

# **Development of Glenrock Area Fields, Converse County, Wyoming\***

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Search and Discovery Article #20467 (2019)\*\*

Posted December 11, 2019

\*Adapted from oral presentation given at 2019 AAPG Rocky Mountain Section Meeting, Cheyenne, Wyoming, September 15-18, 2019

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## **Abstract**

In 1916, shallow Shannon Formation oil was discovered on an “oil claim” on University of Wyoming Land Grant acreage near Parkerton about 20 miles east of Casper. This discovery would become the huge Big Muddy Field, rivaling the Salt Creek Field in size and activity. Development soon included the Frontier 2nd Wall Creek, and Dakota Formations. Since then, the Glenrock fields have produced more than 140 MMBO. Revenues from Big Muddy State leases allowed University of Wyoming to survive the depression and construct several buildings at a time when their very existence was in doubt. Poor early-day production practices led to substantial waste. Conoco built the Glenrock refinery in 1925 to process crude from Big Muddy Field and other areas.

A deep test to the Madison Formation in 1935 found no significant shows below the Dakota. By 1943, the Big Muddy Field was essentially depleted after having produced about 30 MMBO. Dakota and Muddy Formation production was discovered in the South Glenrock fields around 1950, and water flooding began in the 1960s. Encouraged by a 1973 low-tension pilot test at Big Muddy, Conoco and DOE teamed up for an unsuccessful Frontier surfactant flood in the 1980s.

In 2007, Rancher Energy purchased the Big Muddy, South Glenrock, and South Cole Creek fields for CO<sub>2</sub> tertiary recovery. Nitec LLC estimated that CO<sub>2</sub> flooding could potentially recover in excess of 10,000 b/d each from South Glenrock and Big Muddy fields. Rancher acquired a take-or-pay CO<sub>2</sub> contract and conducted pipeline and facility FEED studies. In 2009 Rancher attempted to join forces with Elk Petroleum, whom they saw as being likely to get a better CO<sub>2</sub> contract.

In 2011, Queensland-based Linc Energy purchased the fields from a reorganized Rancher, which was recovering from a hostile takeover. Best known for its underground coal gasification (UCG) technology, Linc hoped to conduct miscible floods using waste CO<sub>2</sub> from their UCG projects in the Powder River Basin. Linc acquired an interruptible CO<sub>2</sub> contract from Exxon, built a line tap, and planned to truck CO<sub>2</sub> from Jeffrey City to Glenrock. Linc planned CO<sub>2</sub> injection rates of up to 30 MMCFD after completion of the CO<sub>2</sub> injection infrastructure. In 2011, Linc unsuccessfully attempted a Dakota CO<sub>2</sub> cycling (huff-n-puff) project in South Glenrock B using 500 tons of CO<sub>2</sub>.

Linc subsequently sold all of the Glenrock properties to Glenrock Energy. In 2016 Glenrock Energy began focusing on re-development and optimizing depleted reservoirs. A large high-resolution 3-D seismic acquisition program has been completed. To date, there is no public information available on the company's re-development plans or results of the 3-D seismic program.

In 2019, Southwestern Production LLC is securing State and Federal approval for the Barron Flats (Shannon) Unit north of Glenrock. The secondary unit will use a miscible natural gas flood in existing vertical Shannon wells originally drilled within the Barron Flats (Deep) Unit.

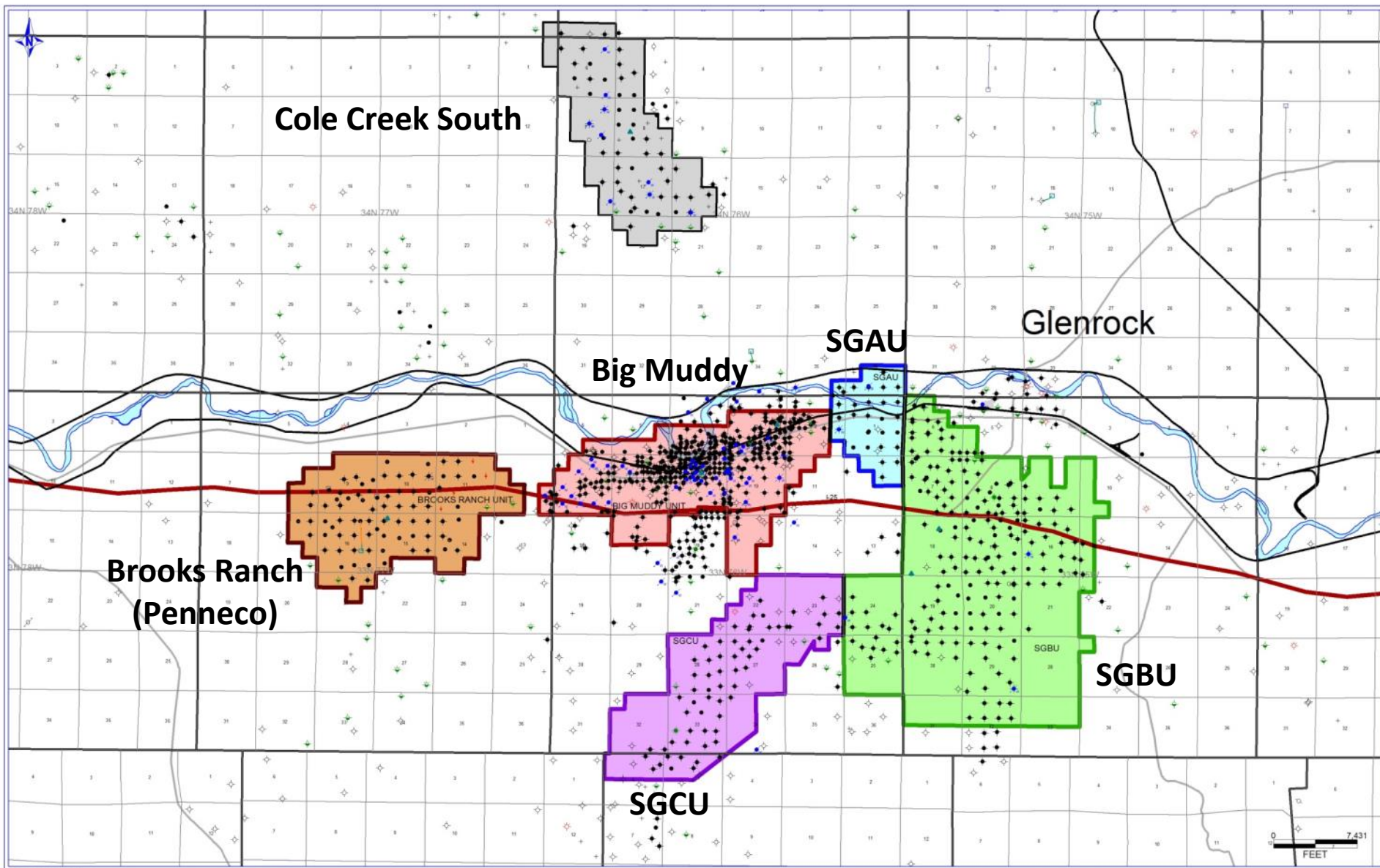
# ***Development of Glenrock Area Fields, Converse Co., WY***

## **AAPG ROCKY MOUNTAIN SECTION ANNUAL CONFERENCE**

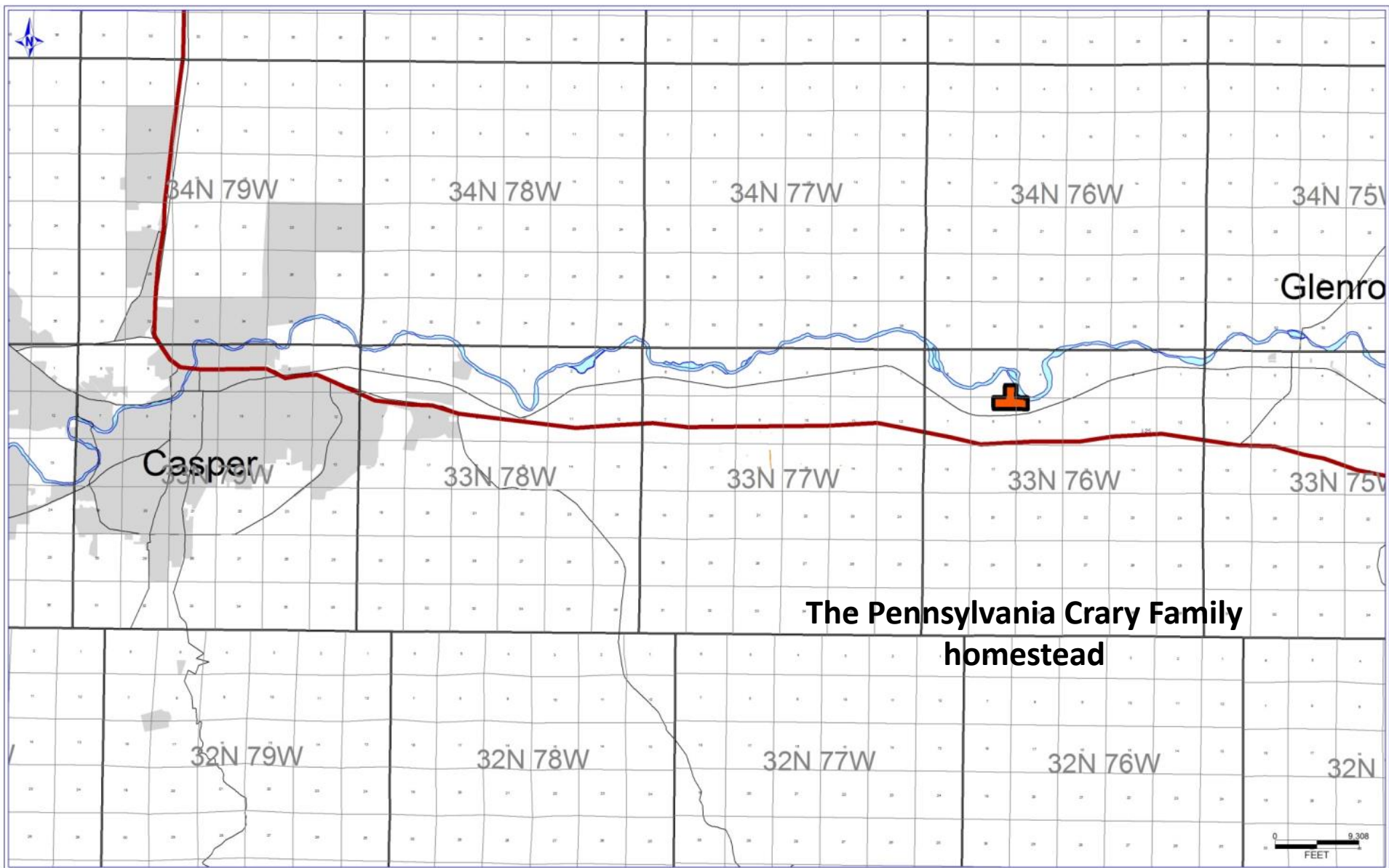
**September 16, 2019**

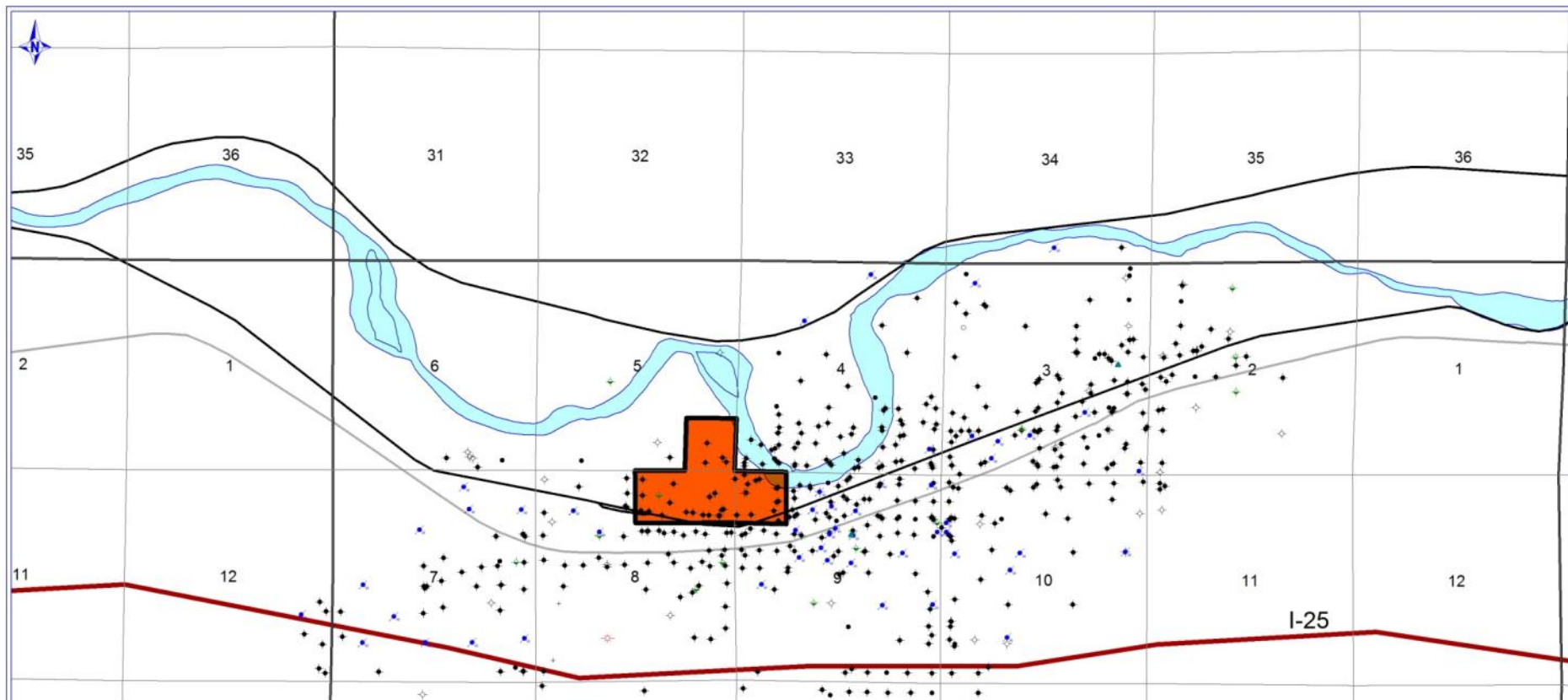
**Mark Milliken**











Early 1920s Parkerton



## BIG MUDDY AREA EARLY DEVELOPMENT

1916: Shannon oil discovered, 600 FT, 26 BOPD,

1917: Frontier oil discovered, 3100 FT, 128 BOPD,

1919: Peak Shannon-Frontier production at 3.6 MMBOPD,

1922: Dakota-Lakota oil discovered,

1923: Conoco builds the Glenrock Refinery,

1935: Deep test to Madison (6597 TD) found no shows below Dakota,

1943: Comingled Shannon and Frontier were pressure depleted,

development focused on Dakota,

1949: Cum production from all zones was 29.3 MMBO,

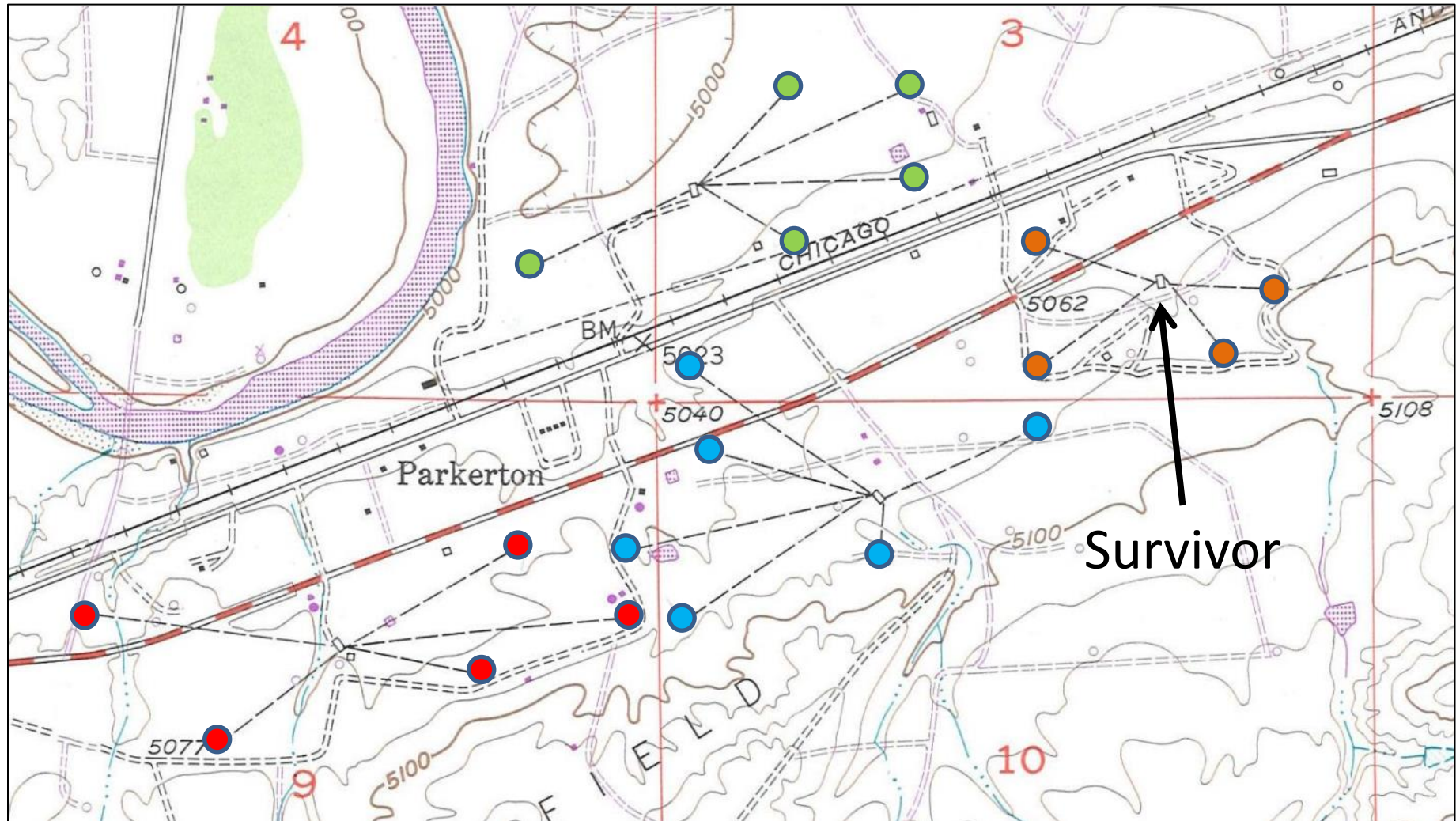
1953: Active water flood program began.





# CENTRAL POWER UNIT ARRAYS

## PARKERTON AREA





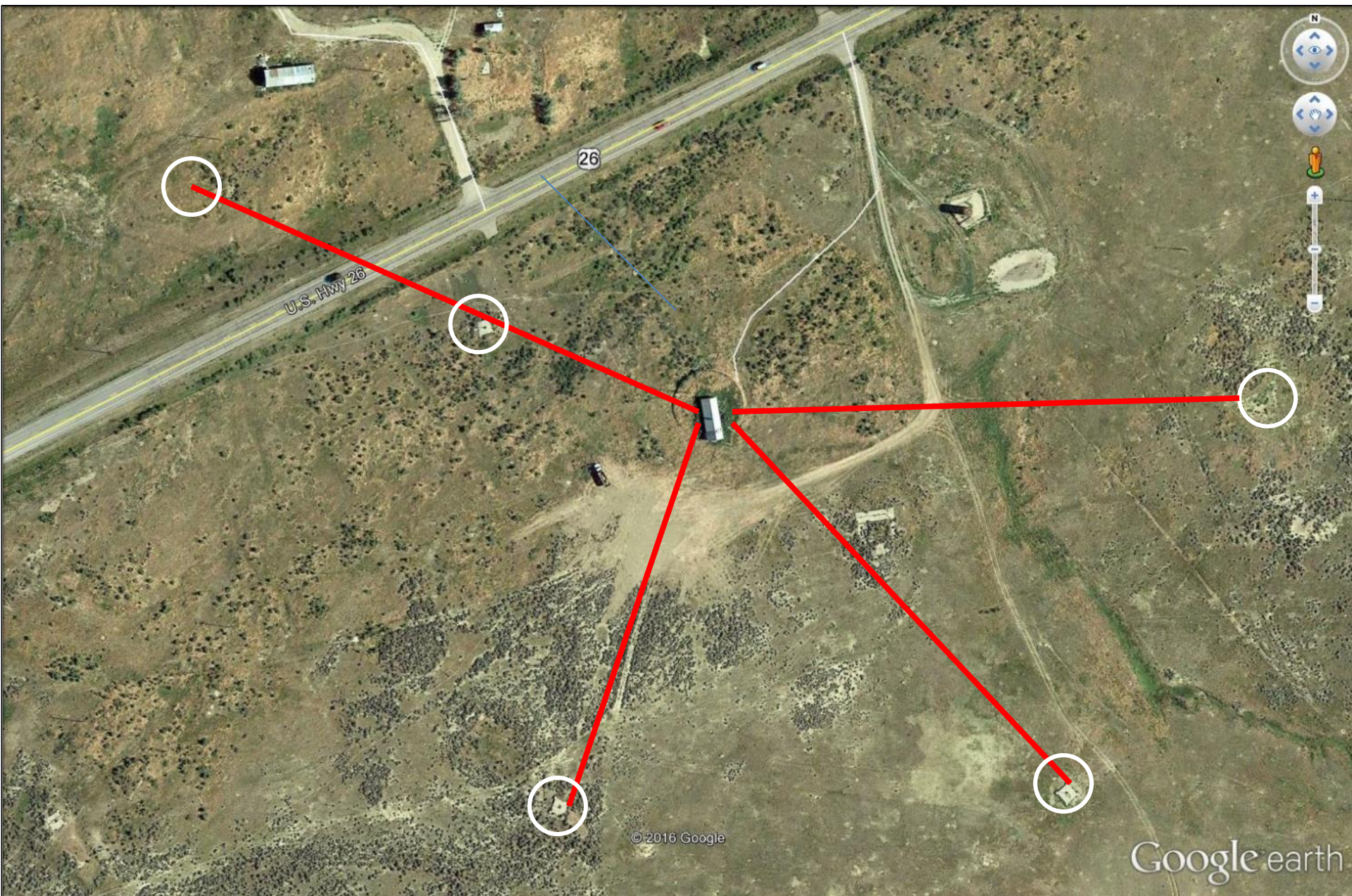










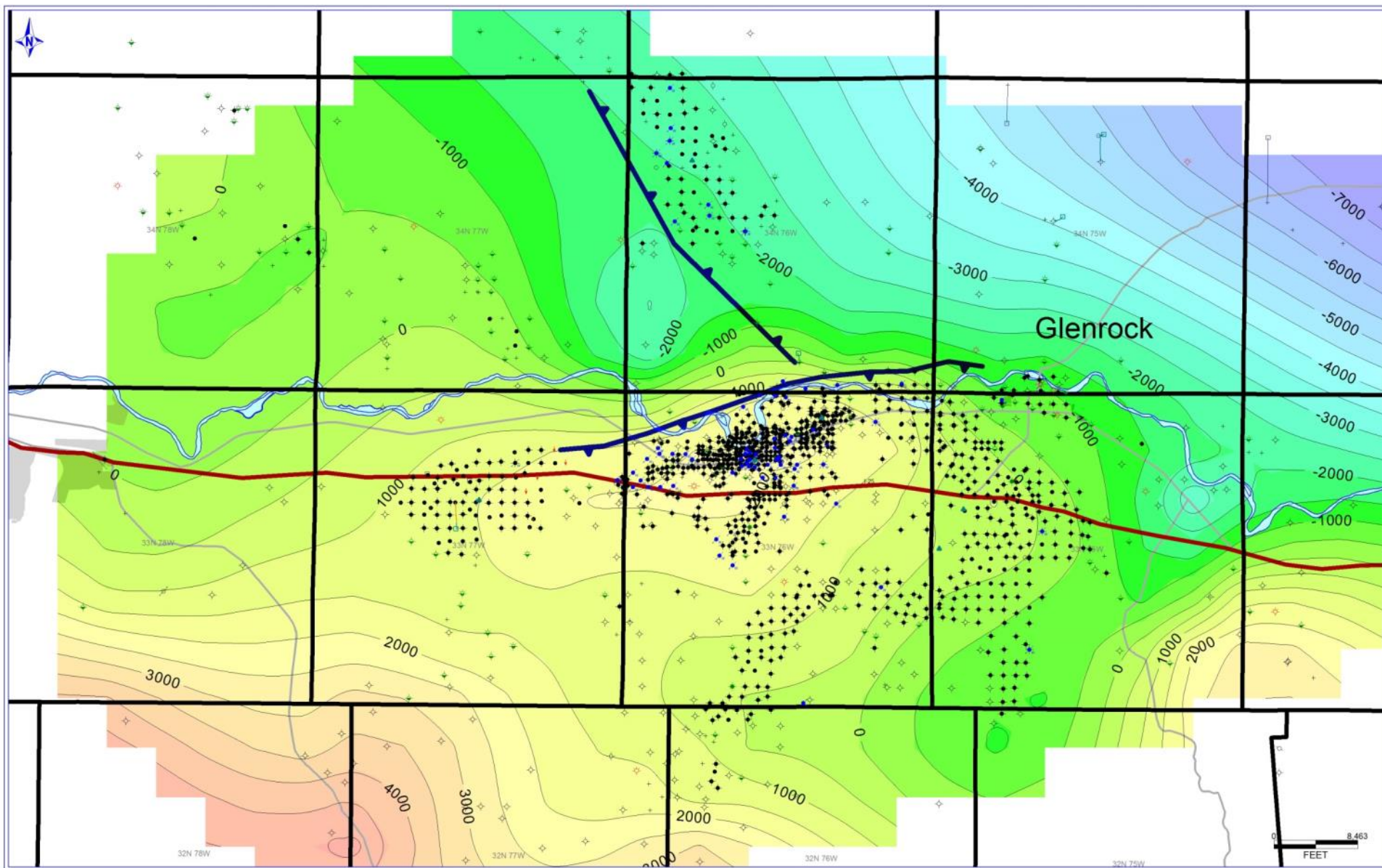








# GENERALIZED FRONTIER STRUCTURE

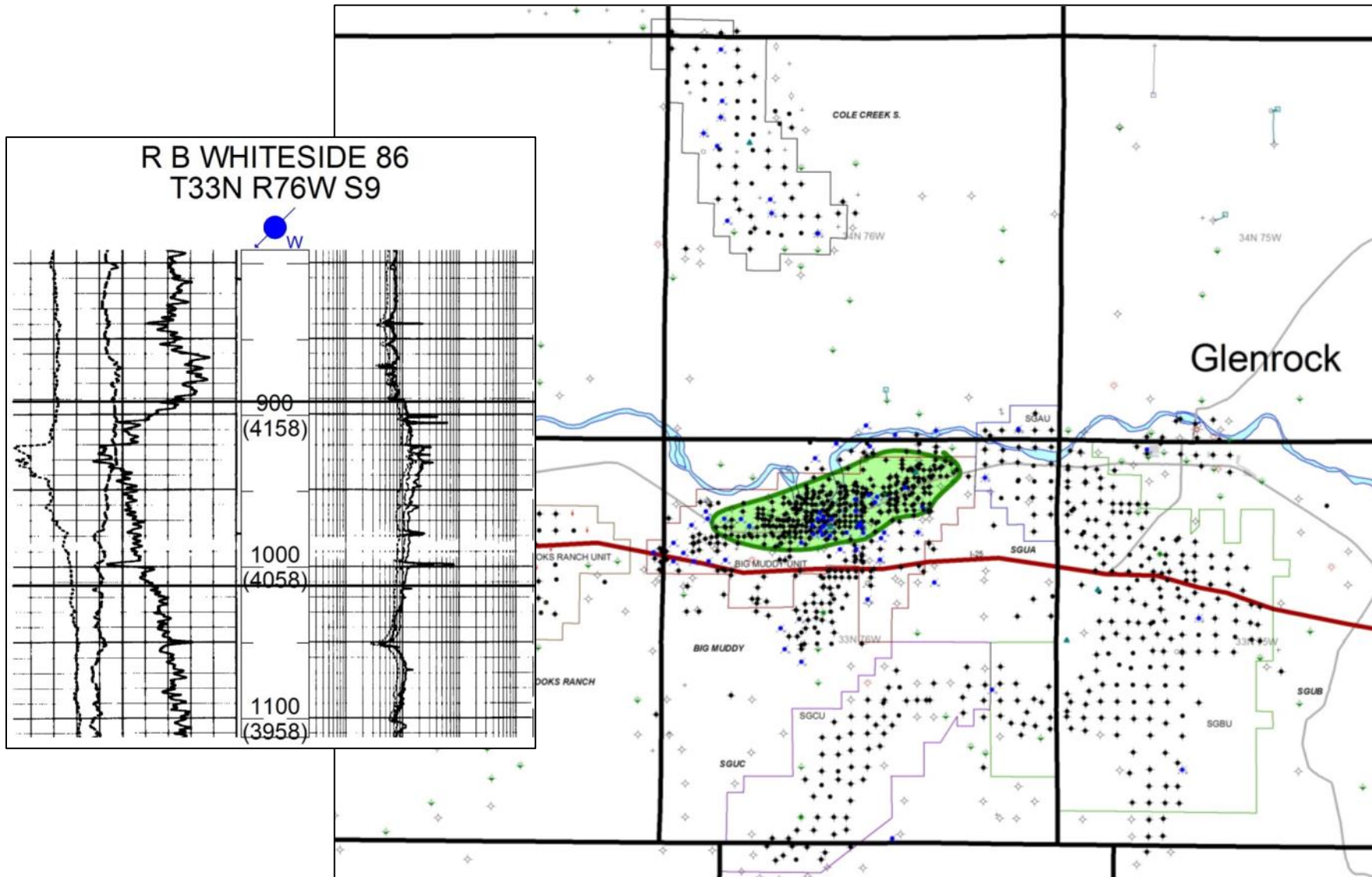


# PRODUCING ZONES

- Shannon
- Niobrara
- Frontier
- Upper Muddy
- Lower muddy
- Dakota

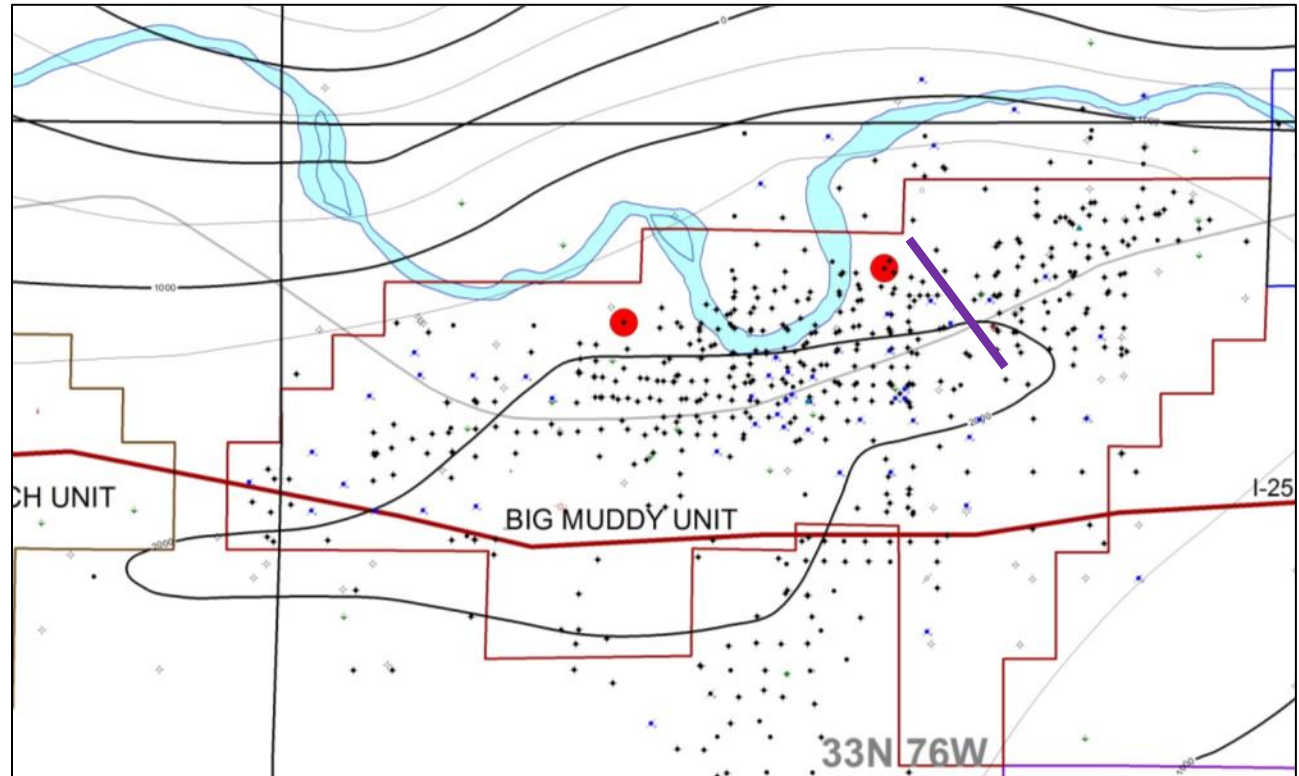
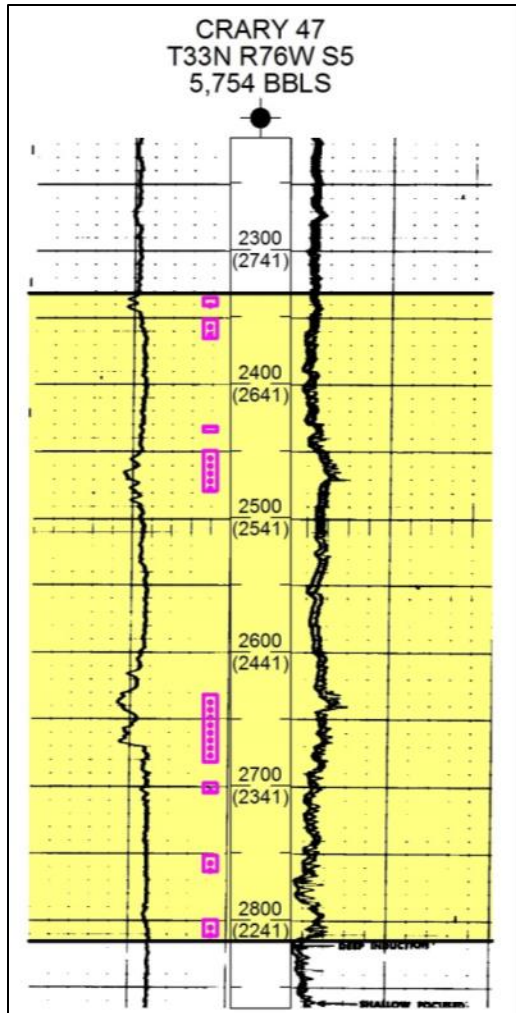


# SHANNON

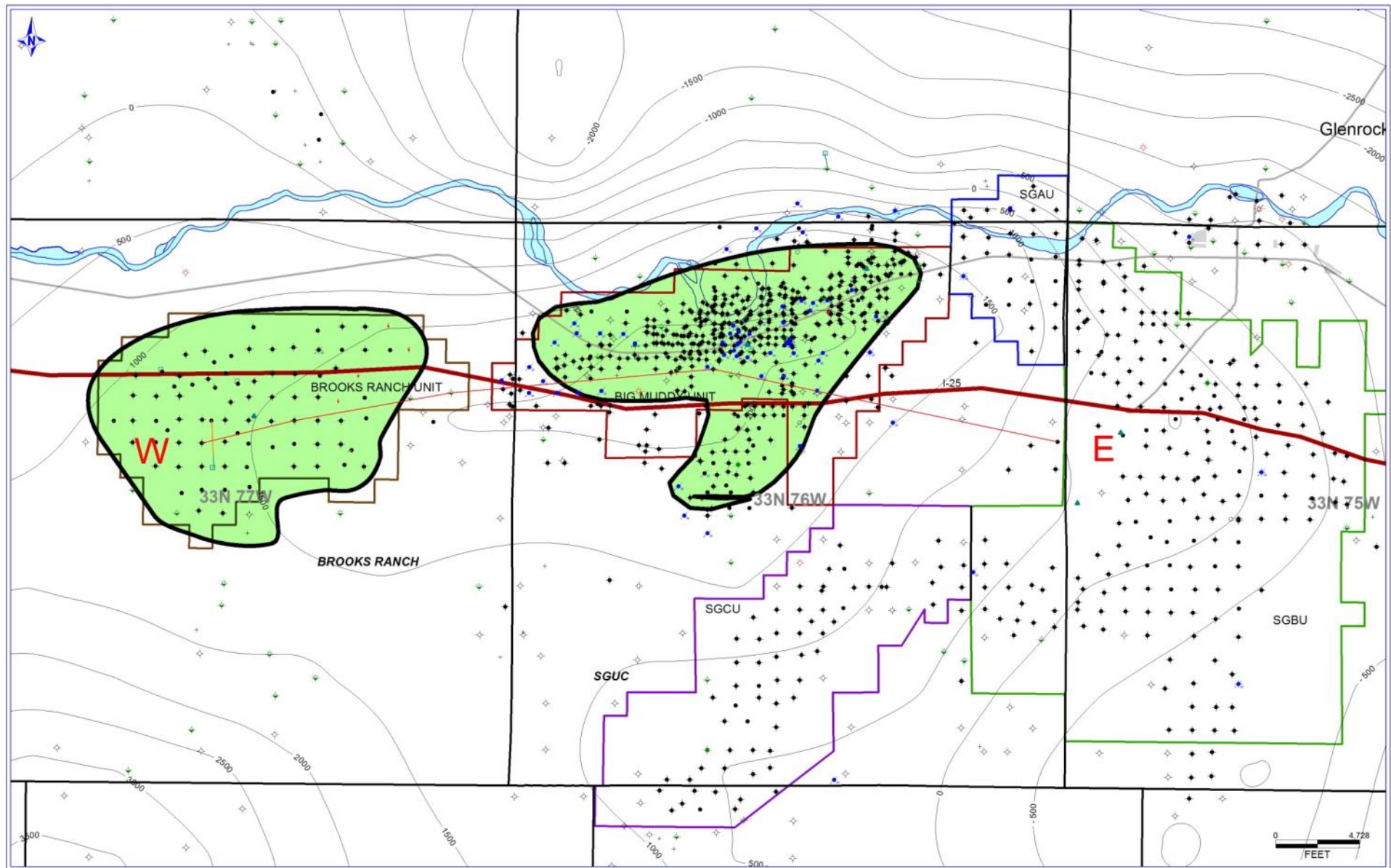




# NIOBRARA

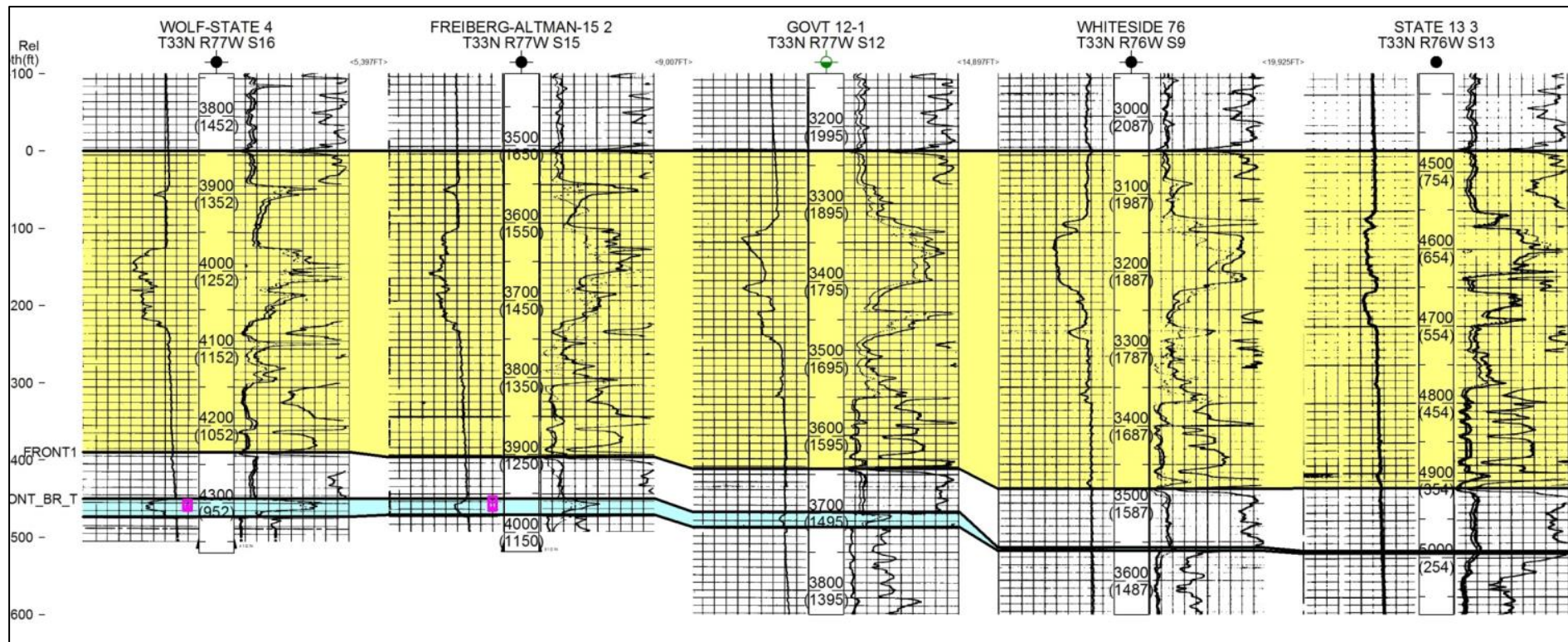


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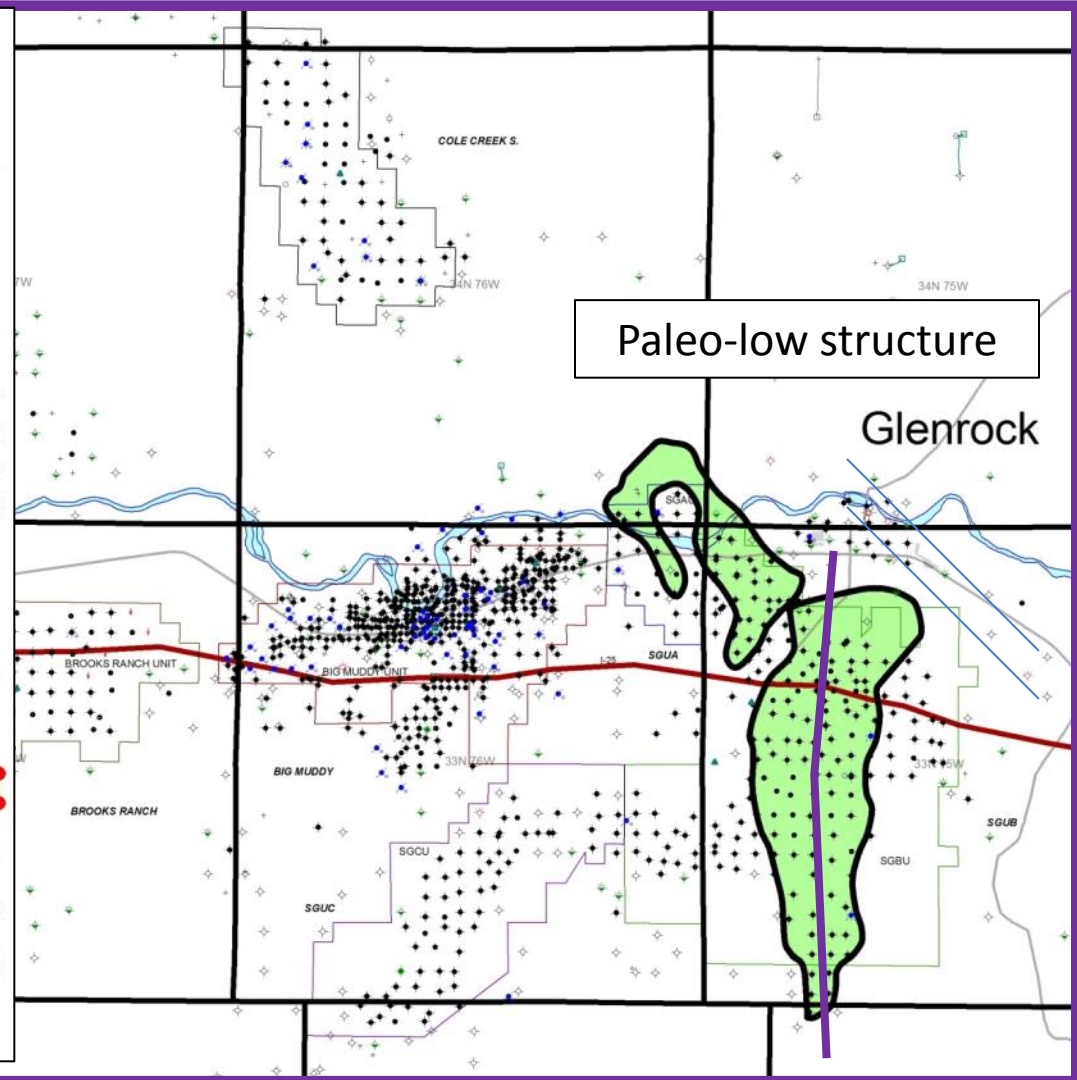
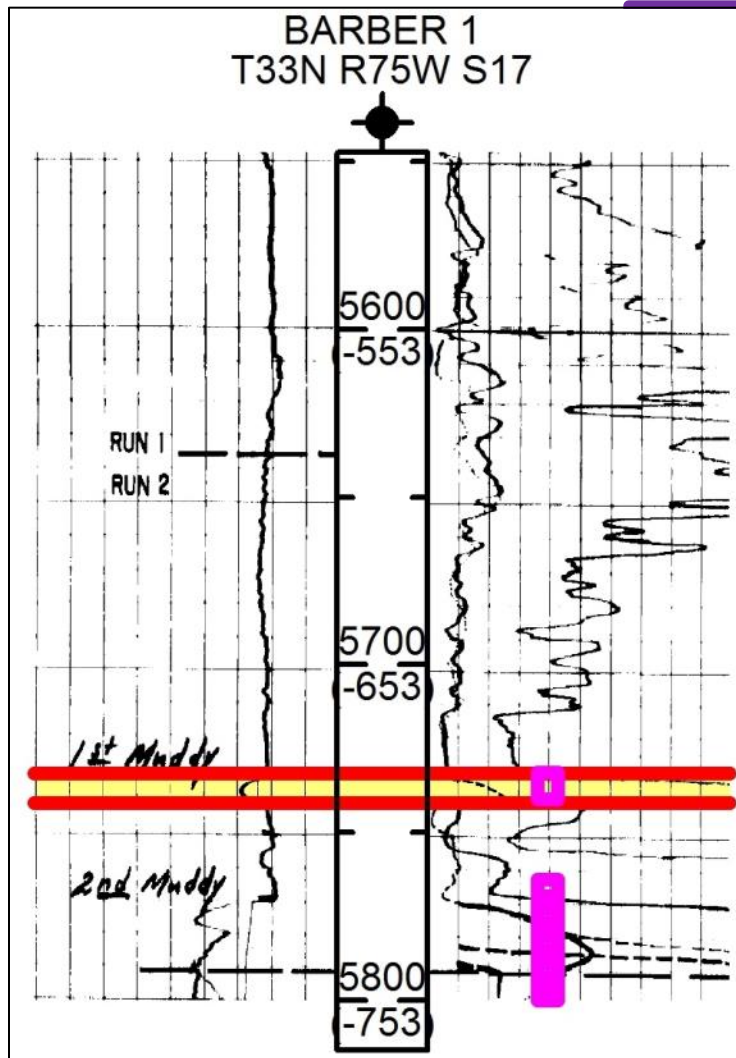




# FRONTIER



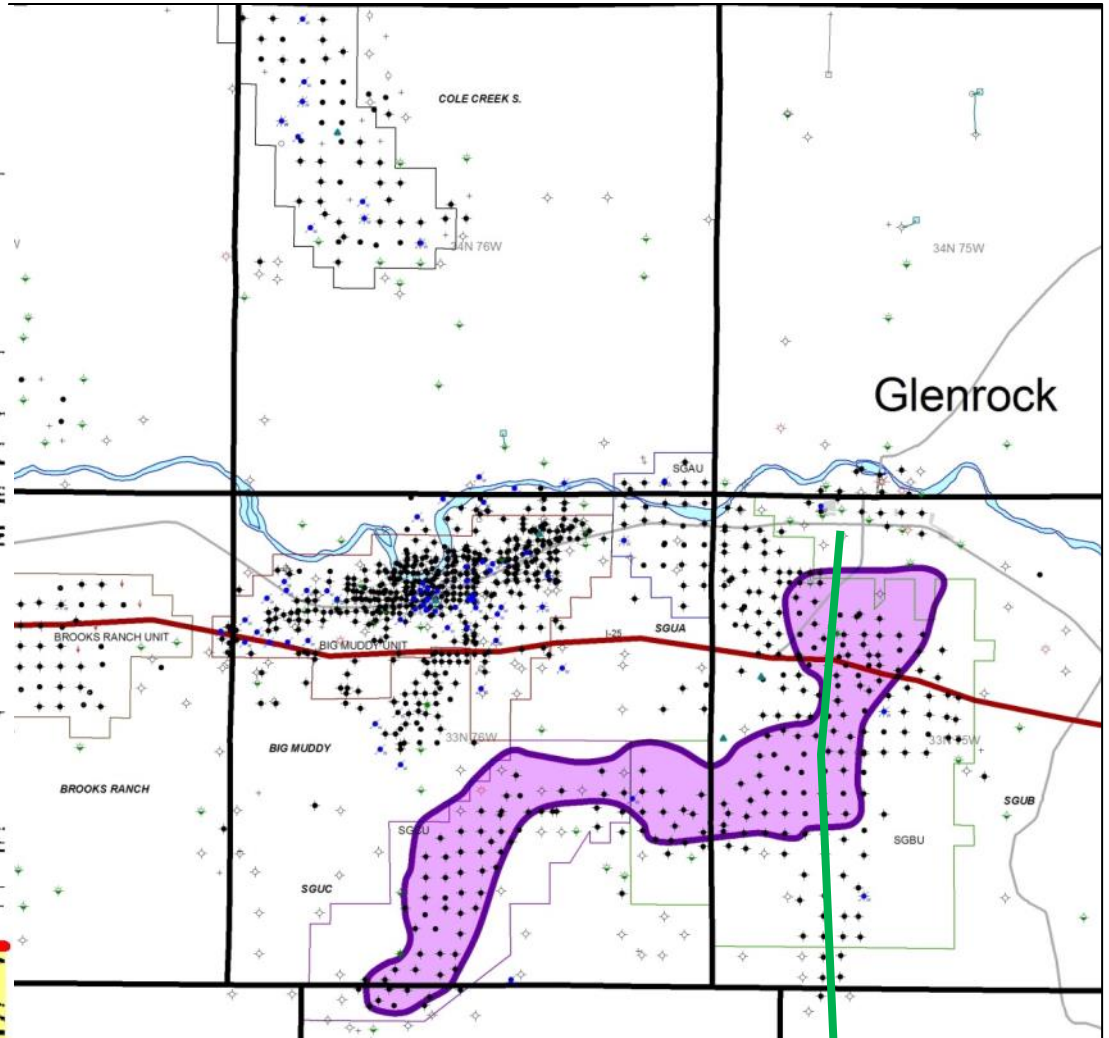
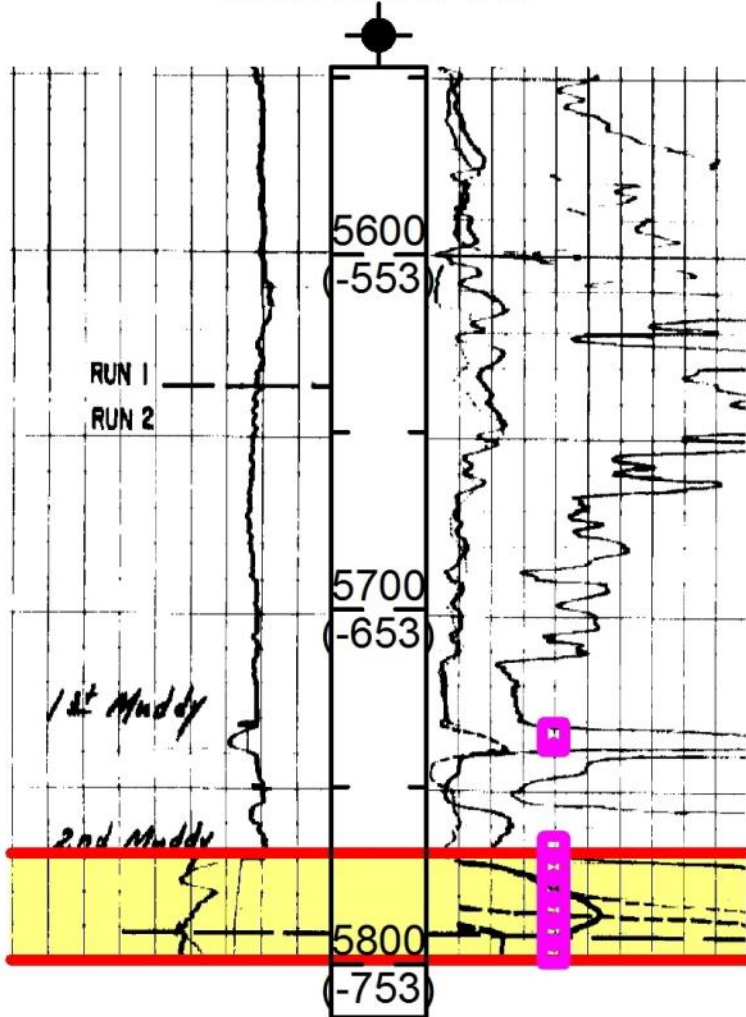
# UPPER MUDDY



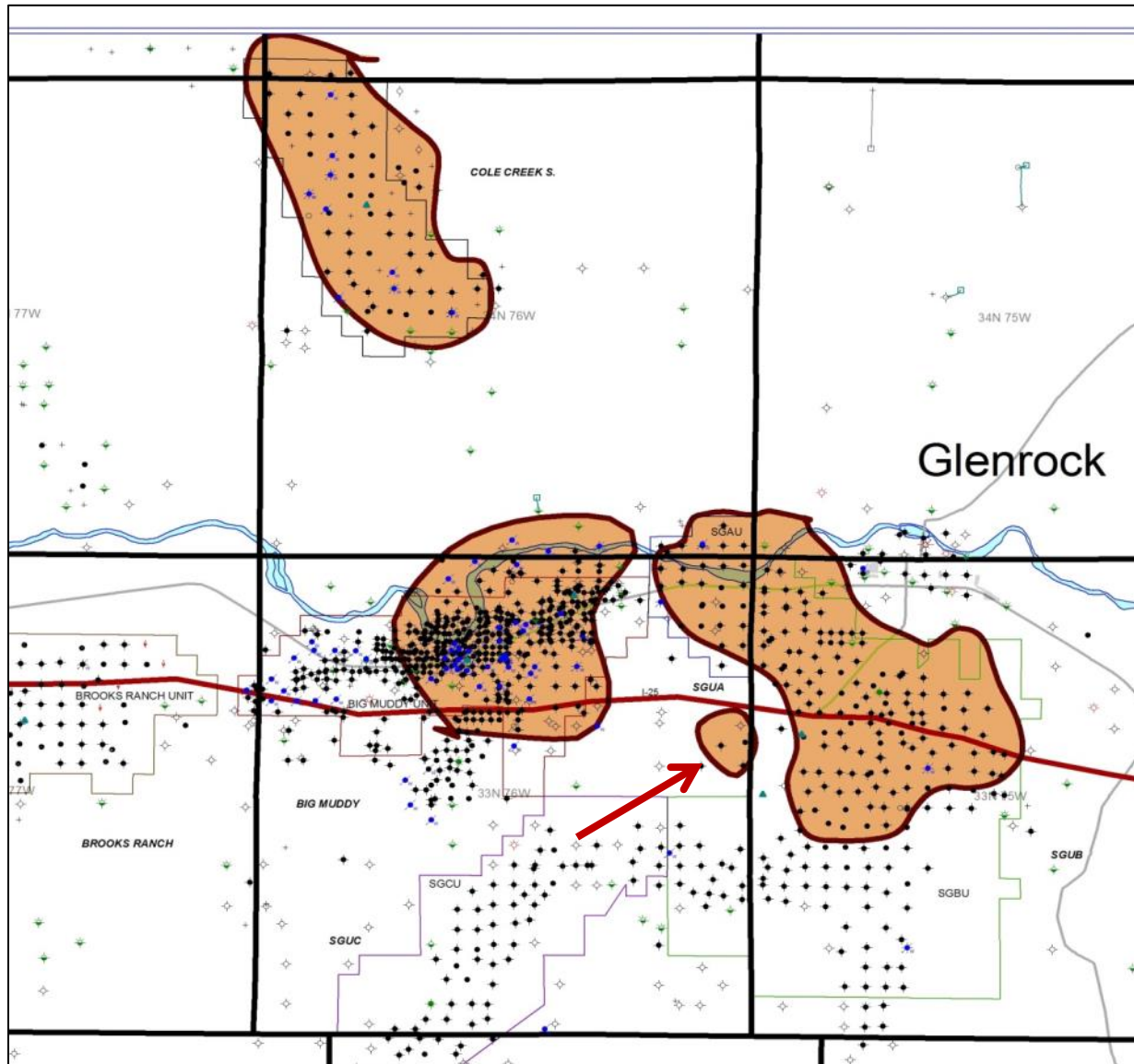


# LOWER MUDDY

BARBER 1  
T33N R75W S17



# DAKOTA



# DAKOTA RAPID FACIES CHANGES

GLENROCK-STATE 13 4  
T33N R76W S13

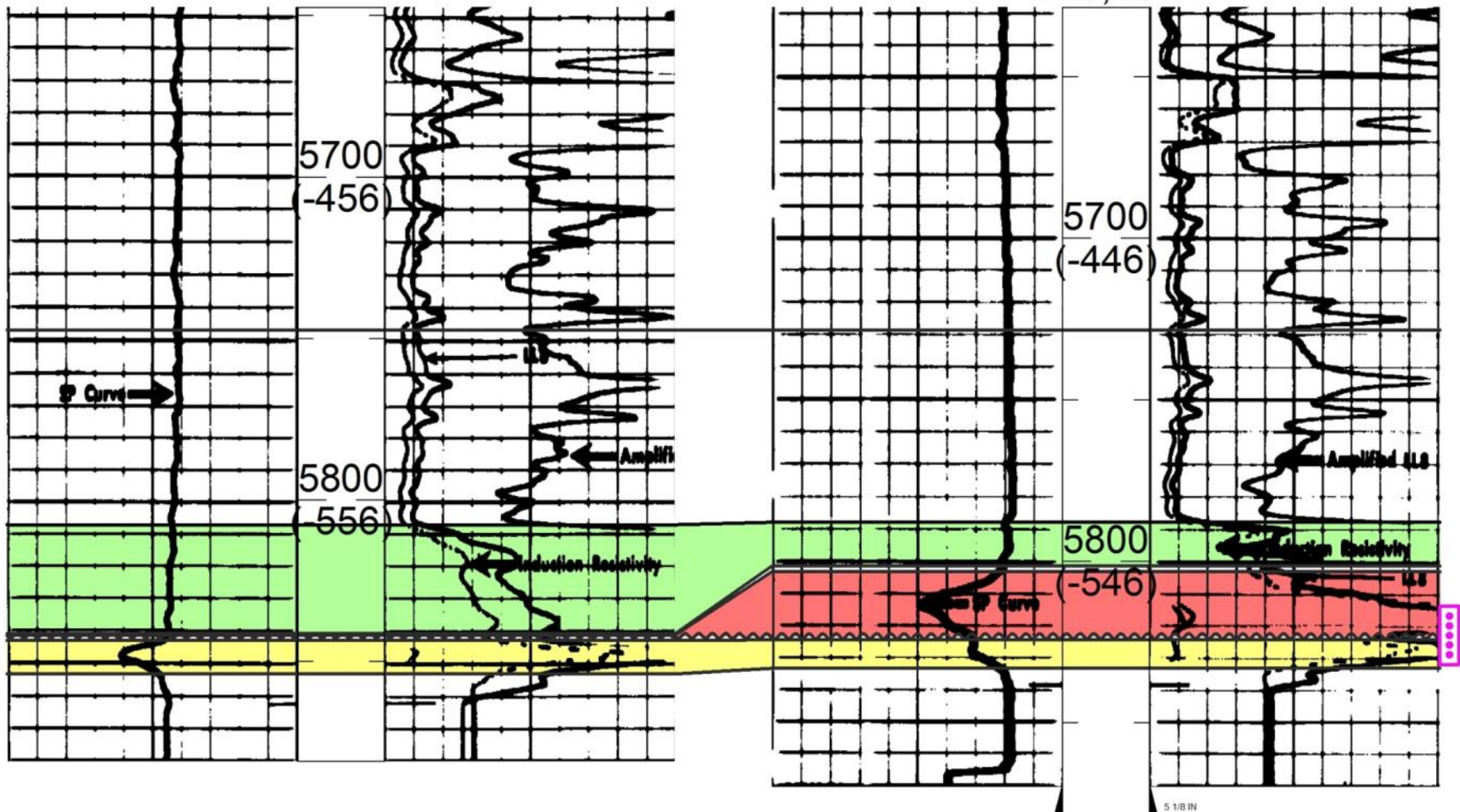


<1,155FT>

STATE 13 3  
T33N R76W S13

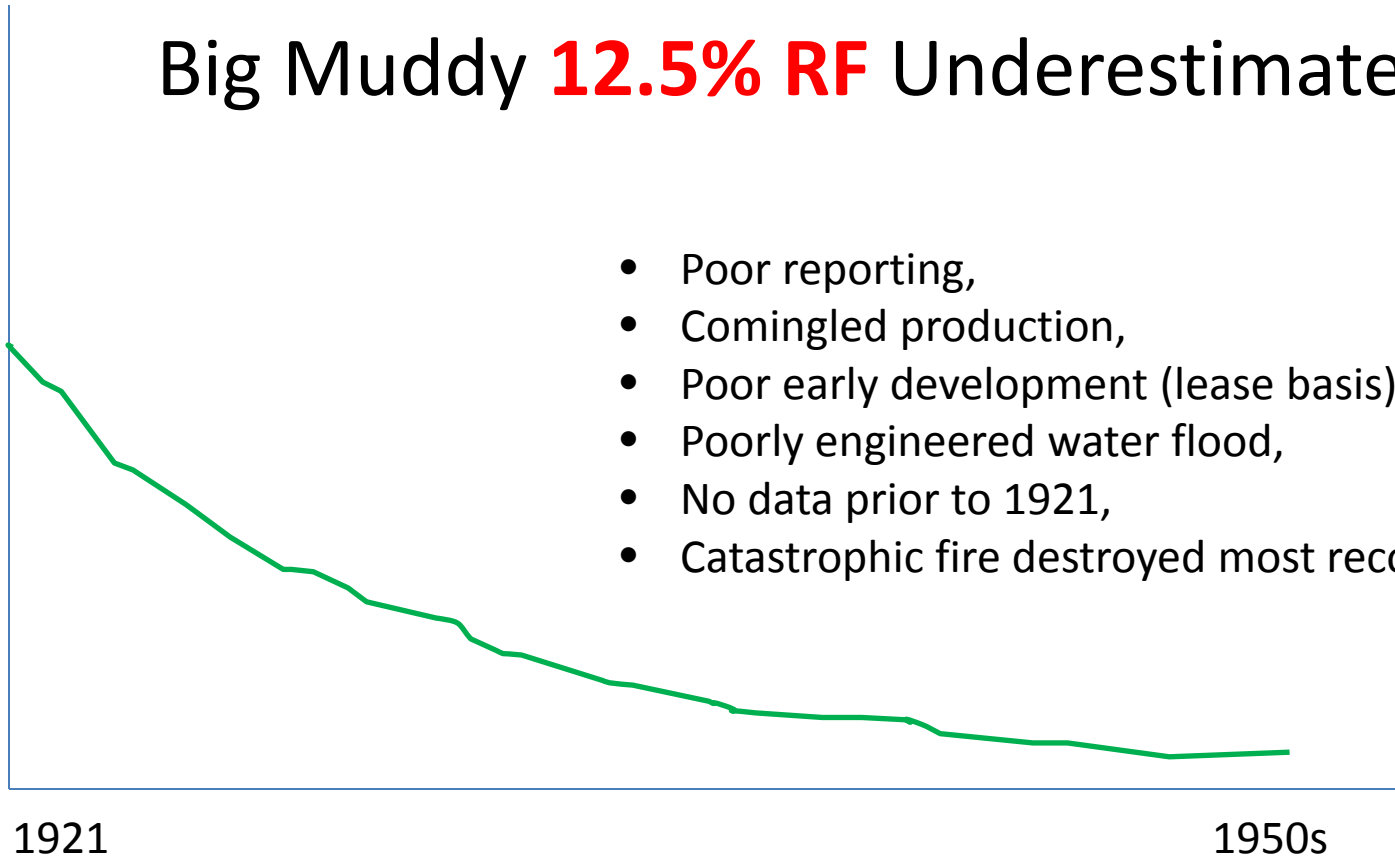


316,404



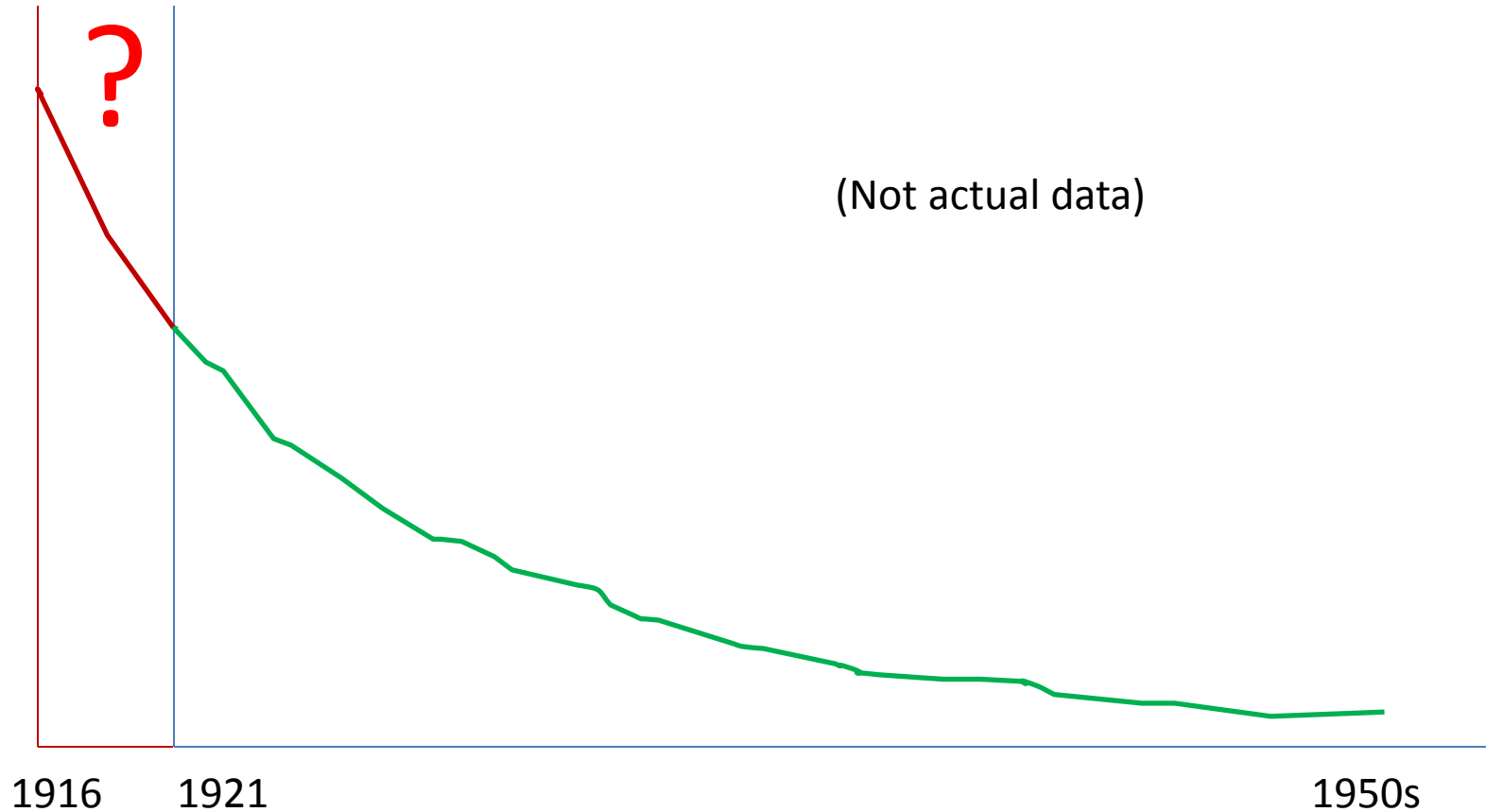
# EOR IN THE GLENROCK FIELDS

Big Muddy **12.5% RF** Underestimated?

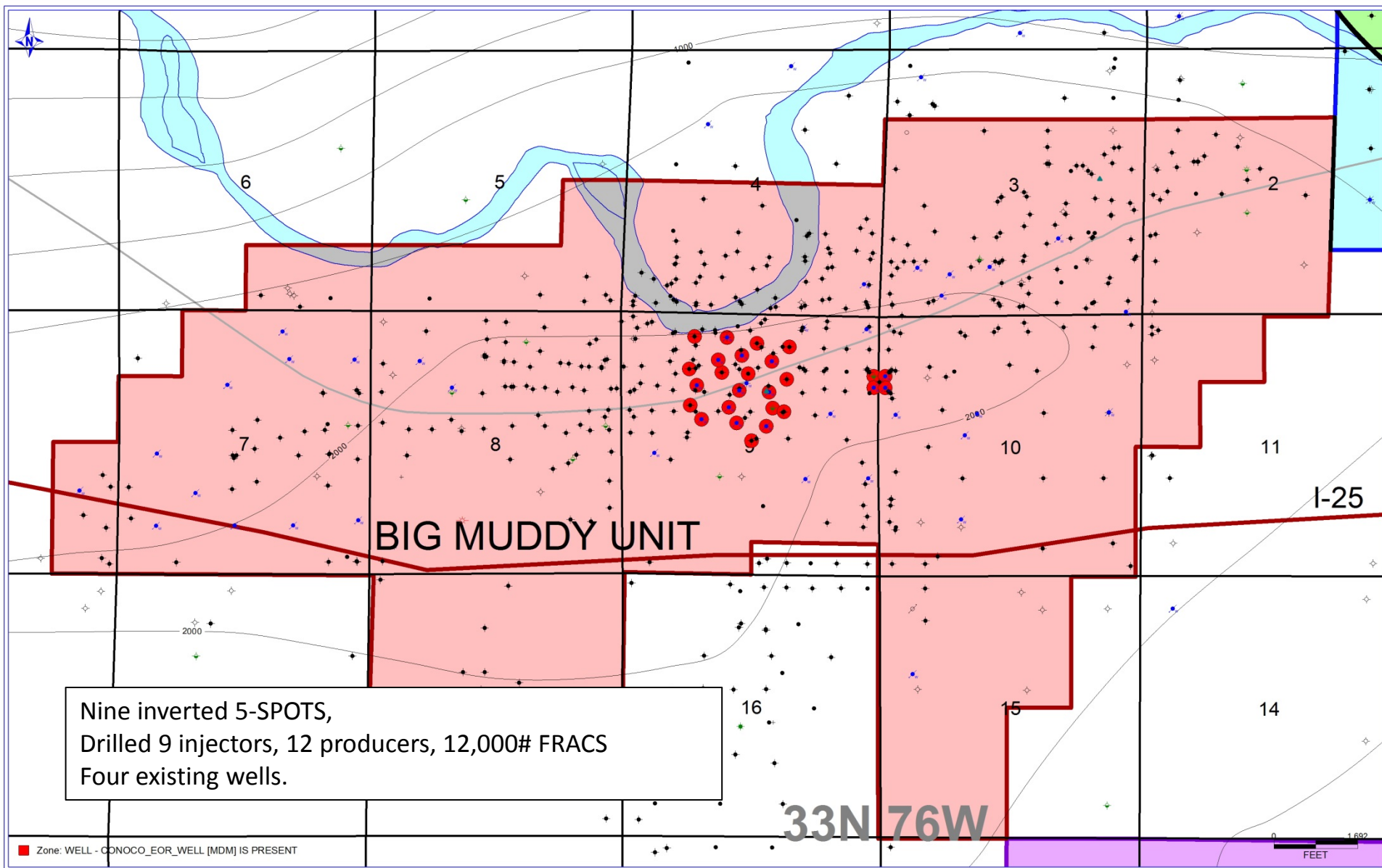




# EOR IN THE GLENROCK FIELDS



# CONOCO PROJECT AREA 1978-1985



Nine inverted 5-SPOTS,  
Drilled 9 injectors, 12 producers, 12,000# FRACS  
Four existing wells.

# BIG MUDDY BOPD







- Peak oil rate did not match predictive models,
- Chemical went far out of the pattern and into other formations,
- Conoco investment: **\$30 MM**,
- DOE investment: **\$9.5 MM**.

# RANCHER CO<sub>2</sub>

- **2006:** Rancher Energy Corp. acquires the Big Muddy field. South Glenrock and Cole Creek fields are later acquired,
- **2007:** Rancher enters into an onerous “take-or-pay” contract with Anadarko, allowing 25-40 MMCFD CO<sub>2</sub> delivered at Salt Creek,
- **2008:** Rancher signs a CO<sub>2</sub> agreement with Exxon allowing 70 MMCFD for 10 years with a second ten year option,
- An investor group headed by Jon Nicolaysen conducts a hostile takeover of Rancher,
- Nicolaysen leads the company through bankruptcy and settles all debts.







Powder  
River  
Basin

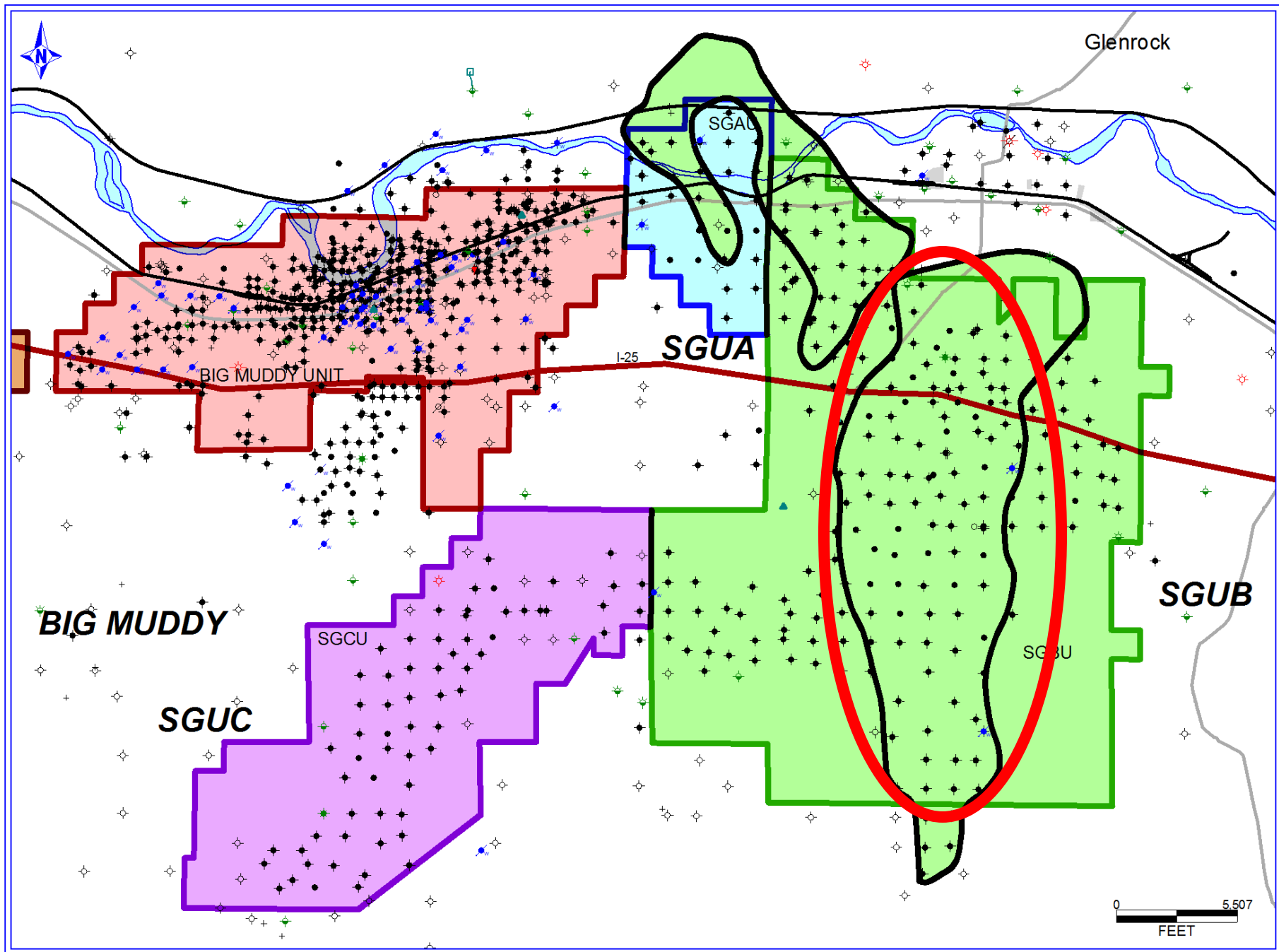
South I

GasTech  
Leasehold

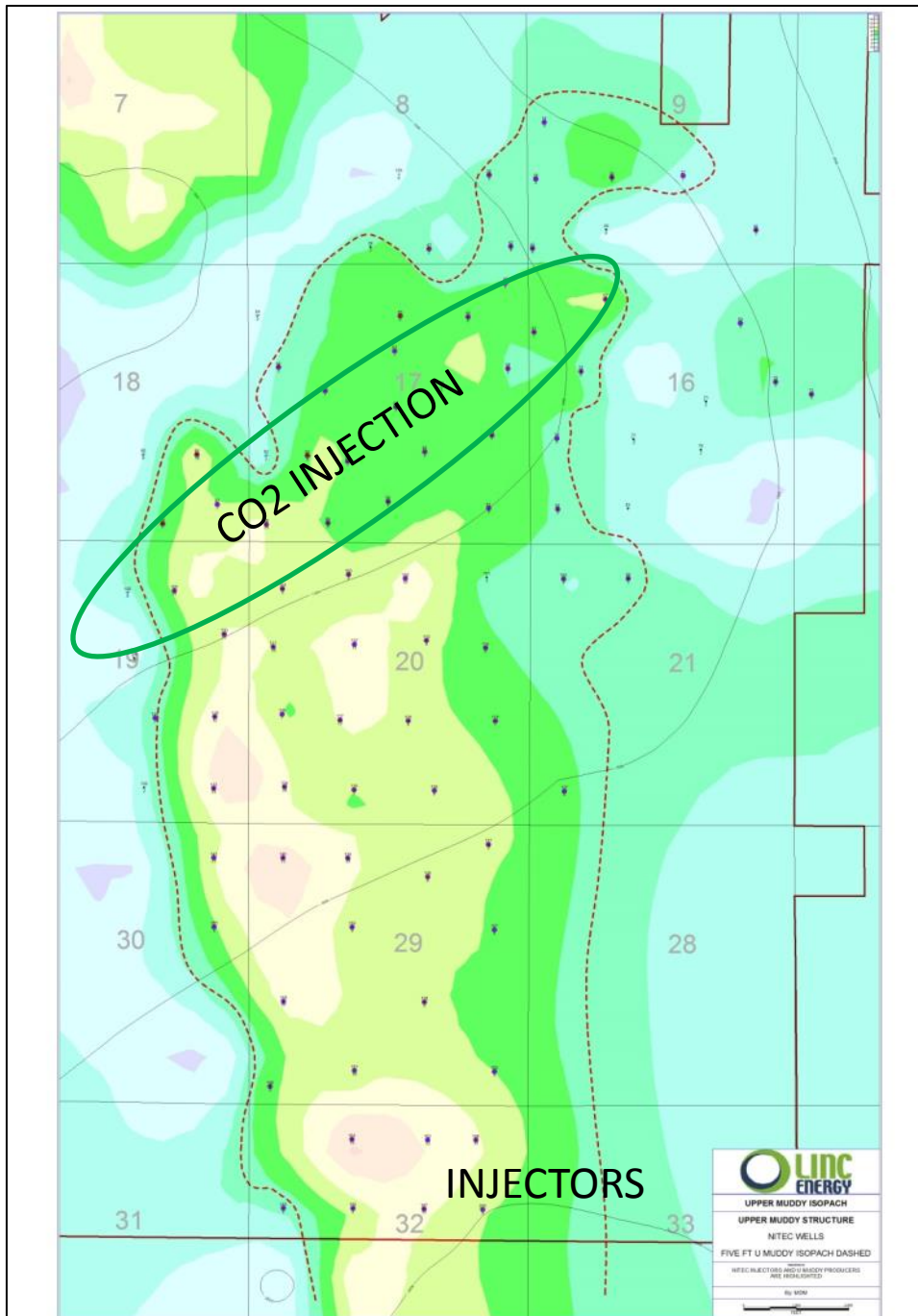
Wyoming

★  
Glenrock area

- 2011: Glenrock fields are purchased from Rancher for about \$20 MM, or about 1/3 of what Rancher paid.
- Linc estimated 80 MMBO recoverable from CO<sub>2</sub> flooding.

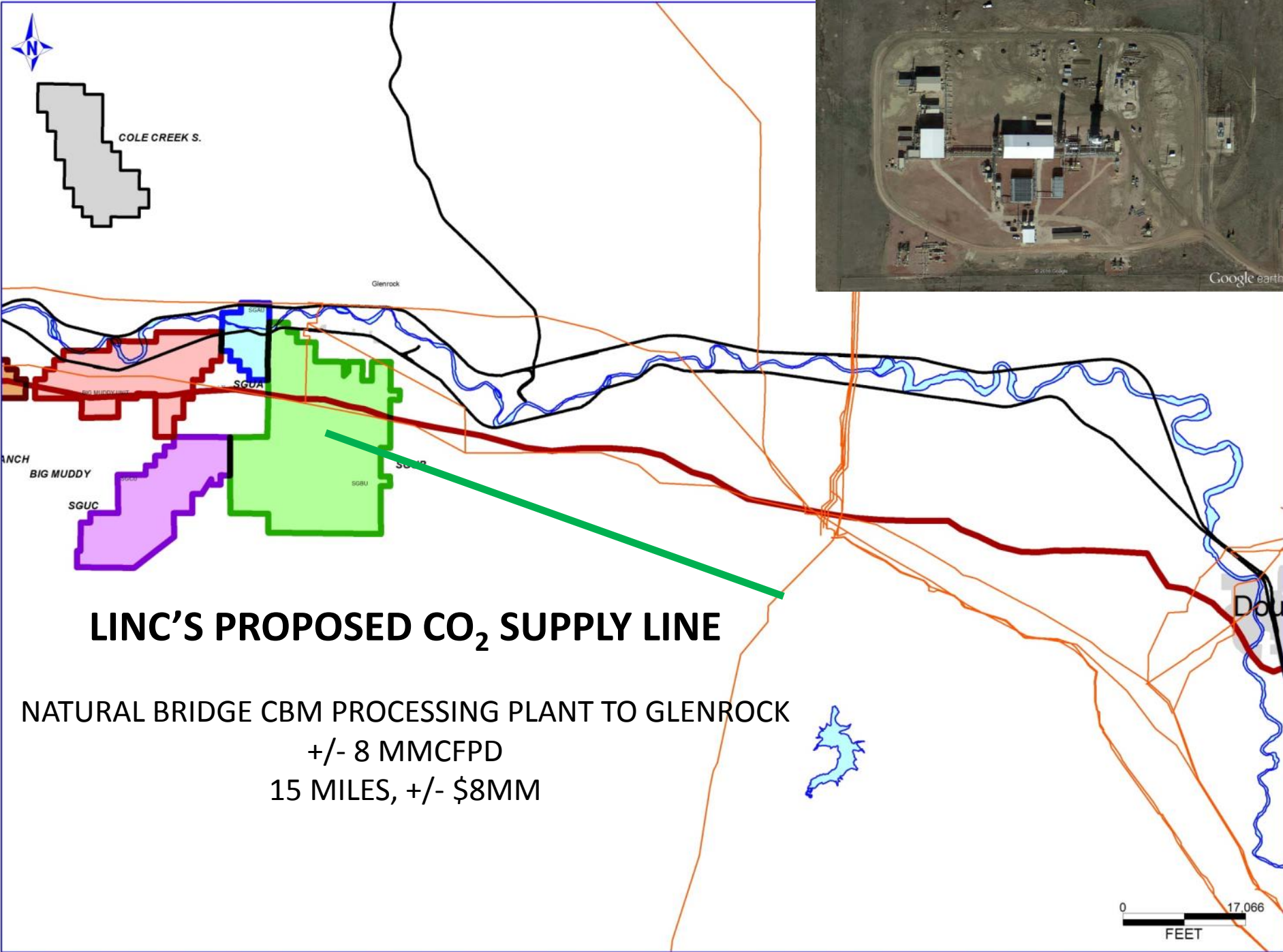
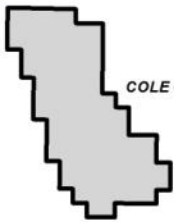






## UPPER MUDDY DEVELOPMENT

- Thin sandstone of uniform quality would yield fast response.
- Comingled and probably underdeveloped

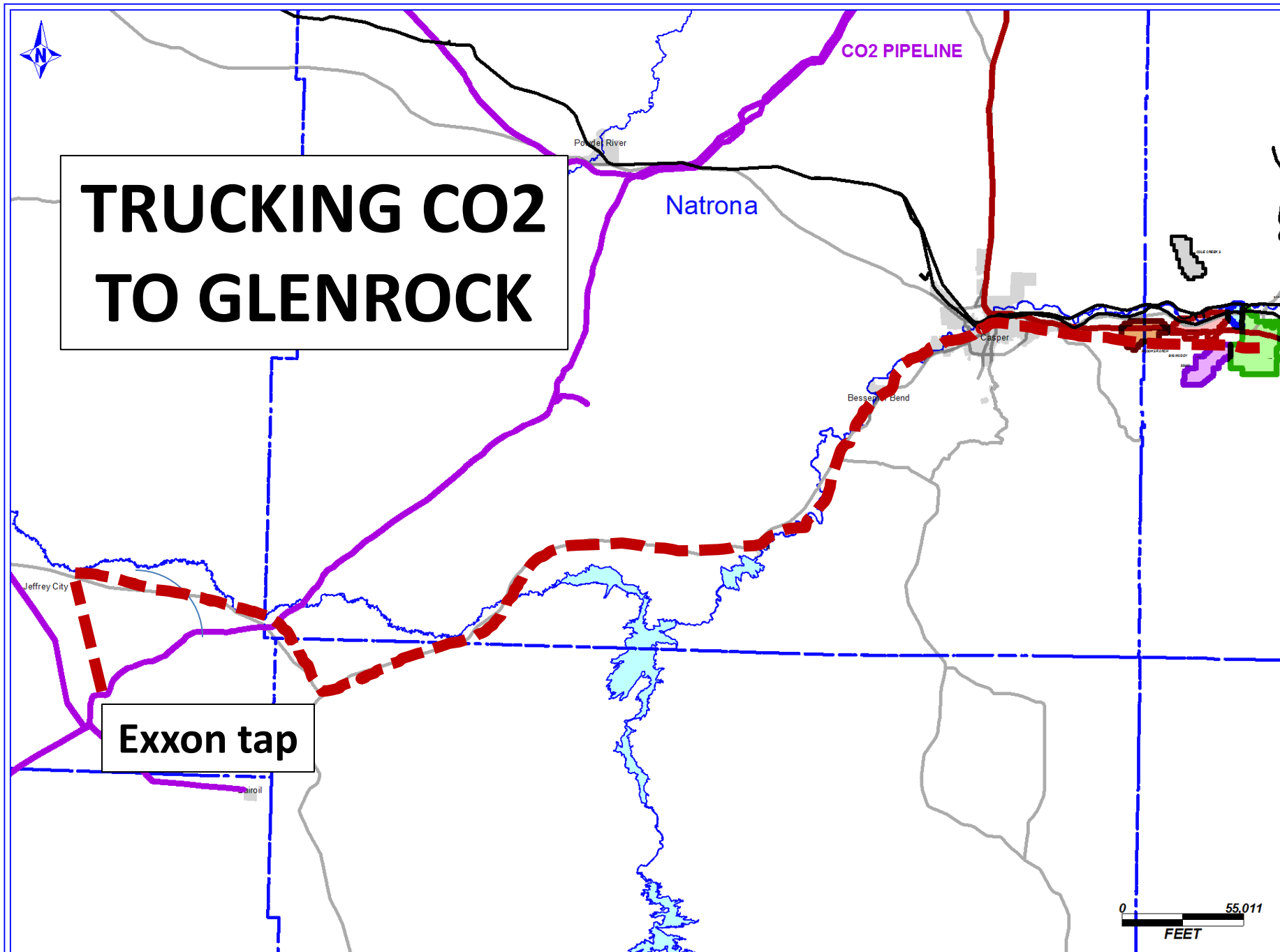


# LINC'S PROPOSED CO<sub>2</sub> SUPPLY LINE

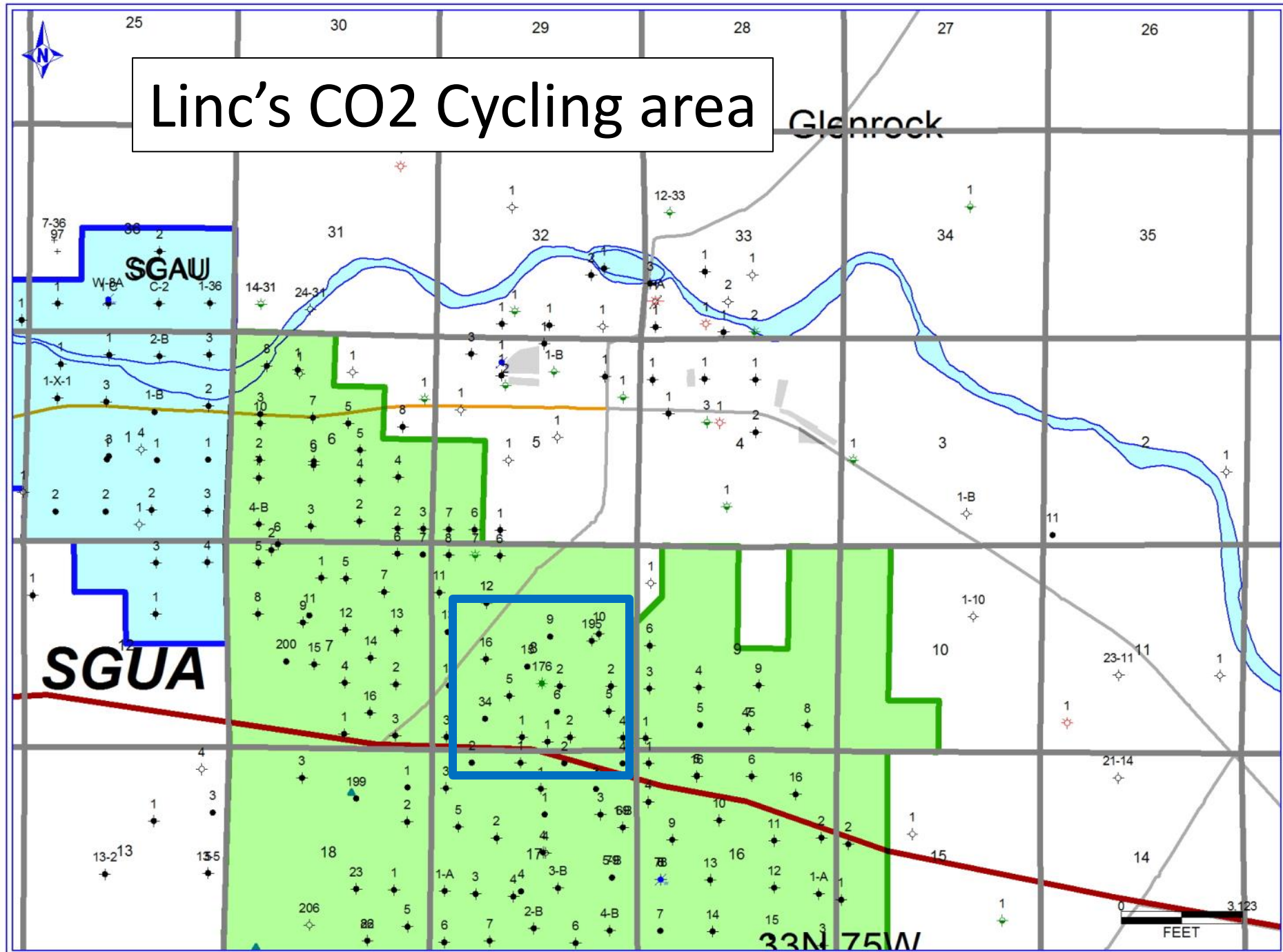
NATURAL BRIDGE CBM PROCESSING PLANT TO GLENROCK  
+/- 8 MMCFPD  
15 MILES, +/- \$8MM



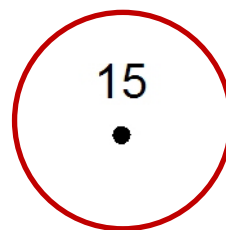




# Linc's CO2 Cycling area



**Conoco #15**  
**250 tons CO2**  
**1991**



176



2



5



6



**Linc #34**

34

**Conoco #1**

1



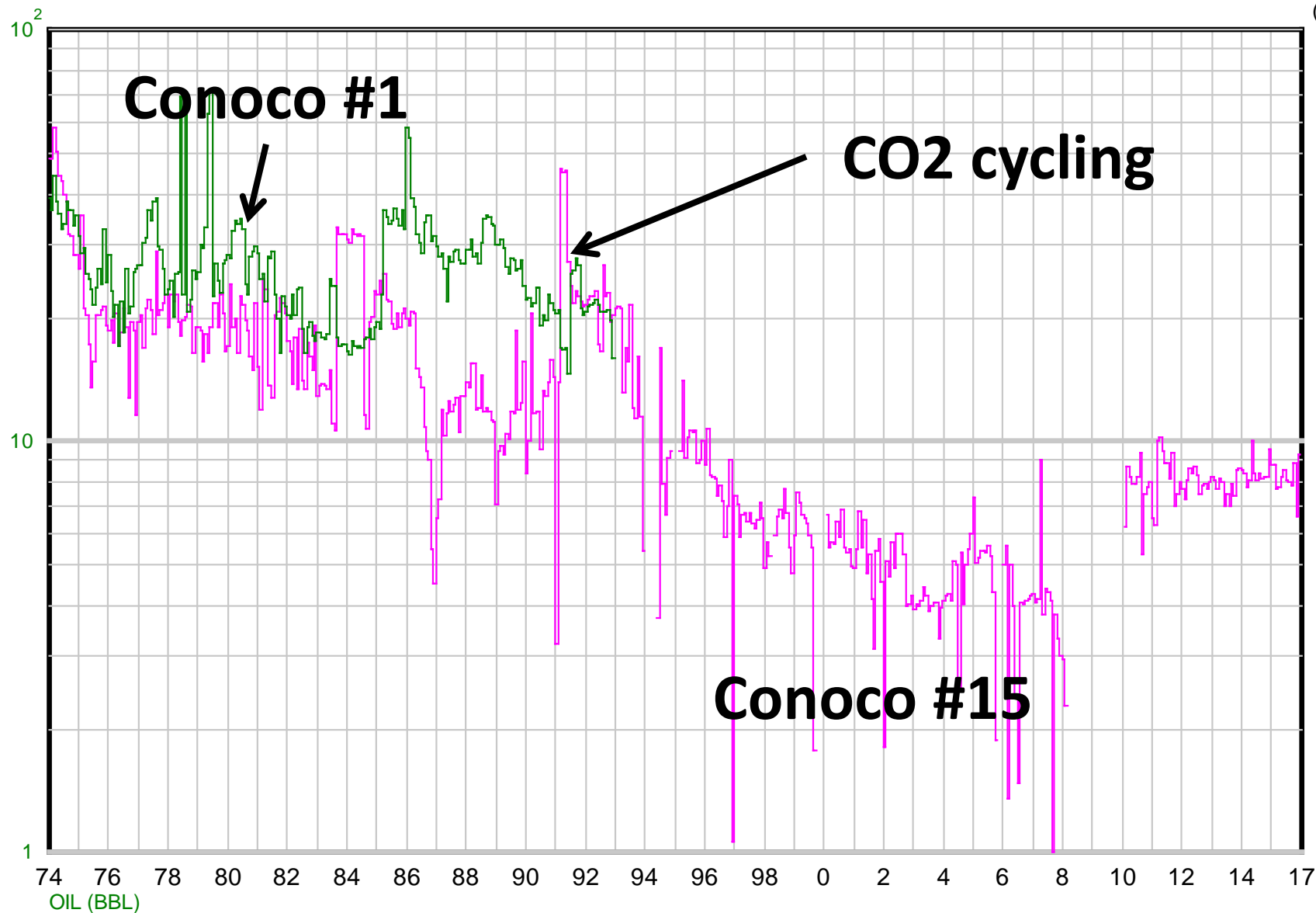
1



2







An incremental 12 MBO were reportedly produced

15 well is RED



8

15

176

2

2

**Linc #34**  
**500 tons CO<sub>2</sub>**

5

34

6

5

1

1

2

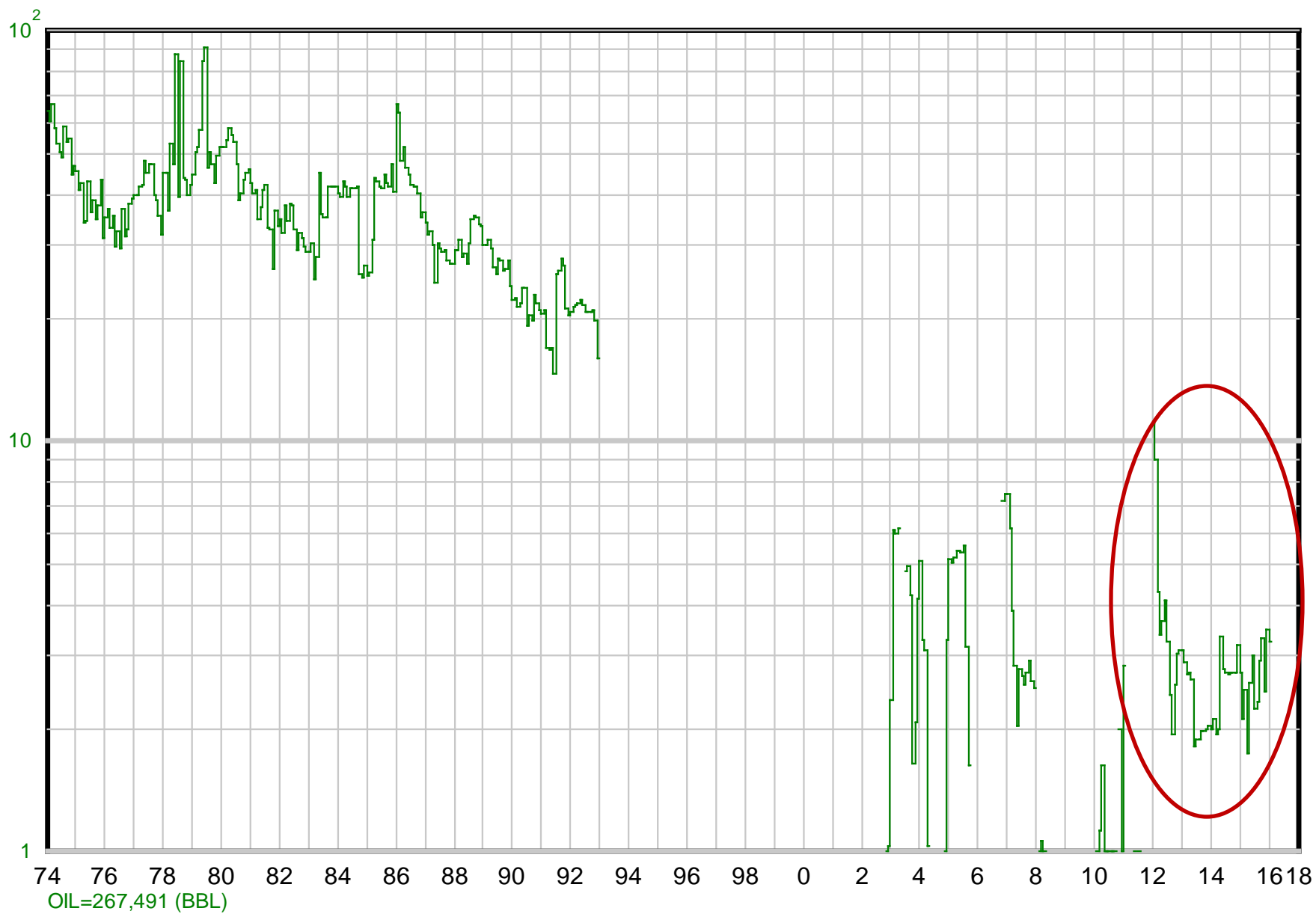
**Linc Attempts a CO<sub>2</sub> Cycling Project in the  
Dakota Fm., November 2011**

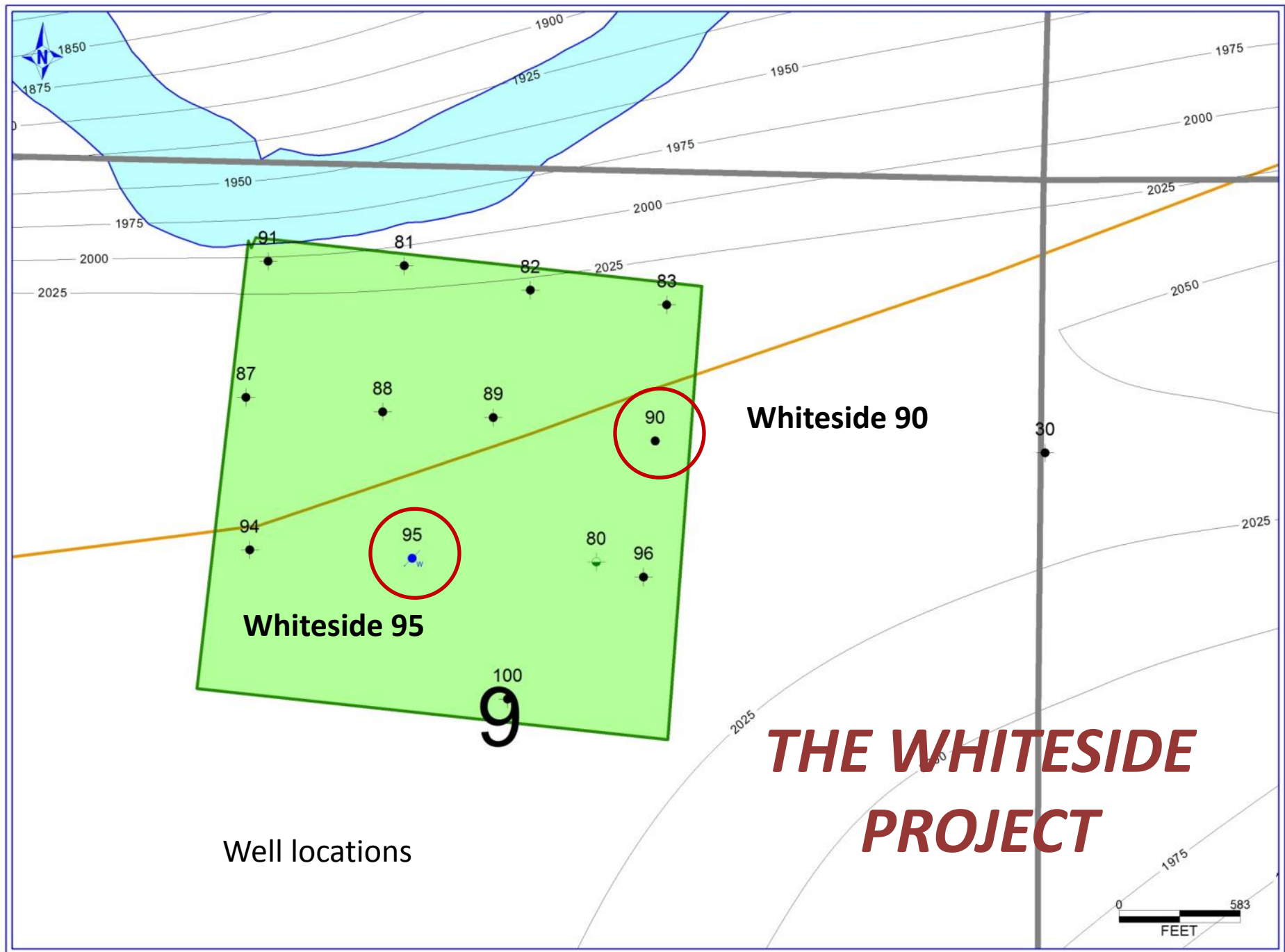
491  
FEET



- 500 tons liquid CO<sub>2</sub>
- Soak period 21 days,
- 10 BOPD, immediately goes to 3-4 BOPD,

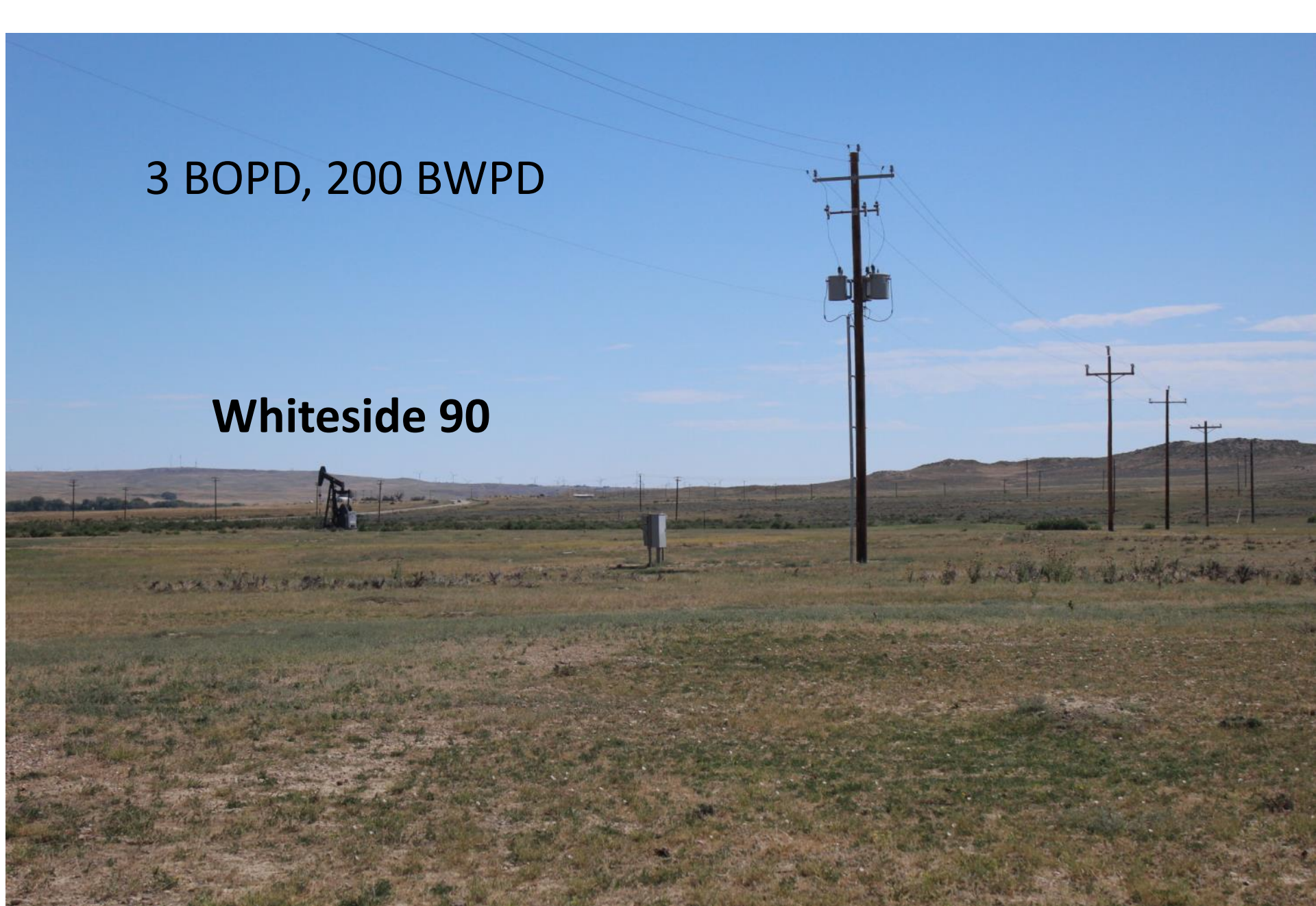






3 BOPD, 200 BWPD

**Whiteside 90**







# ***THANKS FOR YOUR HELP***

Jim Nations	Jon Nicolaysen
Darren Rodgers	Walt Merschat
Mike Hawks	John Scherlin
Mike Borah	Elk Petroleum
Steve Morzenti	Brian Deurloo
John Wold	Frank Ingham
Margie Nauda	Steve Delger
Sandy Blackburn	Dale Valentine
Mick Lehner	John Bettridge

# QUESTIONS?



Courtesy of Jon Nicolaysen