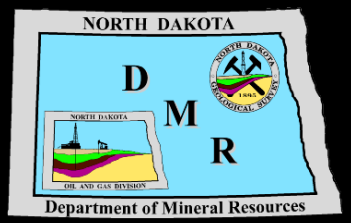
Oil & Gas Activity UPDATE

Midwest Ground Water Conference

Minneapolis, MN – October 1, 2012

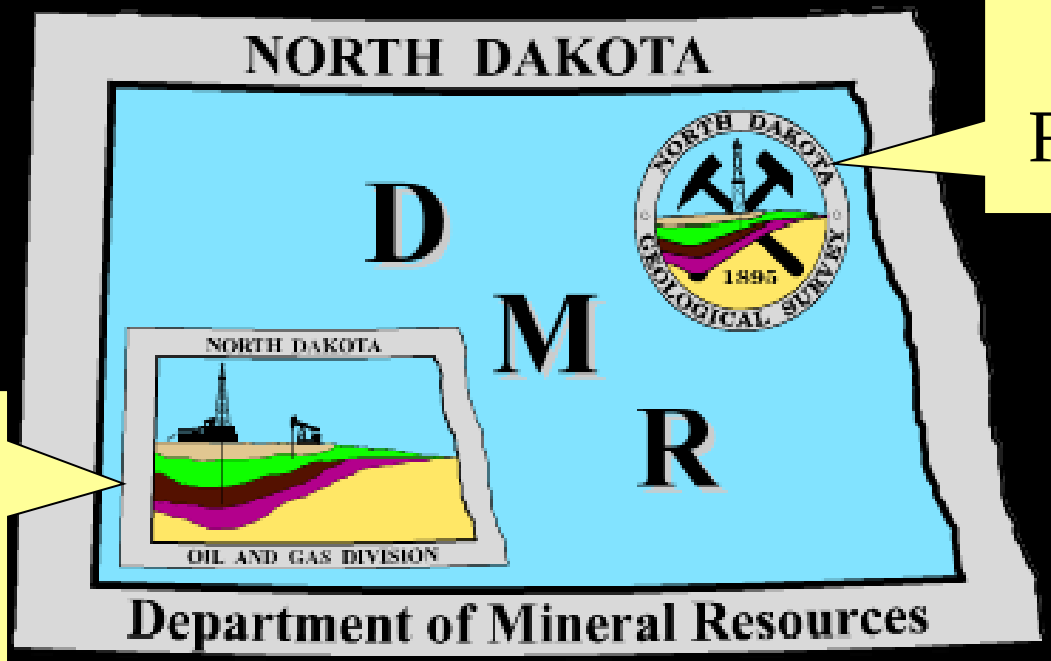


OIL & GAS UPDATE

- **North Dakota Update**
- **Hydraulic Fracing**
- **Disposal of Fluids**

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

North Dakota Department of Mineral Resources

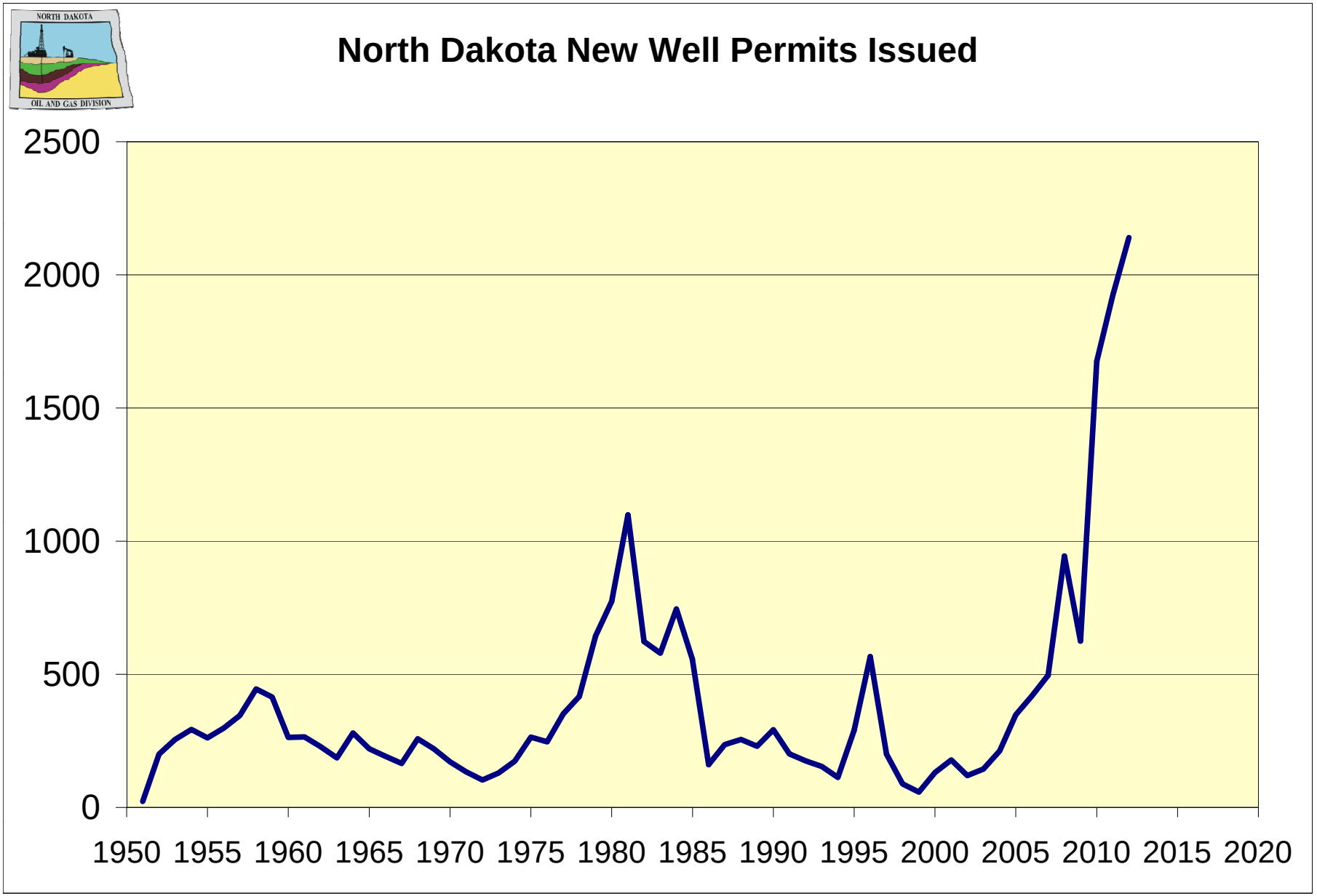


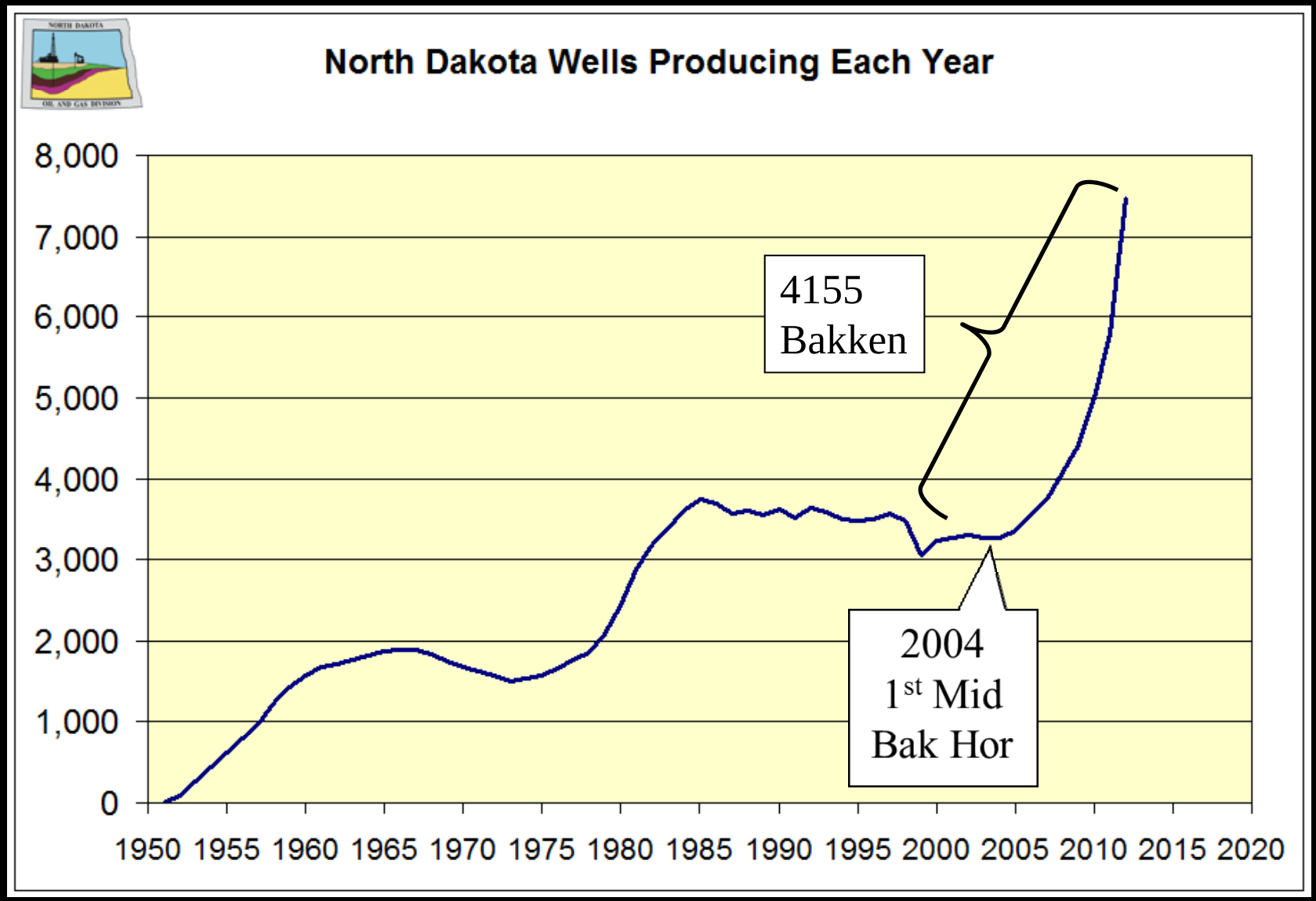
NDGS
Research Arm

OGD
Regulatory
Arm

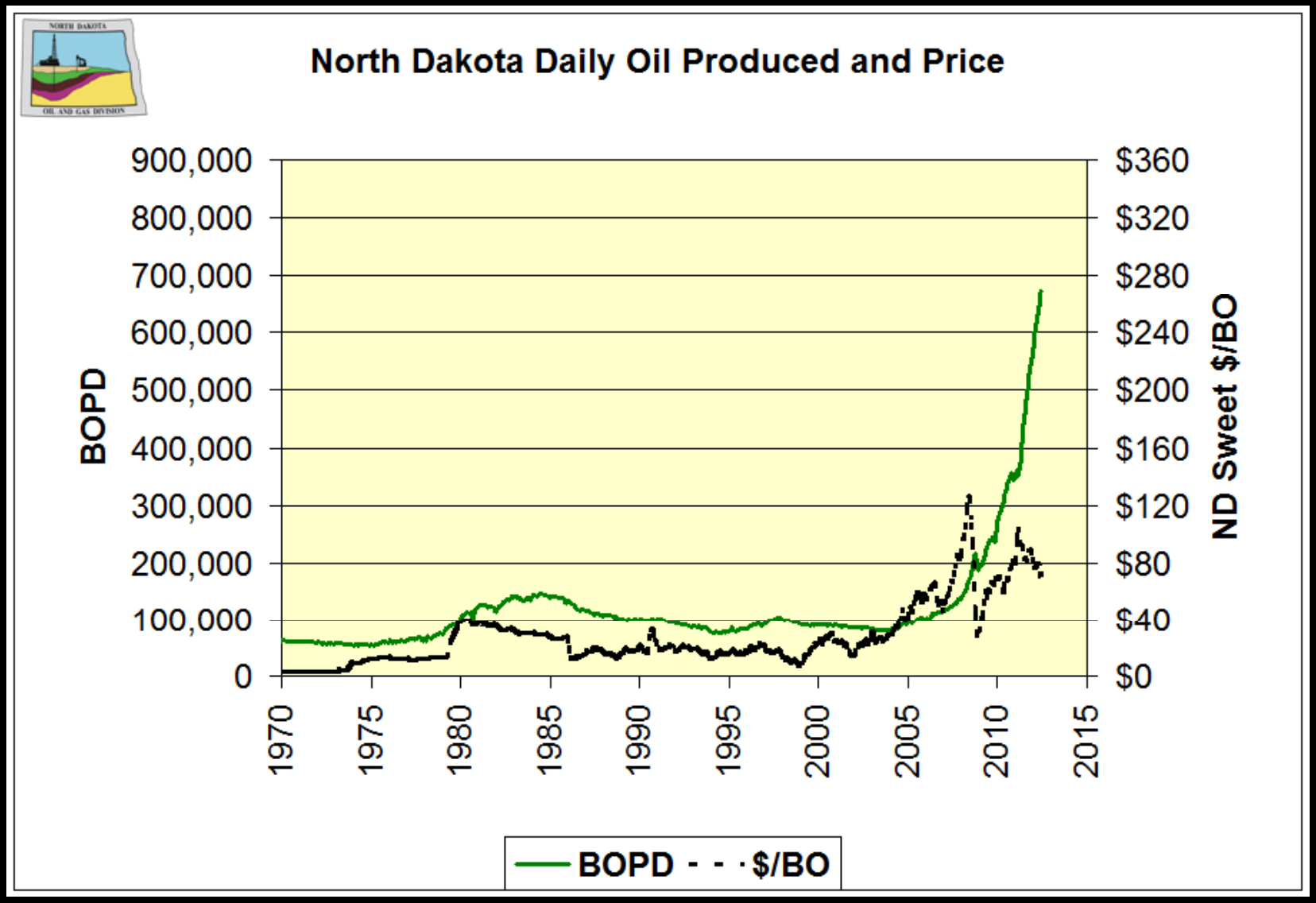
https://www.dmr.nd.gov/oilgas/ ***https://www.dmr.nd.gov/ndgs/***

600 East Boulevard Ave. - Dept 405
Bismarck, ND 58505-0840
(701) 328-8020 (701) 328-8000

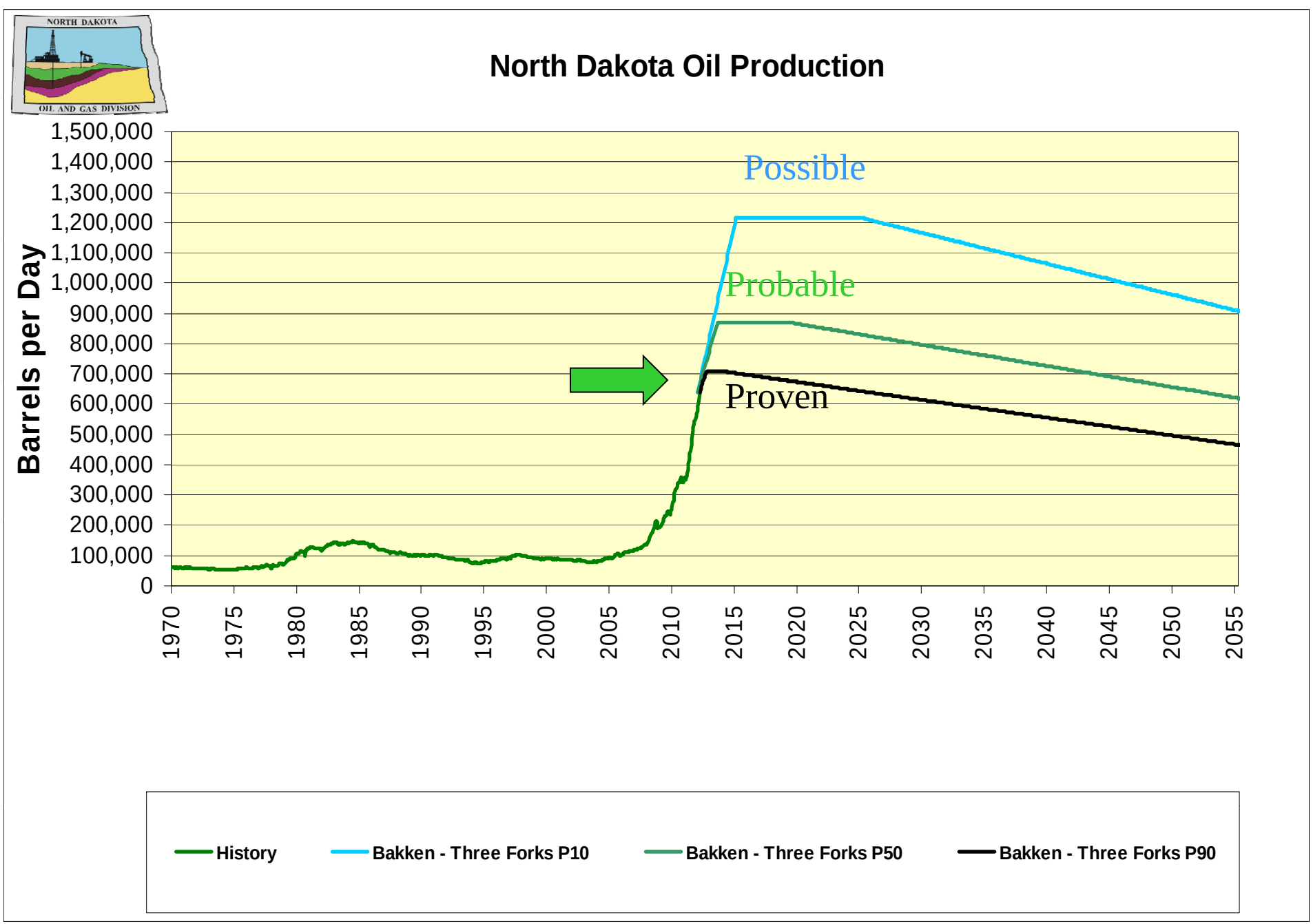

NORTH DAKOTA
OIL AND GAS DIVISION
North Dakota New Well Permits Issued
2500
2000
1500
1000
500
0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

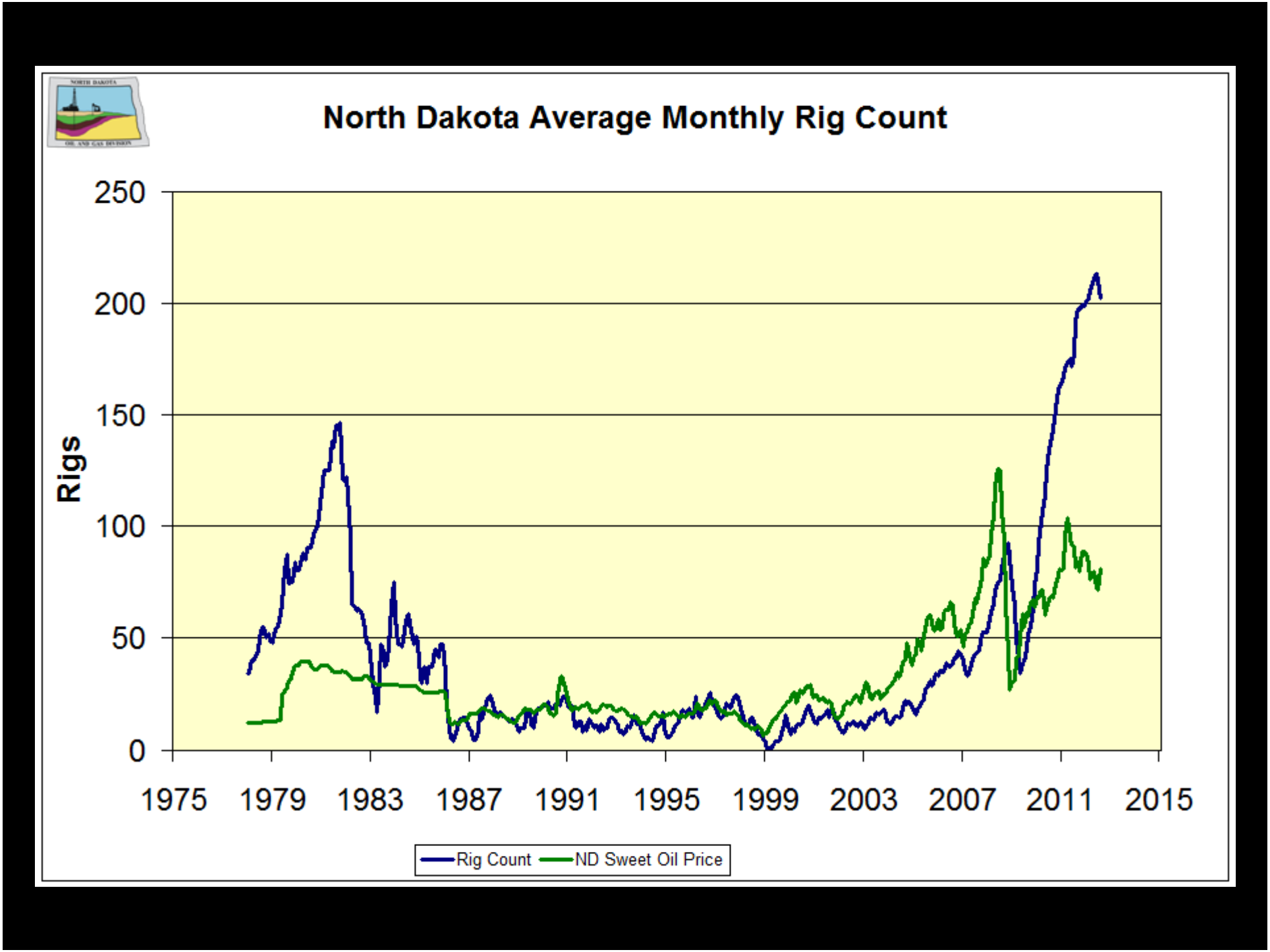


7467 total wells – 4155 Bakken horizontal (55.6%)

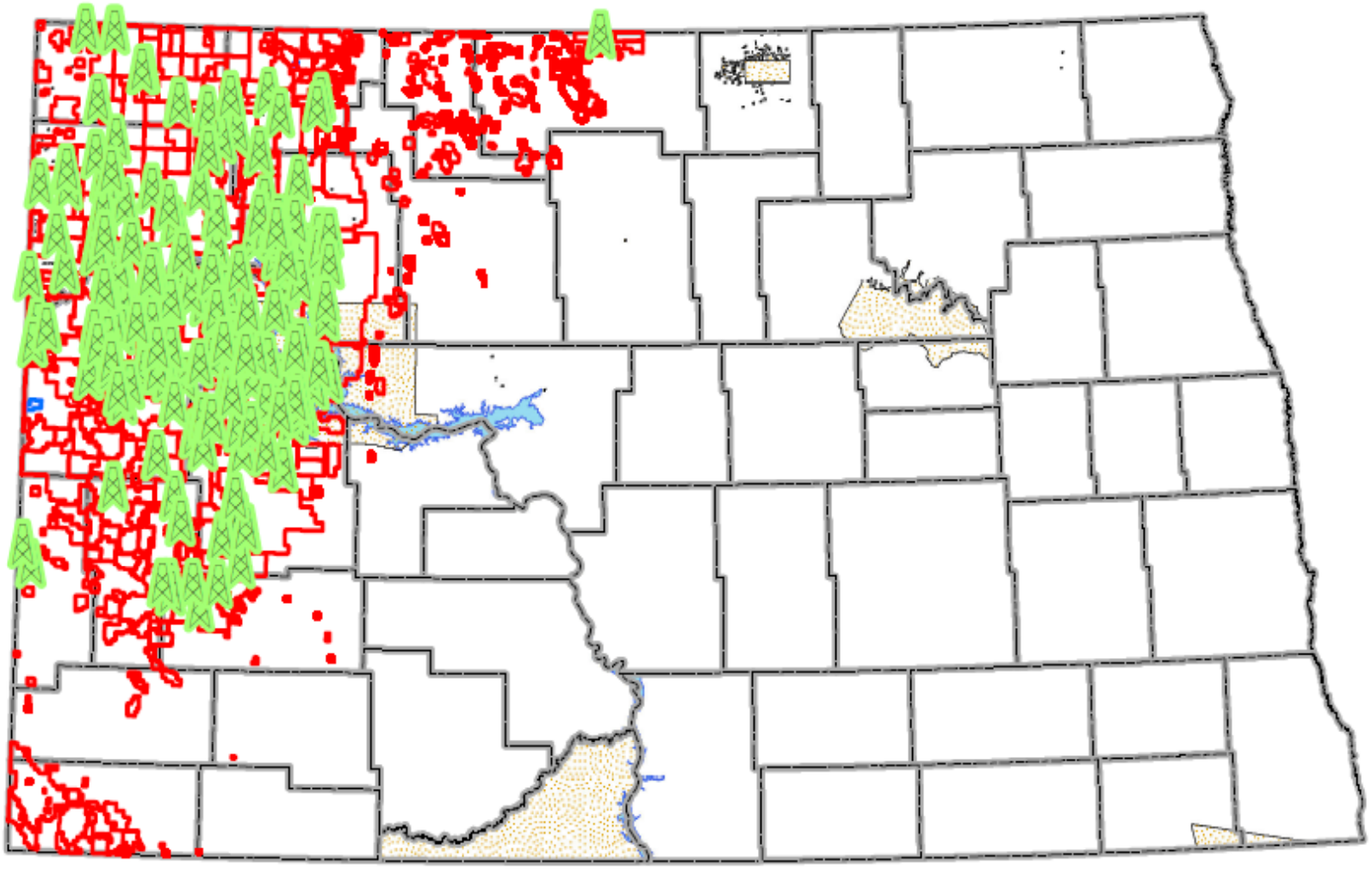


Production 674,000 bopd (appr 607,000 from Bakken—90%)


NORTH DAKOTA
OIL AND GAS DIVISION
North Dakota Oil Production
Barrels per Day
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
Possible
Probable
Proven
History
Bakken - Three Forks P10
Bakken - Three Forks P50
Bakken - Three Forks P90


North Dakota Average Monthly Rig Count
Rigs
250
200
150
100
50
0
1975
1979
1983
1987
1991
1995
1999
2003
2007
2011
2015
Rig Count
ND Sweet Oil Price

NORTH DAKOTA – 190 DRILLING RIGS – SEP 2012



Current drilling activity is focused

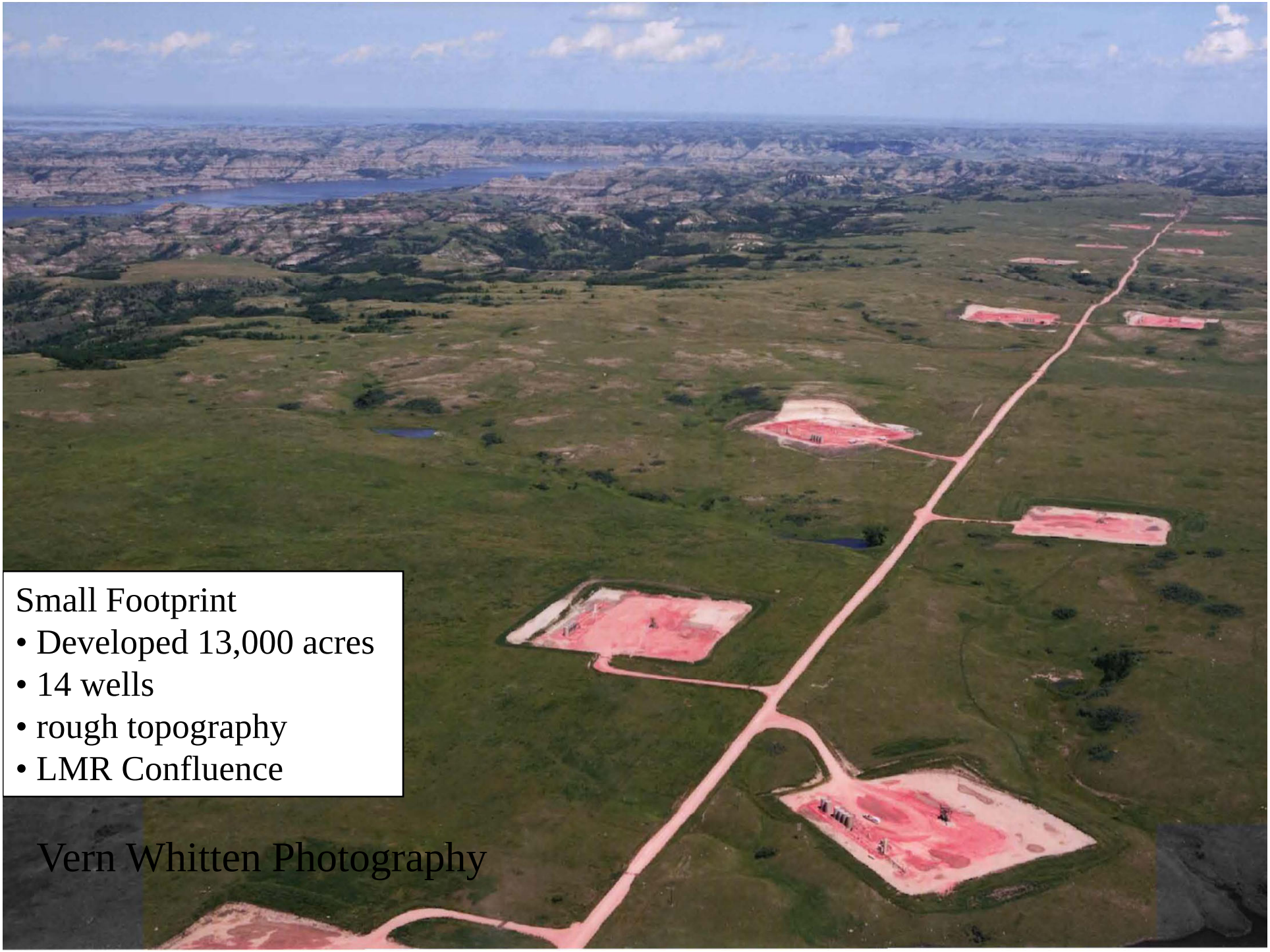
in Mountrail, Dunn, McKenzie, and Williams Counties.

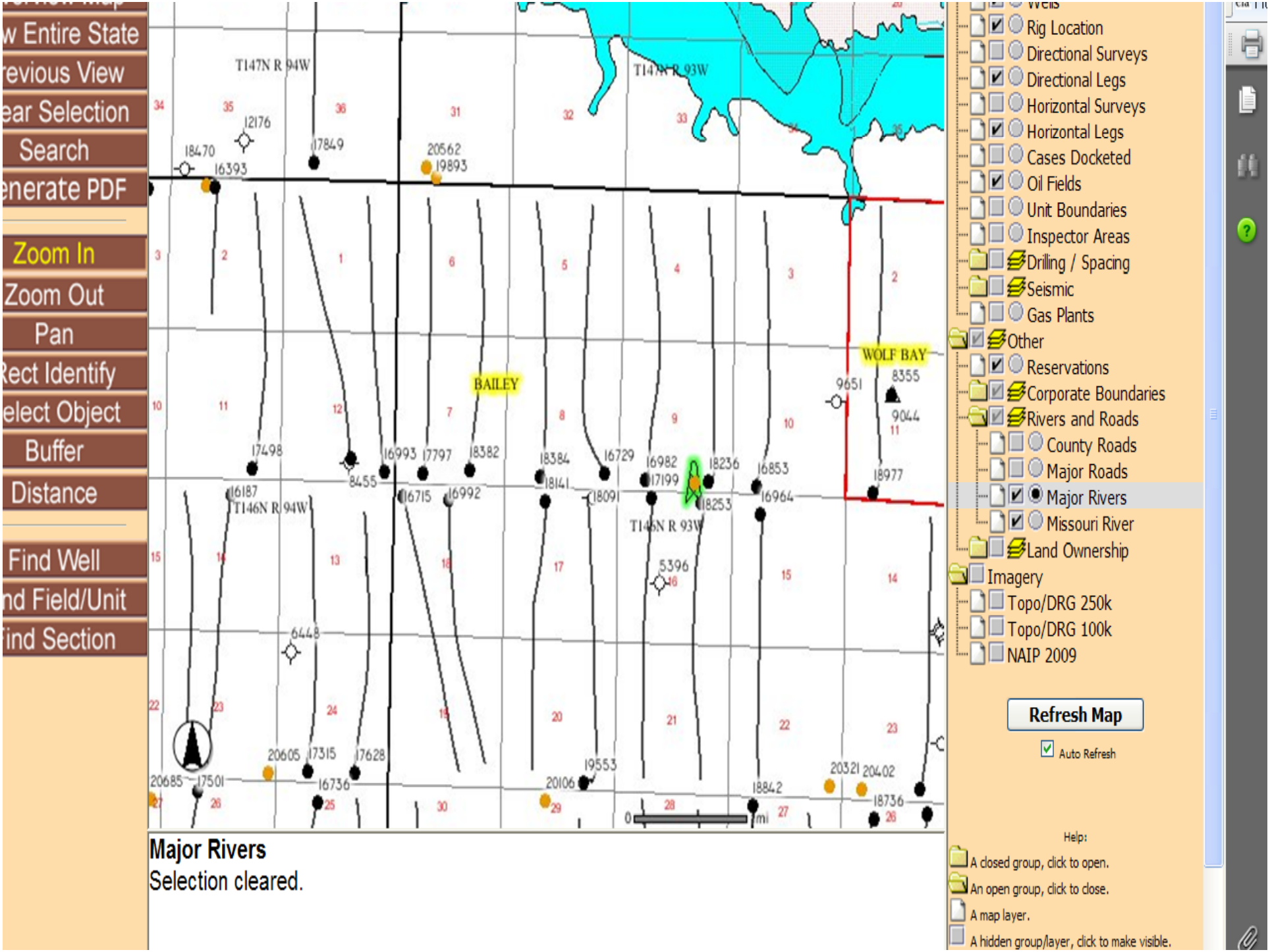
RIGS

- 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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Zoom In
Zoom Out
Pan
Rect Identify
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Distance
Find Well
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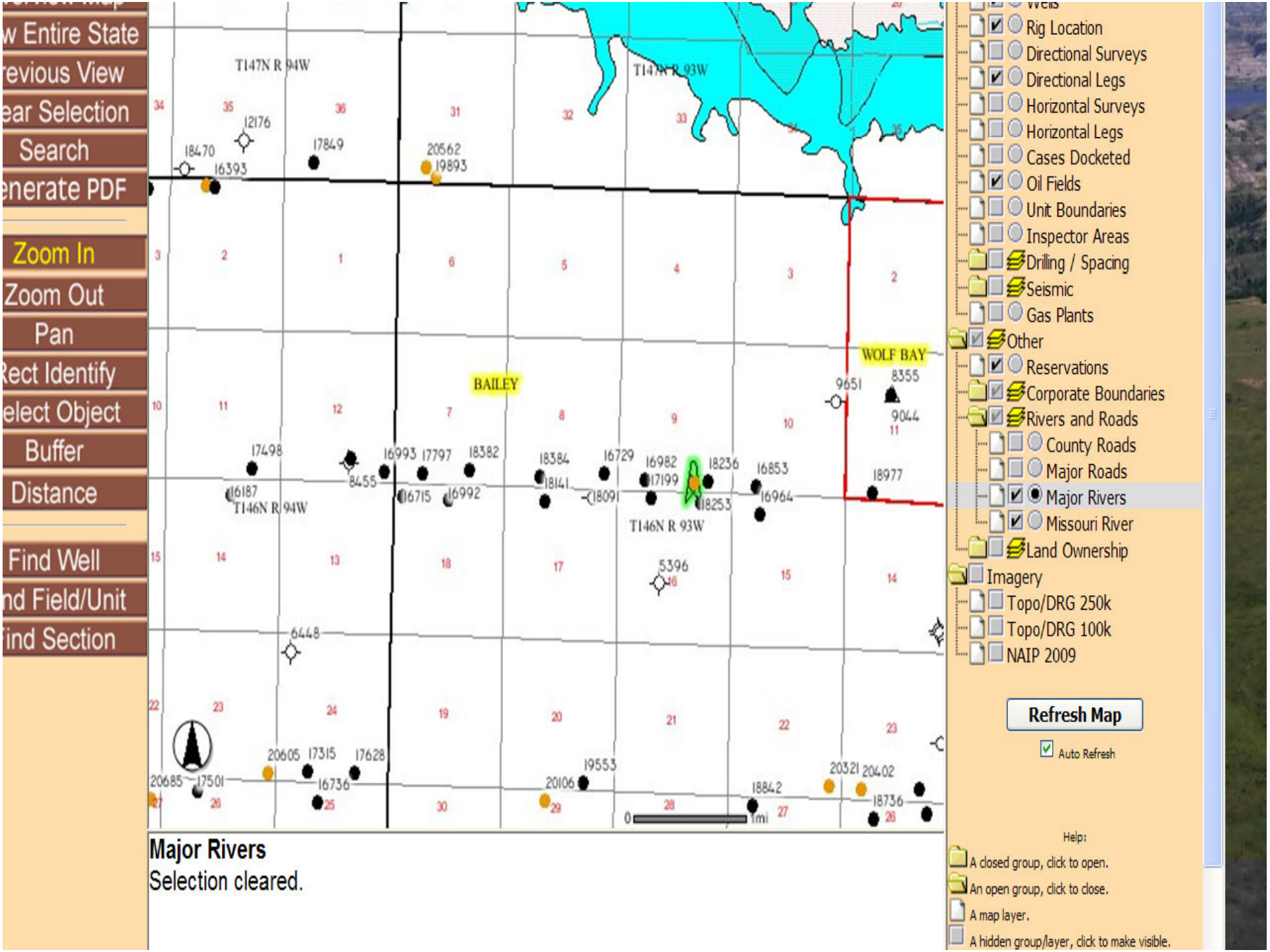
ind Section
T147N R 94W
T147N R 93W
T146N R 94W
T146N R 93W
BAILEY
WOLF BAY
Rig Location
Directional Surveys
Directional Legs
Horizontal Surveys
Horizontal Legs
Cases Docketed
Oil Fields
Unit Boundaries
Inspector Areas
Drilling / Spacing
Seismic
Gas Plants
Other
Reservations
Corporate Boundaries
Rivers 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.
Major Rivers
Selection cleared.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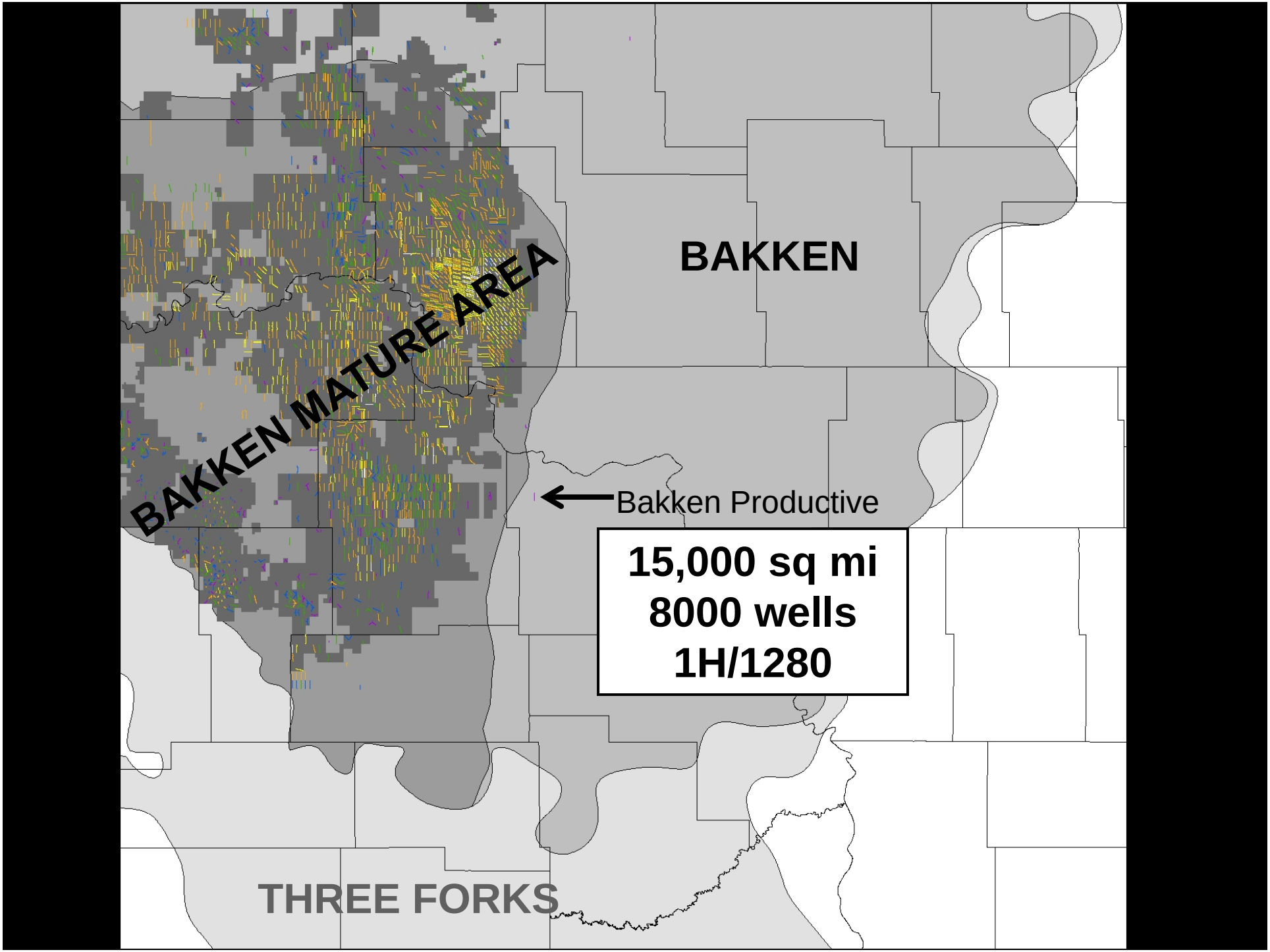
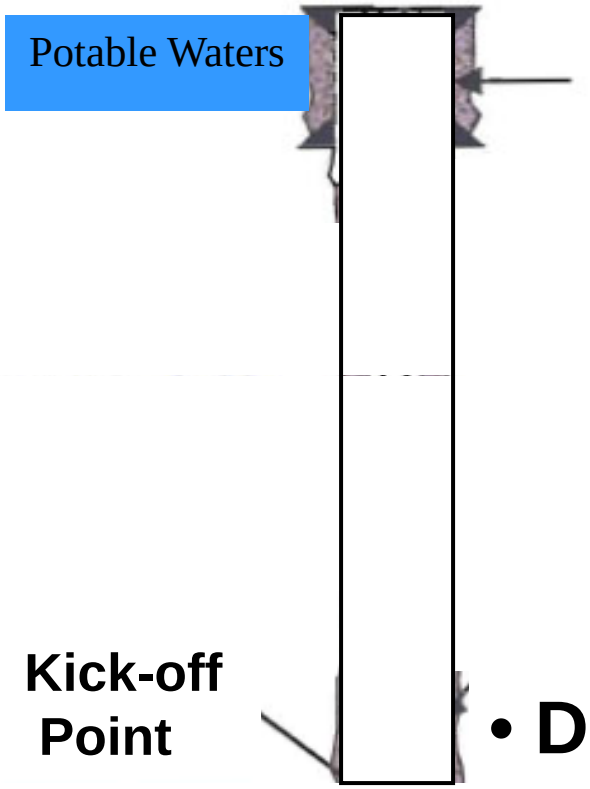
Vern Whitten Photography


BAKKEN
BAKKEN MATURE AREA
Bakken Productive
15,000 sq mi
8000 wells
1H/1280
THREE FORKS

TYPICAL HORIZONTAL OIL WELL

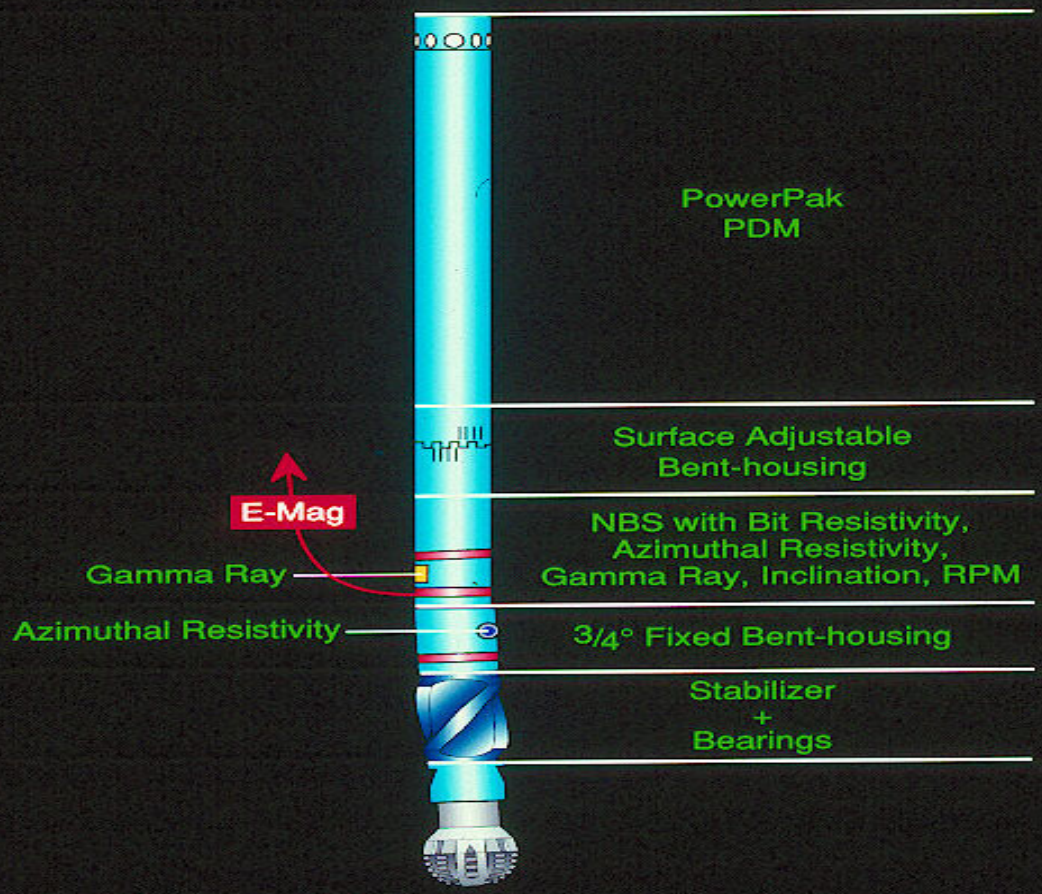
- Drill with fresh water
- Total depth below lowest potable water
- Run in hole with surface casing
  - 1st layer of surface water protection
- Cement casing back to surface of ground
  - 2nd layer of surface water protection

TYPICAL HORIZONTAL OIL WELL

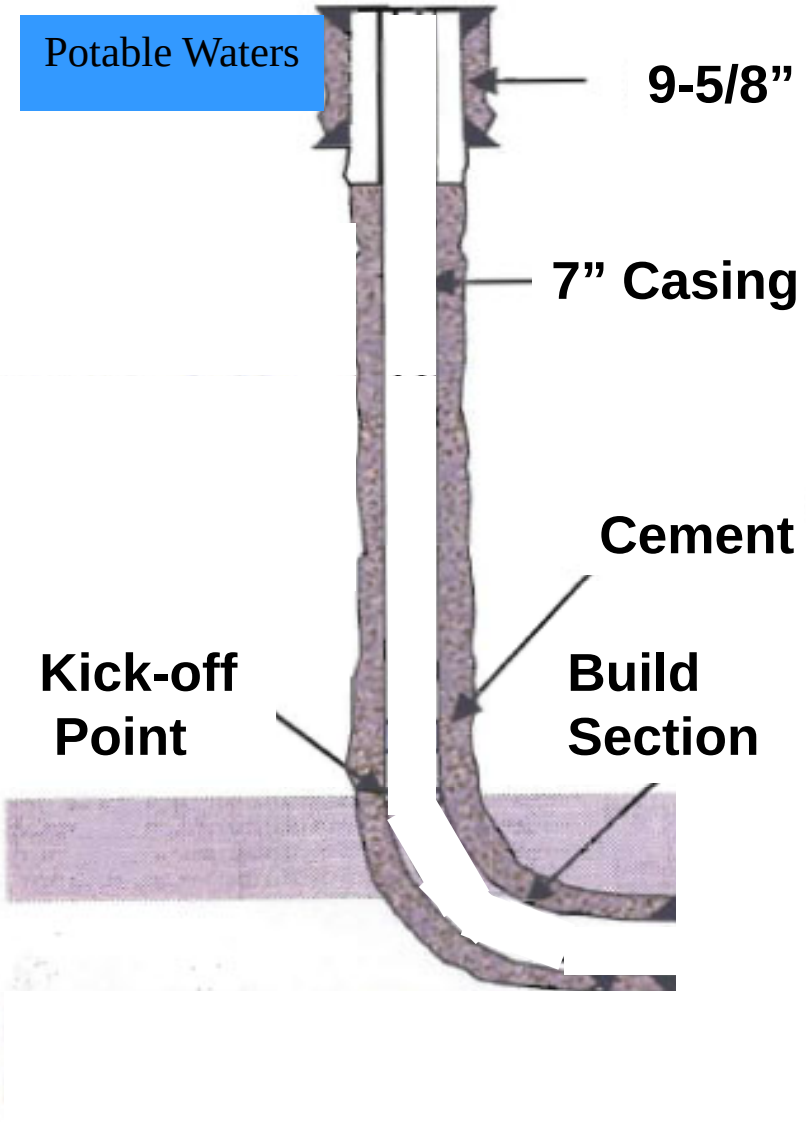


- Drill vertically to kick-off point
- Run in hole with bent assembly
- Downhole mud motor

GeoSteering Tool

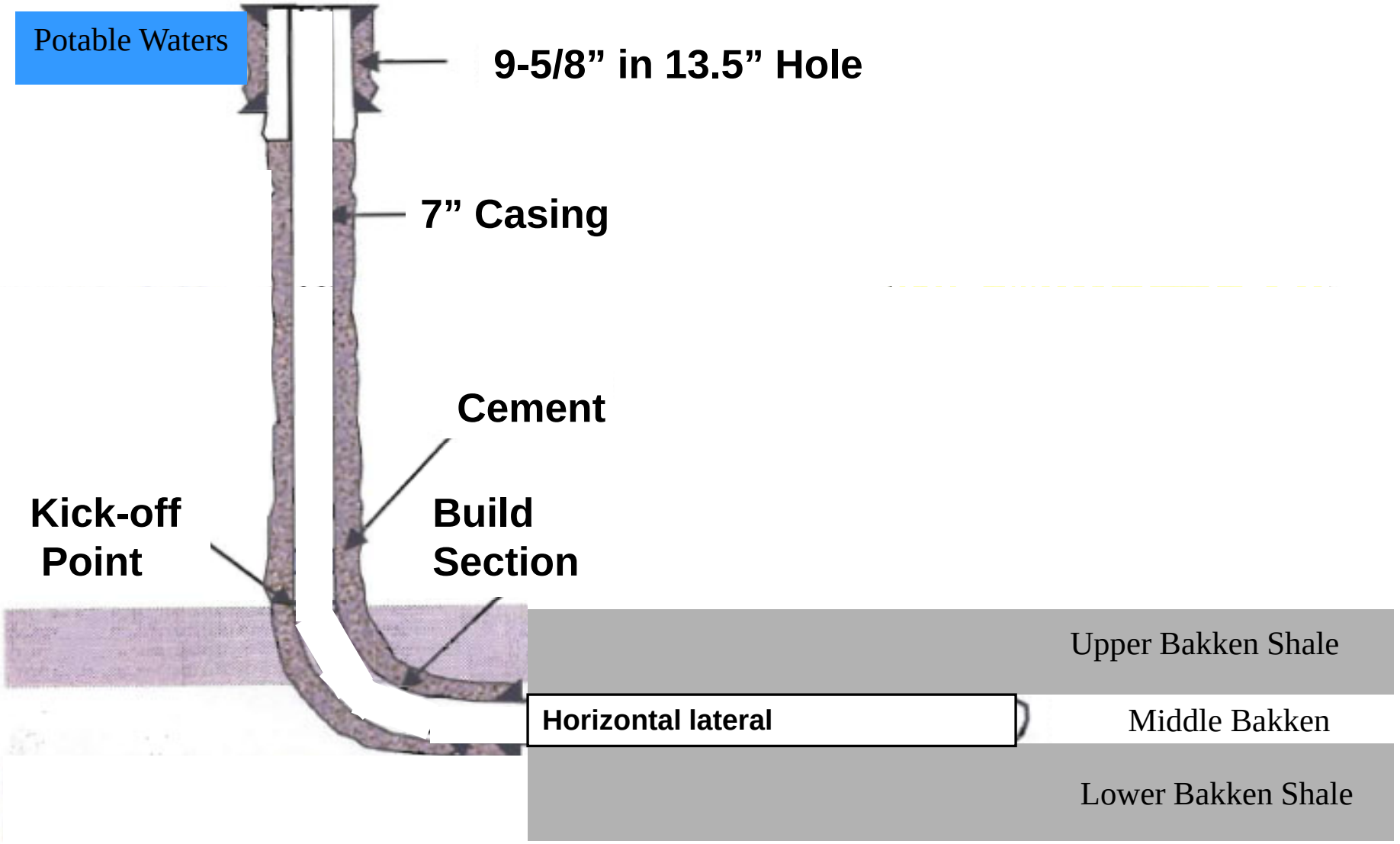


TYPICAL HORIZONTAL OIL WELL

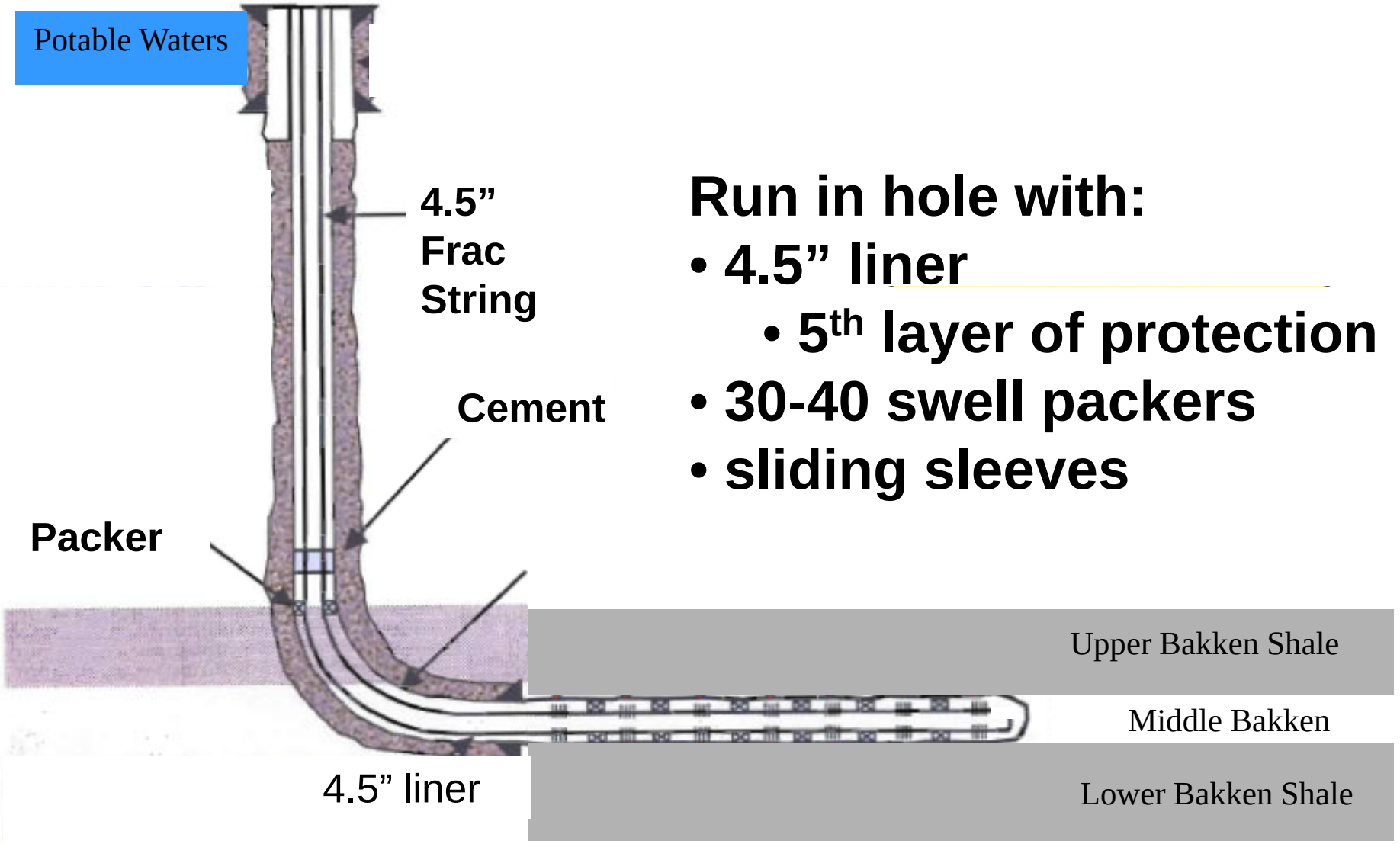


- Drill 8-3/4” hole to pay
- Run in hole with 7” casing
  - 3rd layer of protection
- Cement 7” casing
  - 4th layer of protection

TYPICAL HORIZONTAL OIL WELL



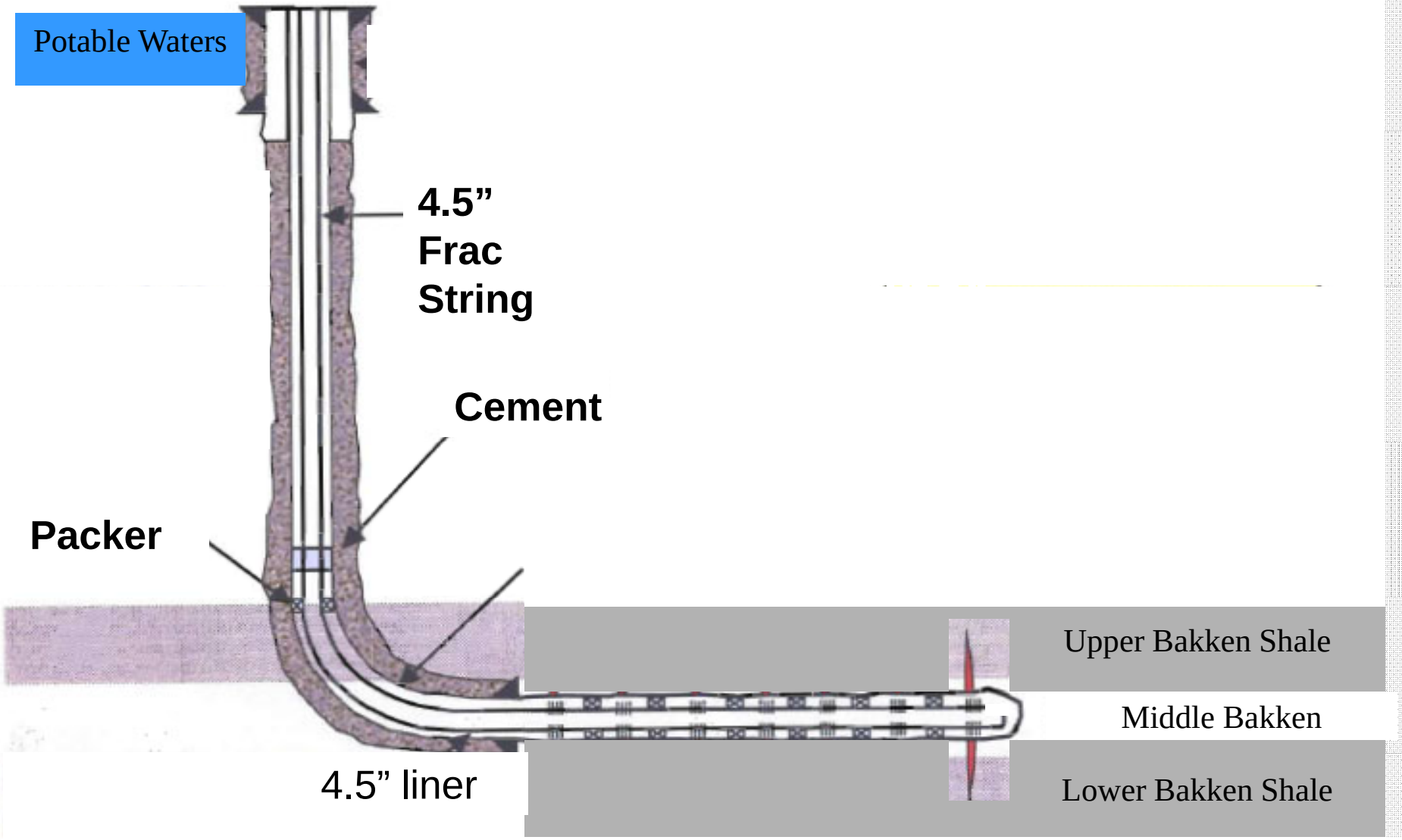
TYPICAL HORIZONTAL OIL WELL



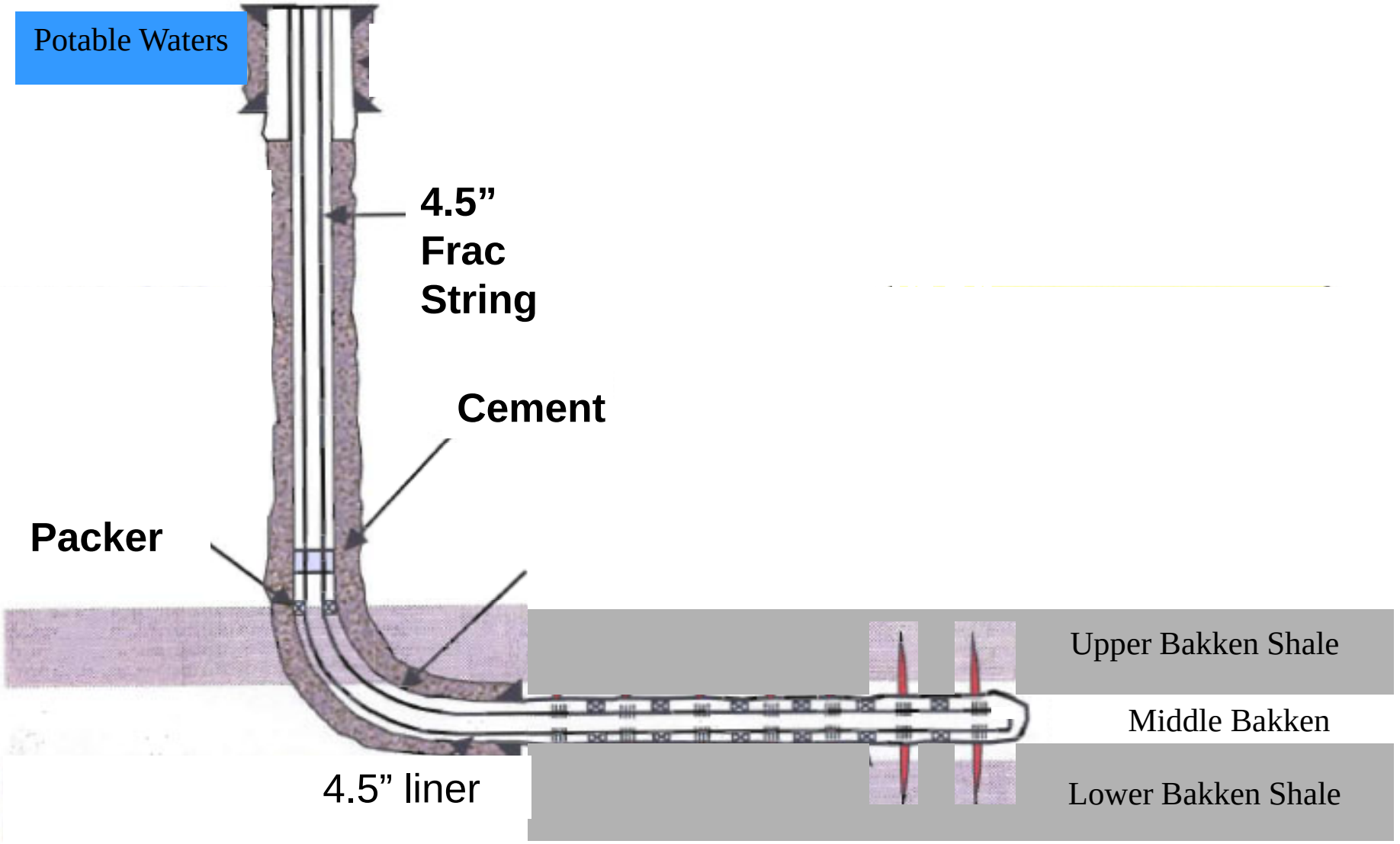
Run in hole with:

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

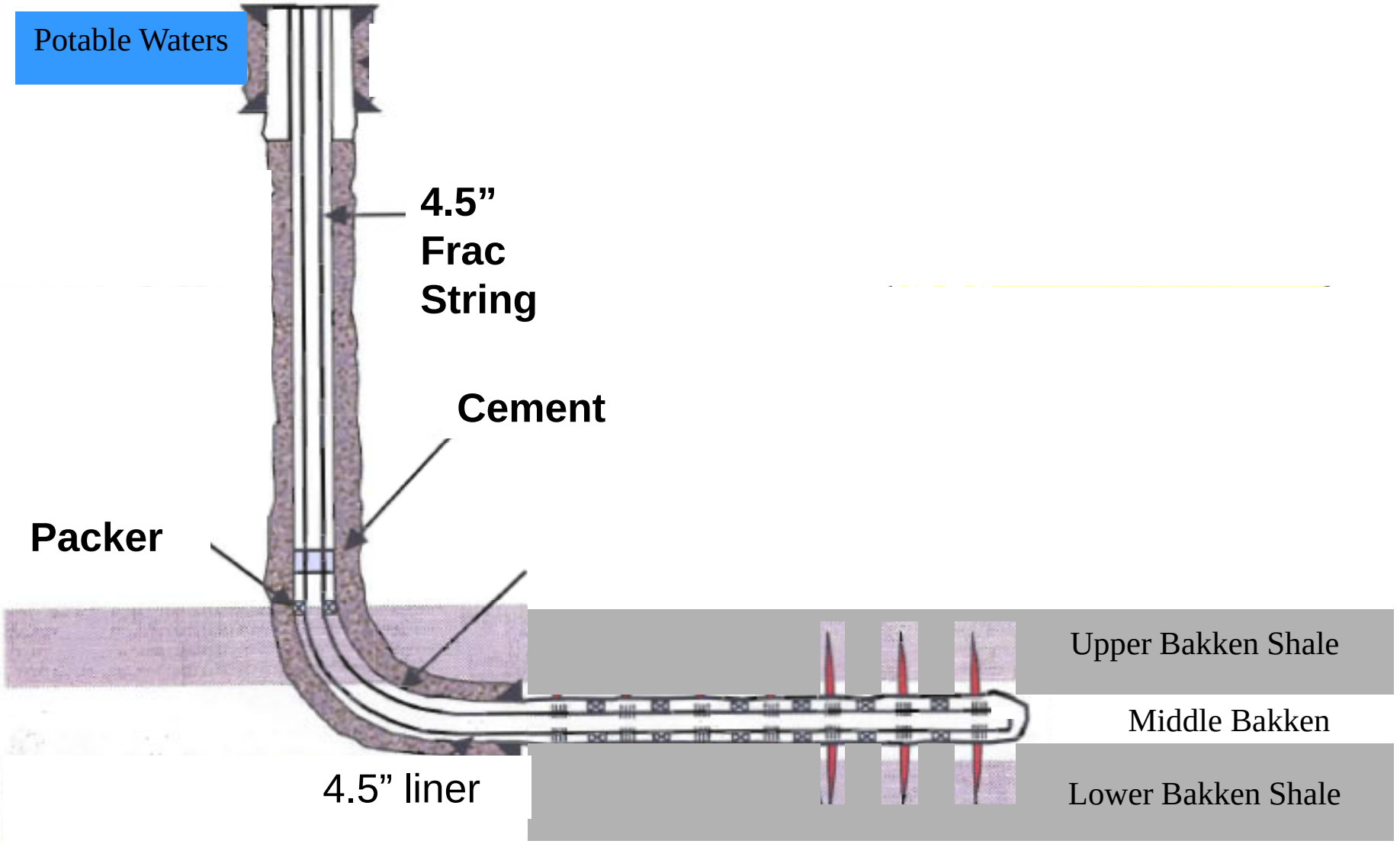
TYPICAL HORIZONTAL OIL WELL



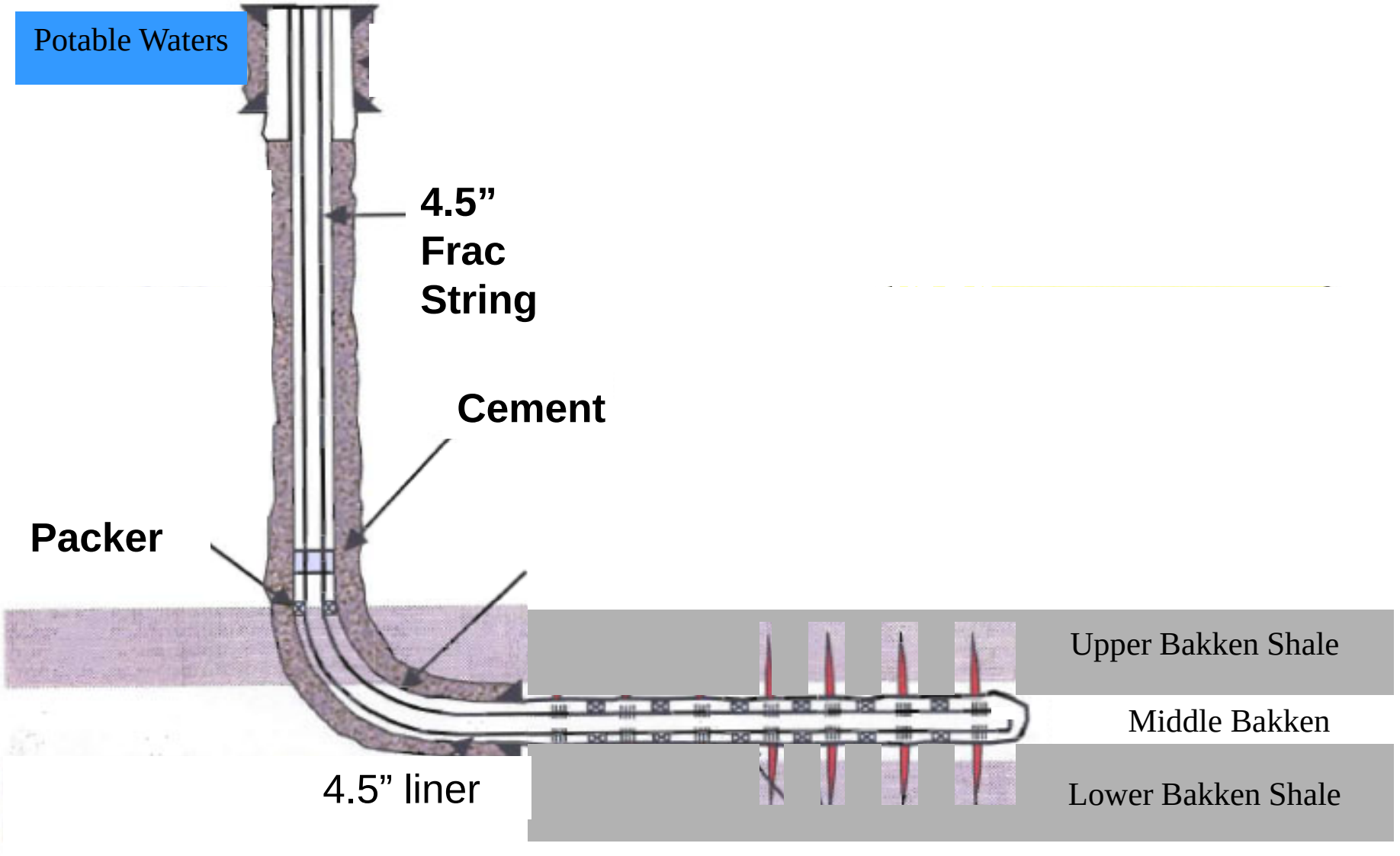
TYPICAL HORIZONTAL OIL WELL



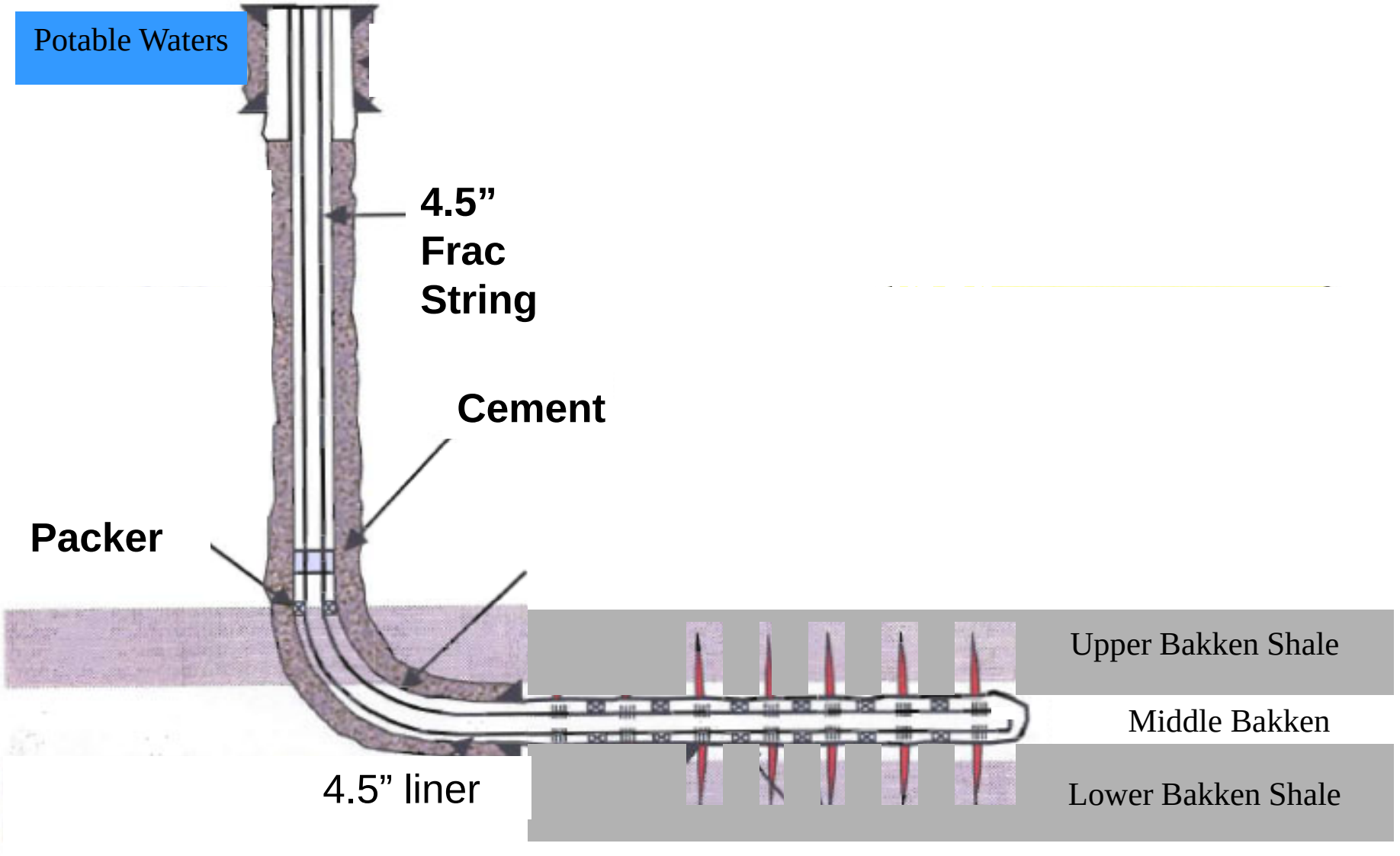
TYPICAL HORIZONTAL OIL WELL



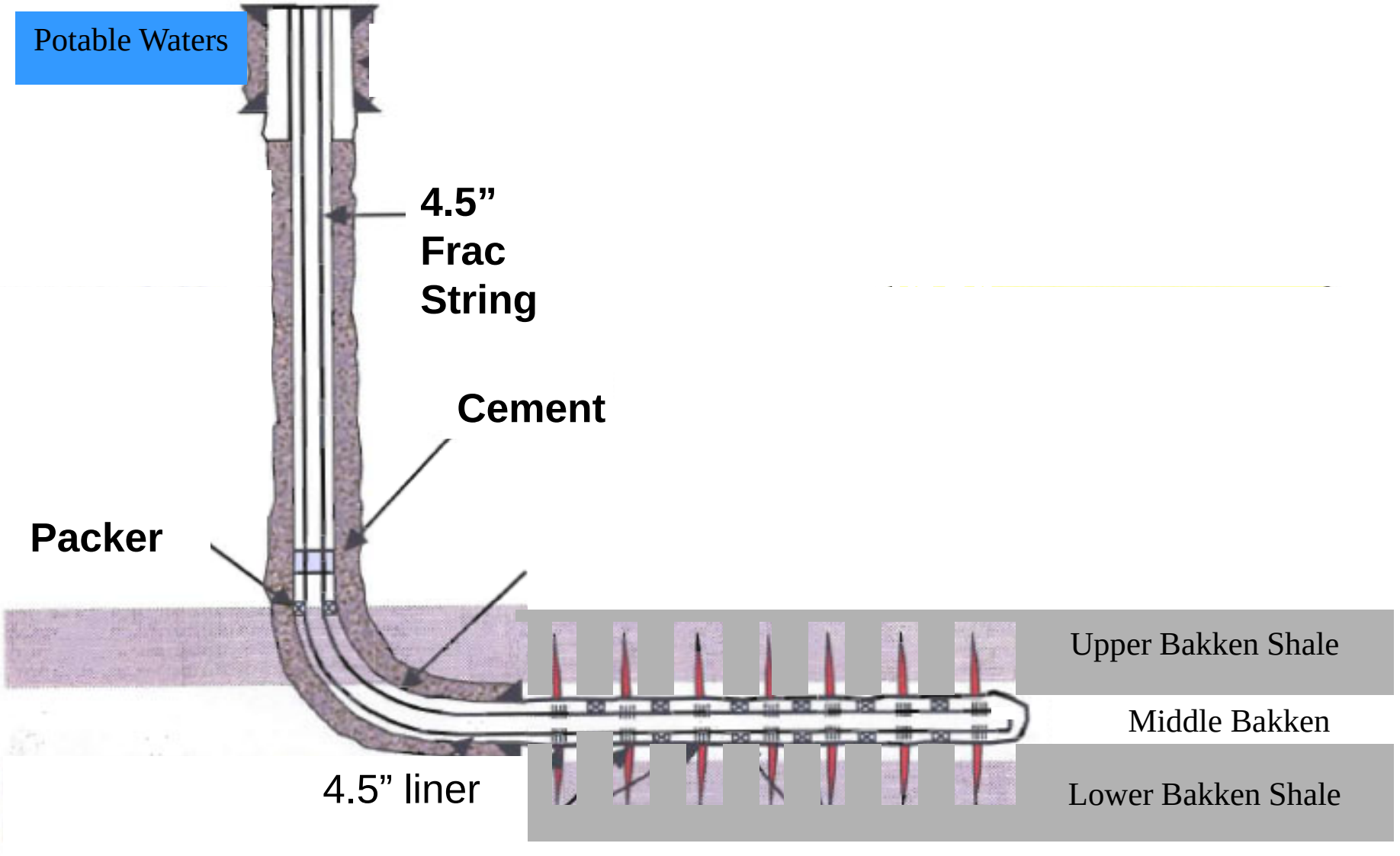
TYPICAL HORIZONTAL OIL WELL



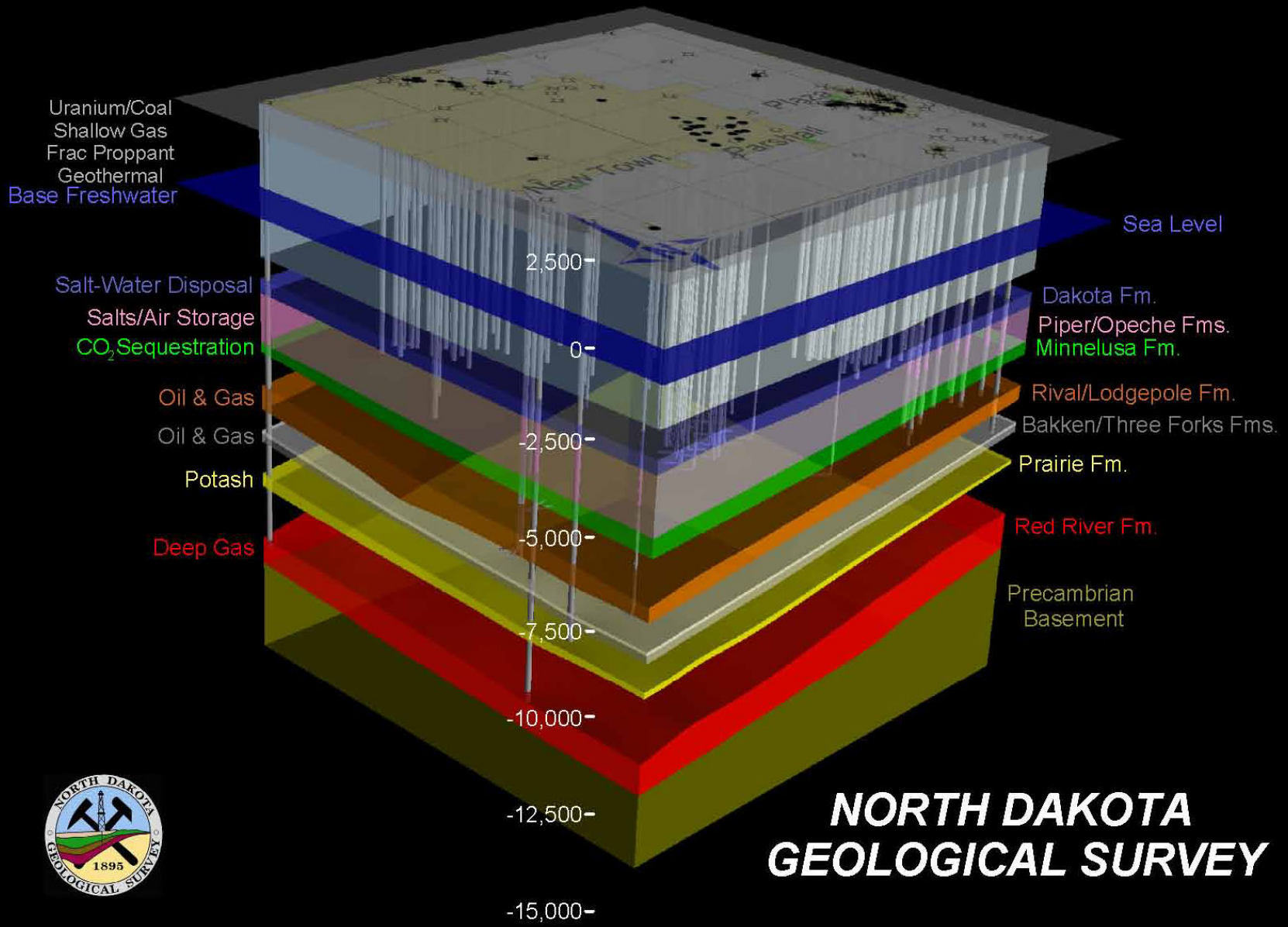
TYPICAL HORIZONTAL OIL WELL



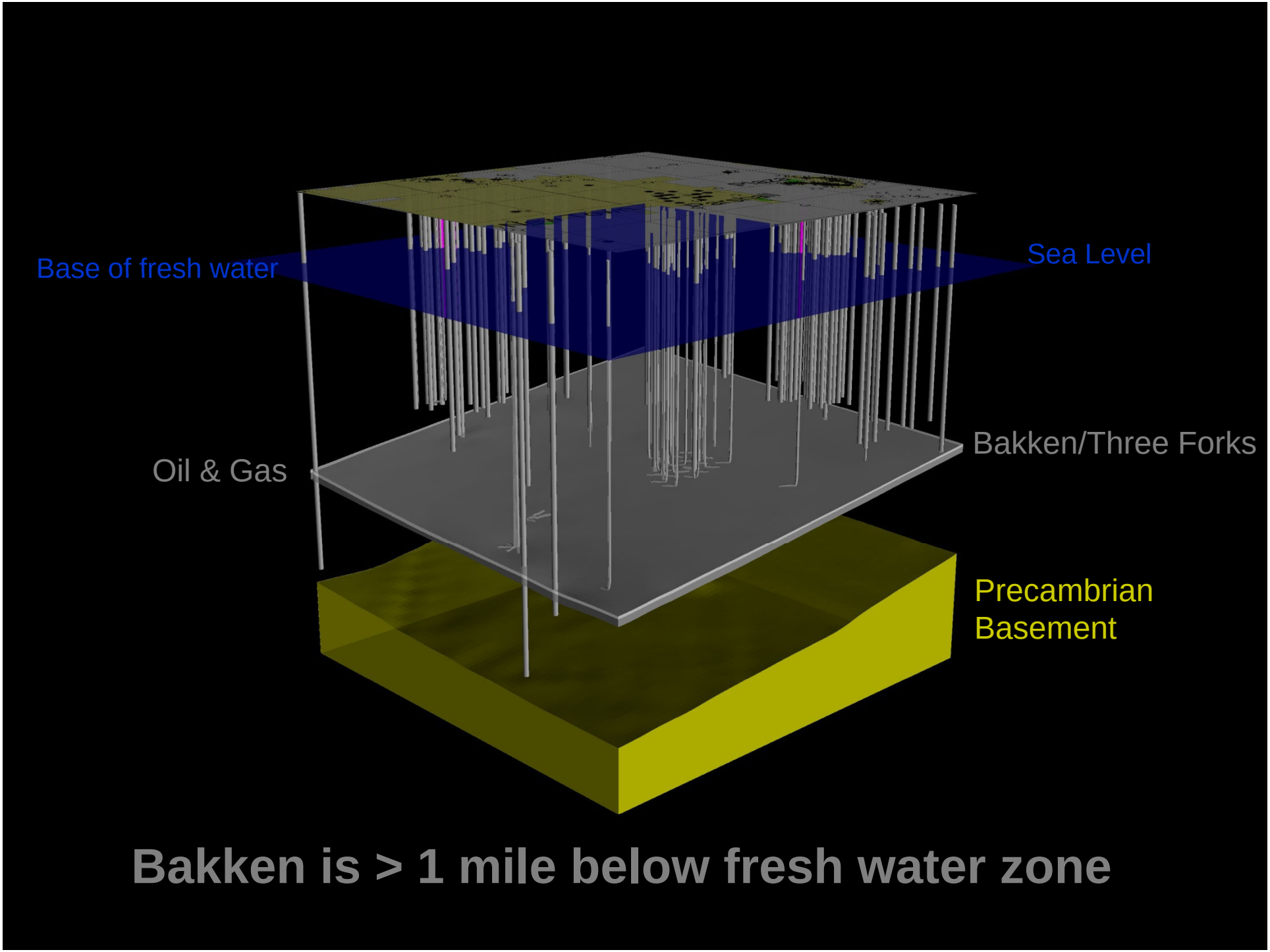
TYPICAL HORIZONTAL OIL WELL



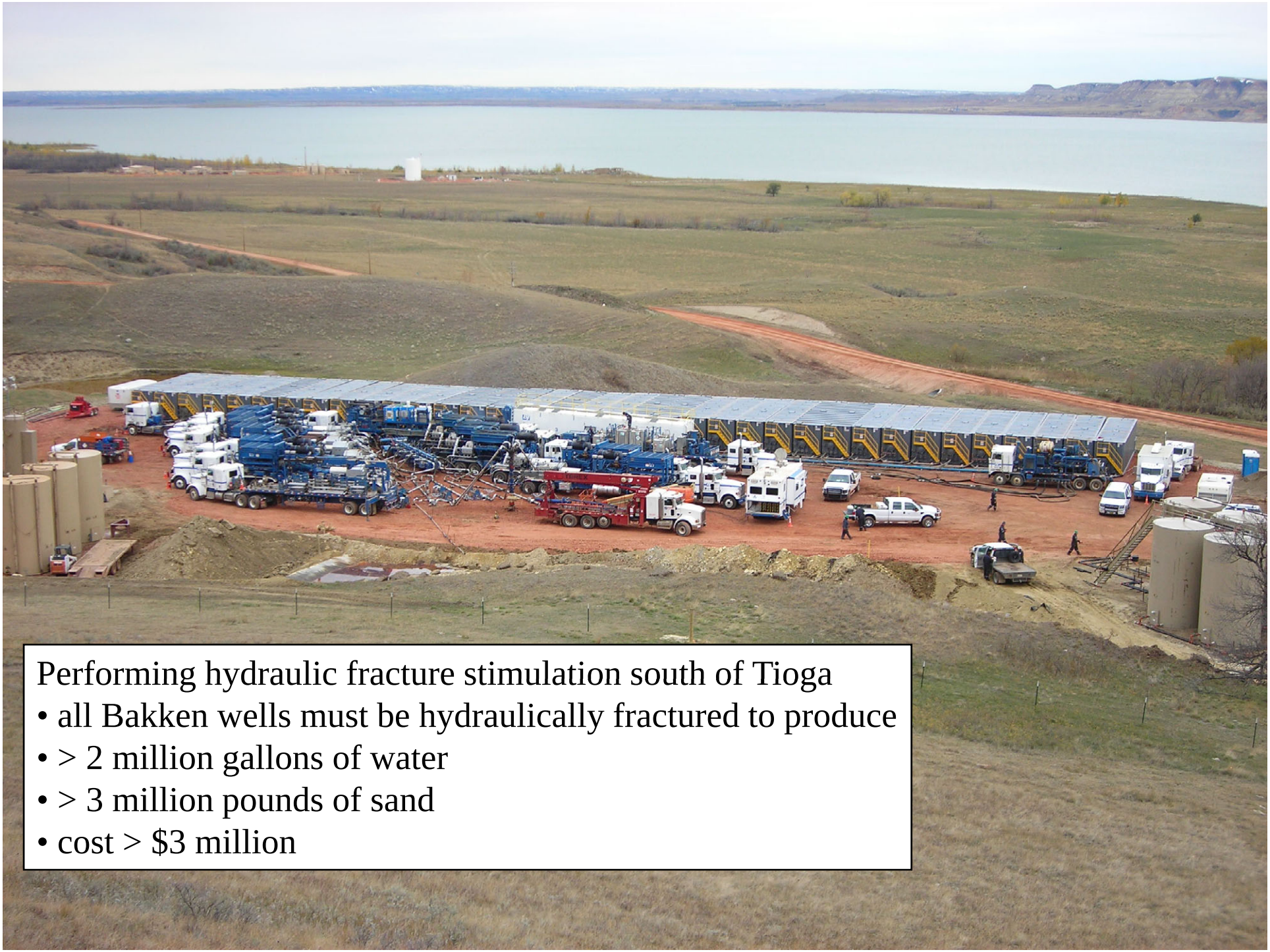
Three-Dimensional Geologic Model of the Parshall Area



NORTH DAKOTA GEOLOGICAL SURVEY



Bakken is > 1 mile below fresh water zone



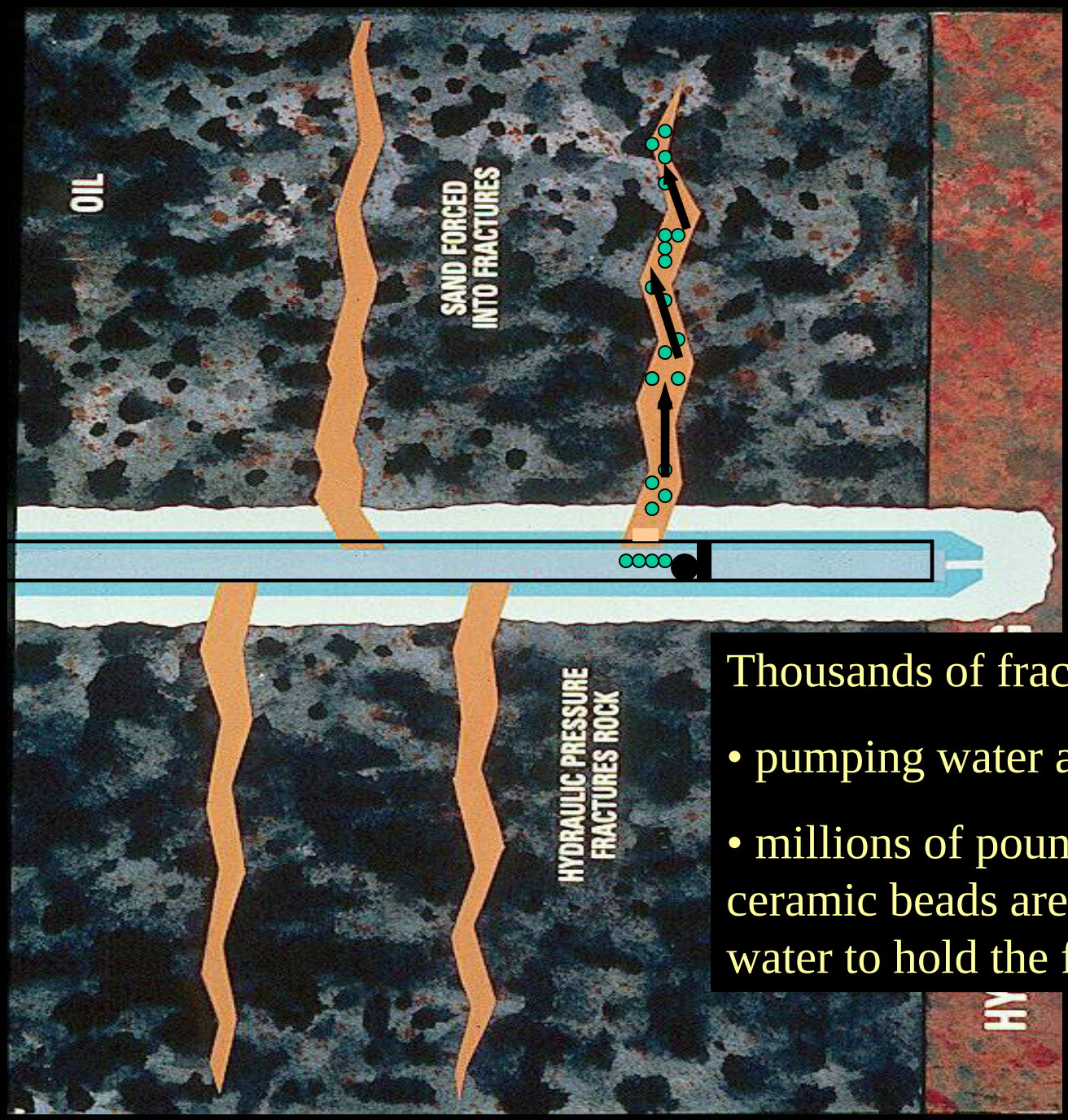
Performing hydraulic fracture stimulation south of Tioga

- 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

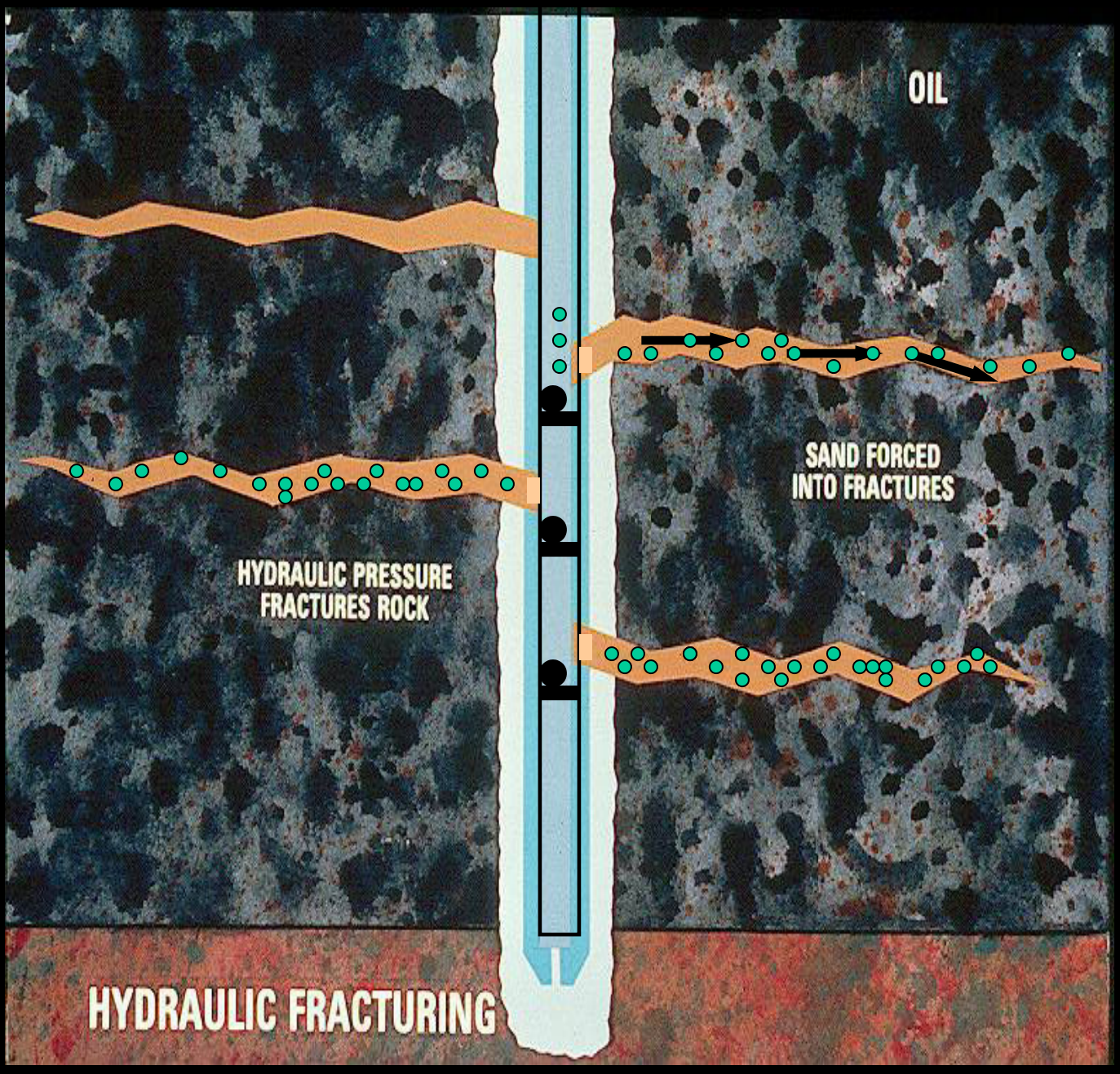


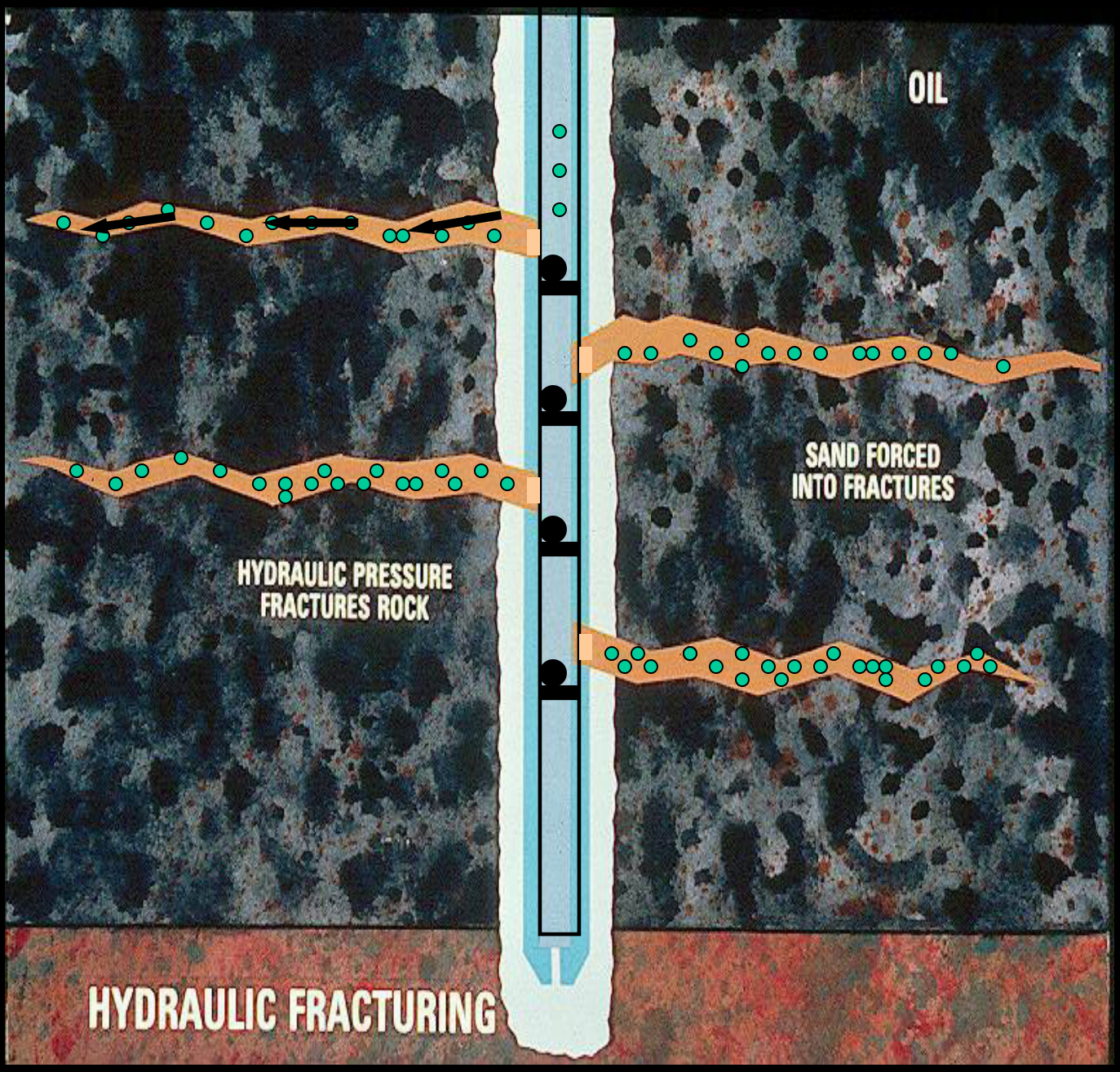
Thousands of fractures are created

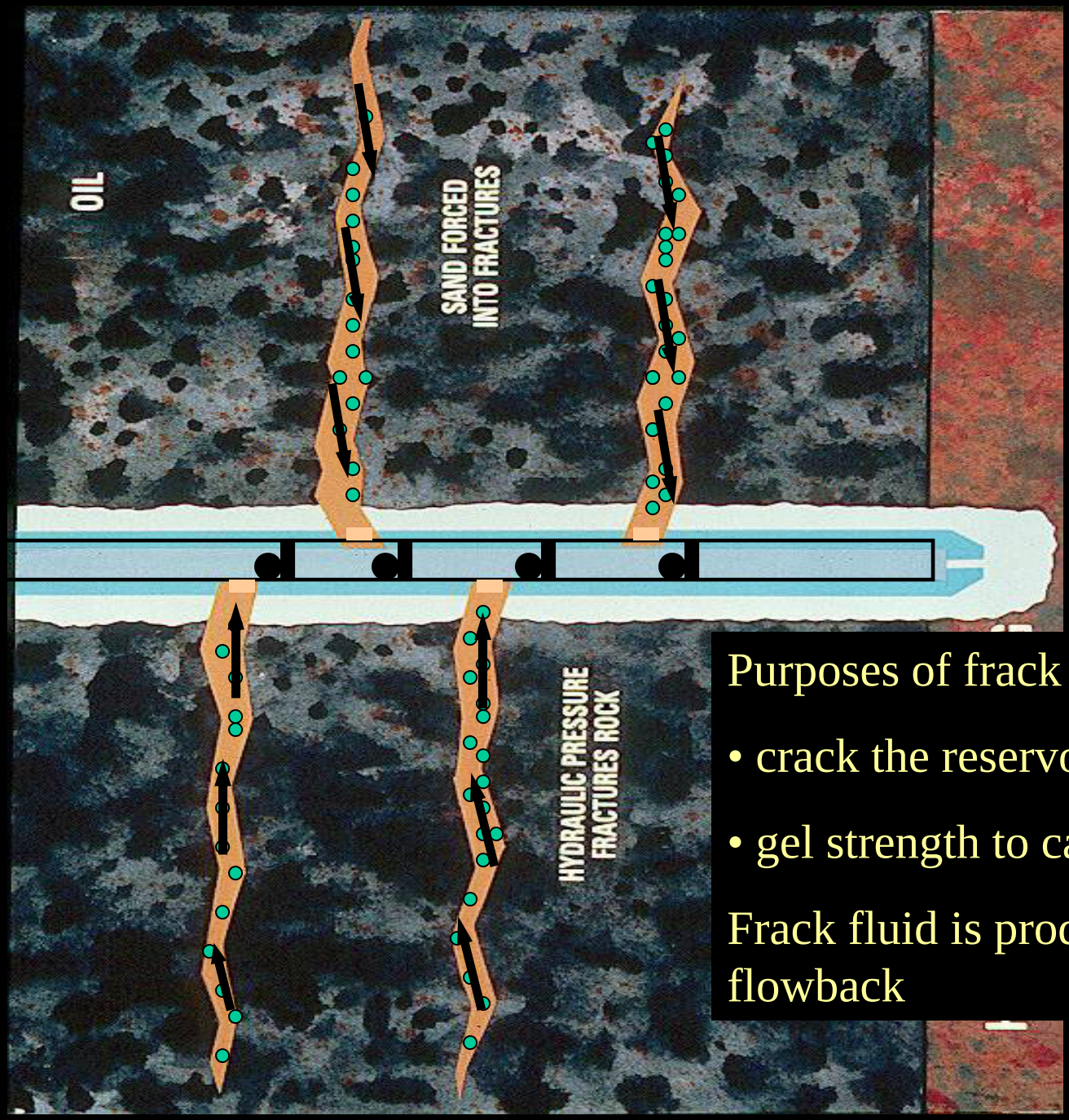
- pumping water at 6,000-9,000 psi
- millions of pounds of sand and ceramic beads are pumped with the water to hold the fractures open.

Stage Fracturing

- up to 40 stages


OIL
SAND FORCED
INTO FRACTURES
HYDRAULIC PRESSURE
FRACTURES ROCK
HYDRAULIC FRACTURING


OIL
SAND FORCED
INTO FRACTURES
HYDRAULIC PRESSURE
FRACTURES ROCK
HYDRAULIC FRACTURING

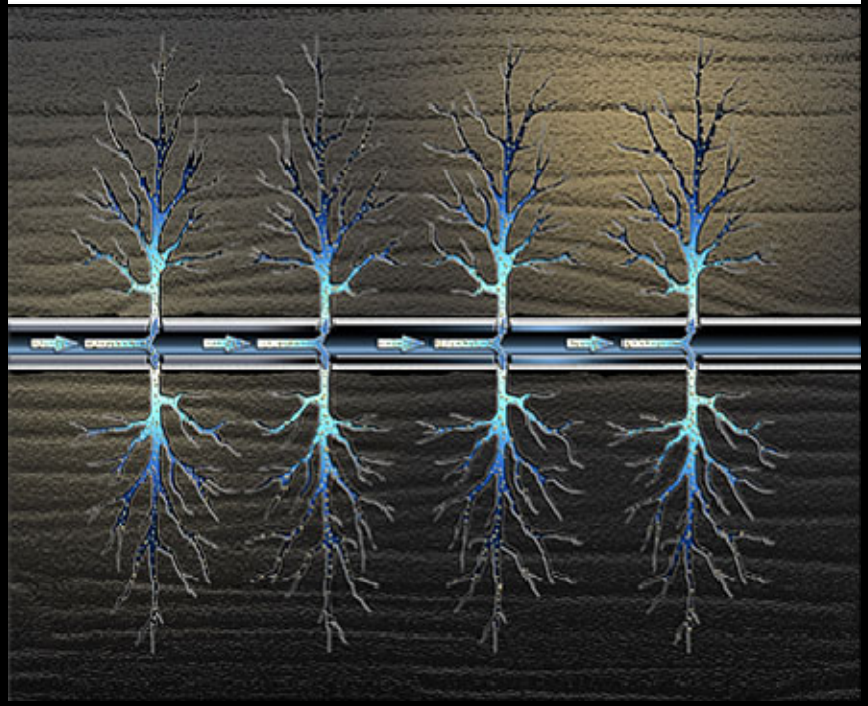


Purposes of frack fluid

- crack the reservoir
- gel strength to carry sand

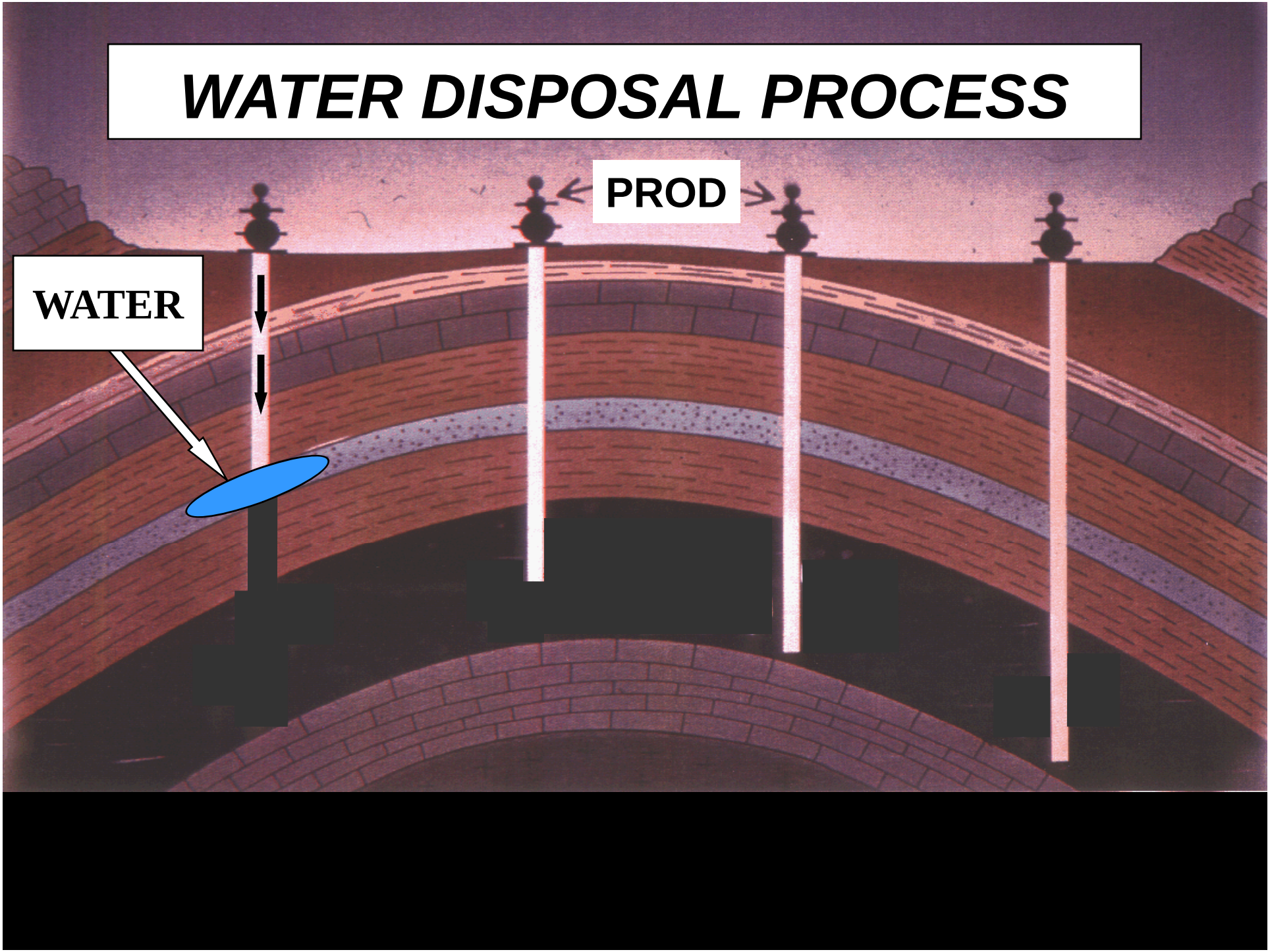
Frack fluid is produced back as flowback

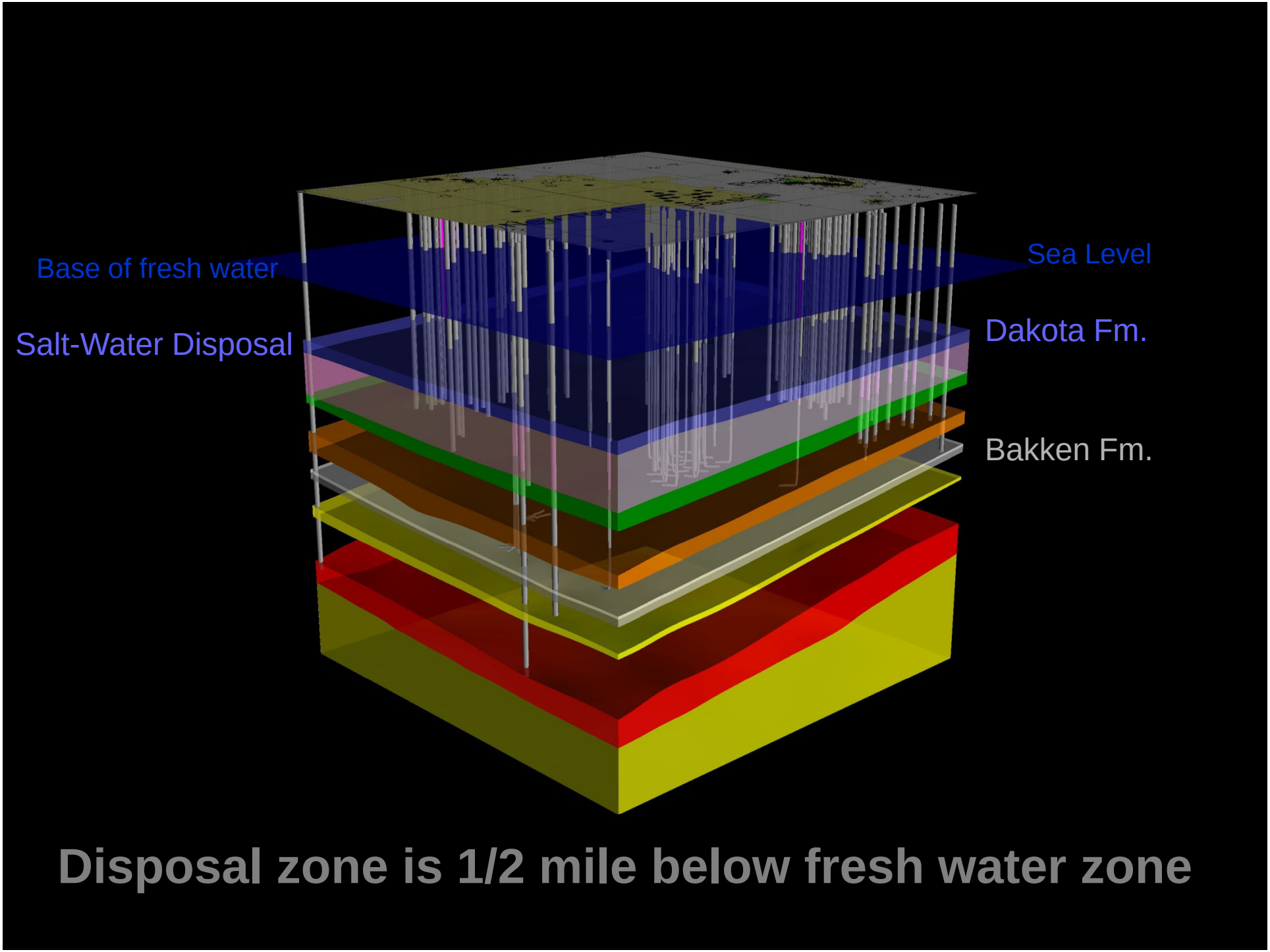
- **Hydraulic Fracturing:** Mixture of water, sand and chemicals pressurized and pumped into the well to form microscopic fractures in shale.



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
PROD
WATER



Disposal zone is 1/2 mile below fresh water zone

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

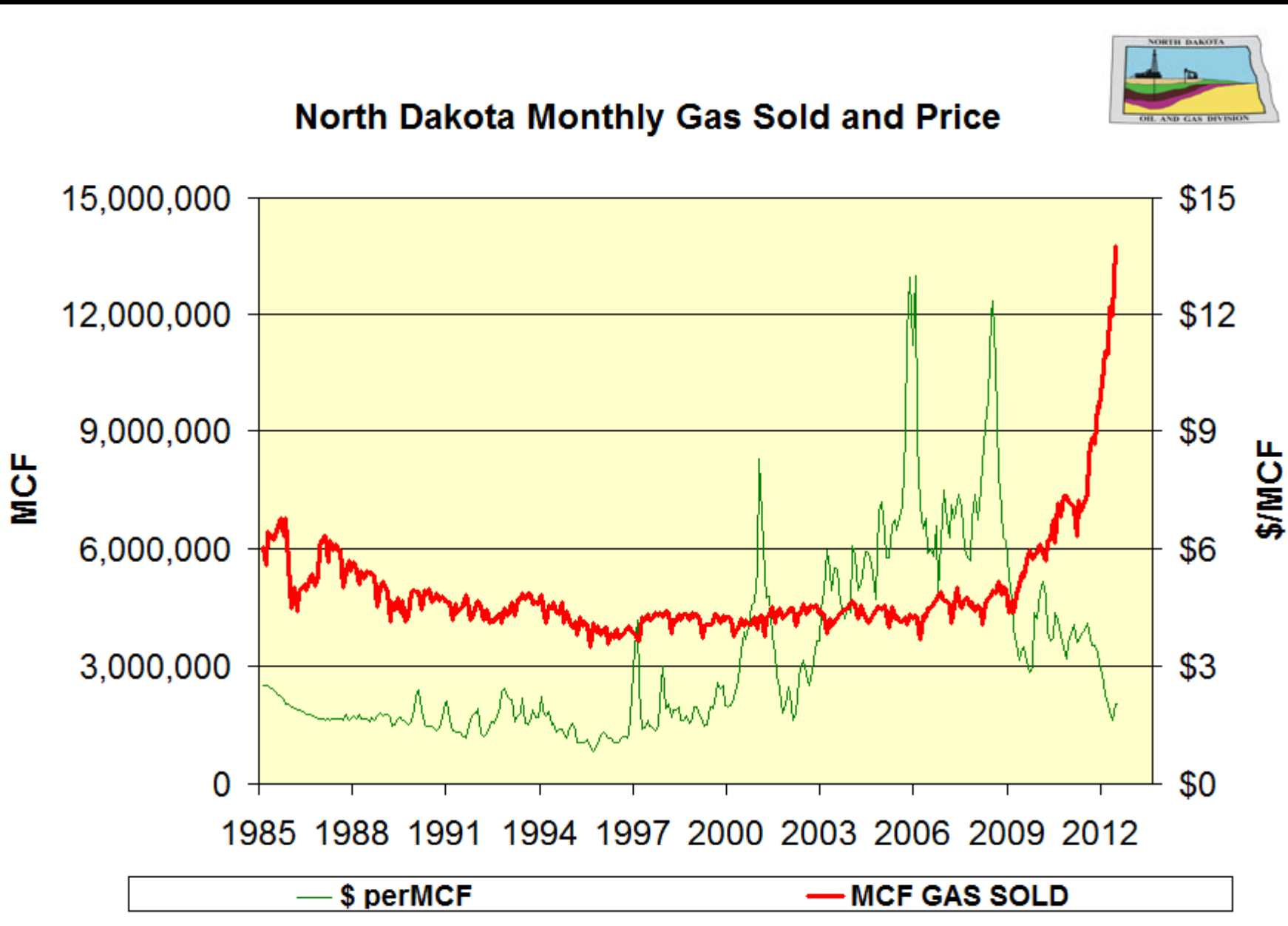
- 2,500 wells / year
- 15 - 25 years duration
- 20 - 30 million gallons water / day

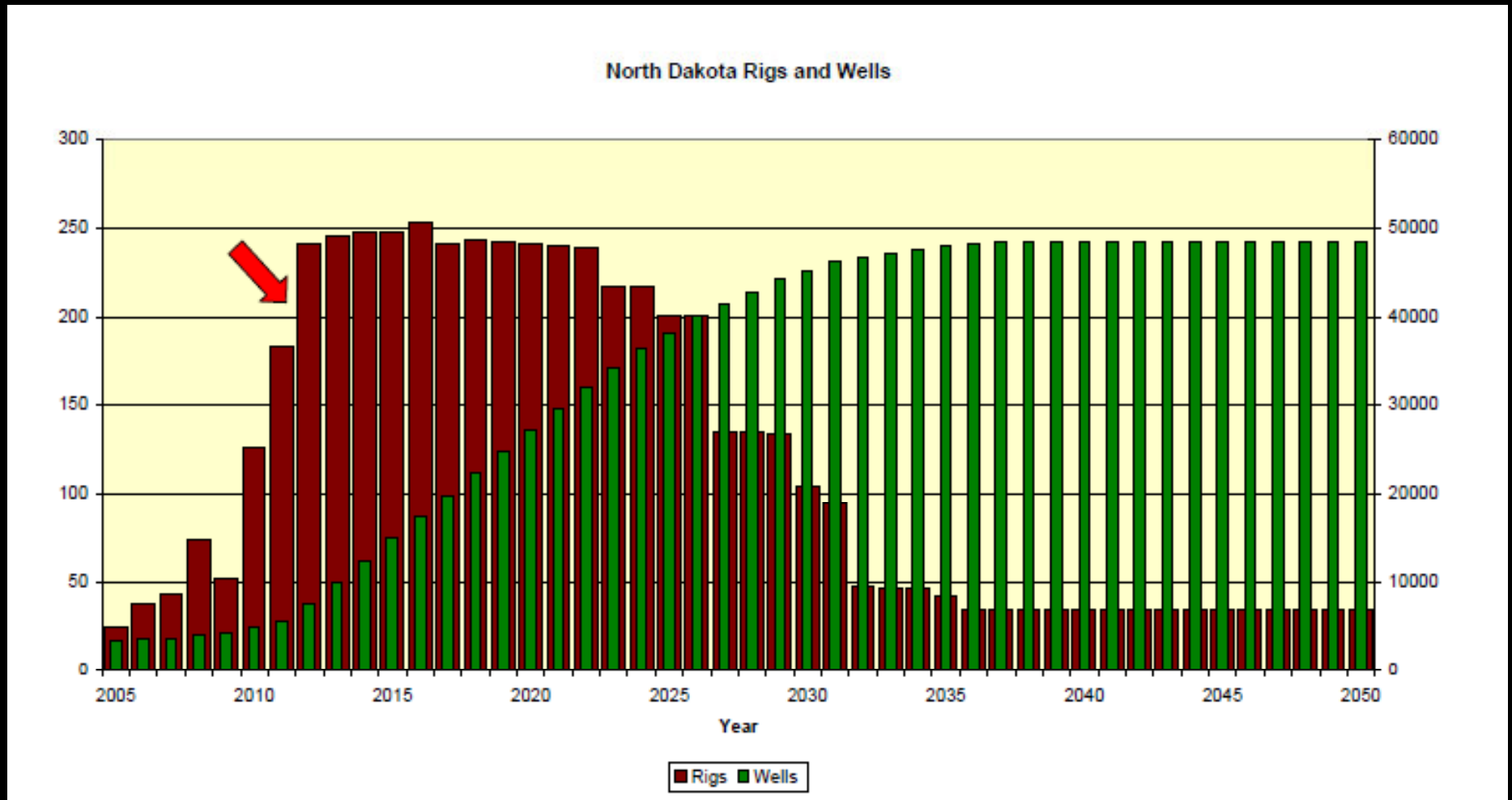
Commission supports surface water use

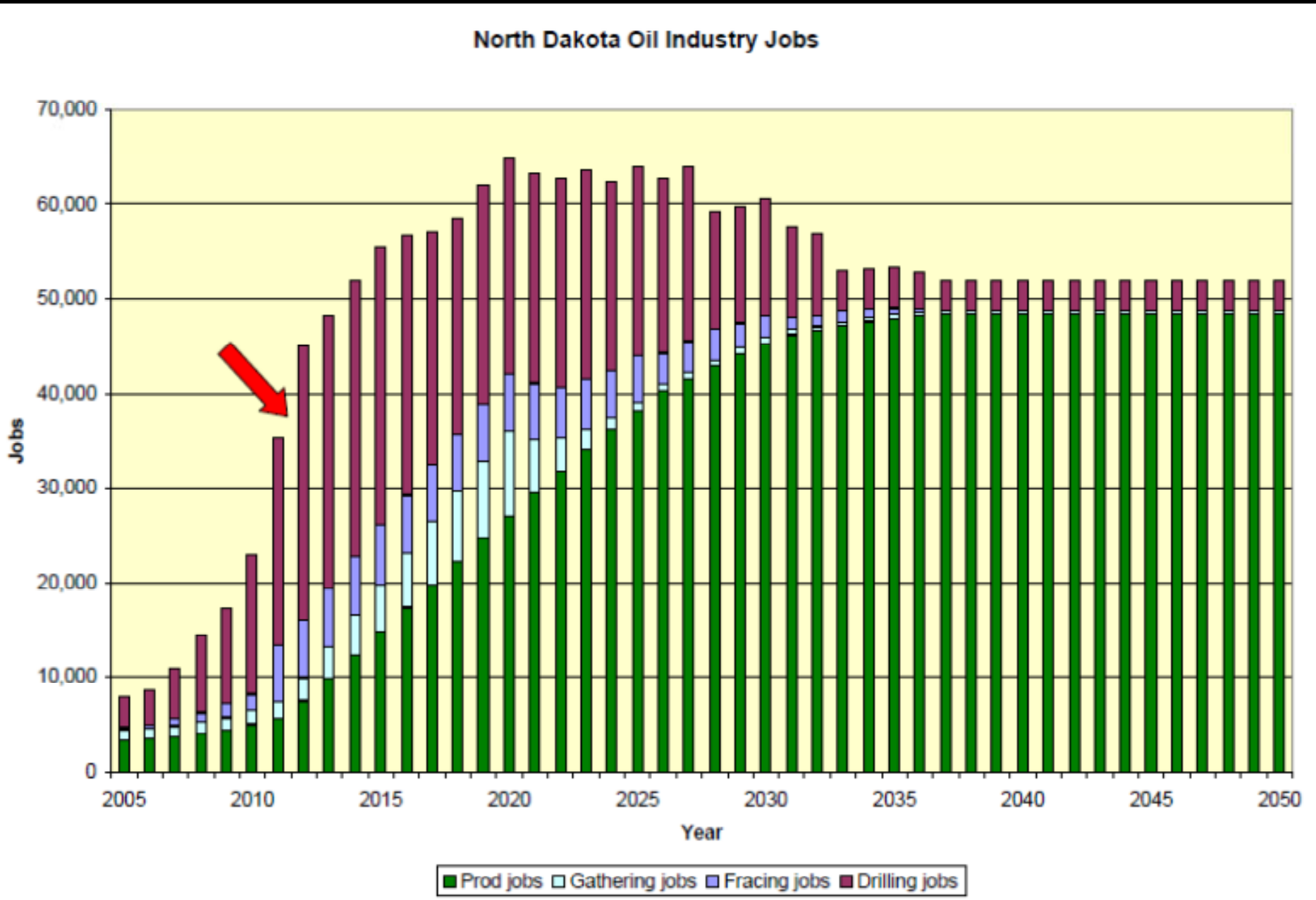
- Lake Sakakawea best water resource
  - one inch contains 10 billion gal water
    - 5000 wells @ 2mil gal wtr/well
    - 2-year supply

Western North Dakota

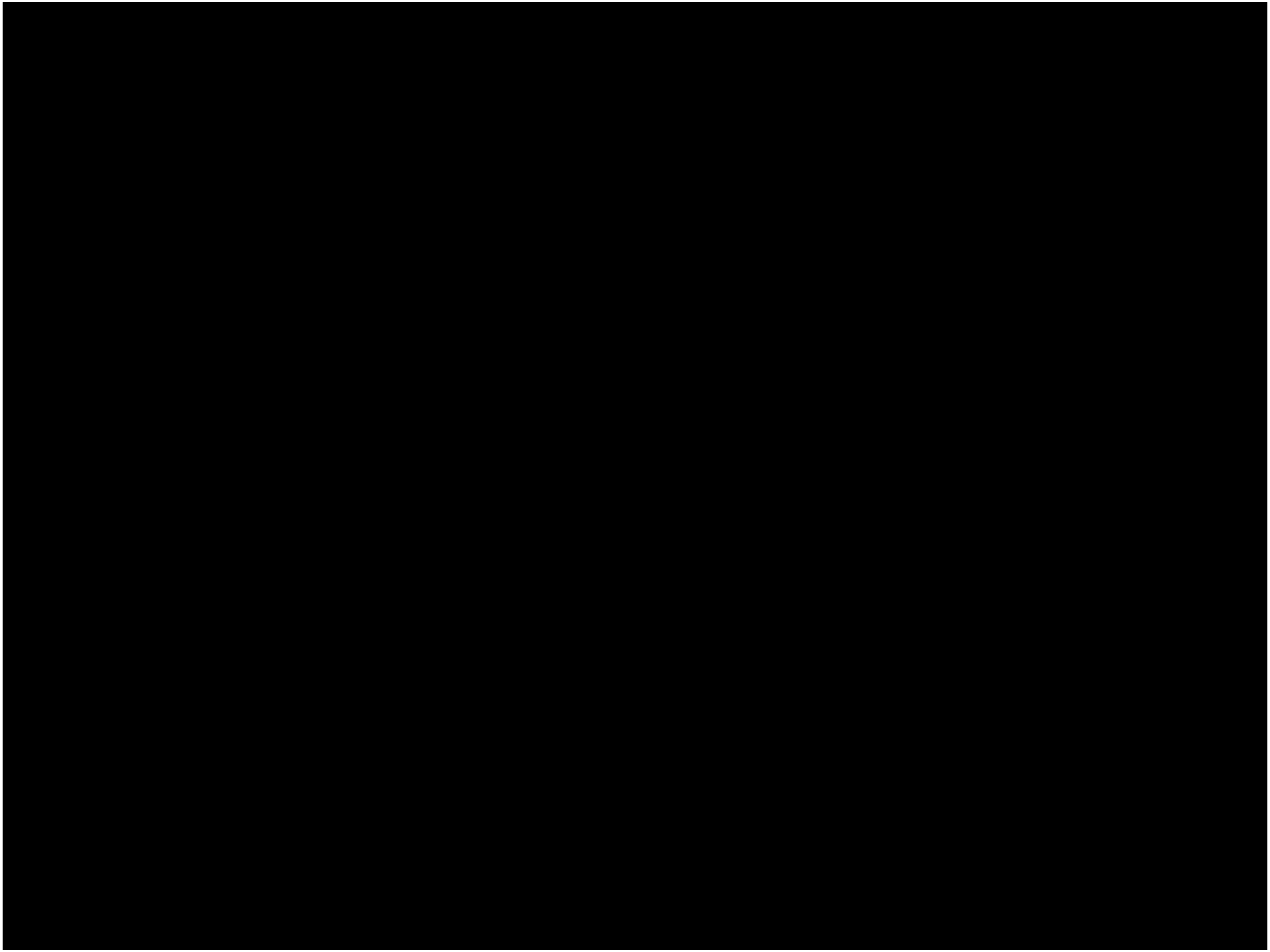
- 1,050 to 2,700 wells / year = 2,000 expected
  - 85-225 rigs = 10,000 – 27,000 jobs = 21,000 expected
- 10 - 25 million gallons frac water / day
  - Equal to 1” of water from Lake Sakakawea / yr
- 10 to 20 years
  - 28,000 new wells expected = ±28,000 long term jobs


North Dakota Monthly Gas Sold and Price
NORTH DAKOTA
OIL AND GAS DIVISION
MCF
$/MCF
15,000,000
12,000,000
9,000,000
6,000,000
3,000,000
0
$15
$12
$9
$6
$3
$0
1985 1988 1991 1994 1997 2000 2003 2006 2009 2012
$ perMCF
MCF GAS SOLD

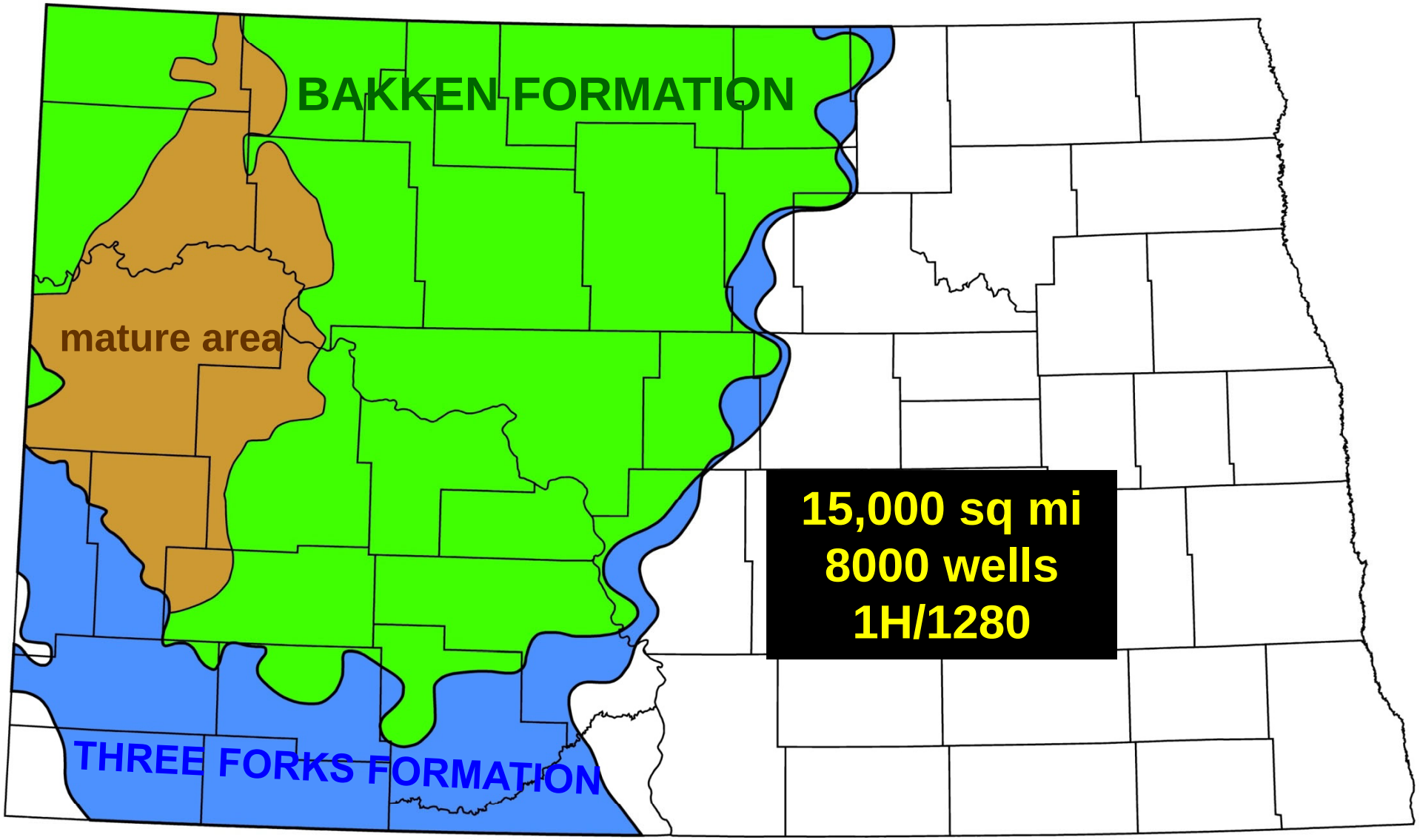

North Dakota Rigs and Wells
300
250
200
150
100
50
0
60000
50000
40000
30000
20000
10000
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Rigs
Wells


North Dakota Oil Industry Jobs
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Jobs
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Prod jobs
Gathering jobs
Fracing jobs
Drilling 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 withdrawls
- Industrial Comm—well permitting & disposal of flowback water
- Health Dept—spill cleanup