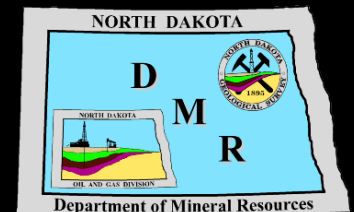


OIL & GAS ACTIVITY UPDATE

***Midwest Ground Water Conference
Minneapolis, MN – October 1, 2012***

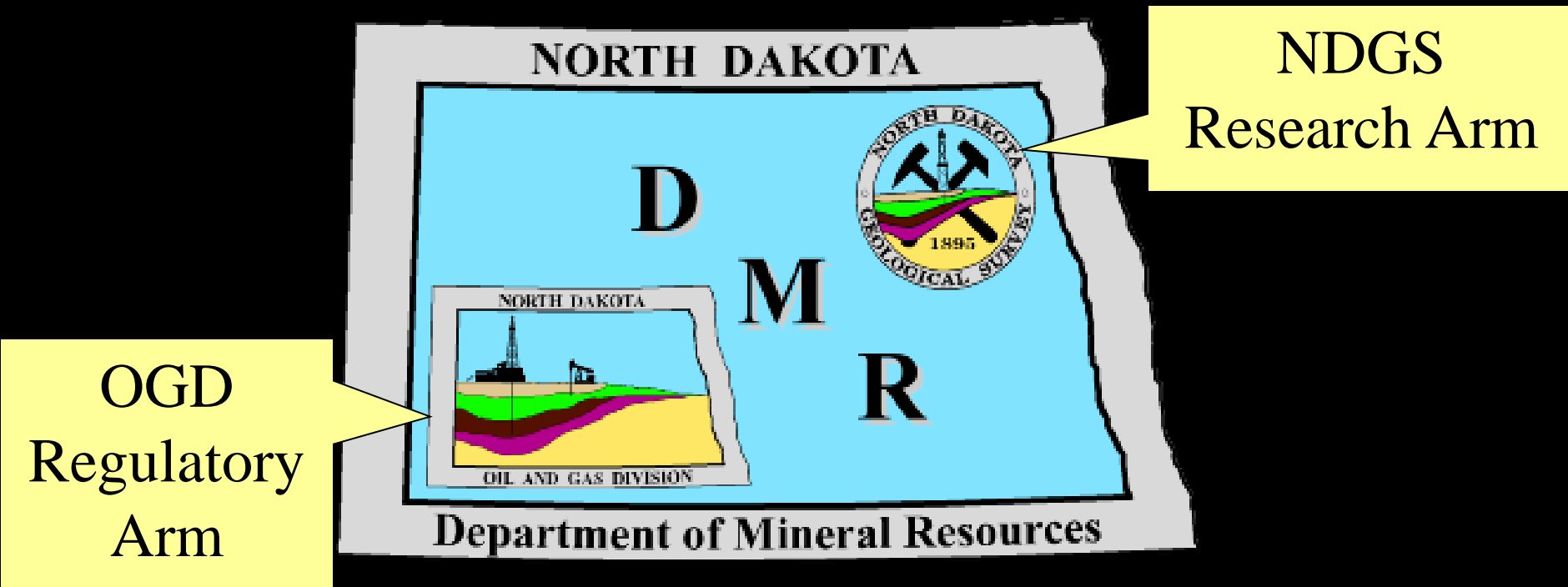


OIL & GAS UPDATE

- North Dakota Update
- Hydraulic Fracing
- Disposal of Fluids

Bruce E. Hicks
Assistant Director
NDIC-DMR-OGD
Bismarck, ND

North Dakota Department of Mineral Resources



<https://www.dmr.nd.gov/oilgas/>

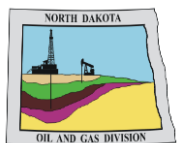
<https://www.dmr.nd.gov/ndgs/>

600 East Boulevard Ave. - Dept 405

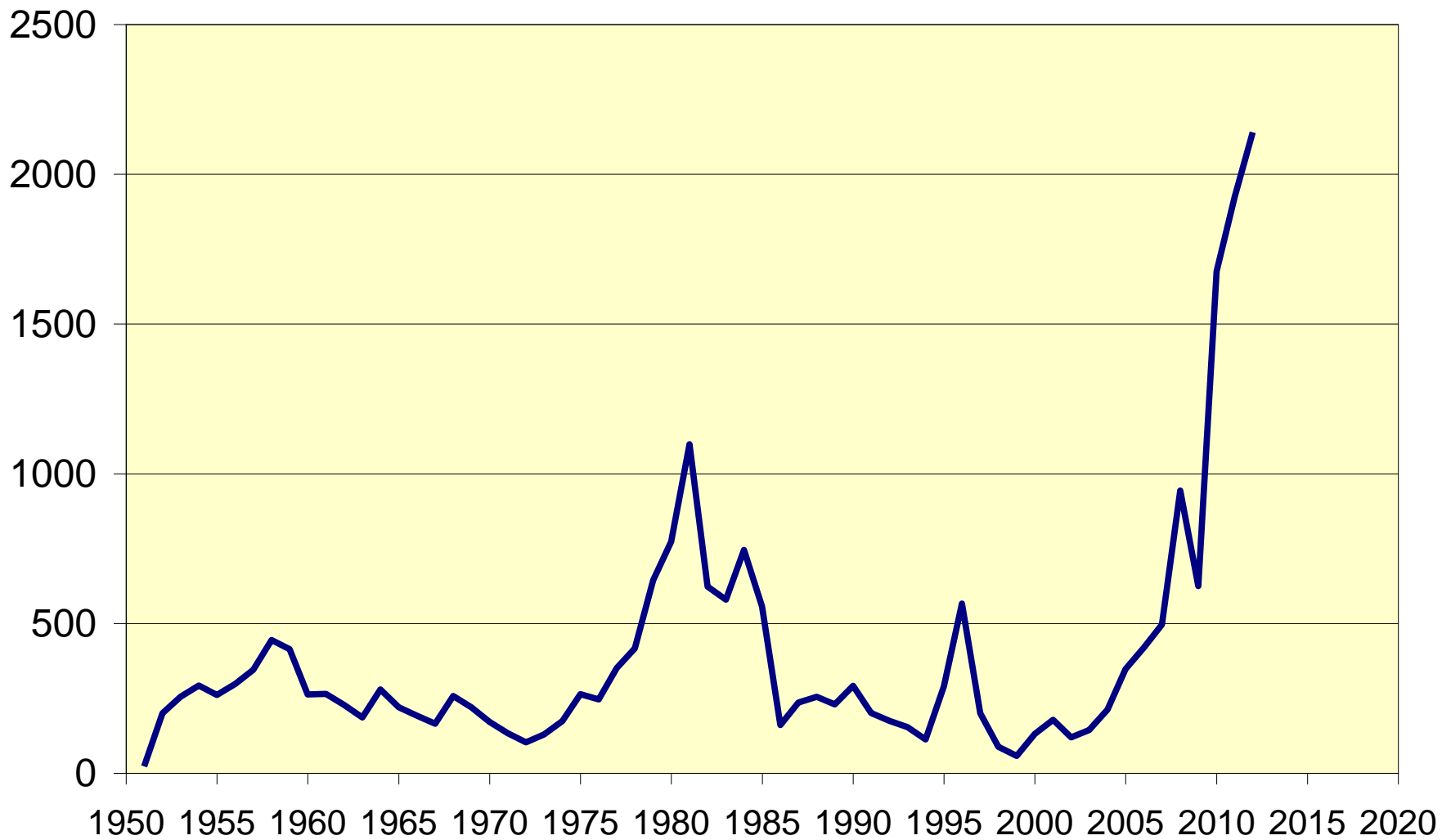
Bismarck, ND 58505-0840

(701) 328-8020

(701) 328-8000

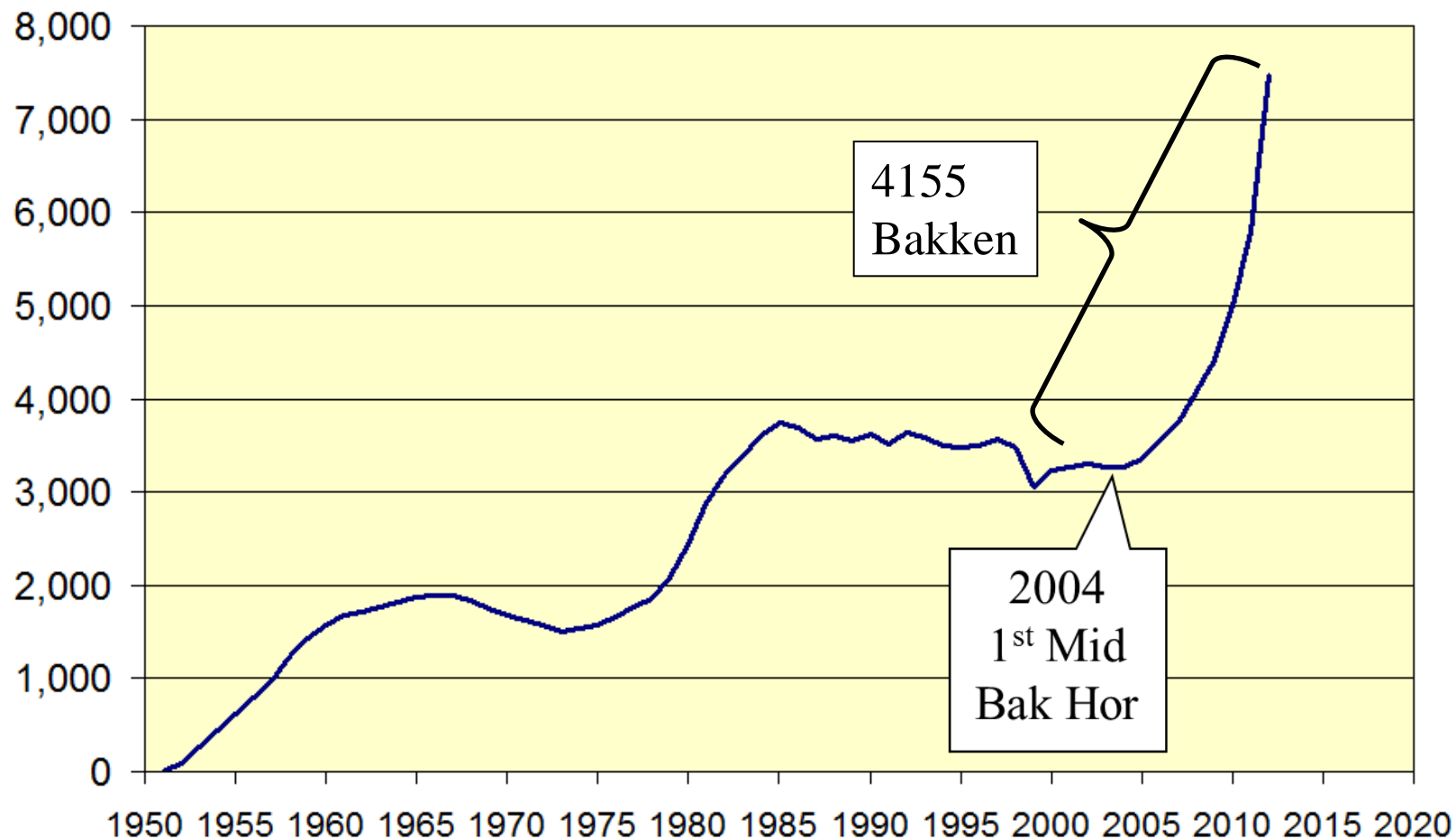


North Dakota New Well Permits Issued





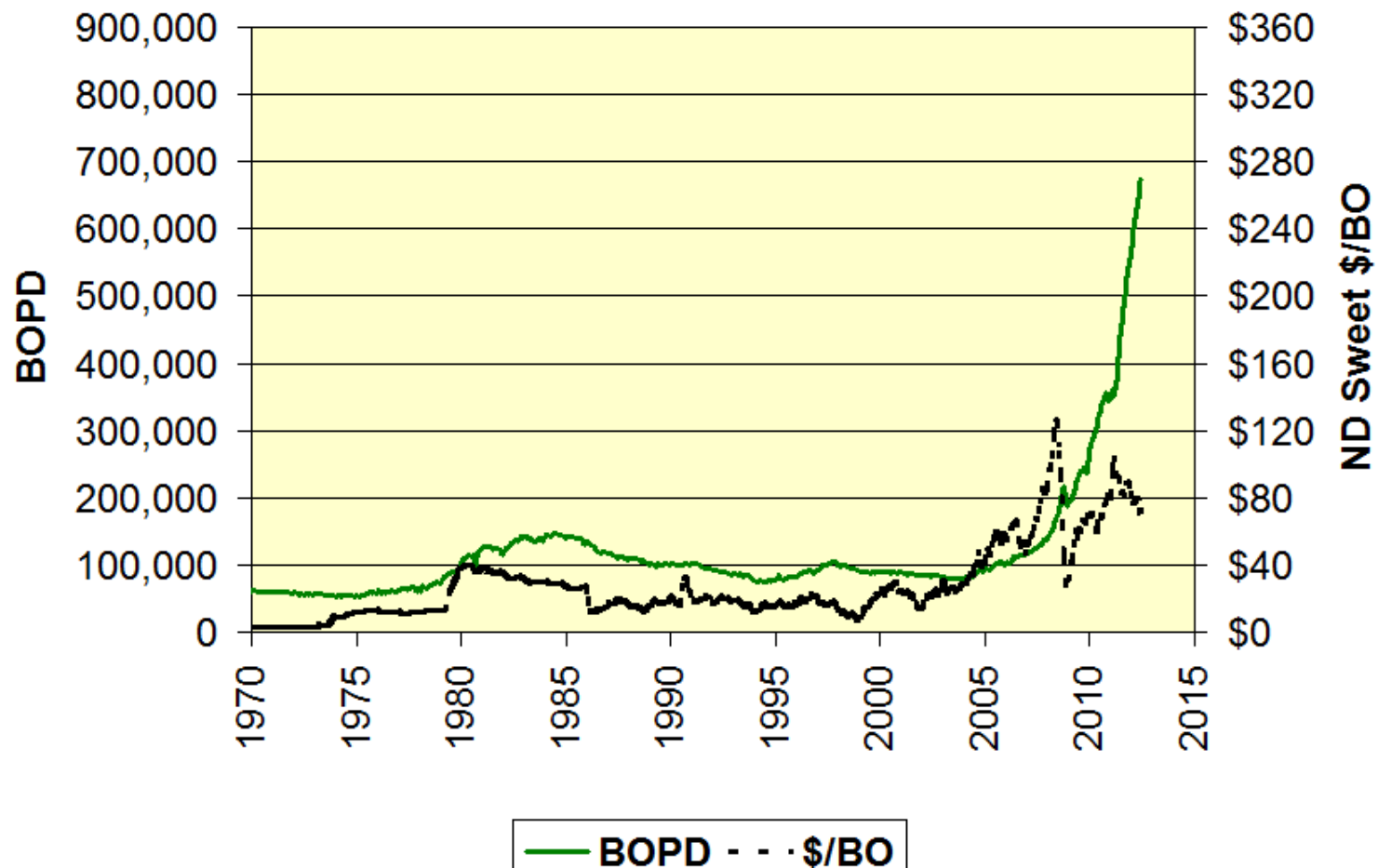
North Dakota Wells Producing Each Year



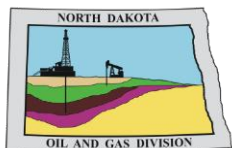
7467 total wells – 4155 Bakken horizontal (55.6%)



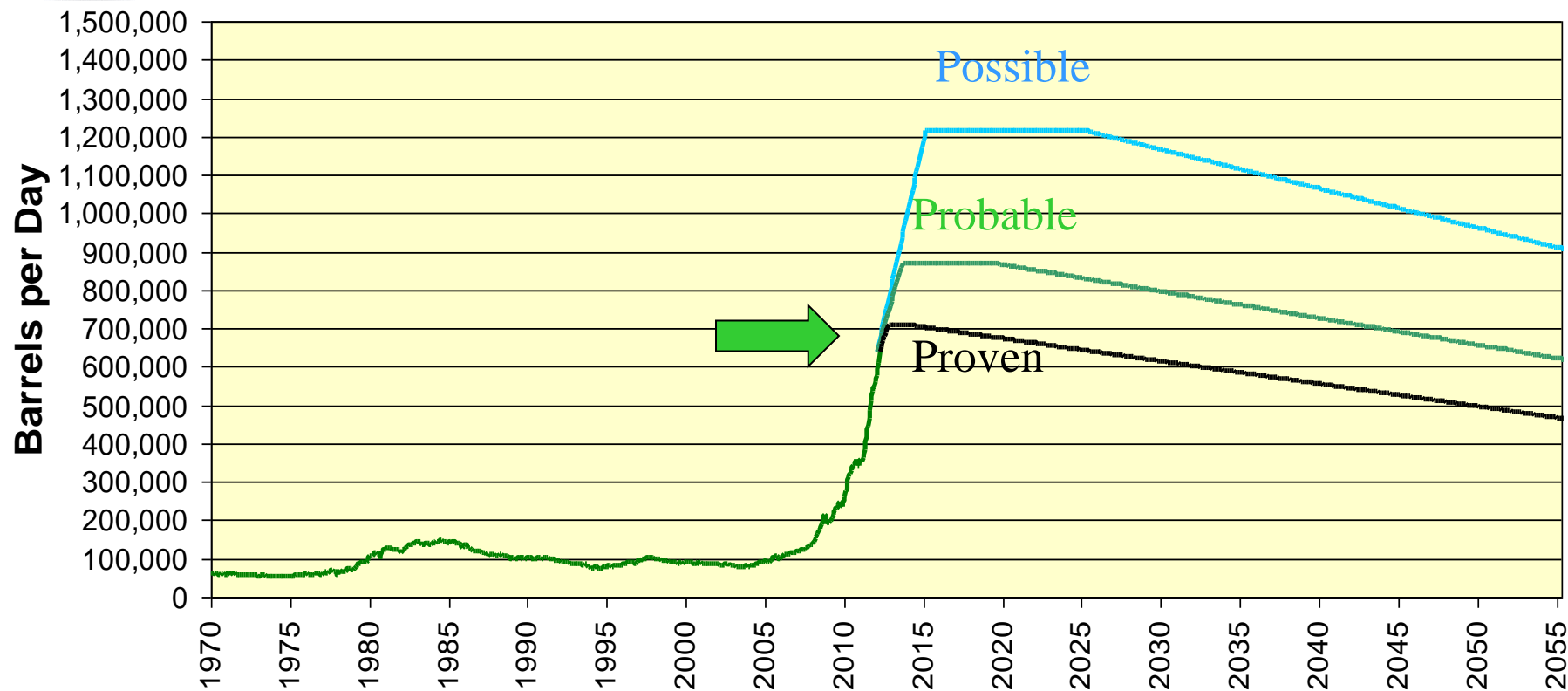
North Dakota Daily Oil Produced and Price



Production 674,000 bopd (appr 607,000 from Bakken—90%)



North Dakota Oil Production

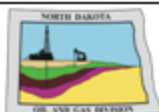


History

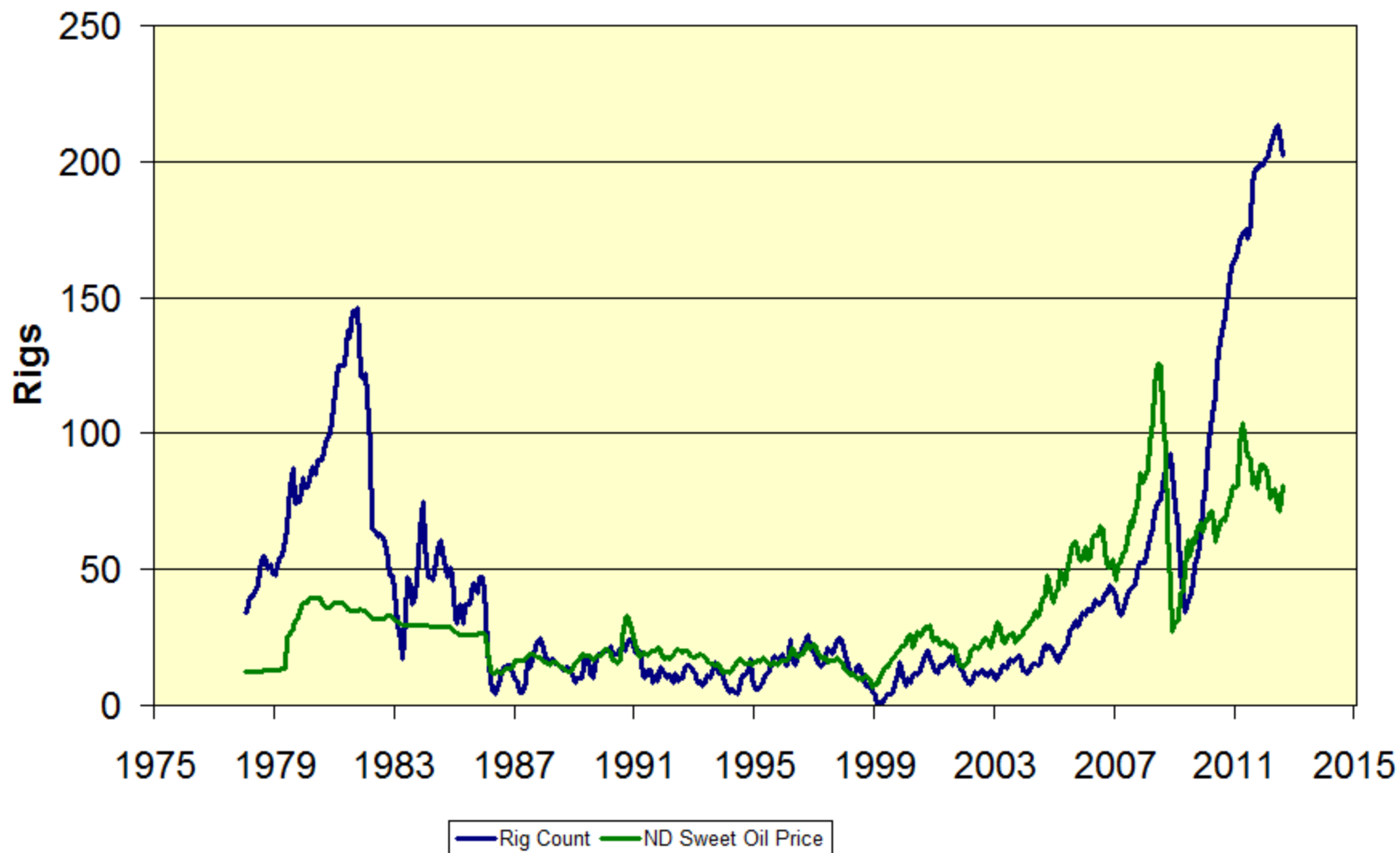
Bakken - Three Forks P10

Bakken - Three Forks P50

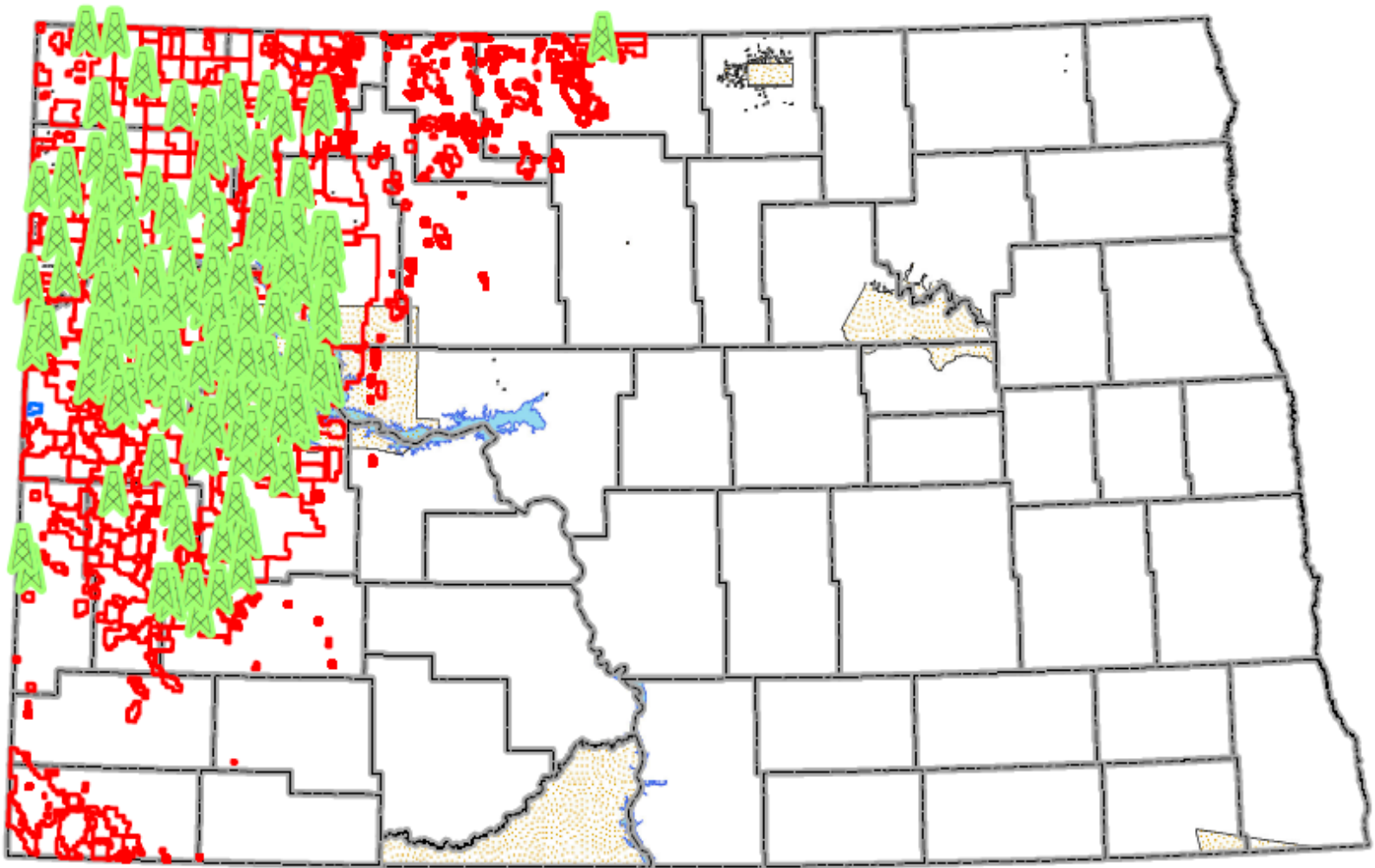
Bakken - Three Forks P90



North Dakota Average Monthly Rig Count



NORTH DAKOTA – 190 DRILLING RIGS – SEP 2012



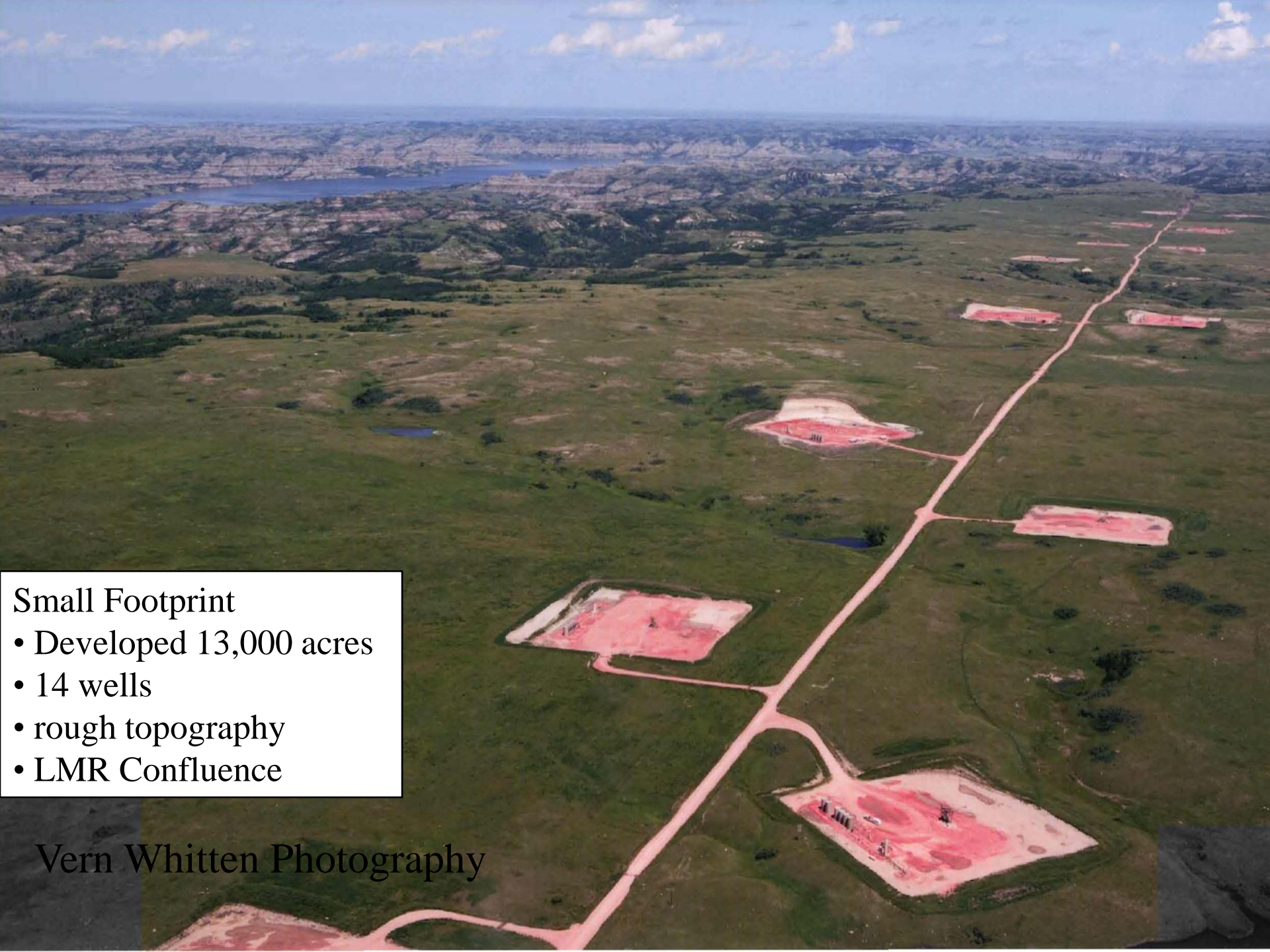
**Current drilling activity is focused
in Mountrail, Dunn, McKenzie, and Williams Counties.**

RIGS

- 190 rigs currently
- 225 rigs - 1 year to secure leases
- 225 rigs – another 16 years f/5H/SU
- Declining rig count?
 - walking rigs replace inefficiencies
 - drilling more wells w/less rigs

PLANNING FOR THE FUTURE

- **Corridors for development**
- **Educate local and County officials**



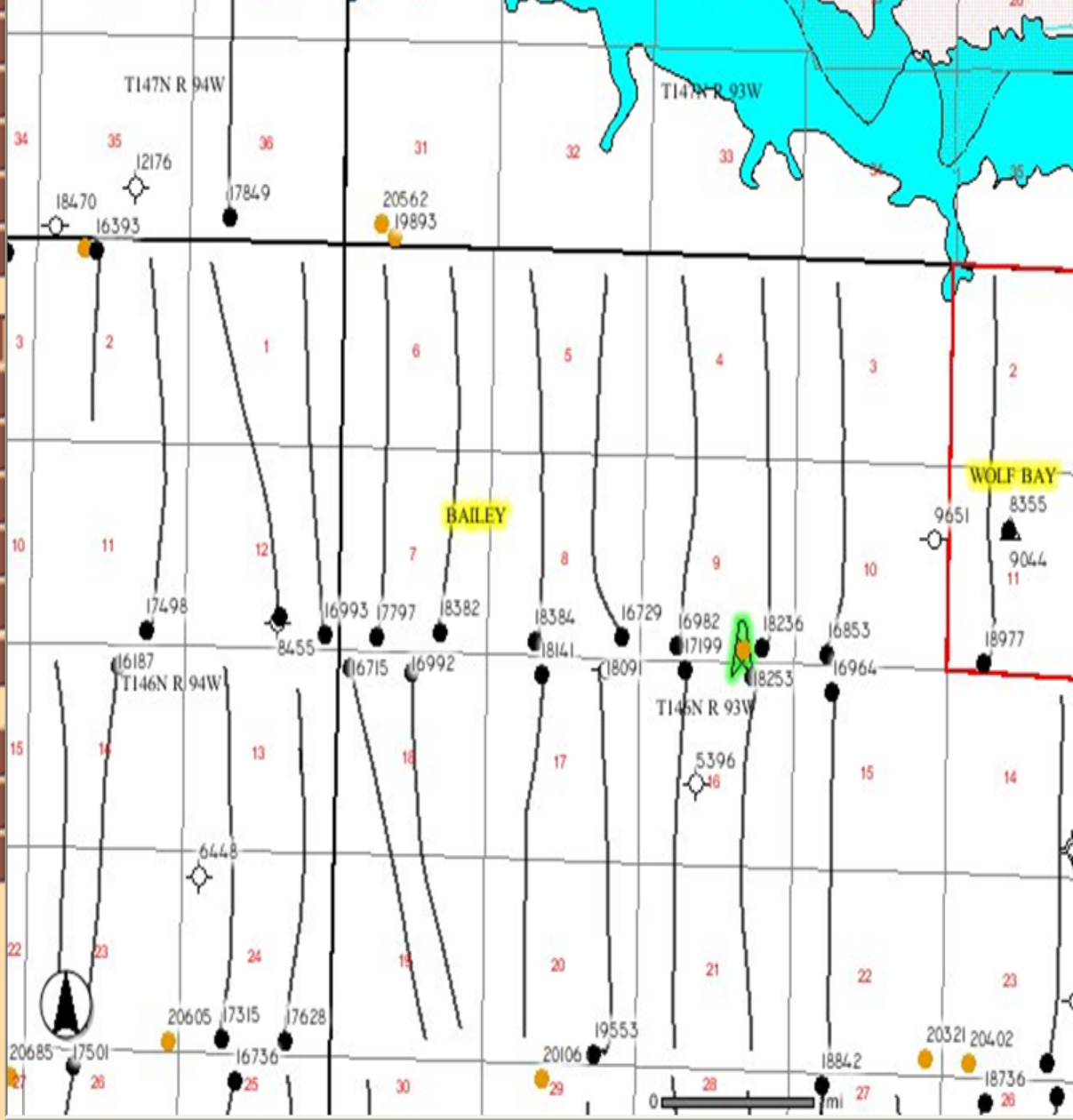
Small Footprint

- Developed 13,000 acres
- 14 wells
- rough topography
- LMR Confluence

Vern Whitten Photography

Full Map
Entire State
Previous View
Near Selection
Search
Generate PDF

Zoom In
Zoom Out
Pan
Rect Identify
Select Object
Buffer
Distance
Find Well
Find Field/Unit
Find Section



Major Rivers
Selection cleared.

- ☒ Wells
- ☒ Rig Location
- ☒ Directional Surveys
- ☒ Directional Legs
- ☒ Horizontal Surveys
- ☒ Horizontal Legs
- ☒ Cases Docketed
- ☒ Oil Fields
- ☒ Unit Boundaries
- ☒ Inspector Areas
- ☒ Drilling / Spacing
- ☒ Seismic
- ☒ Gas Plants
- ☒ Other
- ☒ Reservations
- ☒ Corporate Boundaries
- ☒ Rivers and Roads
- ☒ County Roads
- ☒ Major Roads
- ☒ Major Rivers
- ☒ Missouri River
- ☒ Land Ownership
- ☒ Imagery
 - ☒ Topo/DRG 250k
 - ☒ Topo/DRG 100k
 - ☒ NAIP 2009

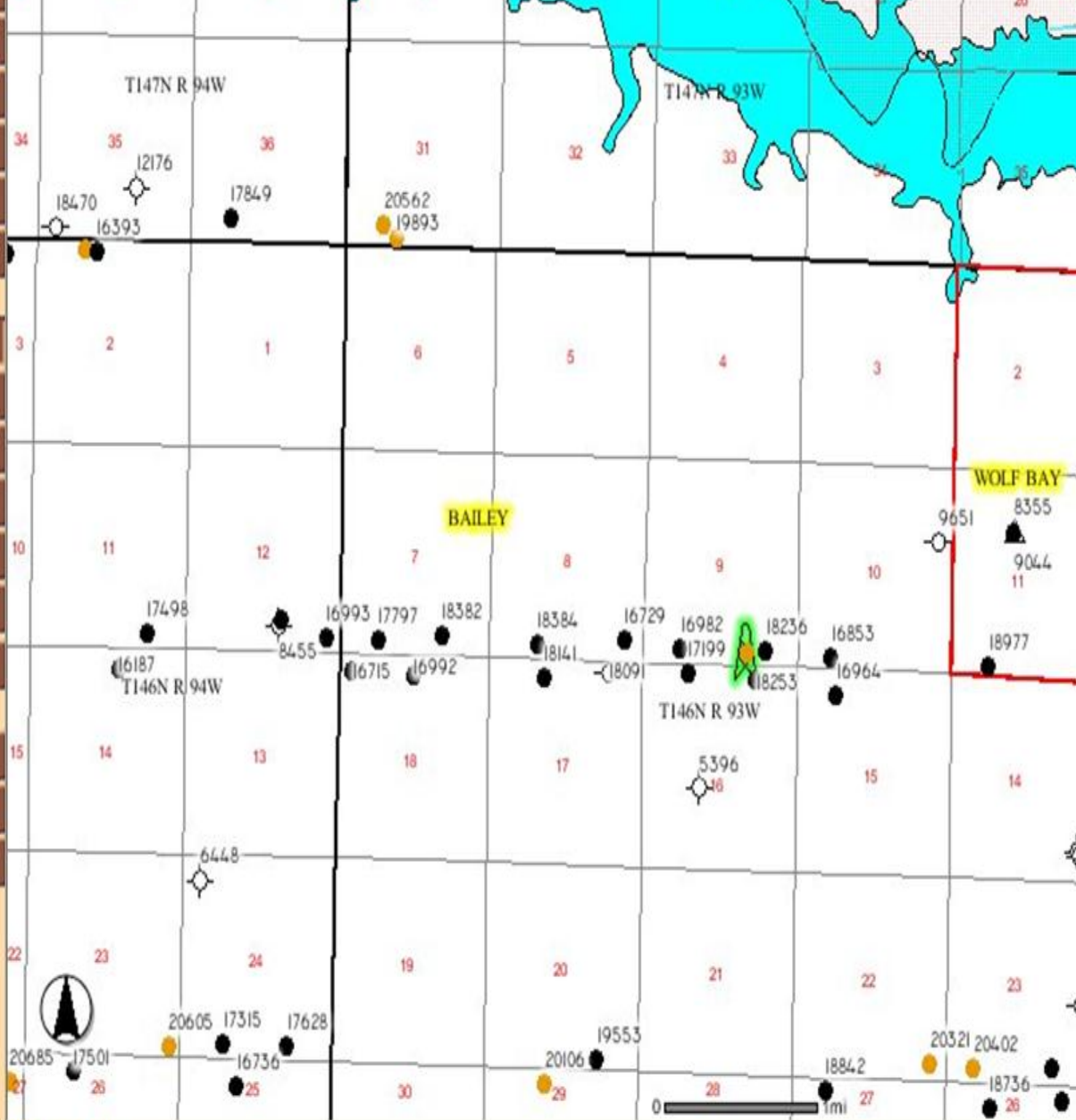
Refresh Map

☒ Auto Refresh

Help:
 A closed group, click to open.
 An open group, click to close.
 A map layer.
 A hidden group/layer, click to make visible.

Full Map
Entire State
Previous View
Near Selection
Search
Generate PDF

Zoom In
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Refresh Map

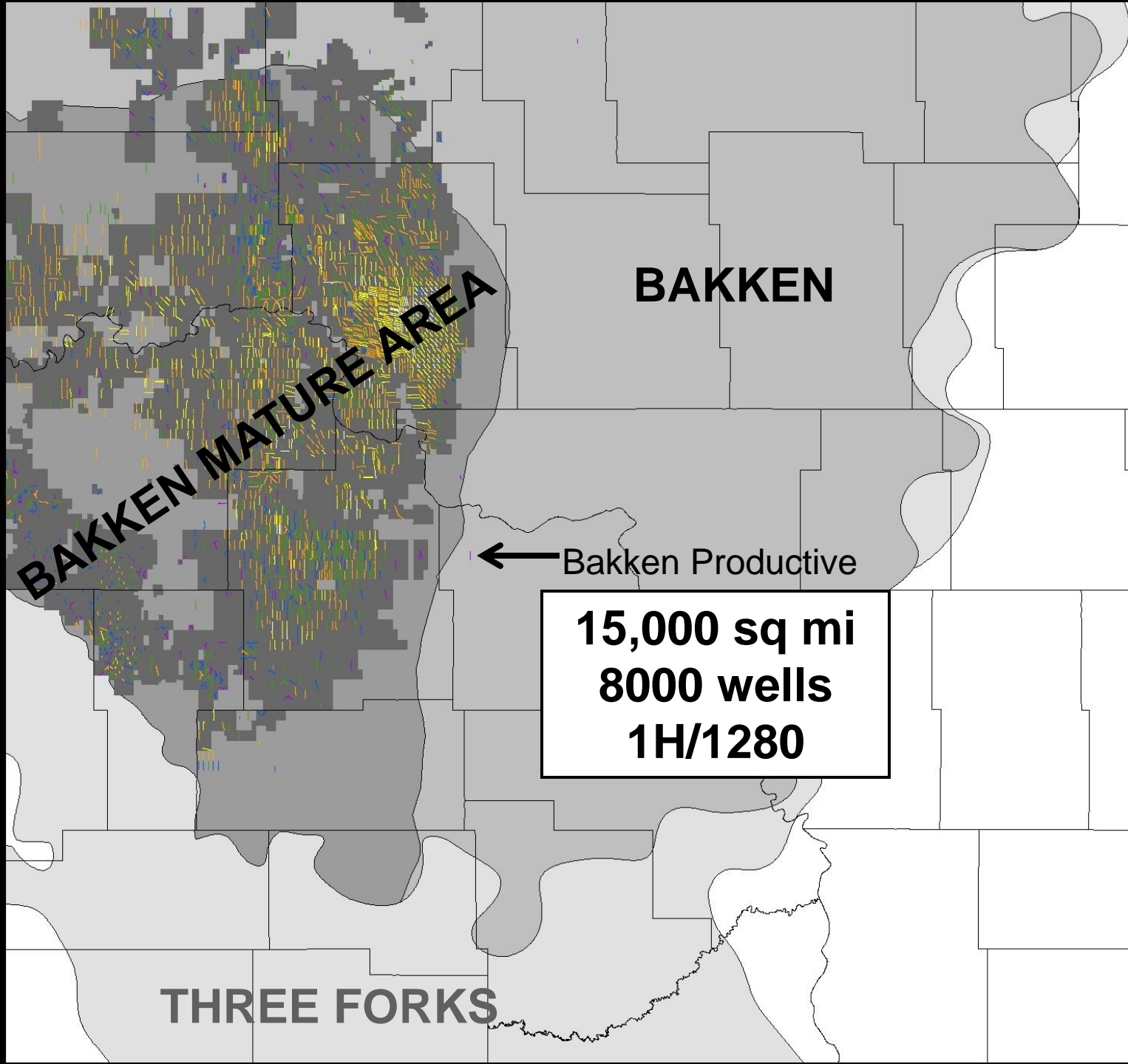
☒ Auto Refresh

Help:

- A closed group, click to open.
- An open group, click to close.
- A map layer.
- A hidden group/layer, click to make visible.



Vern Whitten Photography



TYPICAL HORIZONTAL OIL WELL

Potable Waters



9-5/8" in 13.5" Hole

- Drill with fresh water
- Total depth below lowest potable water
- Run in hole with surface casing
 - 1st layer of surface water protection
- Cement casing back to surface of ground
 - 2nd layer of surface water protection

TYPICAL HORIZONTAL OIL WELL

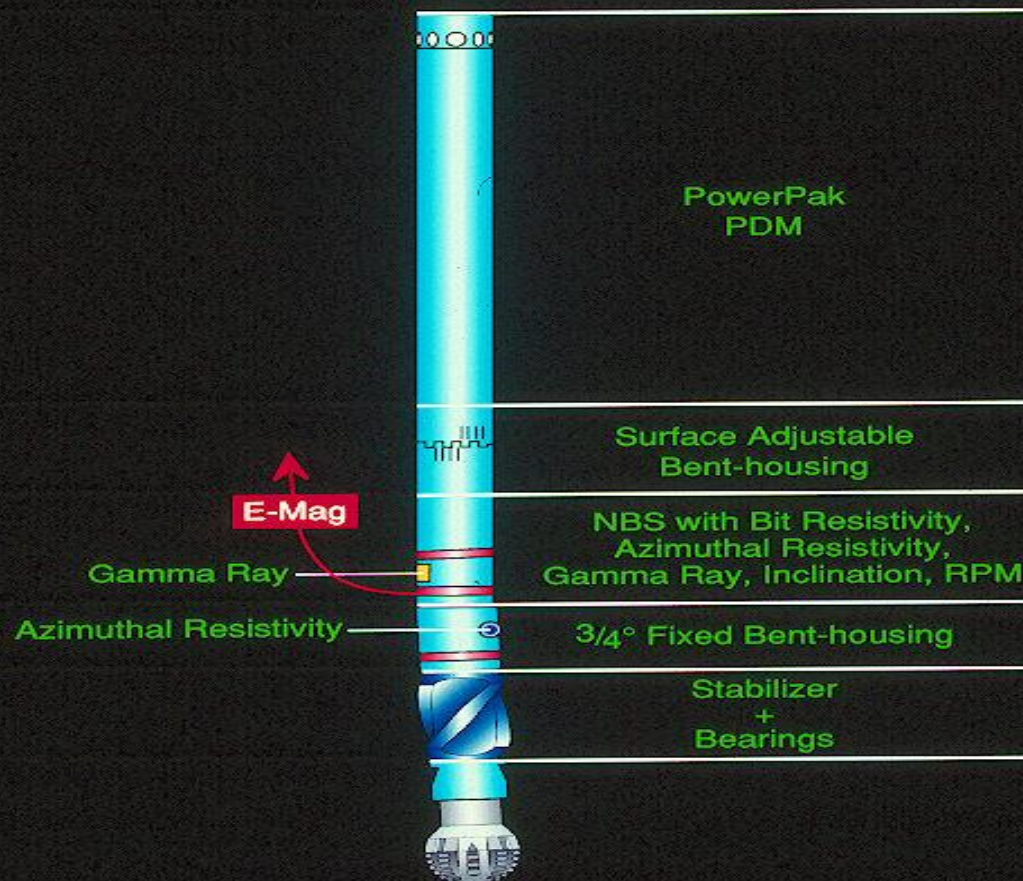
Potable Waters

9-5/8" in 13.5" Hole

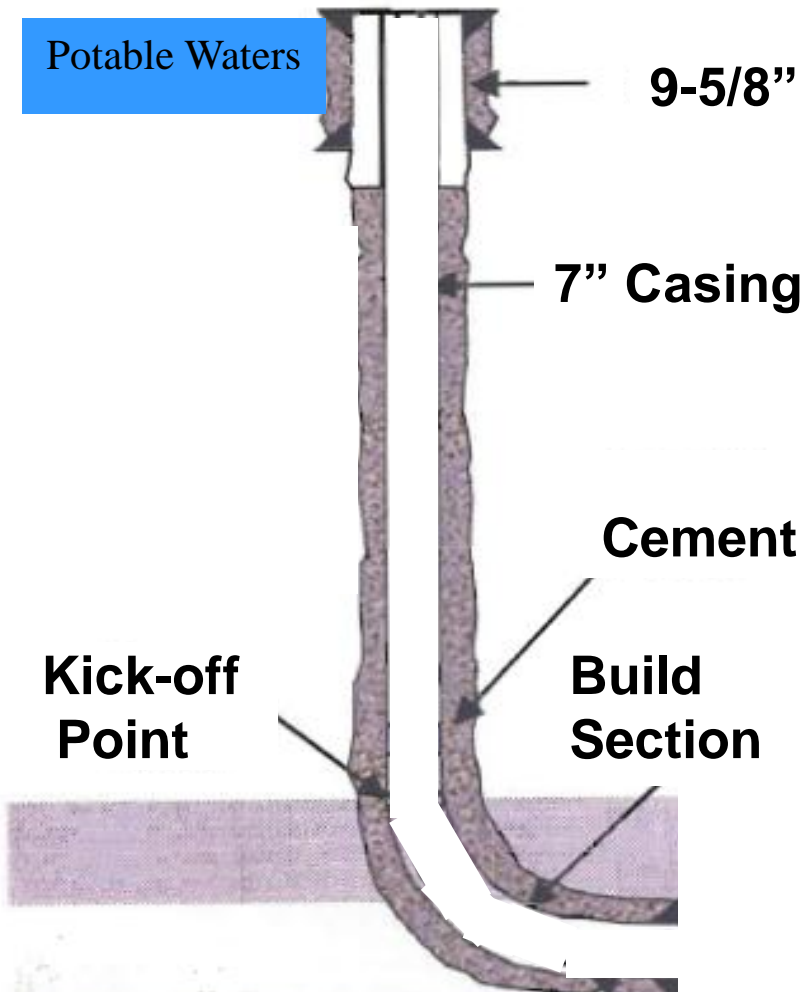
Kick-off
Point

- Drill vertically to kick-off point
- Run in hole with bent assembly
- Downhole mud motor

GeoSteering Tool

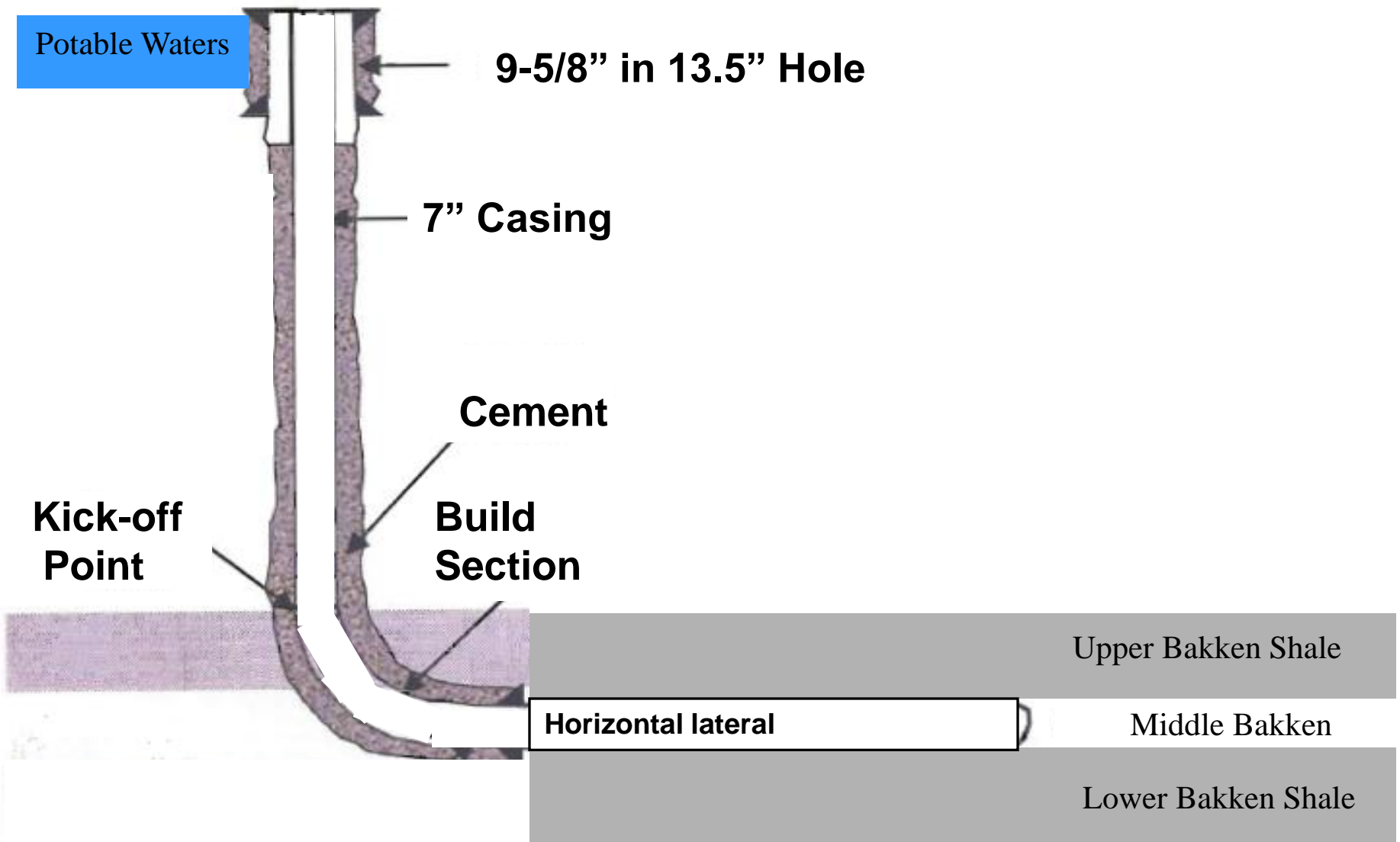


TYPICAL HORIZONTAL OIL WELL



- Drill 8-3/4" hole to pay
- Run in hole with 7" casing
 - 3rd layer of protection
- Cement 7" casing
 - 4th layer of protection

TYPICAL HORIZONTAL OIL WELL



TYPICAL HORIZONTAL OIL WELL

Potable Waters

4.5"
Frac
String

Cement

Packer

4.5" liner

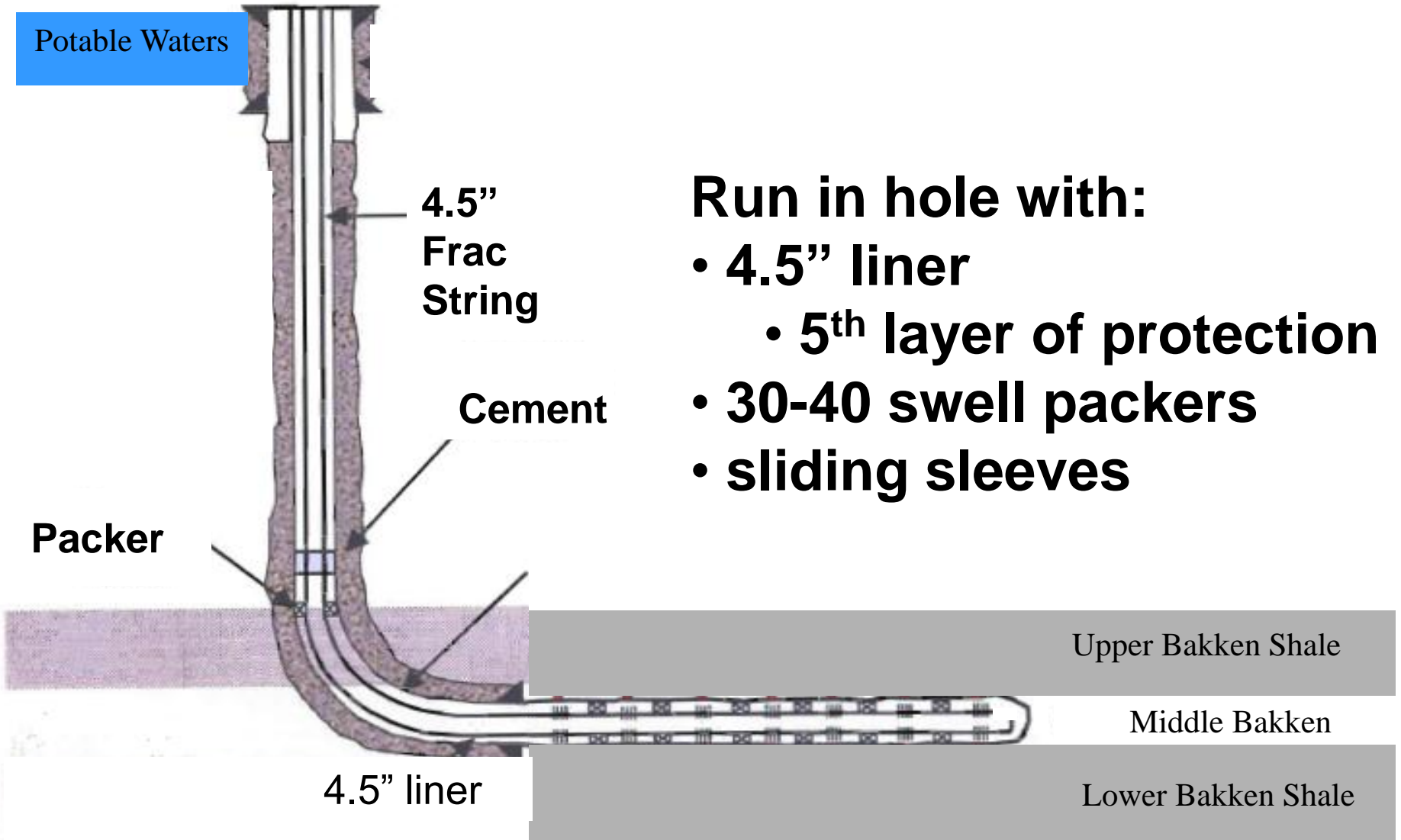
Run in hole with:

- 4.5" liner
 - 5th layer of protection
- 30-40 swell packers
- sliding sleeves

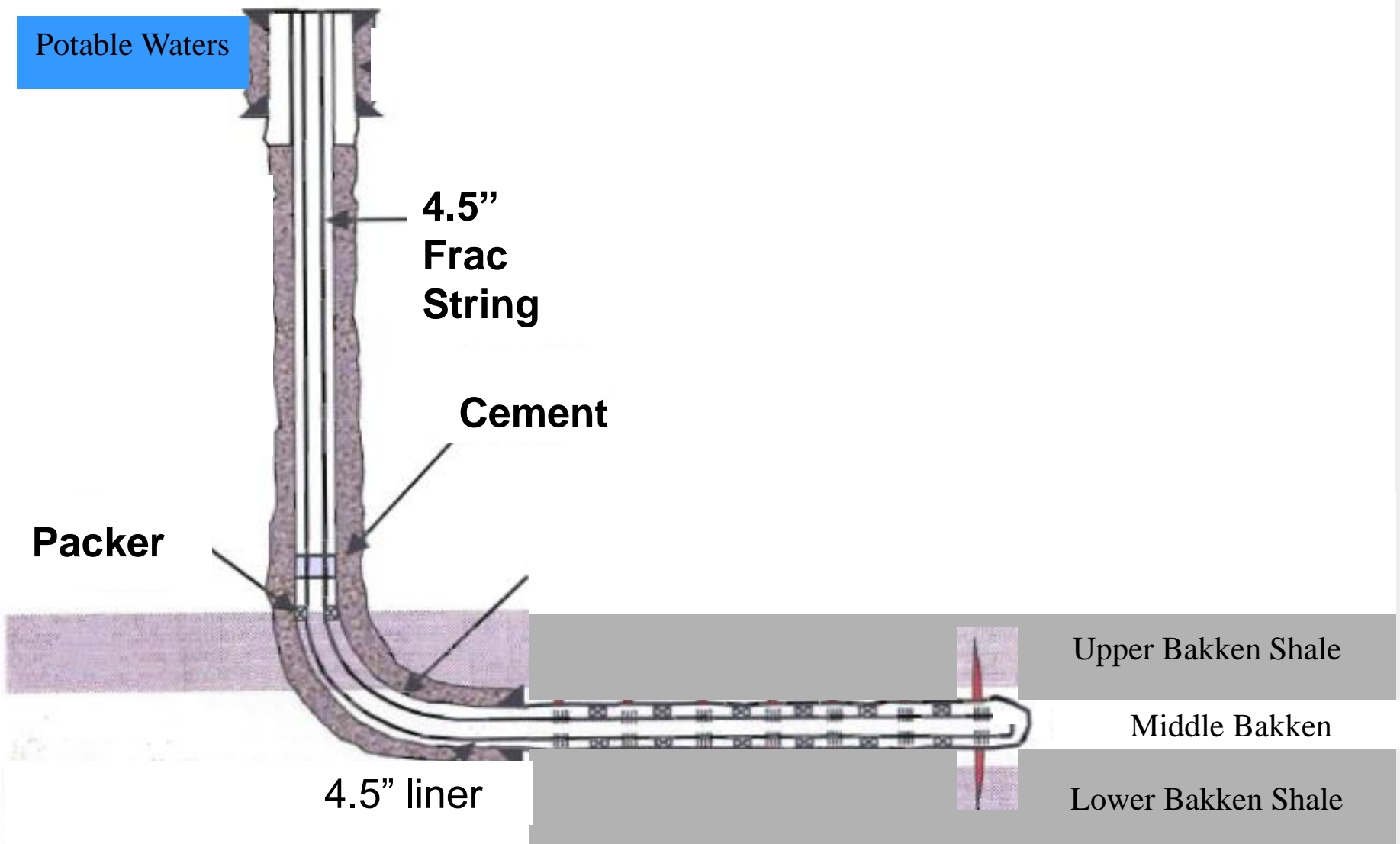
Upper Bakken Shale

Middle Bakken

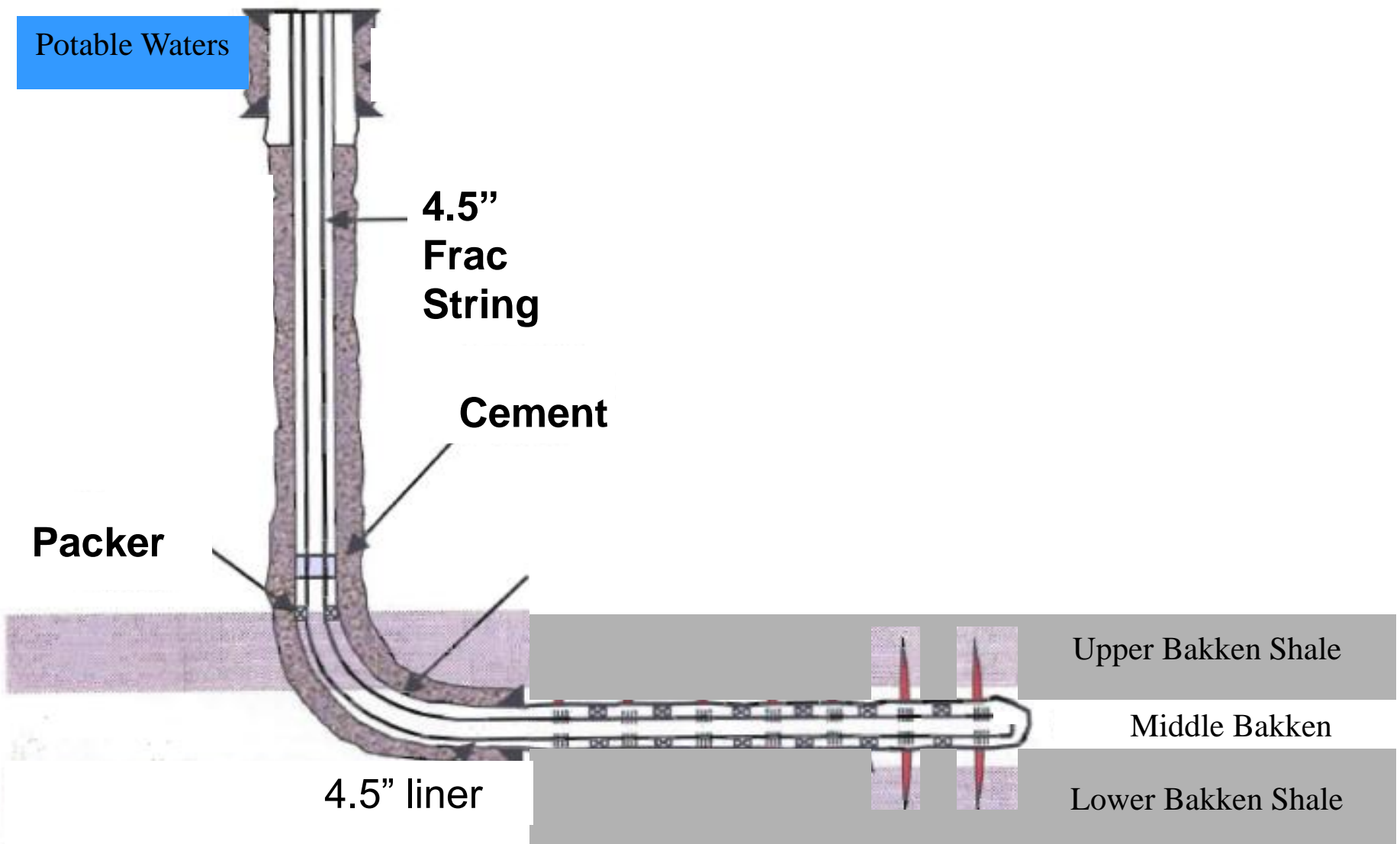
Lower Bakken Shale



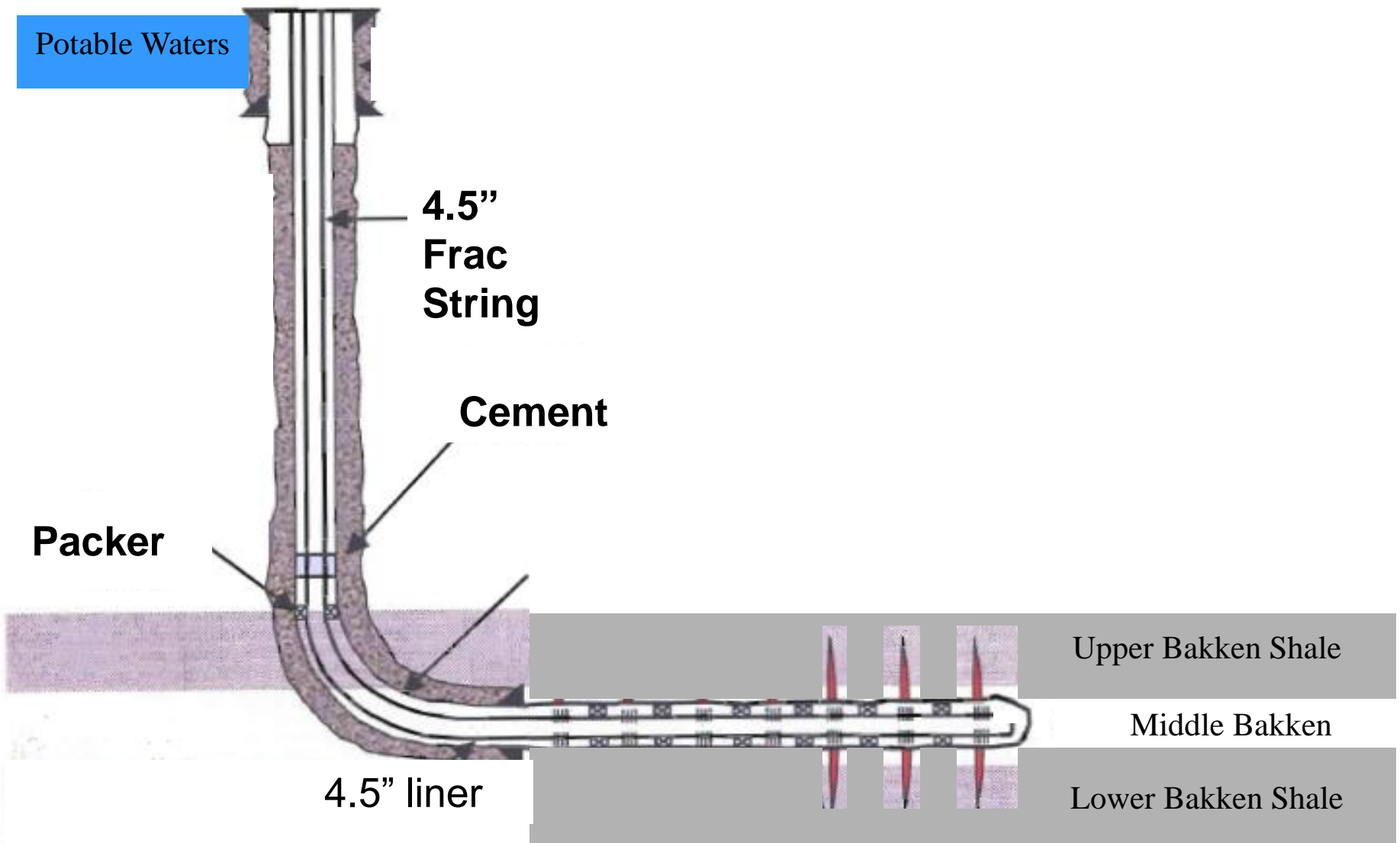
TYPICAL HORIZONTAL OIL WELL



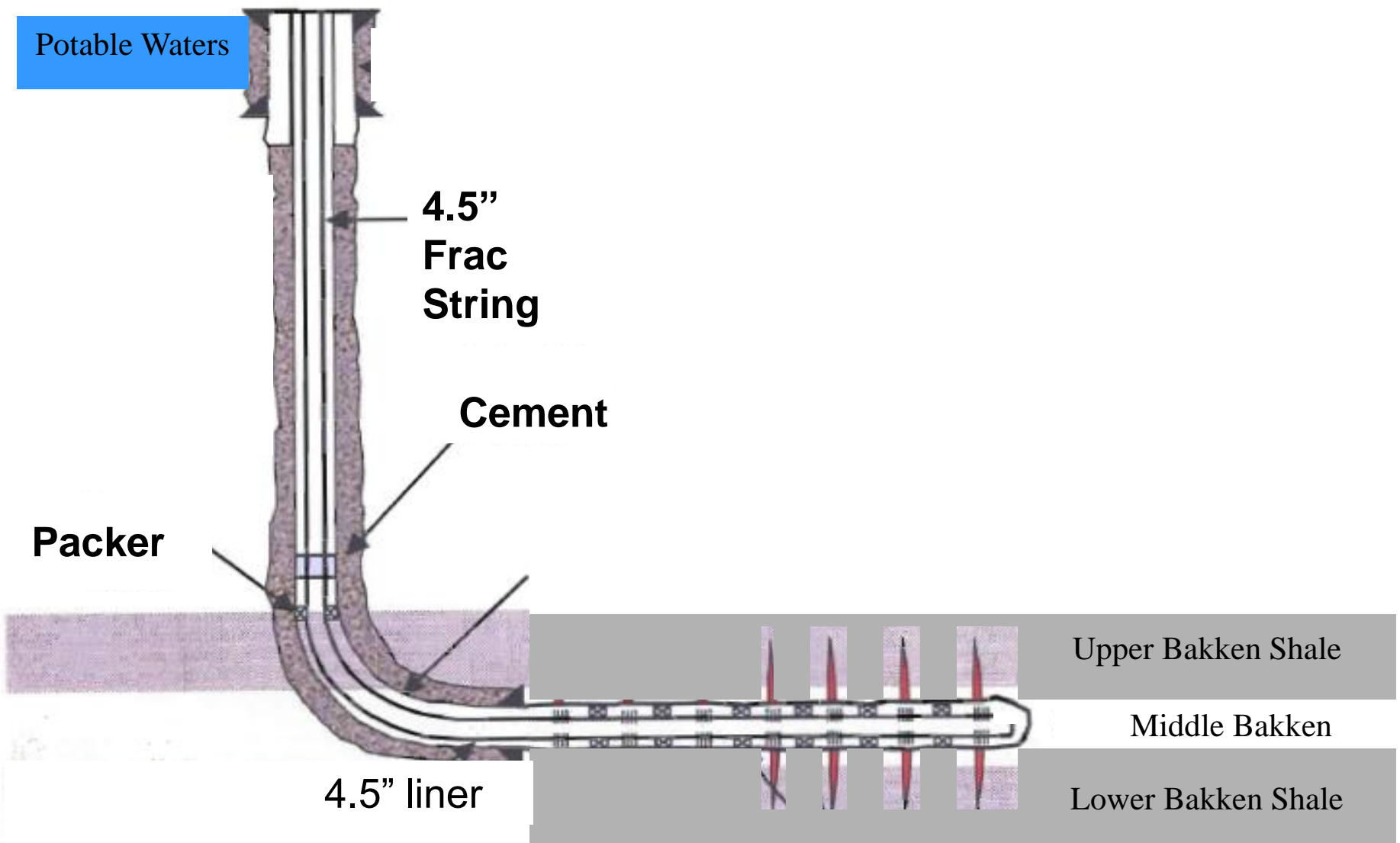
TYPICAL HORIZONTAL OIL WELL



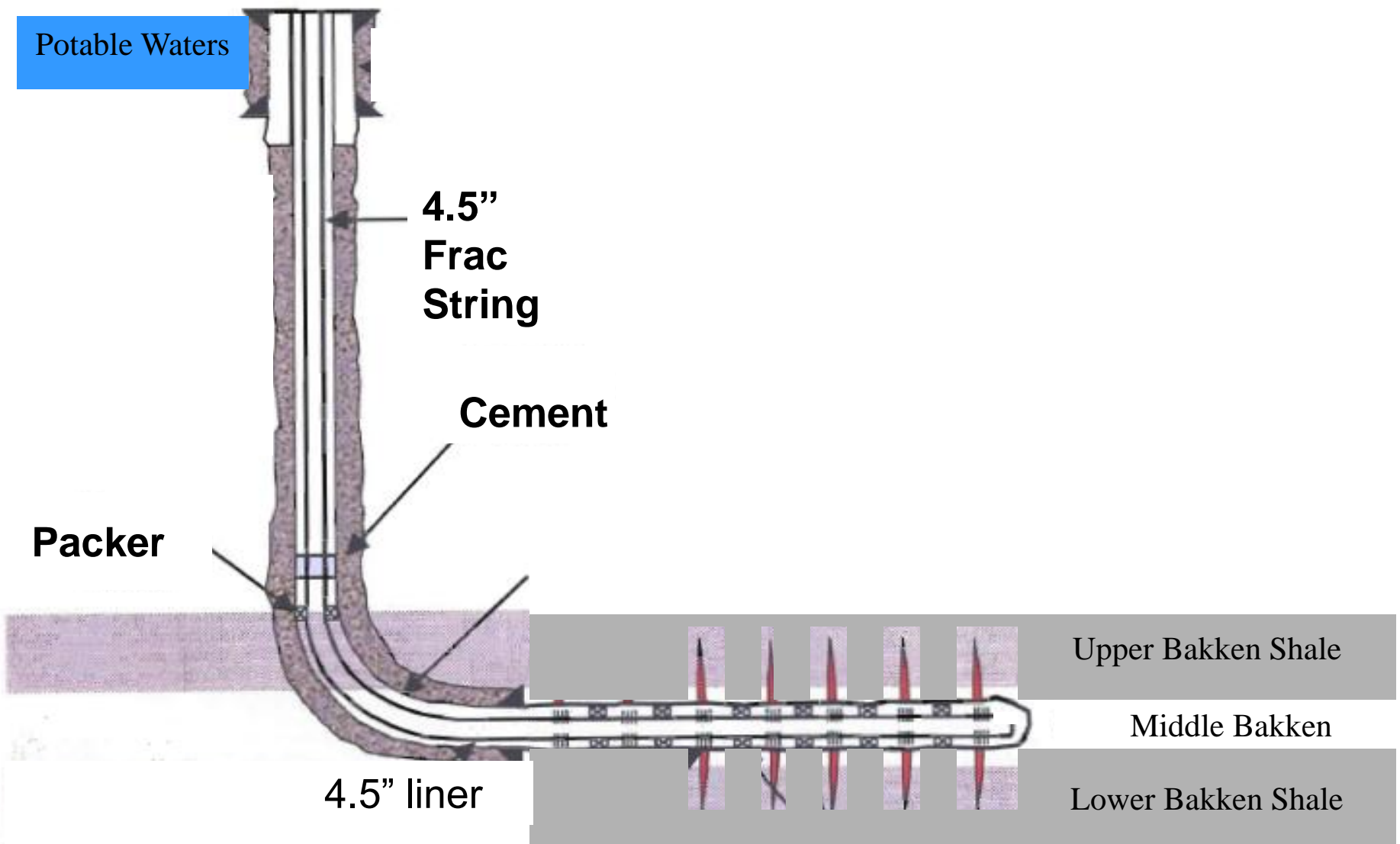
TYPICAL HORIZONTAL OIL WELL



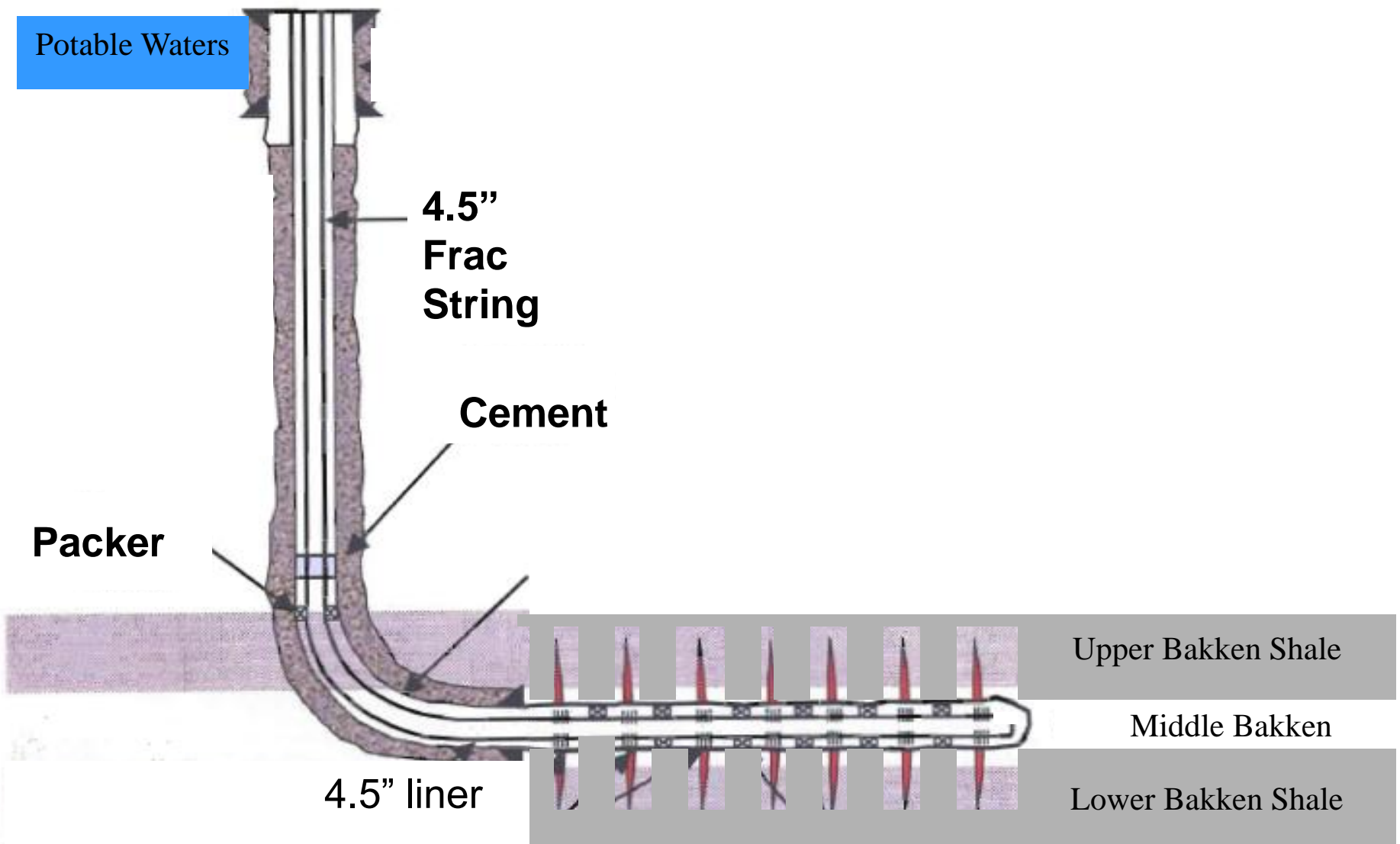
TYPICAL HORIZONTAL OIL WELL



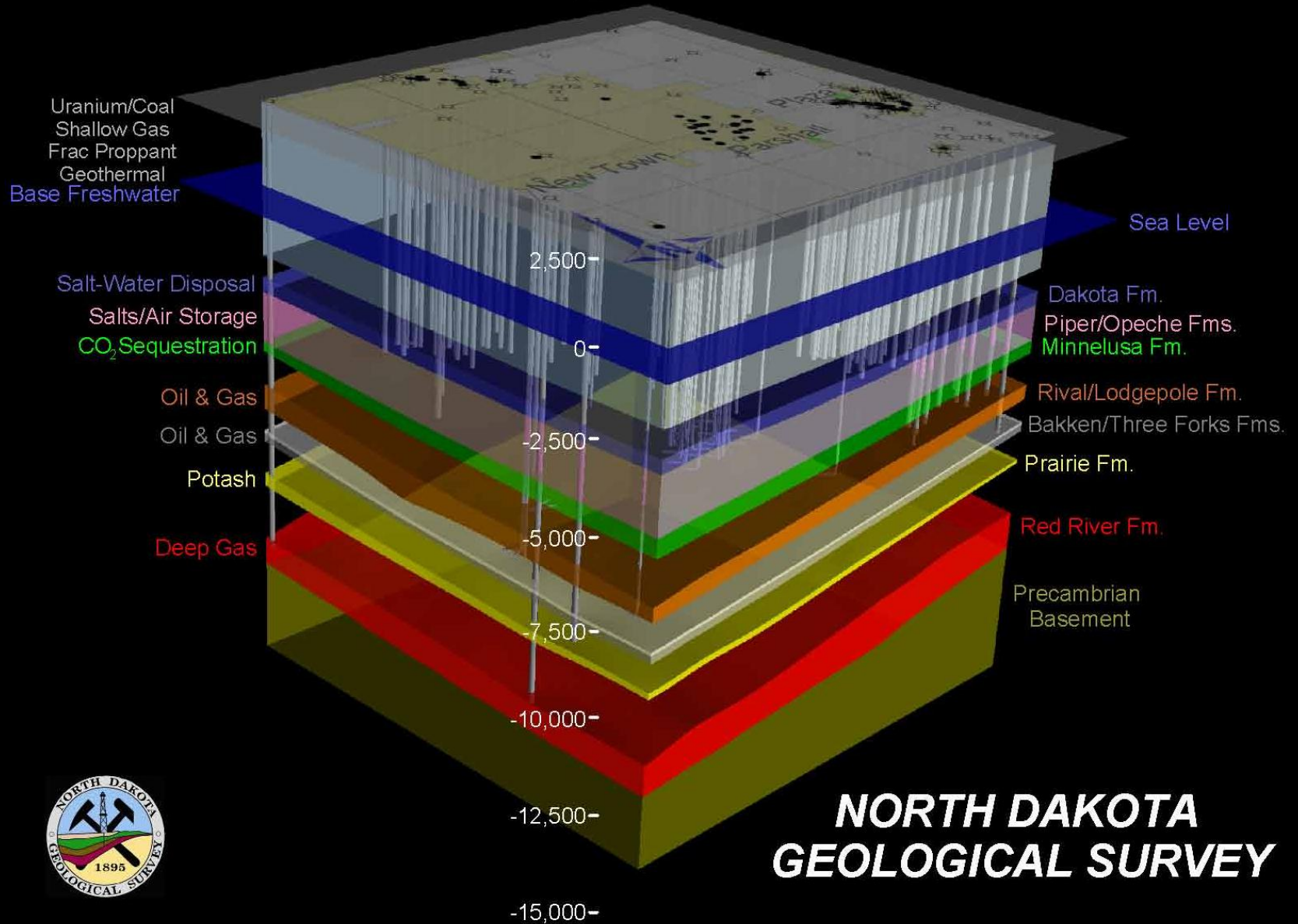
TYPICAL HORIZONTAL OIL WELL

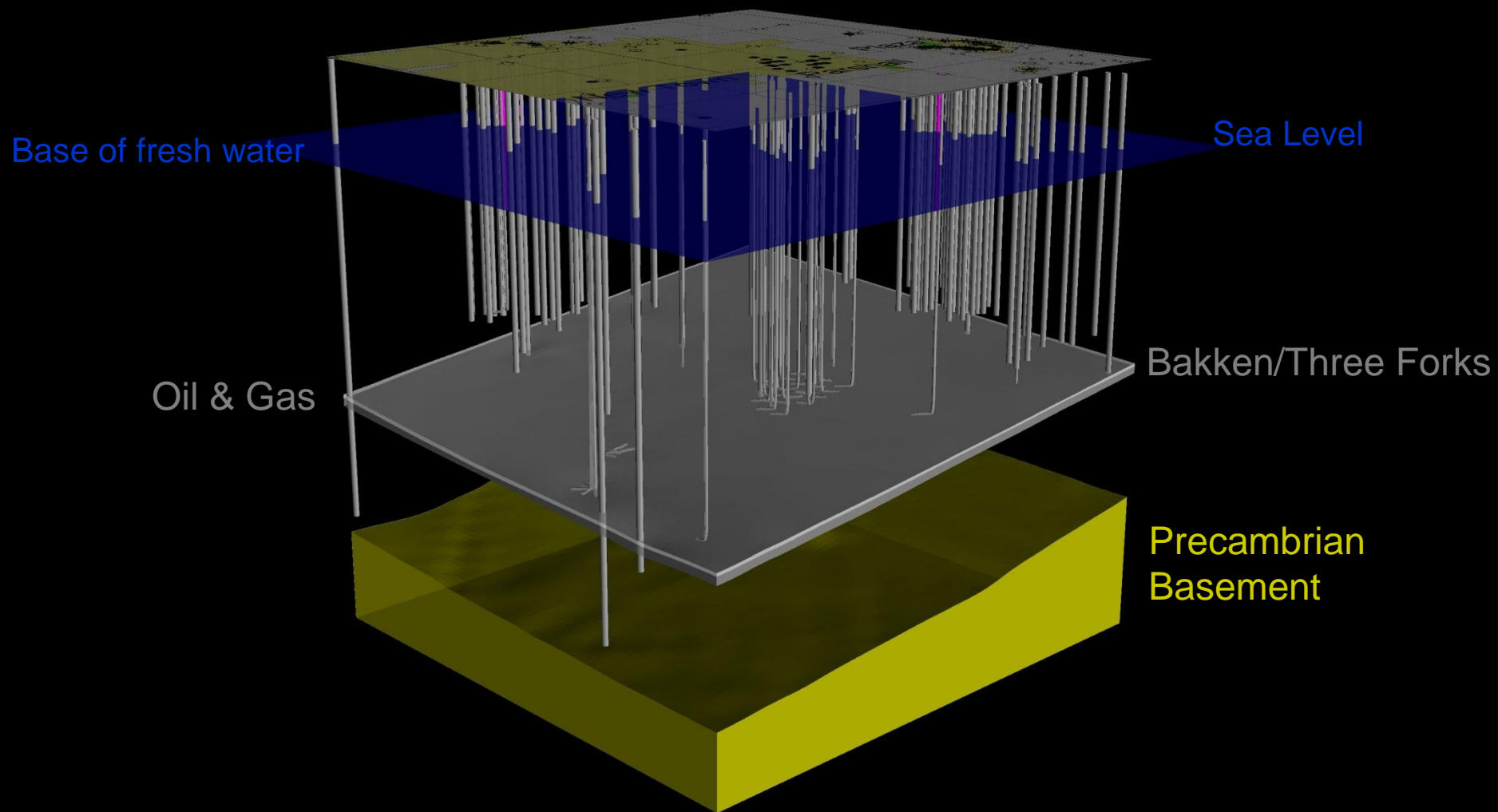


TYPICAL HORIZONTAL OIL WELL



Three-Dimensional Geologic Model of the Parshall Area





Bakken is > 1 mile below fresh water zone

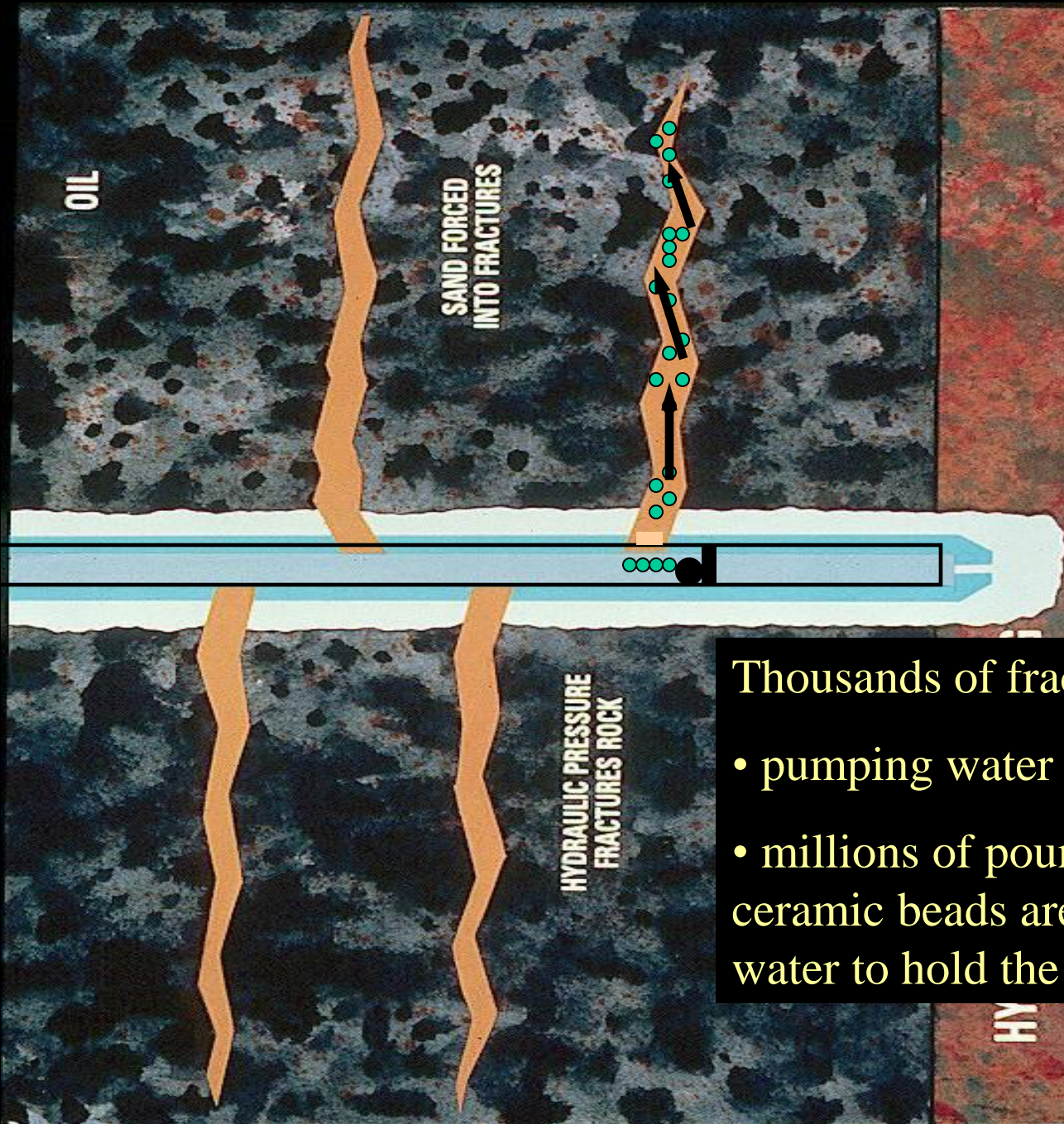


Performing hydraulic fracture stimulation south of Tioga

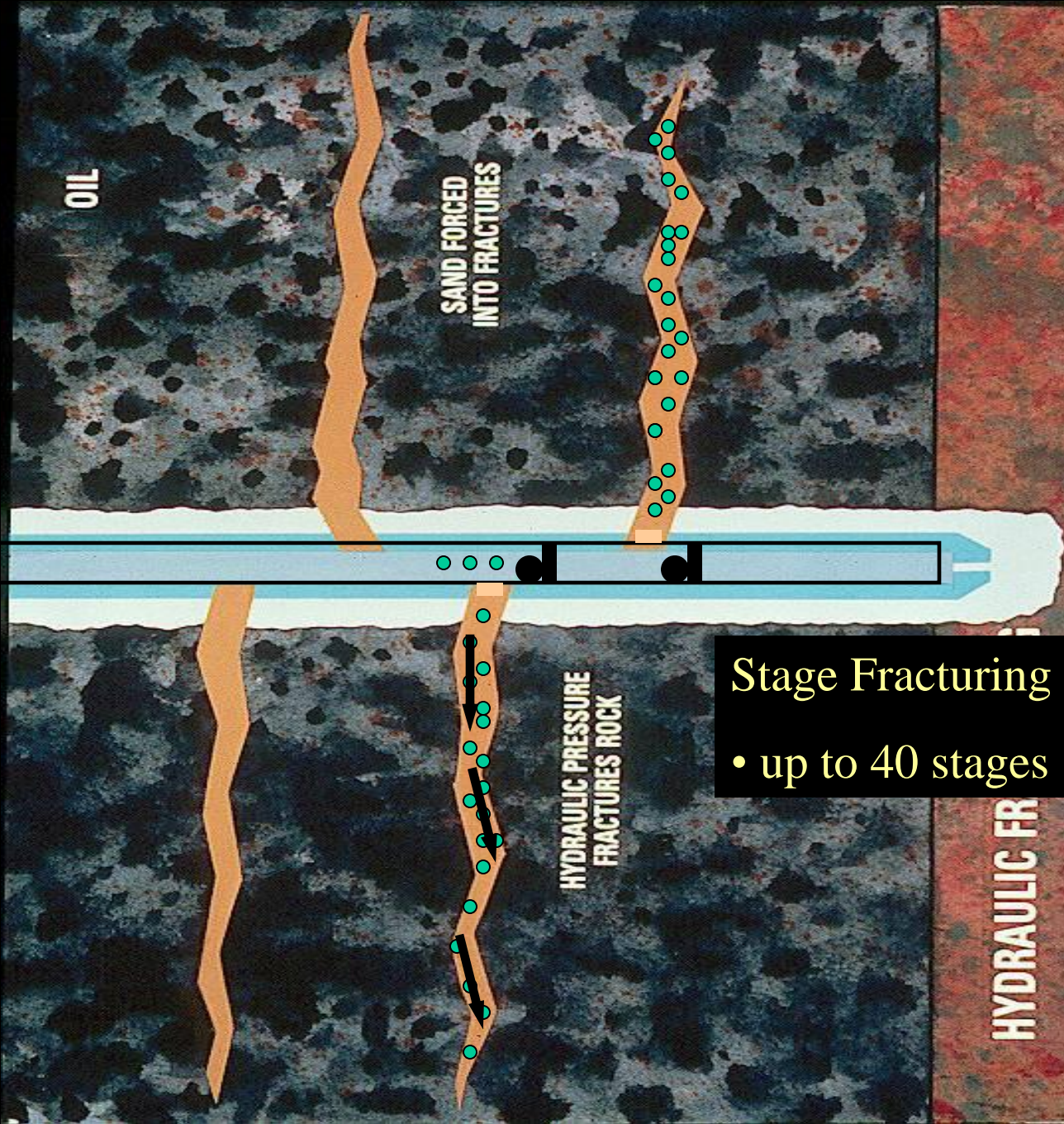
- all Bakken wells must be hydraulically fractured to produce
- > 2 million gallons of water
- > 3 million pounds of sand
- cost > \$3 million

WHY FRAC THE ROCK?

- **already developed easy oil**
 - **oil flows easily without fracking**
- **Unconventional Reserves**
 - **reservoirs are tight**
 - **uneconomic to produce w/o fracking**
 - **must create a path for oil to flow**

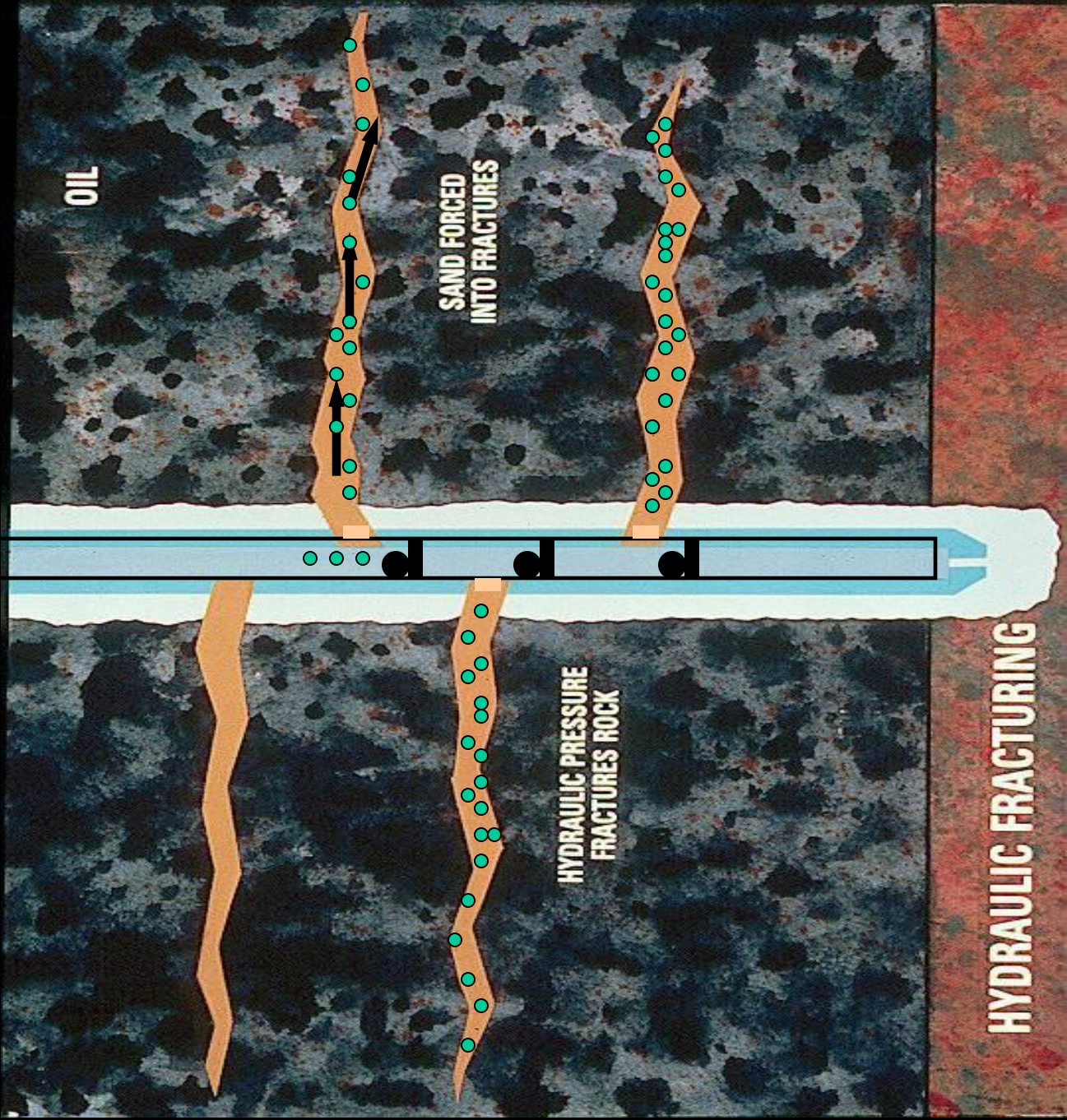


- Thousands of fractures are created
- pumping water at 6,000-9,000 psi
 - millions of pounds of sand and ceramic beads are pumped with the water to hold the fractures open.



Stage Fracturing

- up to 40 stages

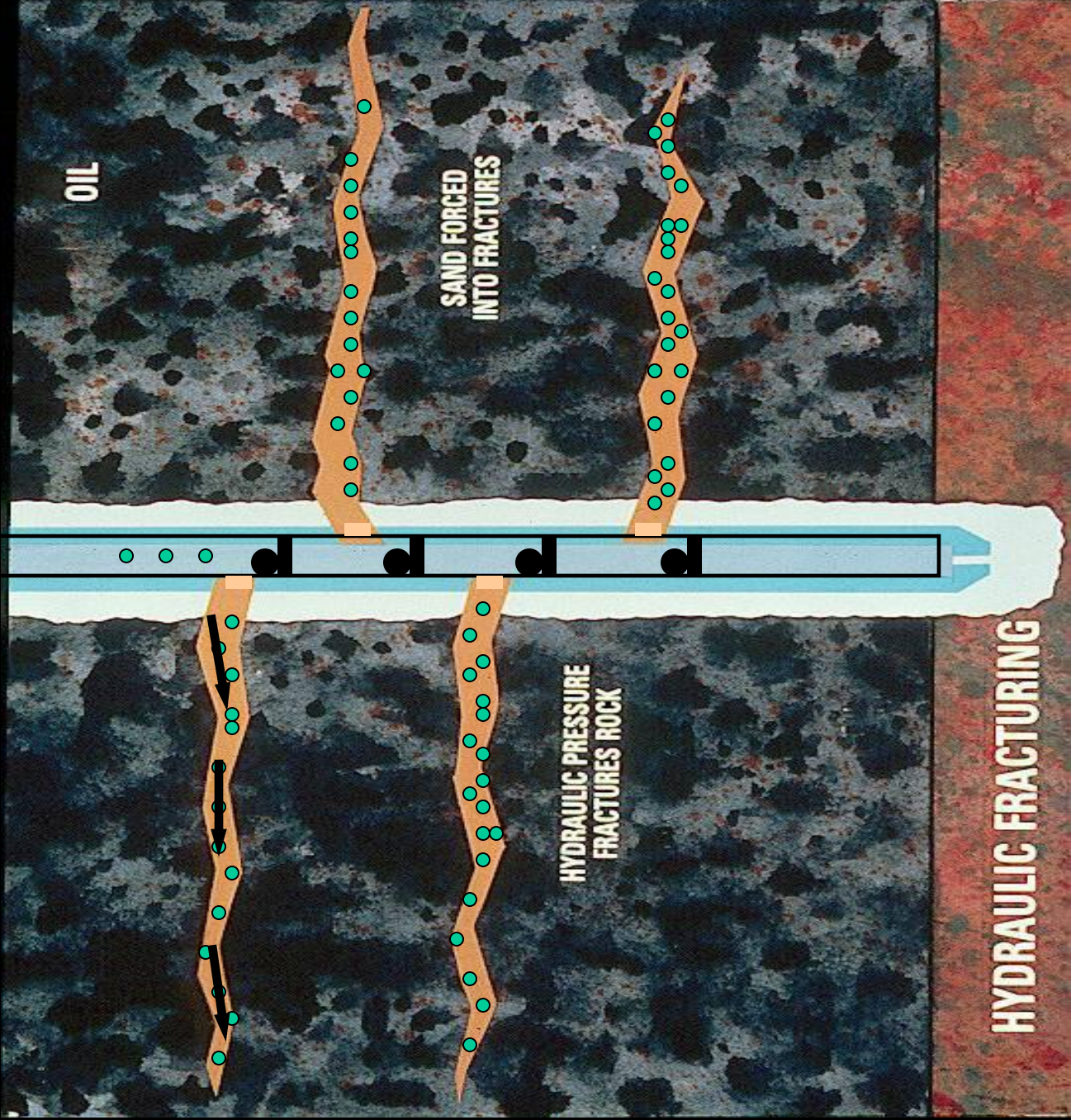


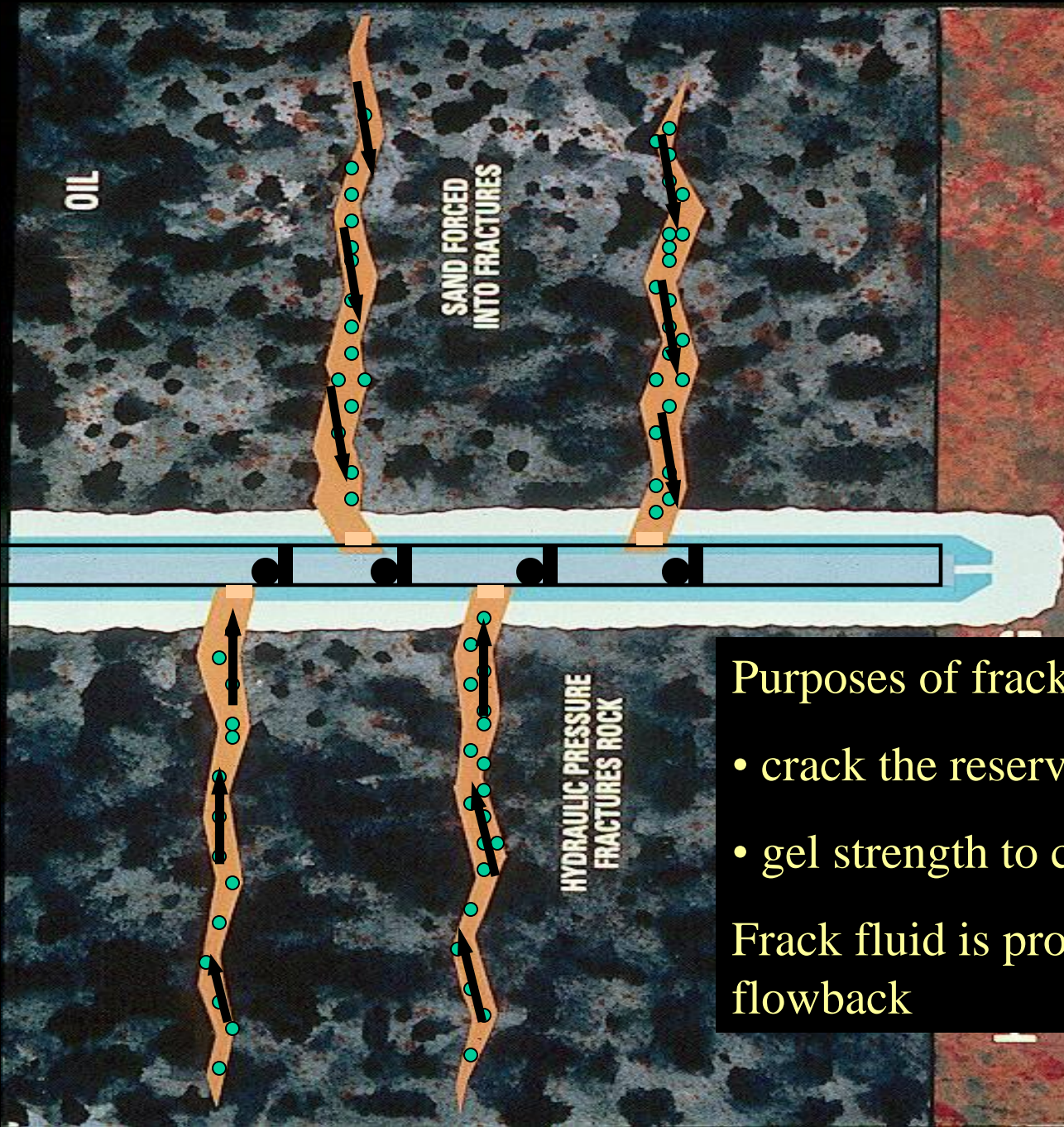
HYDRAULIC FRACTURING

OIL

**SAND FORCED
INTO FRACTURES**

**HYDRAULIC PRESSURE
FRACTURES ROCK**



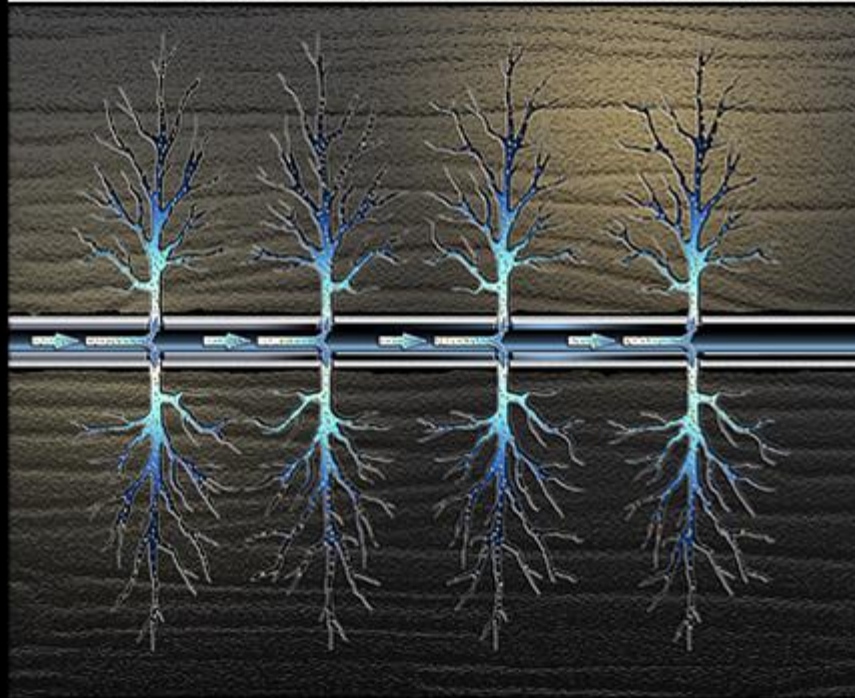


Purposes of frack fluid

- crack the reservoir
- gel strength to carry sand

Frack fluid is produced back as flowback

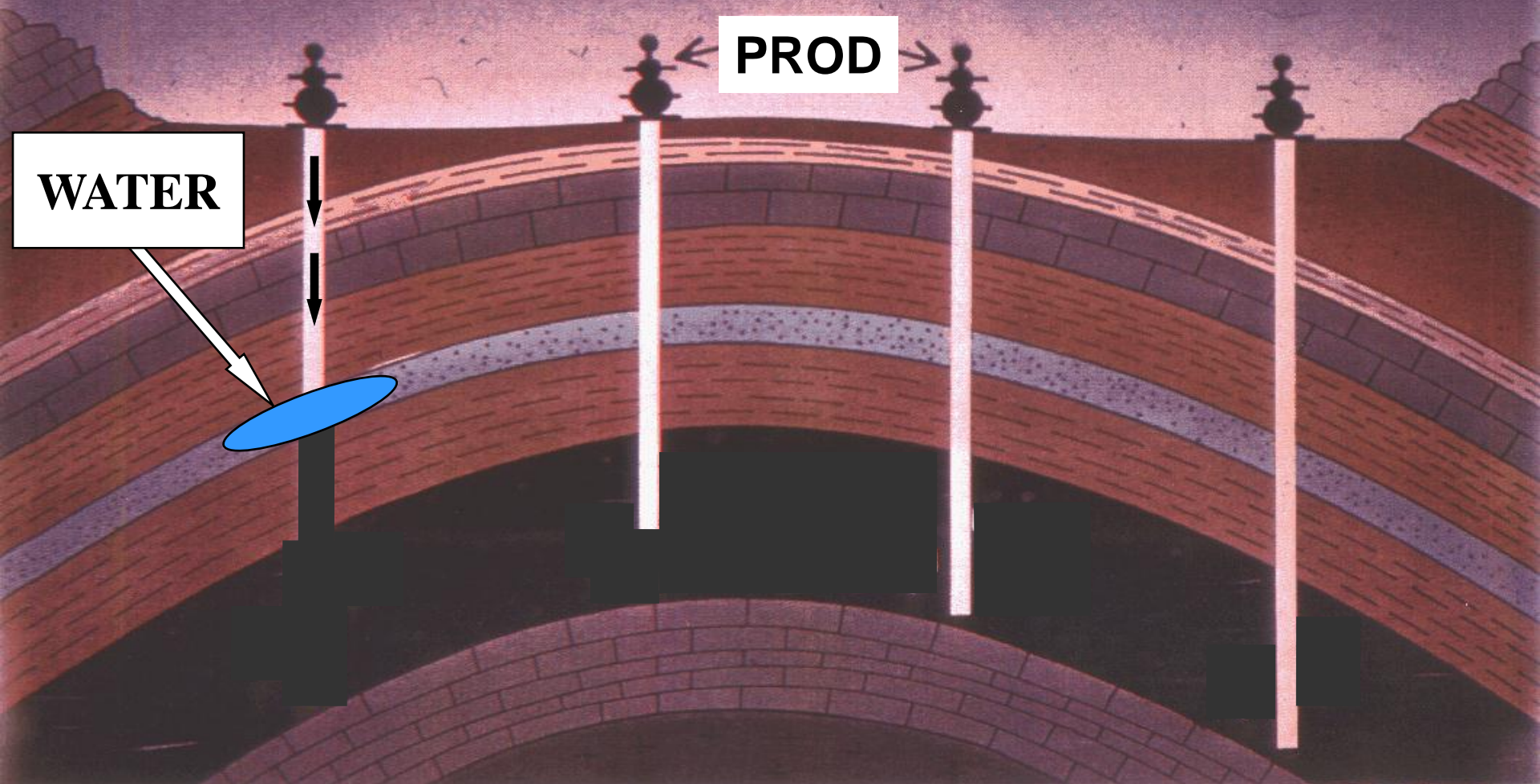
Hydraulic Fracturing: Mixture of water, sand and chemicals pressurized and pumped into the well to form microscopic fractures in shale.



Industrial Commission Regulation

- **Water flowback after frac**
 - **Flowback in lined pit allowed**
 - **Disposal wells permitted through
Underground Injection Program**
 - **Disposal zone is 2,500 feet below
potable waters**

WATER DISPOSAL PROCESS





States have been regulating the full life cycle of hydraulic fracturing for decades

- Water Appropriation Regulation**
- Oil & Gas Regulation**
- Health Department Regulation**
- Geologic setting in each basin different**

Thirsty Horizontal Wells

- **2,500 wells / year**
- **15 - 25 years duration**
- **20 - 30 million gallons water / day**

Commission supports surface water use

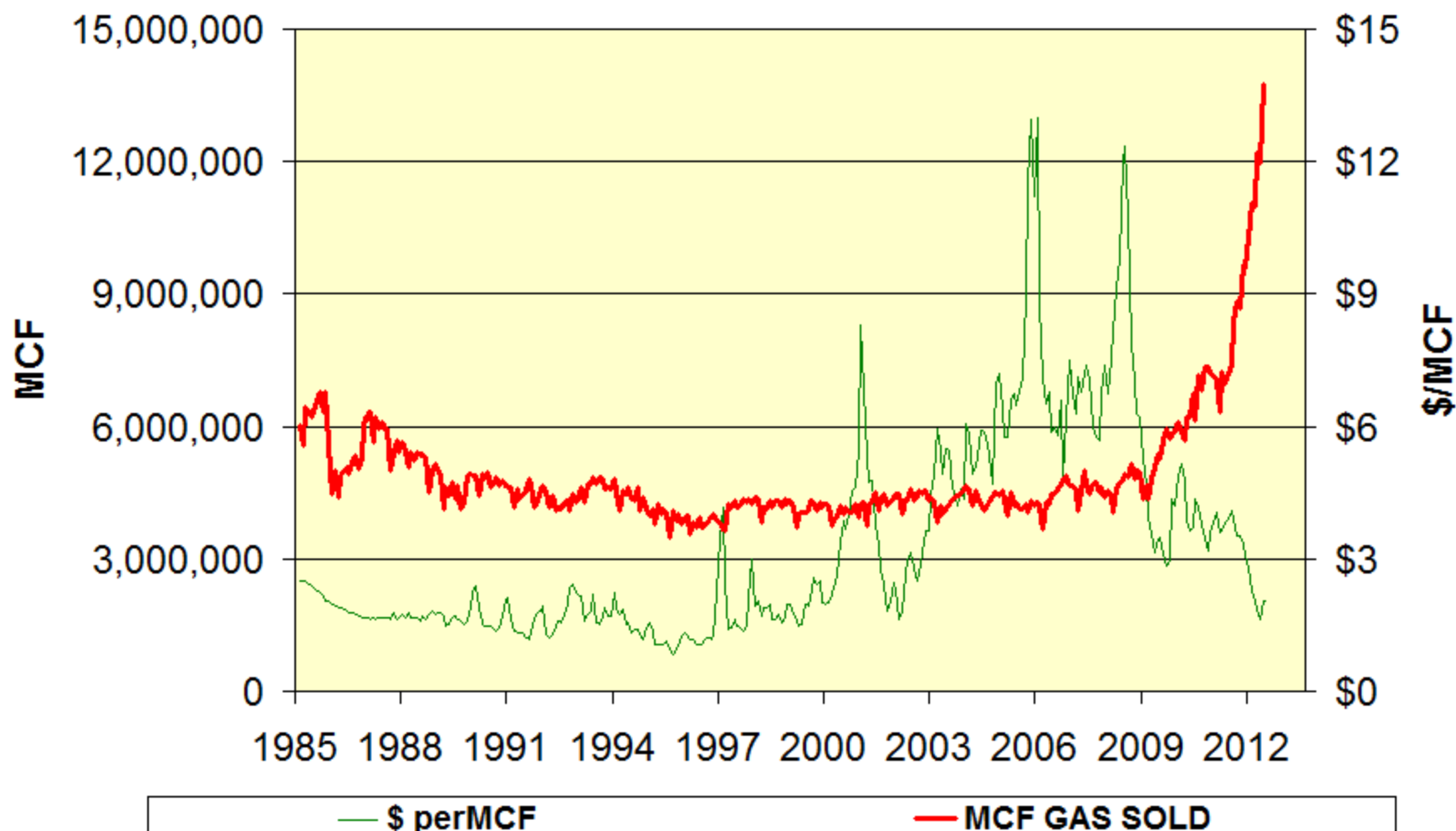
- **Lake Sakakawea best water resource**
 - **one inch contains 10 billion gal water**
 - **5000 wells @ 2mil gal wtr/well**
 - **2-year supply**

Western North Dakota

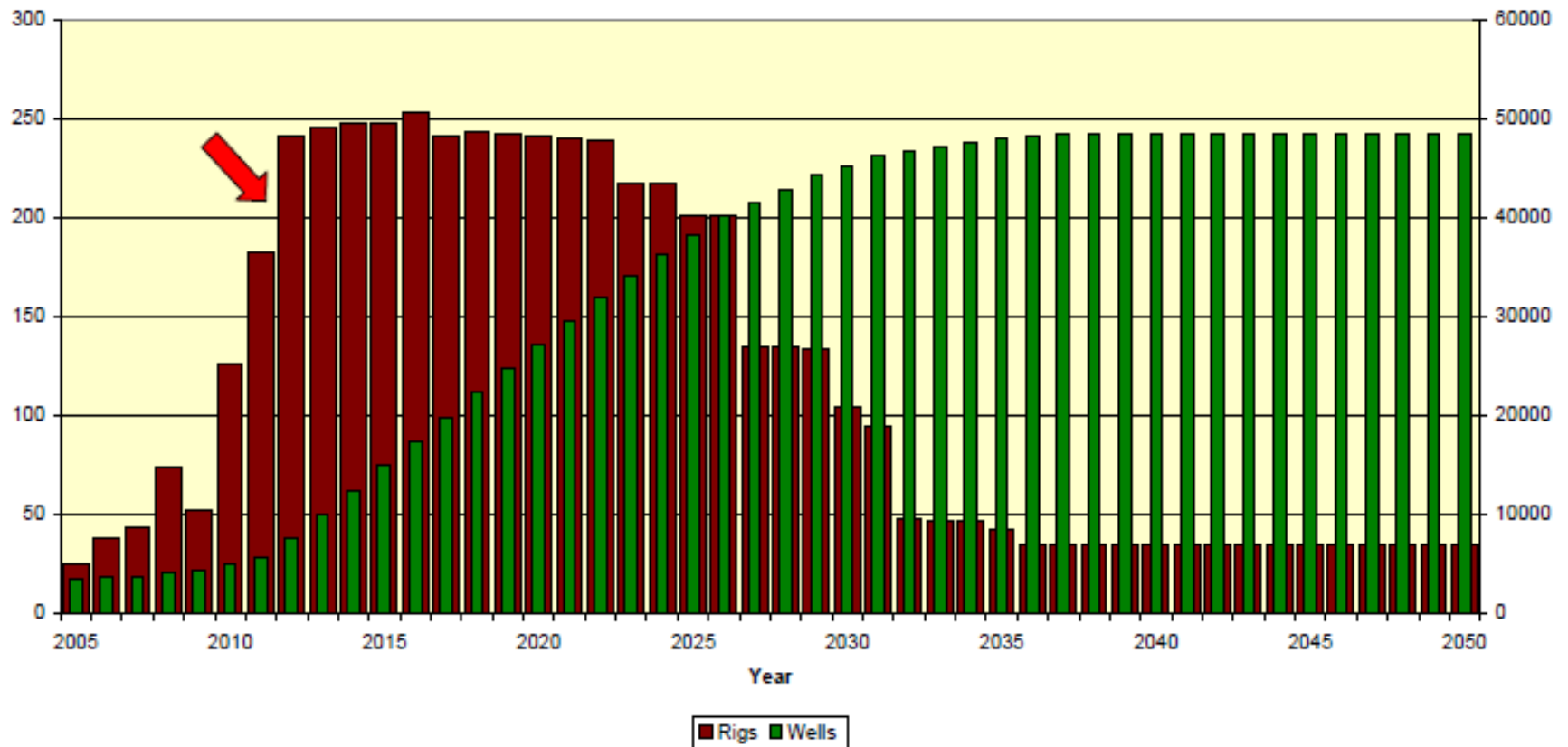
- 1,050 to 2,700 wells / year = 2,000 expected
 - 85-225 rigs = 10,000 – 27,000 jobs = 21,000 expected
- 10 - 25 million gallons frac water / day
 - Equal to 1” of water from Lake Sakakawea / yr
- 10 to 20 years
 - 28,000 new wells expected = $\pm 28,000$ long term jobs



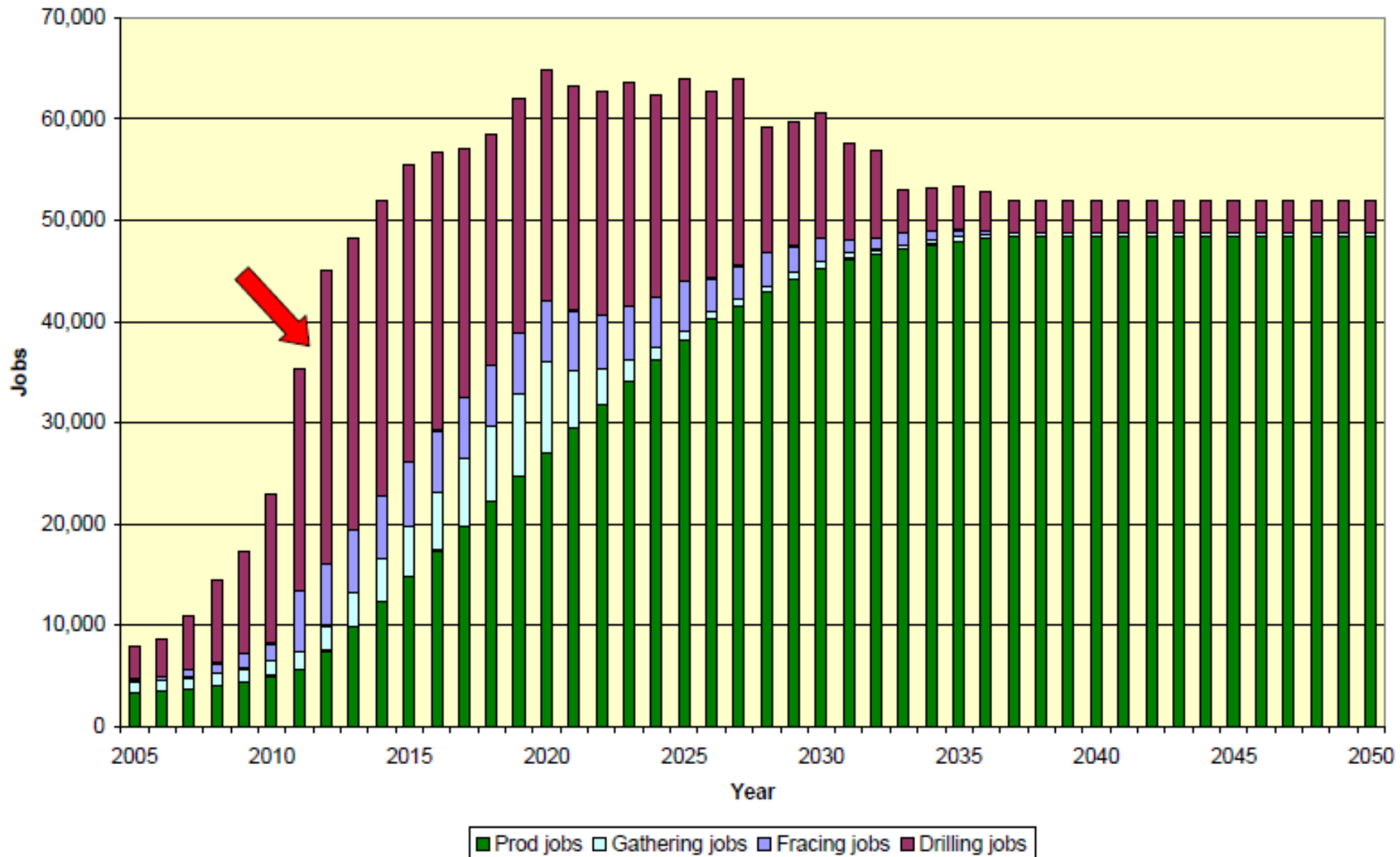
North Dakota Monthly Gas Sold and Price



North Dakota Rigs and Wells



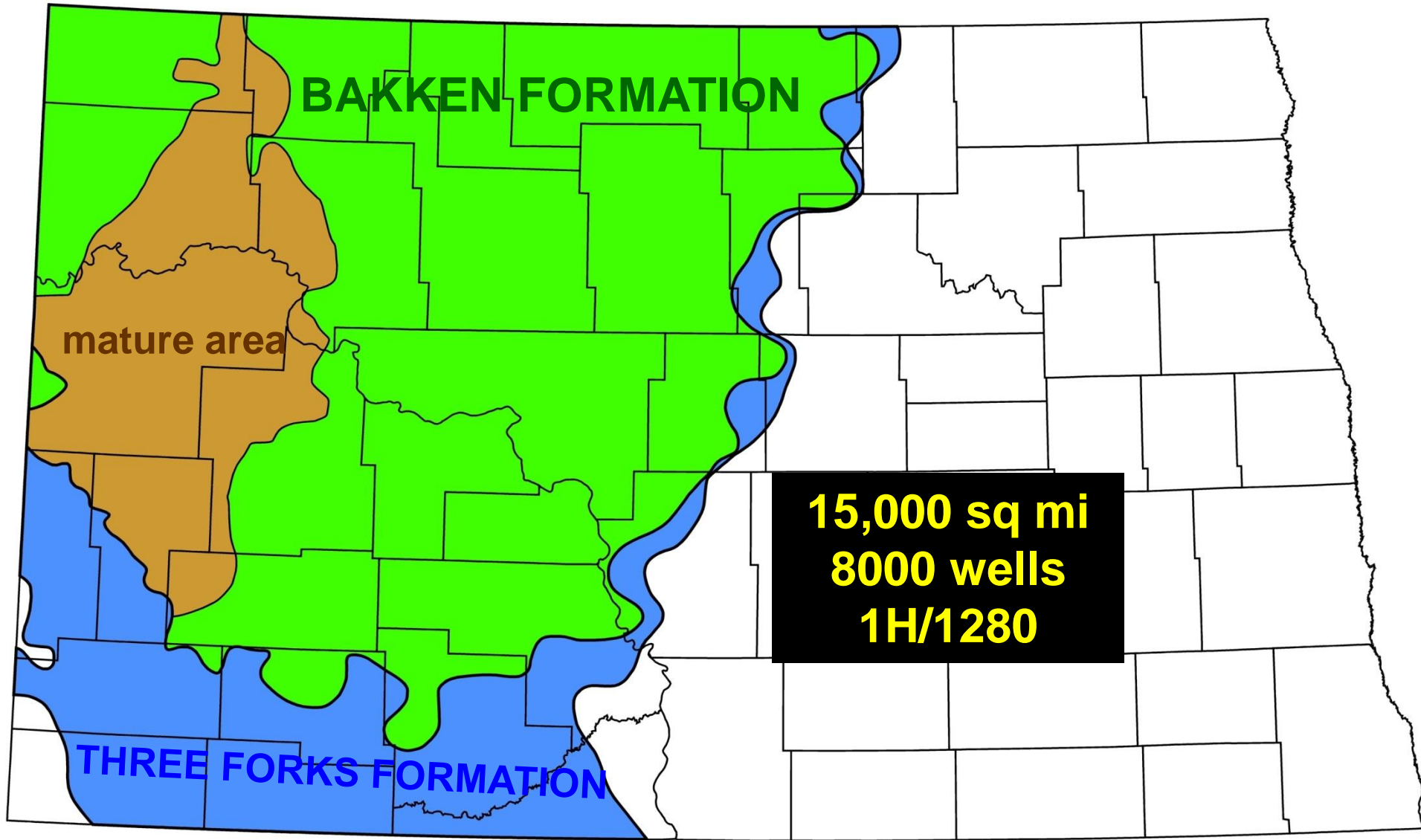
North Dakota Oil Industry Jobs





File No. 15092
Armstrong #1-5 Hanson
Sec 5-T155N-R102W
Williams County, ND

ESTIMATED MATURE AREA OF THE BAKKEN FORMATION



(Nordeng, 2010)

PLANNING FOR THE FUTURE BEST PRACTICES

- **New Commission Rules**
 - **Eliminates 95% of reserve pits**
 - **smaller footprint**
 - **reclaim in 30 days**

PLANNING FOR THE FUTURE

- **New Commission Rules**
 - **Fresh wtr ponds for frac wtr allowed**
 - **eliminates 100s of truck trips**

EPA Guidance for HF using Diesel Fuel

- **Draft guidance presented 5-10-2012**
 - **Comment by 7-9-2012**
 - **Extended to 8-23-2012**
- **NDIC commented on 6-25-2012**

EPA Guidance for HF using Diesel Fuel

- **States have effective HF regulations**
- **UIC permit not appropriate**
- **Definition of diesel too broad**
- **Allows biodiesel w/same chemicals**
- **EPA: N/A to Primacy States**
 - **Guidance appears to require it**

BLM Proposed HF Rules

- **Draft rules presented 5-11-2012**
 - **Comment by 7-10-2012**
 - **Extended to 9-10-2012**
- **NDIC commented on 6-25-2012**

BLM Proposed HF Rules

- **Rules eff on federal and Indian lands**
- **States have effective HF regulations**
- **Defines simple acid job as HF**
- **Duplication of North Dakota regs**
- **BLM short-staffed: Permit > 180 days**

Hydraulic Fracturing Stimulation is Safe

- **IOGCC survey—no contamination**
- **GWPC study verifies State's regs**
- **GWPC National Registry f/chemicals**

**North Dakota has been
regulating the full life cycle of
hydraulic fracturing for decades**

- **Water Comm—water withdrawals**
- **Industrial Comm—well permitting & disposal of flowback water**
- **Health Dept—spill cleanup**