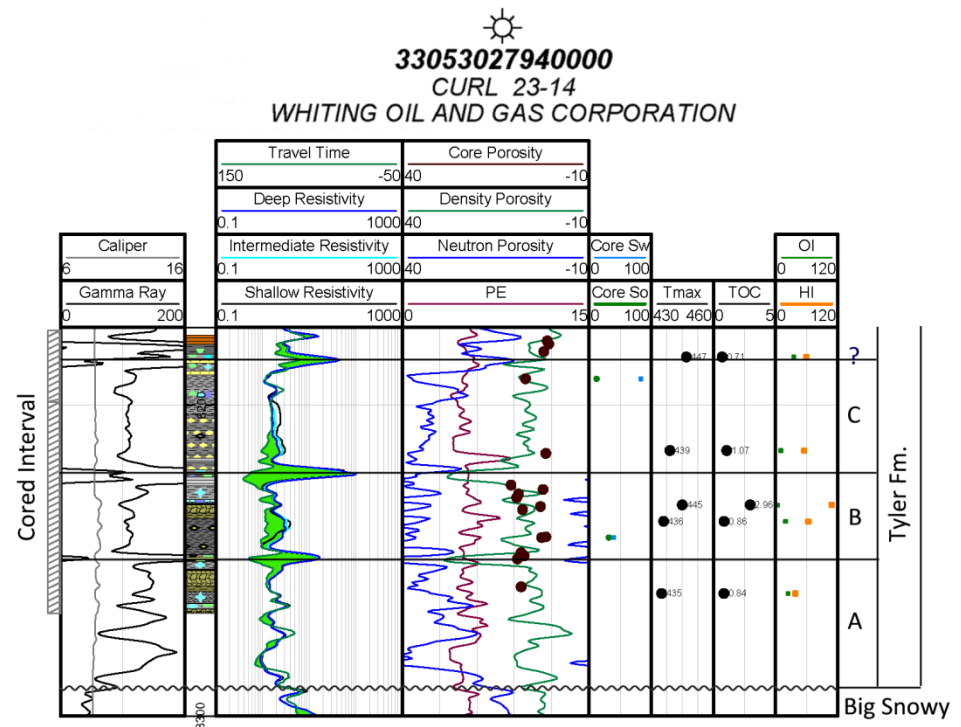
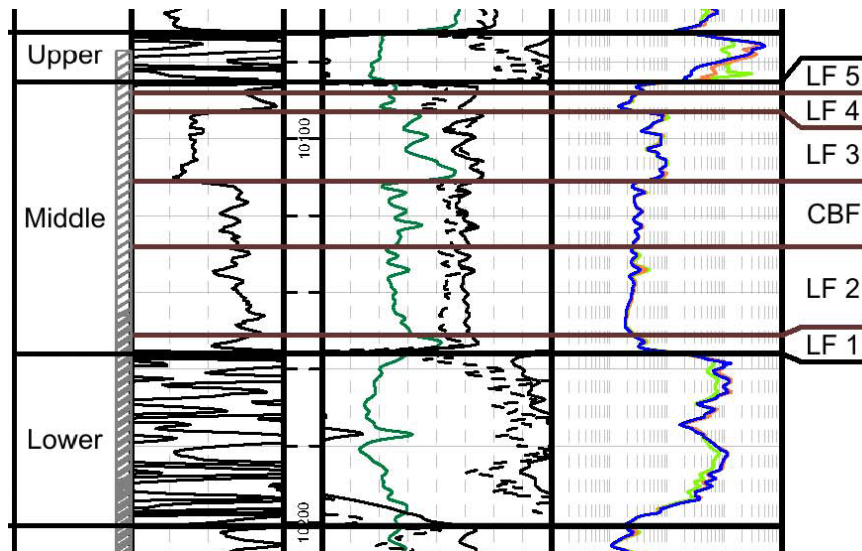
## 2) Bakken $T_{\max}$ : Maturation Index



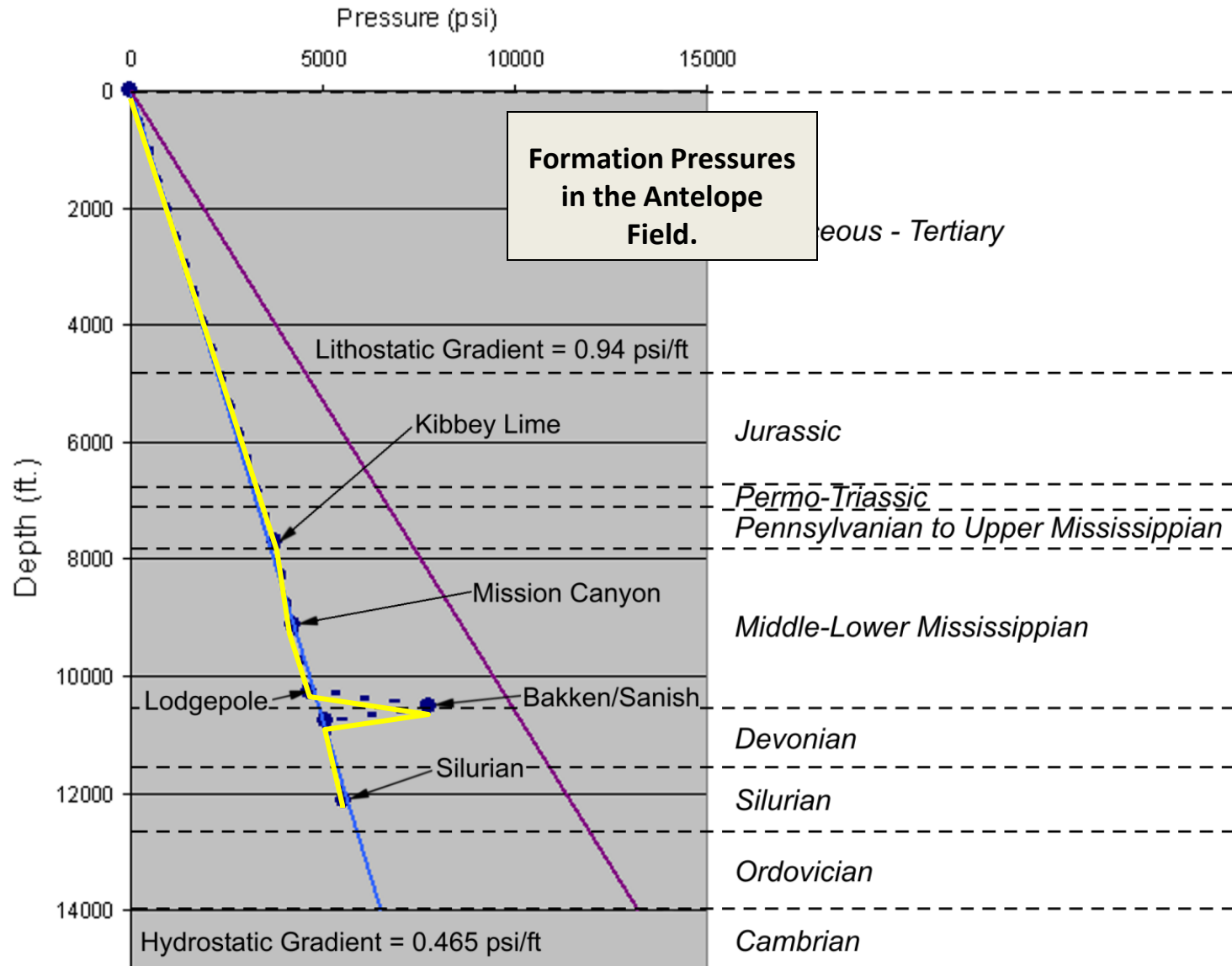
## 2) Tyler $T_{\max}$ Maturation Index



# 3) Expulsion of Petroleum from Source Beds into Low Perm Bounding Beds

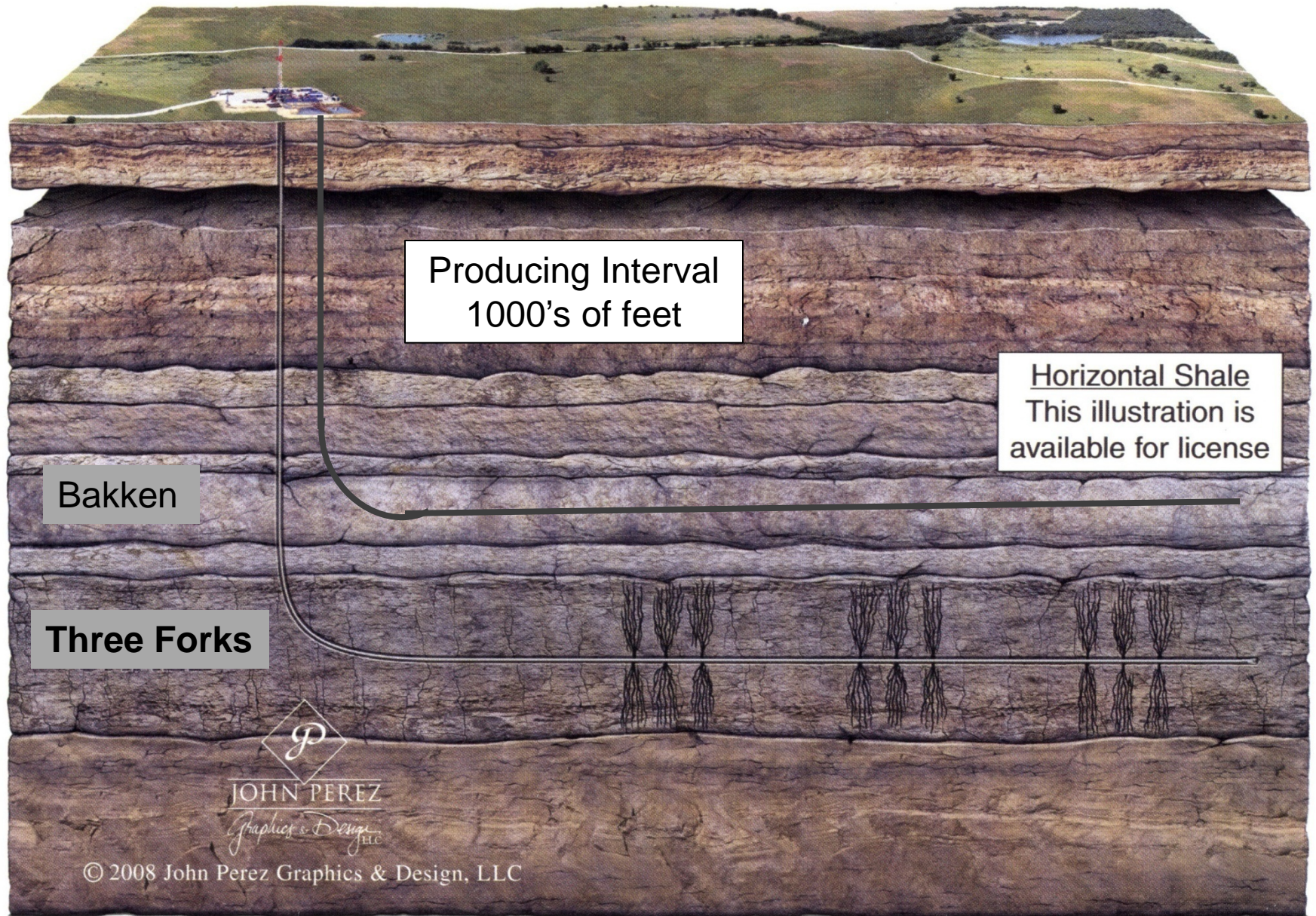


## 4) Trapping → abnormally High Formation Pressure





## 5) Technology = horizontal well / multi stage hydraulic fractured

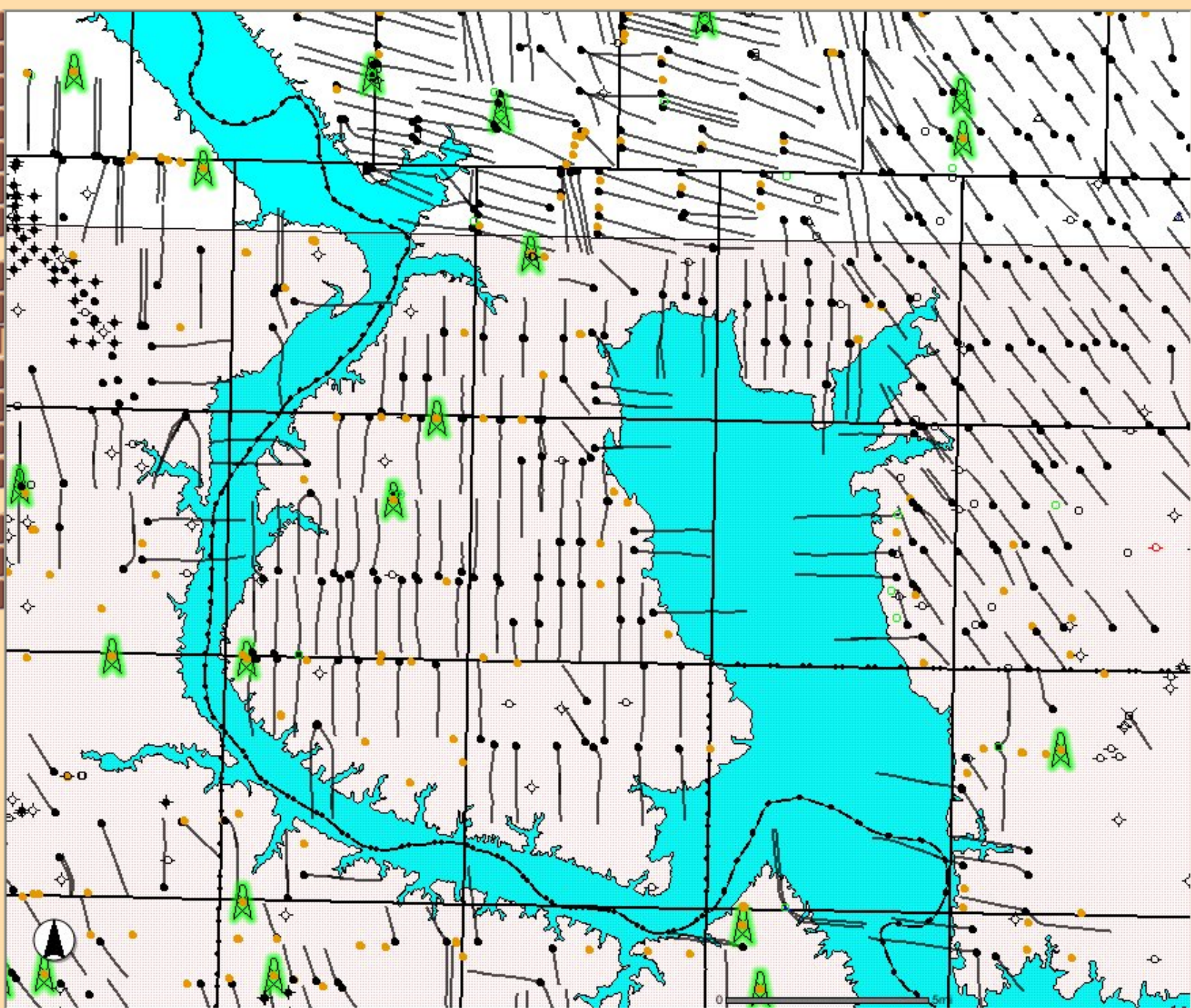




# Topics for Today

- Geology of Resource Plays
- Development History & Intervention Points
- Activity

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



- **Development History & Intervention Points**

- 2001 through 2003 MT Elm Coulee Activity
- 2004 through 2006 operators tried many spacing-drilling-fracing combinations (vertical frac length and pool defined)
- 2006 through 2009 operators focused on 640 & 1,280 acre spaced wells with single stage fracturing
- Q4 of 2009 stage fracturing of +20 - ceramic proppant - 1,280 acre - 10,000 foot lateral combination identified
- Q1 of 2010 Industrial Commission organized 15,000 square miles into North-South 1,280 acre spacing and drilling units





Vern Whitten Photography



Search

Fly To Find Businesses Directions

Fly to e.g., Hotels near JFK

dunn county nd

☒ ☒ [Dunn, North Dakota](#)

☐ ☒ [Sublette, Wyoming](#)

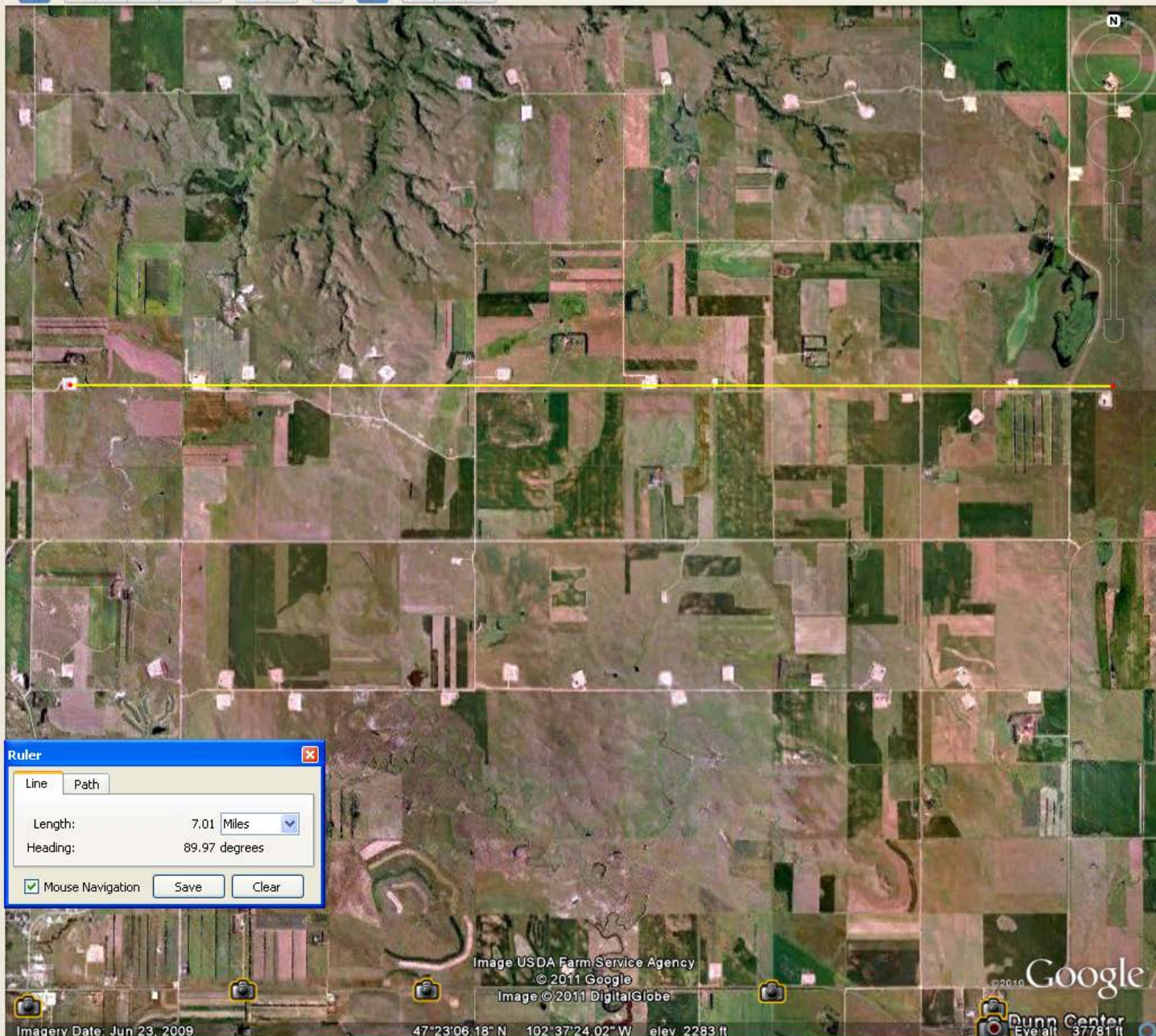
Places

- ☒ ☒ 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



**Ruler**

Line Path

Length: 7.01 Miles

Heading: 89.97 degrees

☒ Mouse Navigation Save Clear

Image USDA Farm Service Agency  
© 2011 Google  
Image © 2011 DigitalGlobe

Google

Imagery Date: Jun 23, 2009

47°23'06.18" N 102°37'24.02" W elev 2283 ft

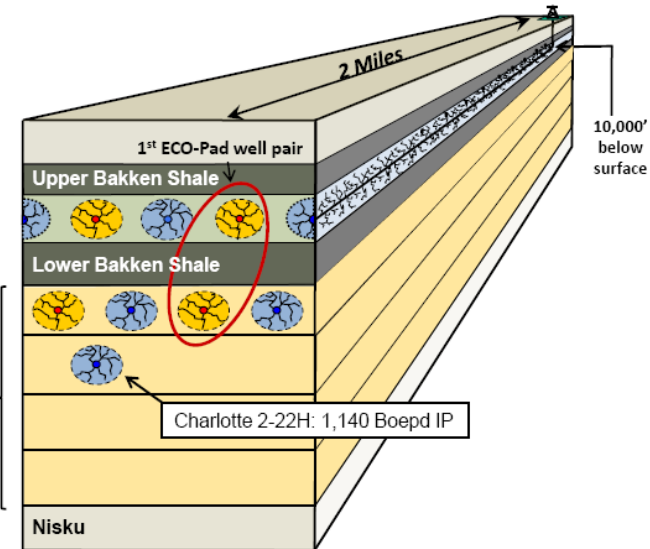
**Dunn Center**  
Eye alt 37781 ft

# 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



11

## Most Likely

	Bakken		Three Forks		Total	
County	OOIP per County	EUR per County	OOIP per County	EUR per County	OOIP per County	EUR per County
Billings	3,141,271,156	115,858,434	1,717,909,400	154,611,846	4,859,180,556	270,470,280
Bottineau			1,642,257,140	147,803,143	1,642,257,140	147,803,143
Burke	14,891,719,317	187,975,278	2,084,609,970	187,614,897	16,976,329,287	375,590,175
Divide	16,836,857,774	123,315,660	855,513,980	76,996,258	17,692,371,754	200,311,919
Dunn	18,059,716,691	294,169,921	2,008,459,540	180,761,359	20,068,176,231	474,931,279
Golden Valley	66,147,411		25,519,700	2,296,773	91,667,111	2,296,773
Grant	62,508,094				62,508,094	
McHenry			539,104,280	48,519,385	539,104,280	48,519,385
McKenzie	32,438,937,580	382,654,320	3,941,684,770	354,751,629	36,380,622,350	737,405,950
McLean	3,253,719,118		351,841,190	31,665,707	3,605,560,308	31,665,707
Mercer			118,427,220	10,658,450	118,427,220	10,658,450
Morton			84,144,950	84,144,950	84,144,950	84,144,950
Mountrail	27,242,795,837	424,826,873	1,676,048,980	150,844,408	28,918,844,817	575,671,281
Oliver			9,002,880	810,259	9,002,880	810,259
Renville			183,377,880	16,504,009	183,377,880	16,504,009
Slope	10,586,089				10,586,089	
Stark	2,349,351,546	86,371,150	1,604,239,450	144,381,551	3,953,590,996	230,752,701
Ward	4,540,670,907		446,420,030	40,177,803	4,987,090,937	40,177,803
Williams	26,263,485,095	474,392,108	2,666,823,630	240,014,127	28,930,308,725	714,406,235
<b>Total</b>	<b>149,157,766,614</b>	<b>2,089,563,745</b>	<b>19,955,384,990</b>	<b>1,872,556,554</b>	<b>169,113,151,604</b>	<b>3,962,120,299</b>





# Six Wells on a Single Pad



Vern Whitten Photography



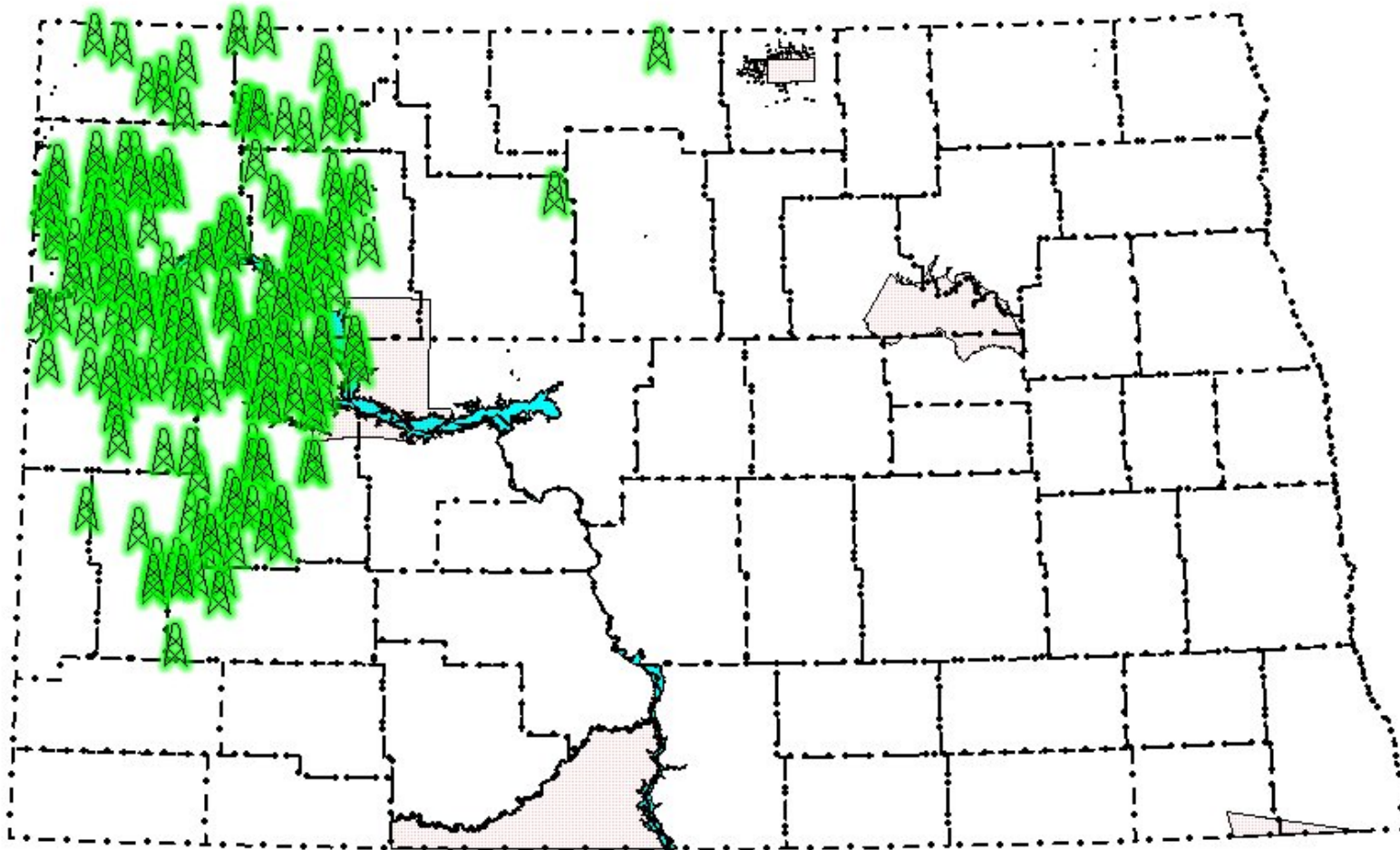
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Buffer  
Distance  
Find Well  
Find Field/Unit  
Find Section

## 205 Rigs



# Western North Dakota

- 1,100 to 2,700 wells/year = 2,000 expected
  - 100-225 rigs = 12,000 – 27,000 jobs = 12,000 – 27,000 jobs
  - Another 10,000 jobs operating wells and building infrastructure
  - 225 rigs can drill the 4,500 wells needed to secure leases in 2 years
  - 225 rigs can drill the 27,500 wells needed to develop spacing units in 16 years
  - 32,000 new wells = 30,000-35,000 long term jobs

# What Does Every New Bakken Well Mean to North Dakota

A typical 2012 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 Bakken well:

Produces approximately 580,000 barrels of oil

Generates over \$22 million net profit

Pays approximately \$4,610,000 in taxes

\$2,200,000 gross production taxes

\$2,000,000 extraction tax

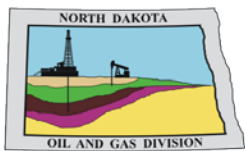
\$410,000 sales tax

Pays royalties of \$7,925,000 to mineral owners

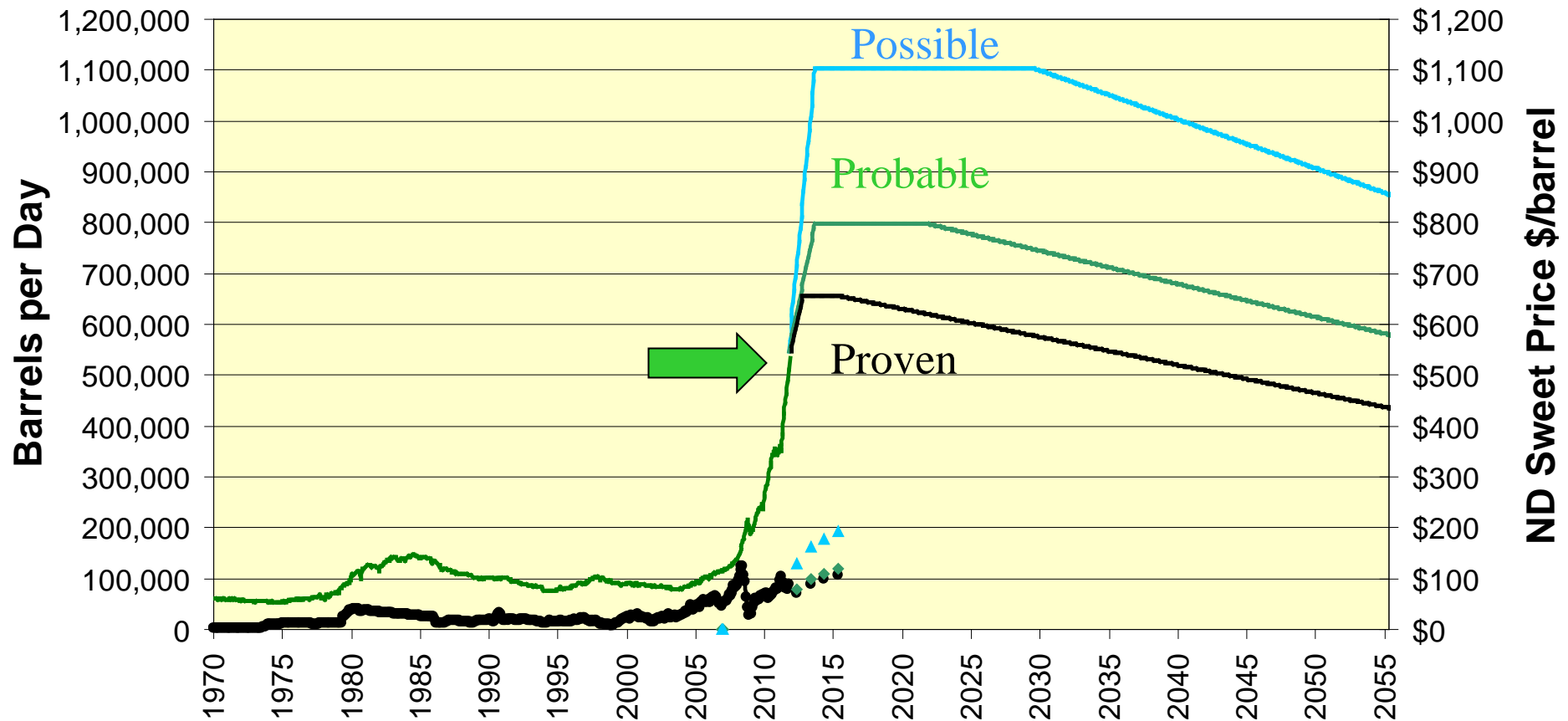
Pays salaries and wages of \$1,500,000

Pays operating expenses of \$2,300,000

Cost \$8,500,000 to drill and complete



## North Dakota Oil Production and Price



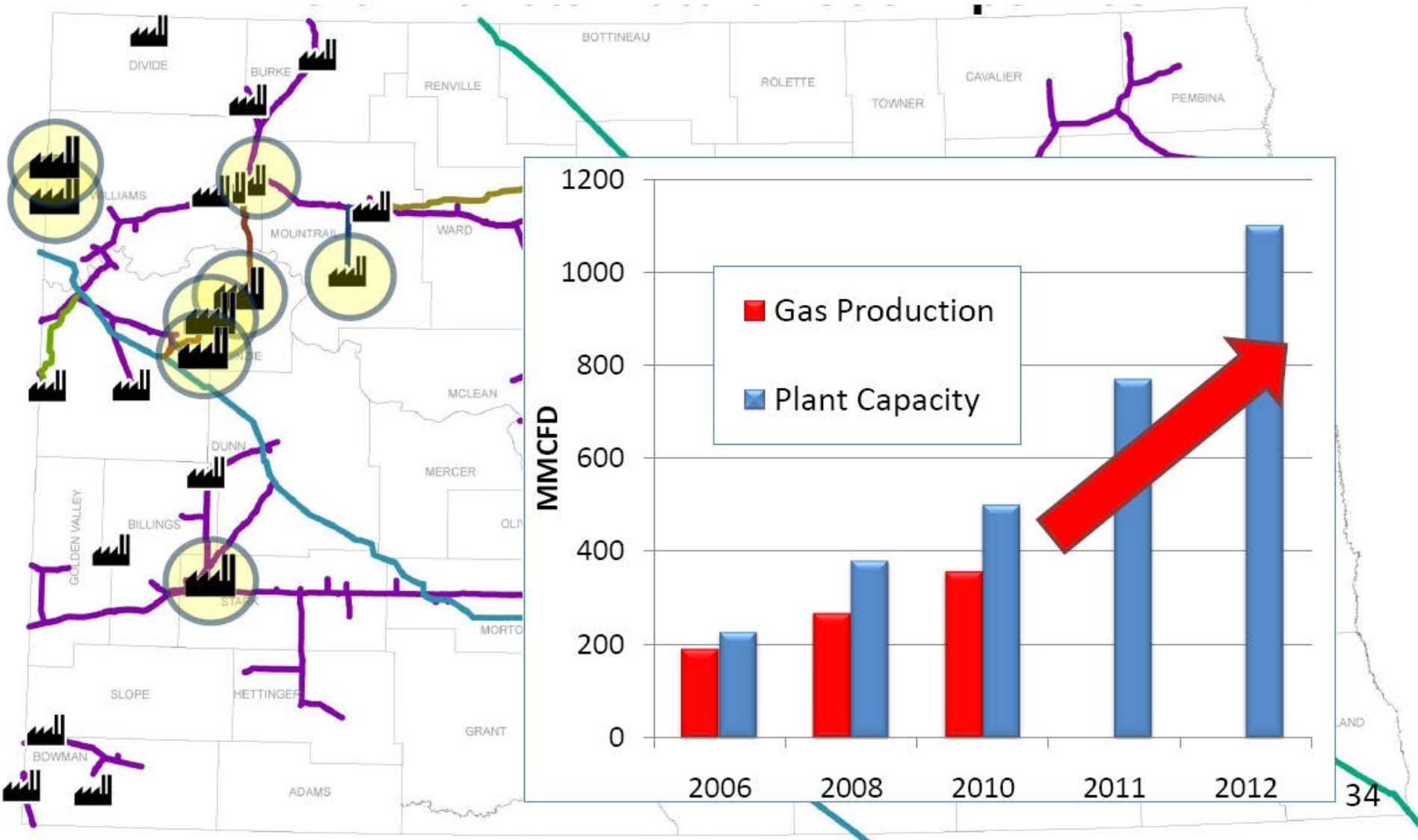
**3,266** Bakken and Three Forks wells drilled and completed

**32,000** more new wells possible in thermal mature area

**Proven=7 BBO – Probable=10 BBO – Possible=14 BBO (billion barrels of oil)**



# New or Expanding Gas Plants



### North Dakota Oil Industry Jobs (Ph2=80% Ph1)

