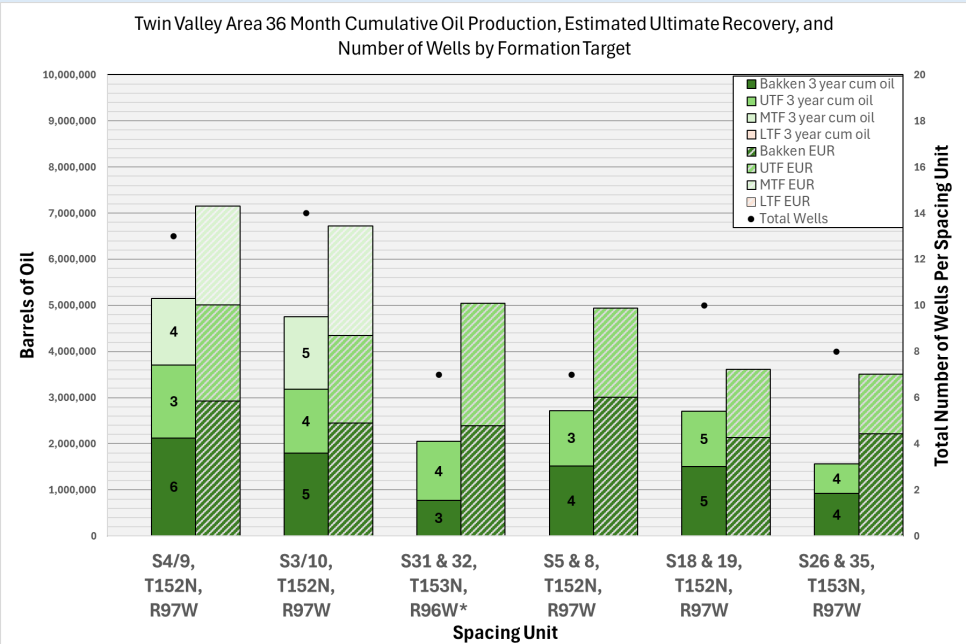
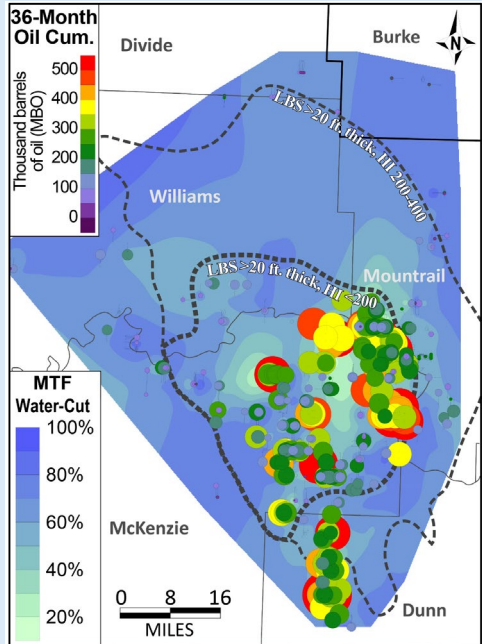
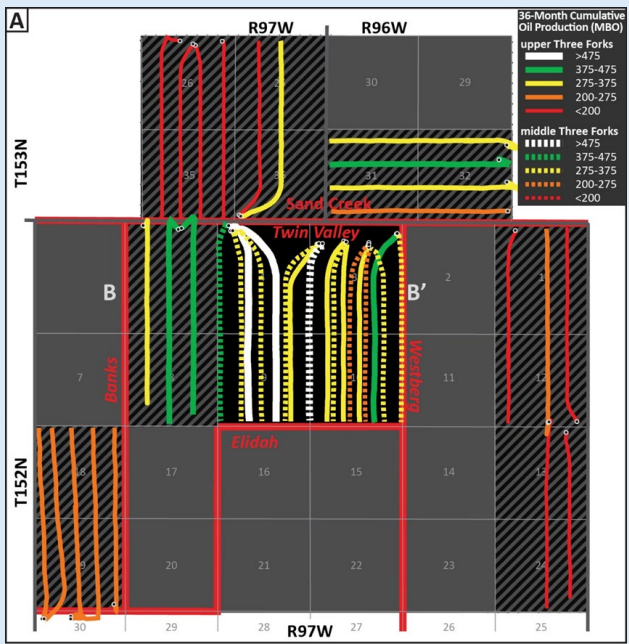




Underdeveloped Resources in the Middle Three Forks Formation



Timothy O. Nesheim* & Ted Starns*

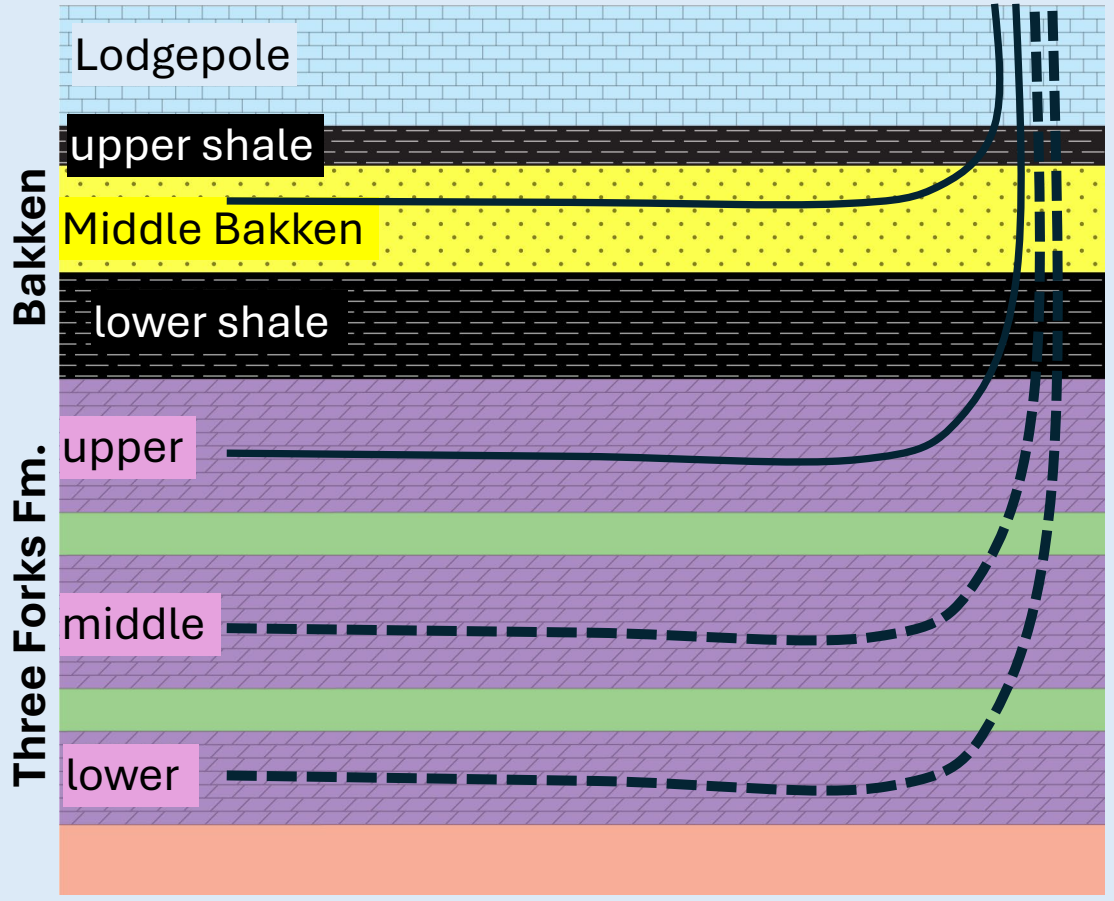
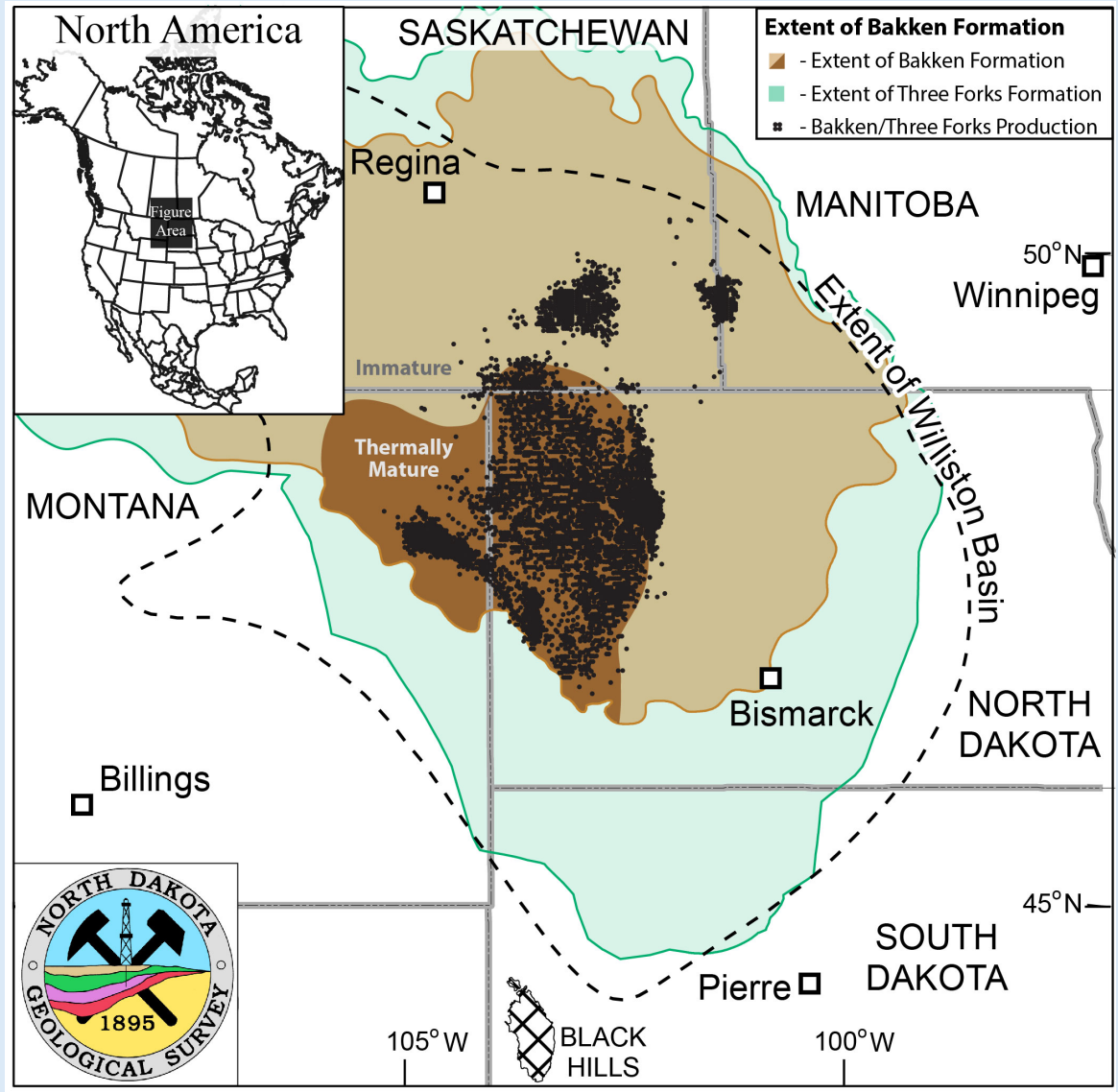
SB-2397

4/15/2025

*North Dakota Geological Survey
Department of Mineral Resources

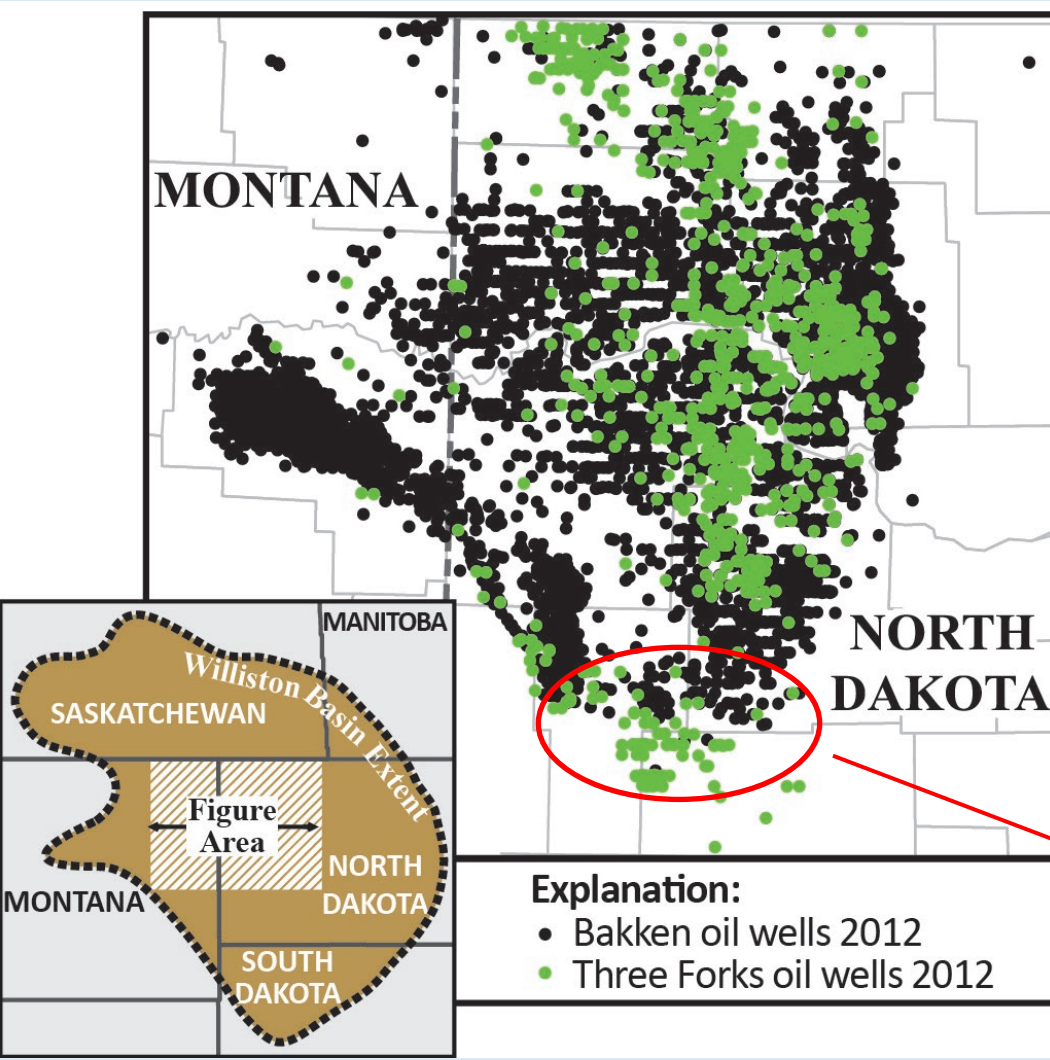


Bakken-Three Forks Play Overview



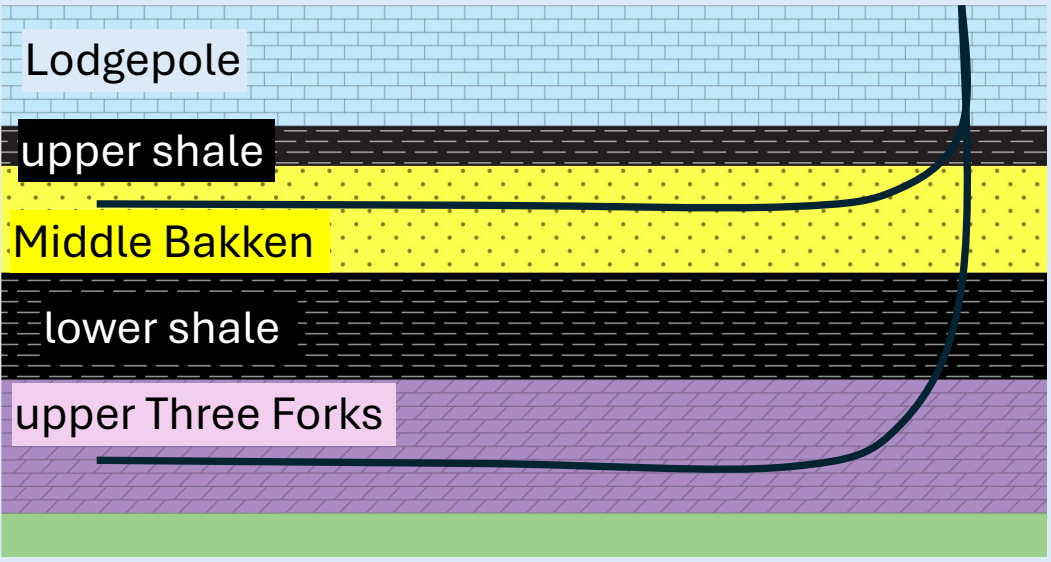


Bakken-Three Forks Play Evolution

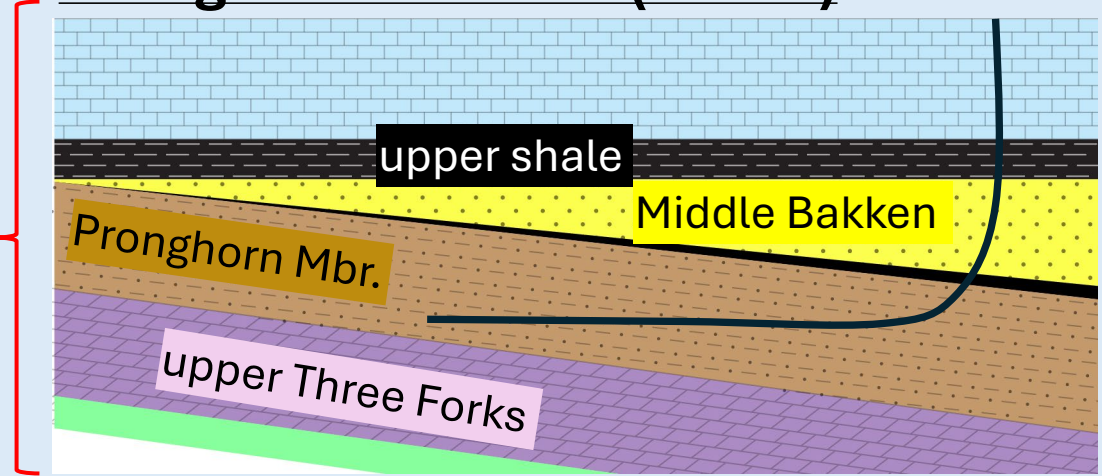


- Explanation:**
- Bakken oil wells 2012
 - Three Forks oil wells 2012

Middle Bakken & u. Three Forks(2000-08)

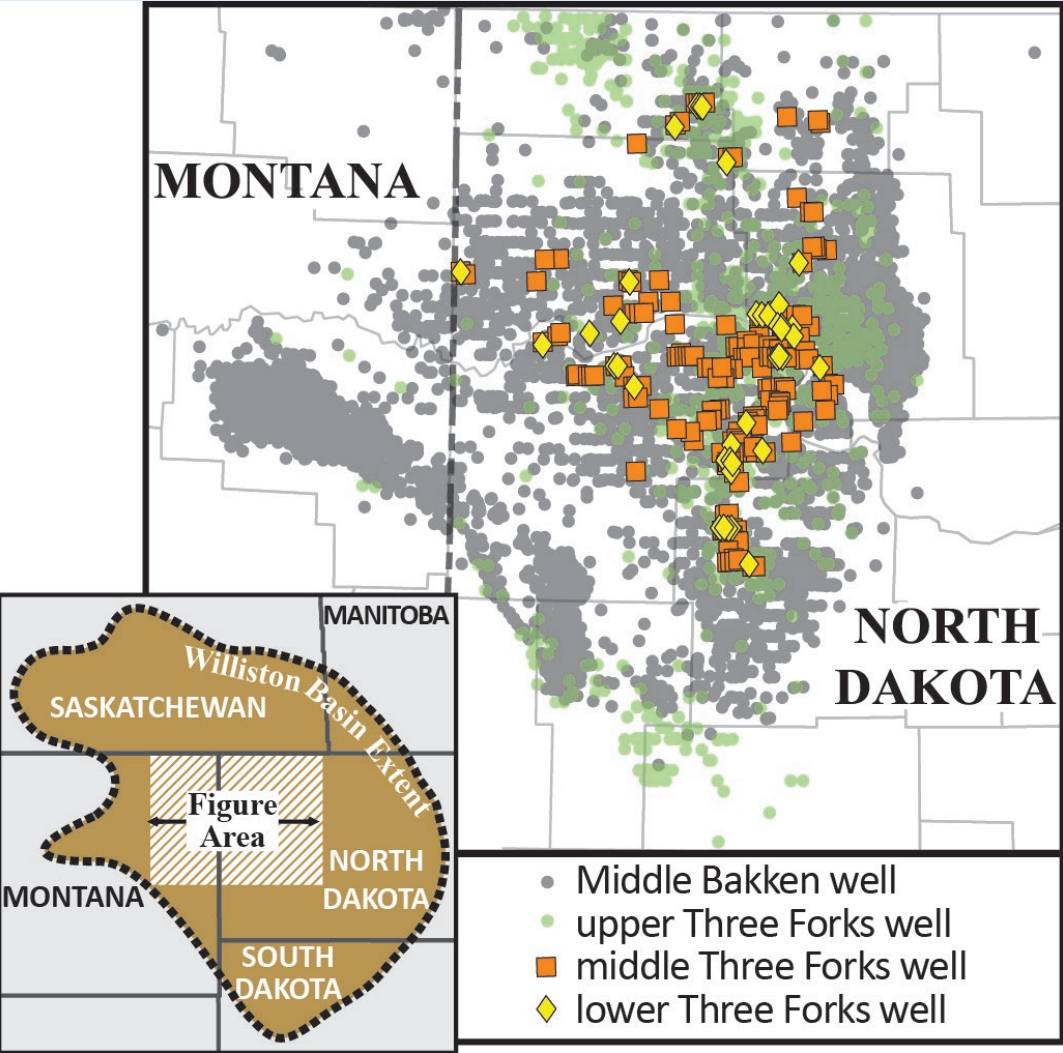


Pronghorn Member (~2010)

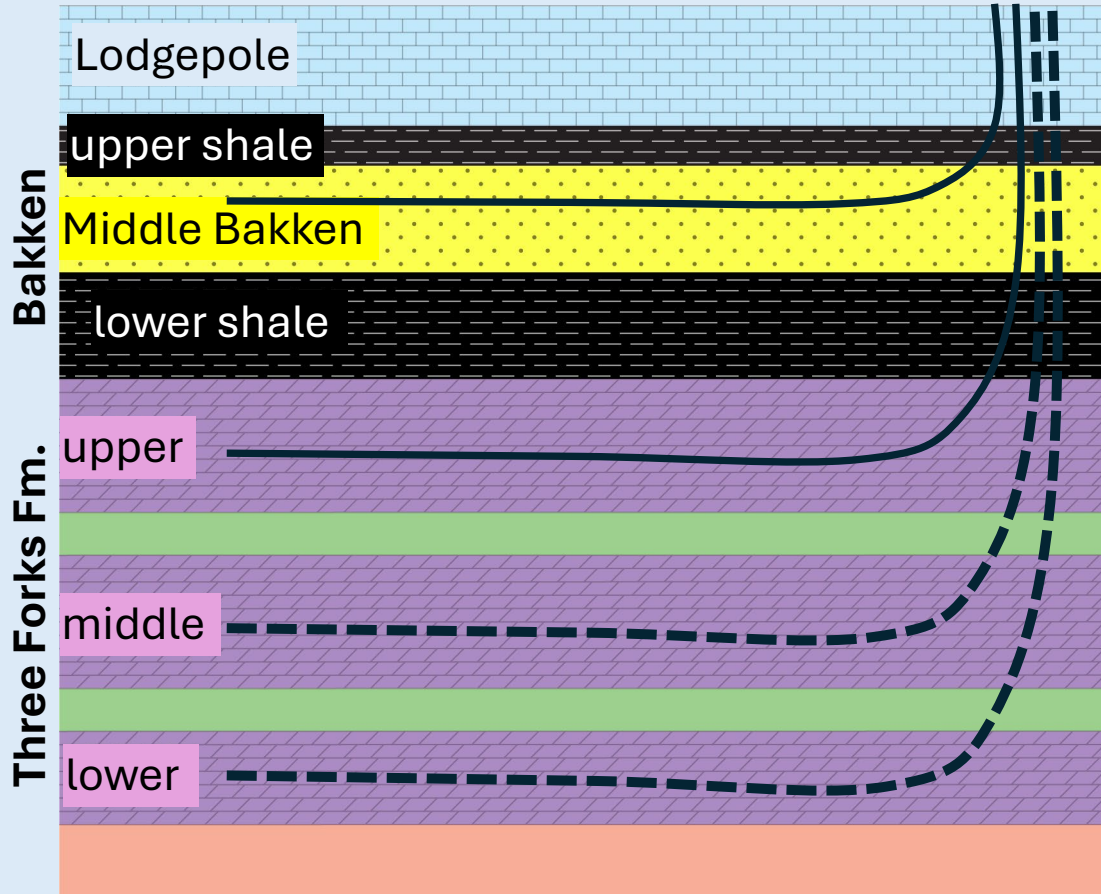




Bakken-Three Forks Play Evolution

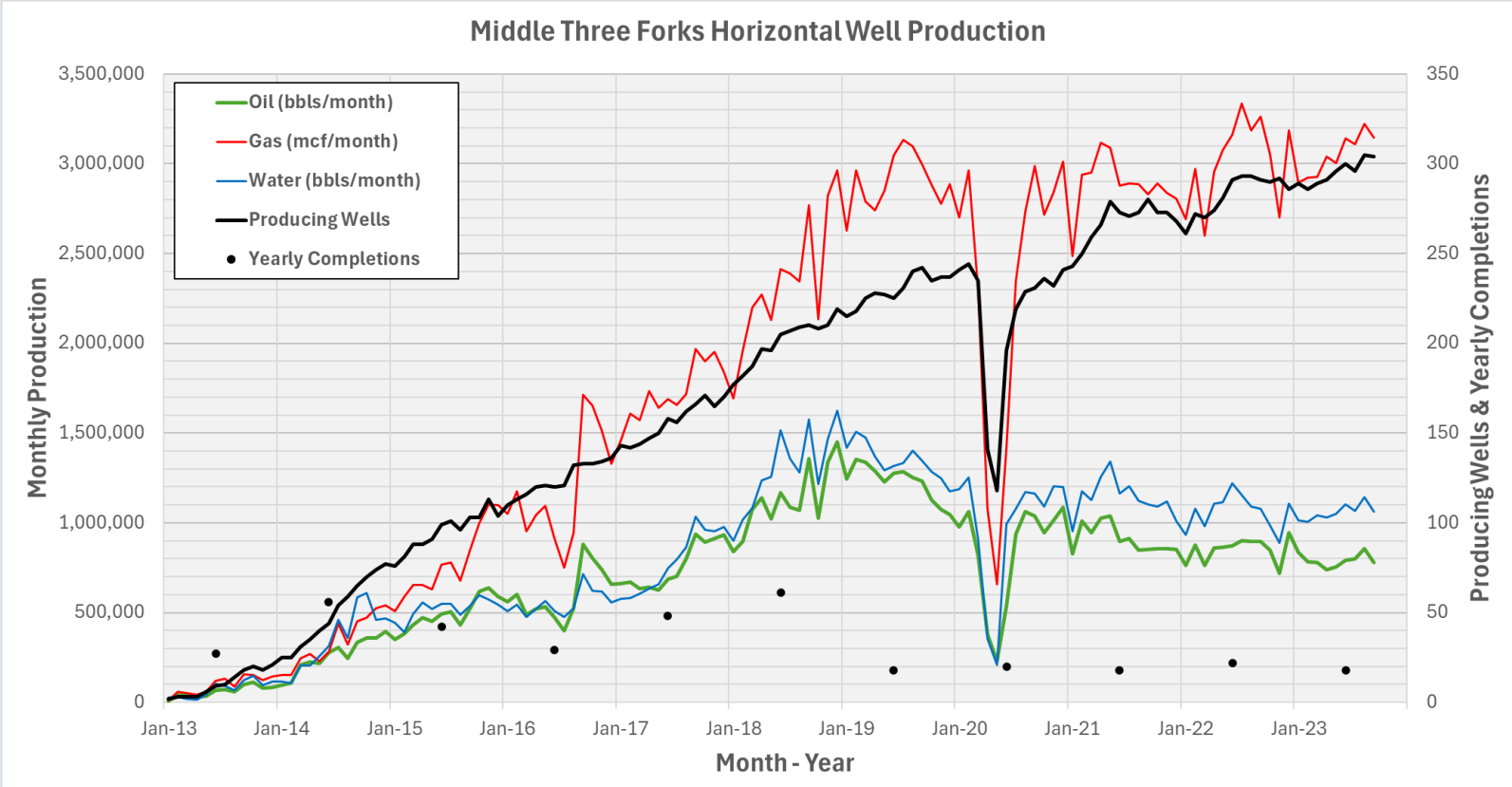
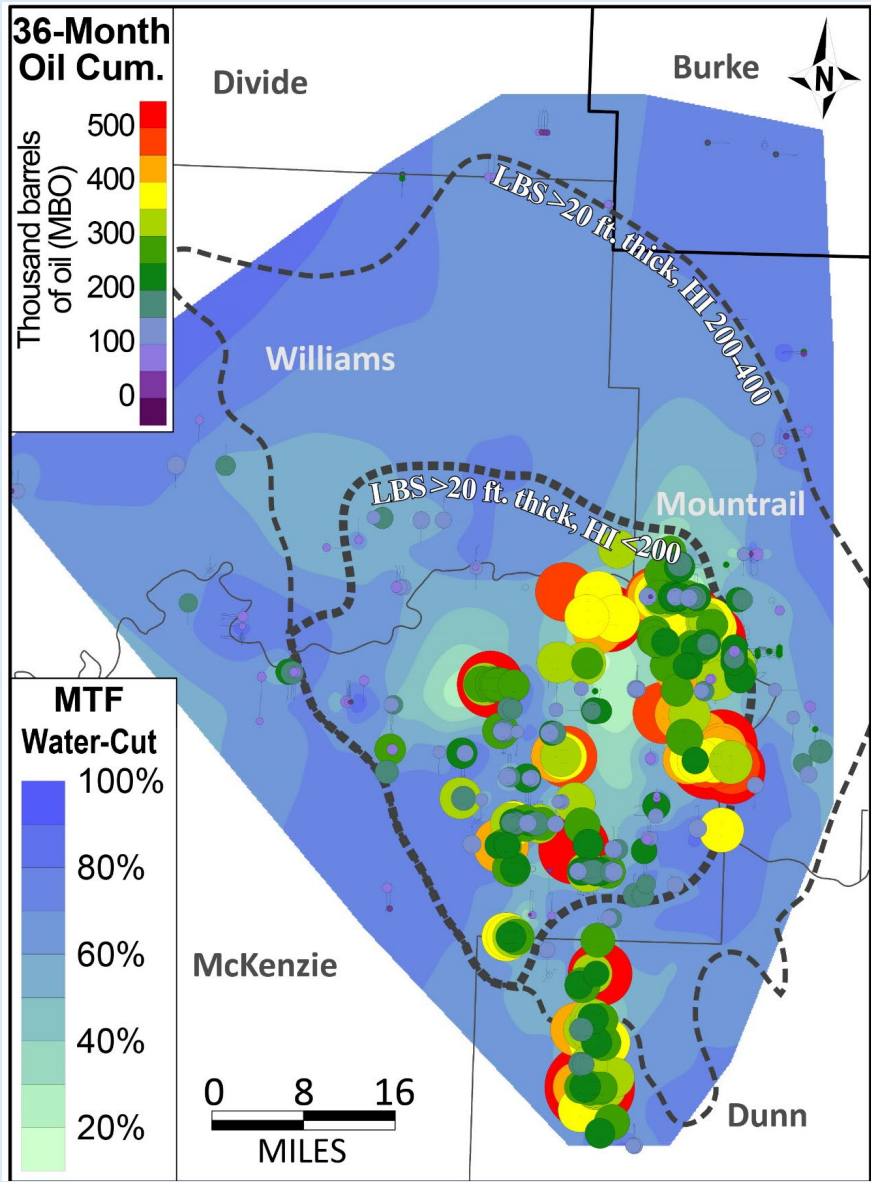


middle & lower Three Forks (~2013)





Middle Three Forks Development



- 373 horizontal producers
- 92.5 MMBO Cum. Oil
- 107.7 MMBW Cum. Water
- 238.2 BCF Cum. Gas



Middle Three Forks Resource Potential – Project Update



Middle Three Forks 36 Month IP Water Cut

1) Twin Valley

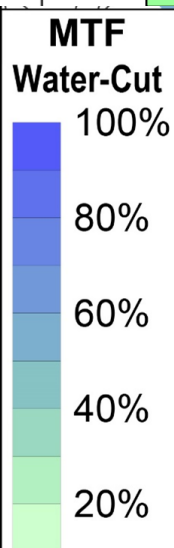
2) Camel Butte

3) Croff / Grail

5) Elm Tree

4) SW Sanish

LBS > 20 ft. thick
MI < 200



8 16
MILES

METHODS:

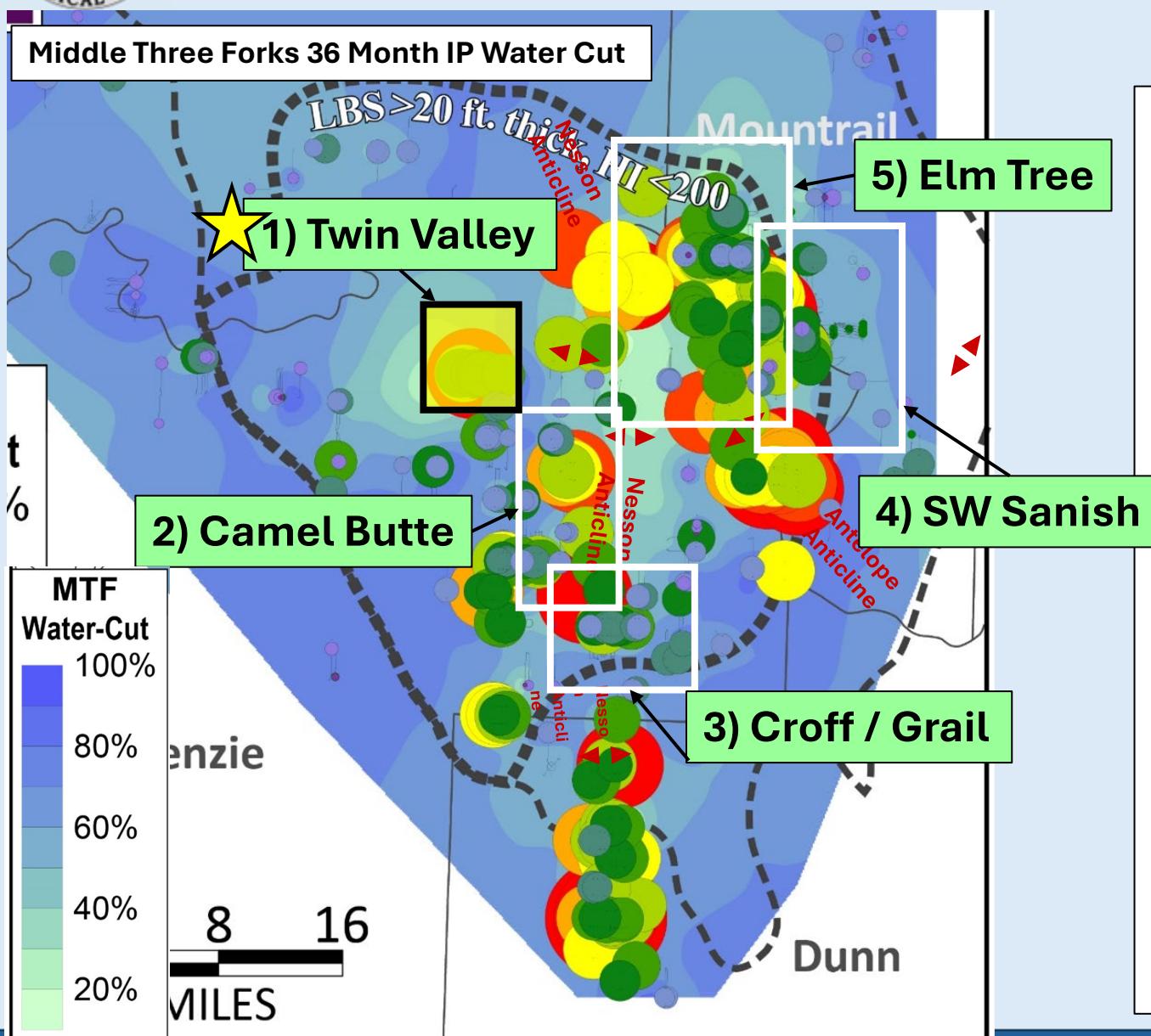
- Selected 1280-acre DSU's with MTF surrounded by DSU' w/o MTF development (avoided contiguous development areas)
- Confirm/determined lateral reservoir target
- Compiled production data, EUR forecasting methodology (e.g., cut off at 300 BBL/Month)
- Investigated cores in immediate area for reservoir quality of upper and middle Three Forks
- Isopach and structure mapping (geologic variations)
- Documented noteworthy interactions where discernible (i.e. existing production w/ later infill)
- Evaluated completions data
- Investigated 532 wells in 45 DSUs



Middle Three Forks Resource Potential – Project Update



Middle Three Forks 36 Month IP Water Cut

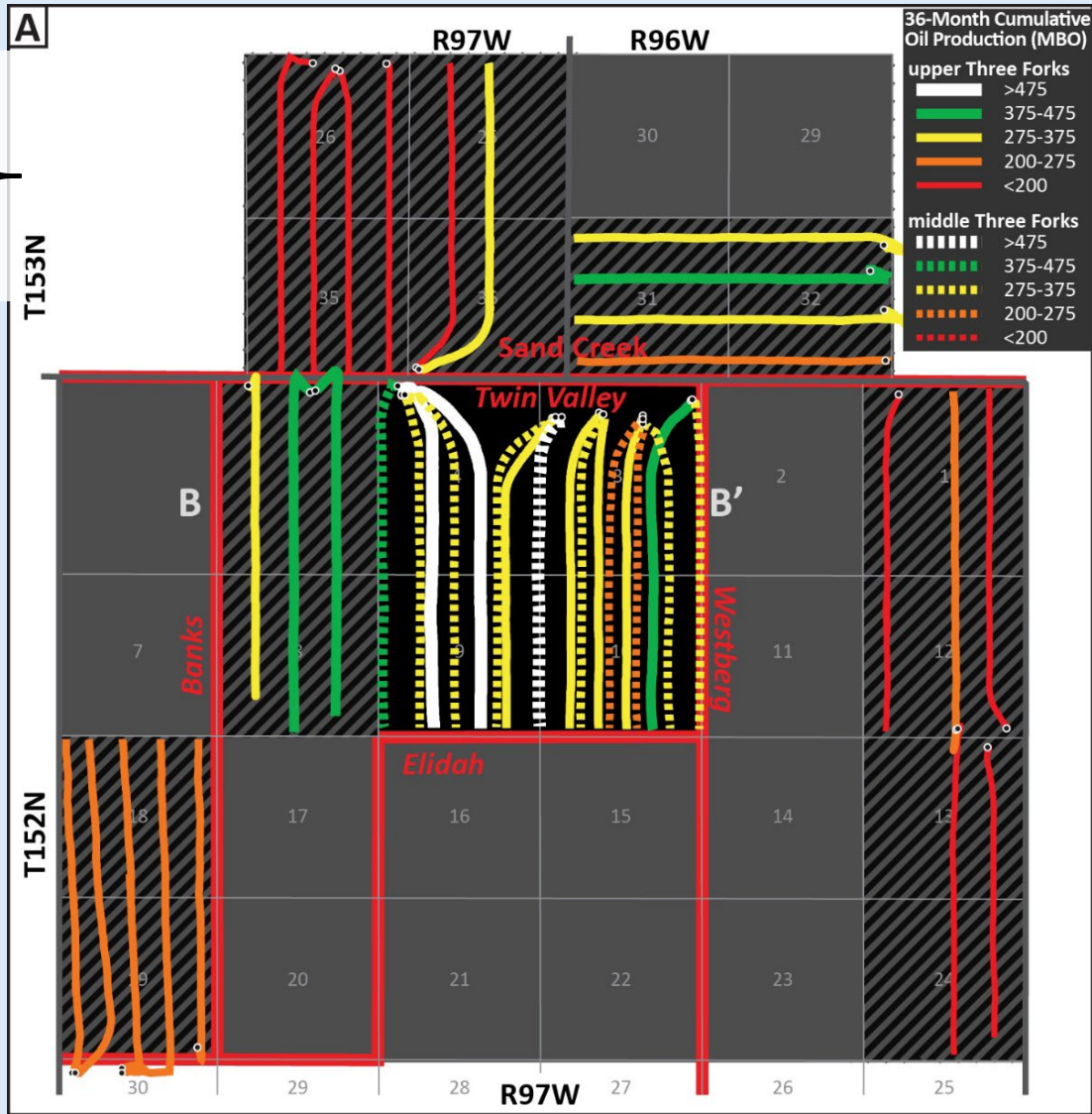
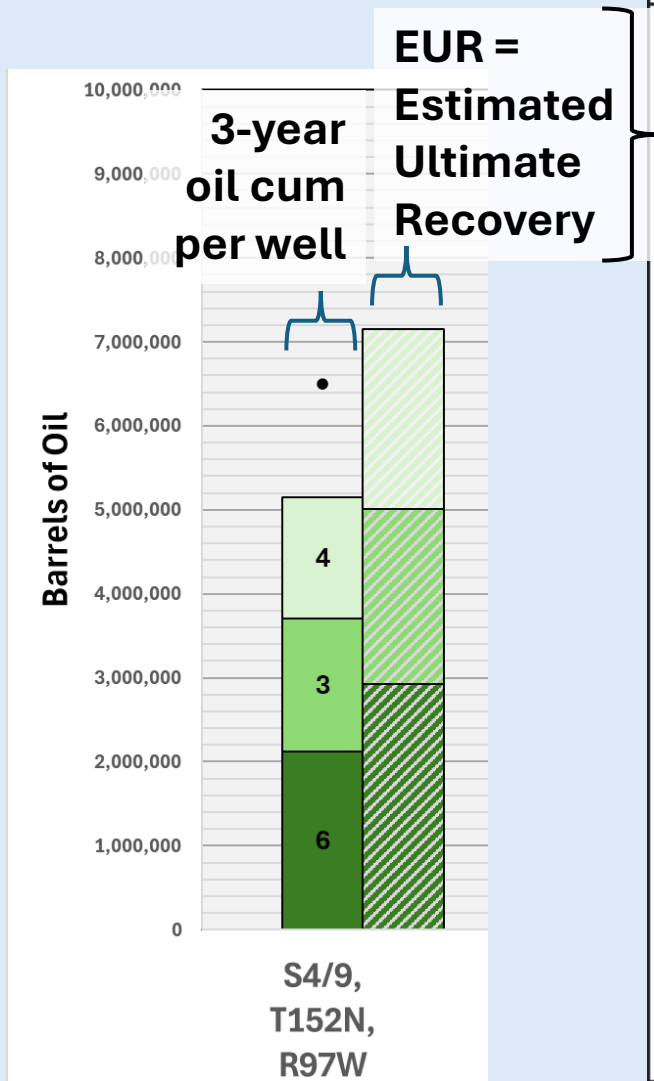
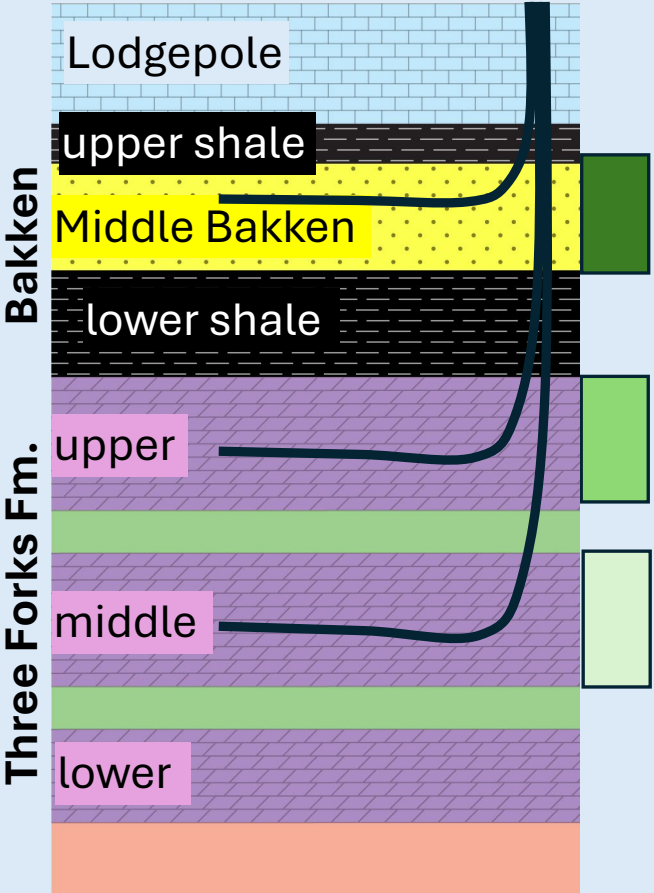


METHODS:

- Selected 1280-acre DSU's with MTF surrounded by DSU' w/o MTF development (avoided contiguous development areas)
- Confirm/determined lateral reservoir target
- Compiled production data, EUR forecasting methodology (e.g., cut off at 300 BBL/Month)
- Investigated cores in immediate area for reservoir quality of upper and middle Three Forks
- Isopach and structure mapping (geologic variations)
- Documented noteworthy interactions where discernible (i.e. existing production w/ later infill)
- Evaluated completions data
- Investigated 532 wells in 45 DSUs

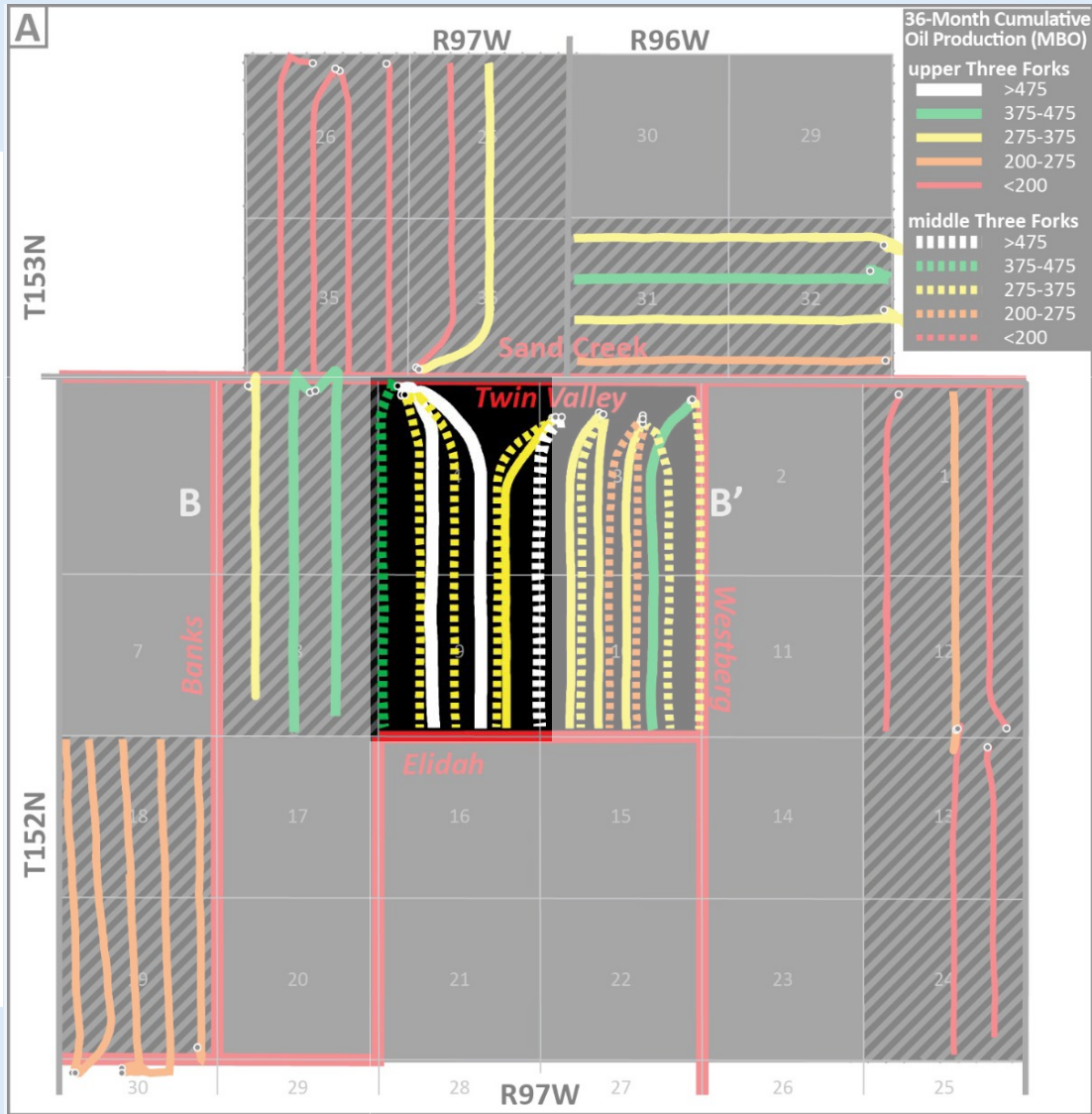
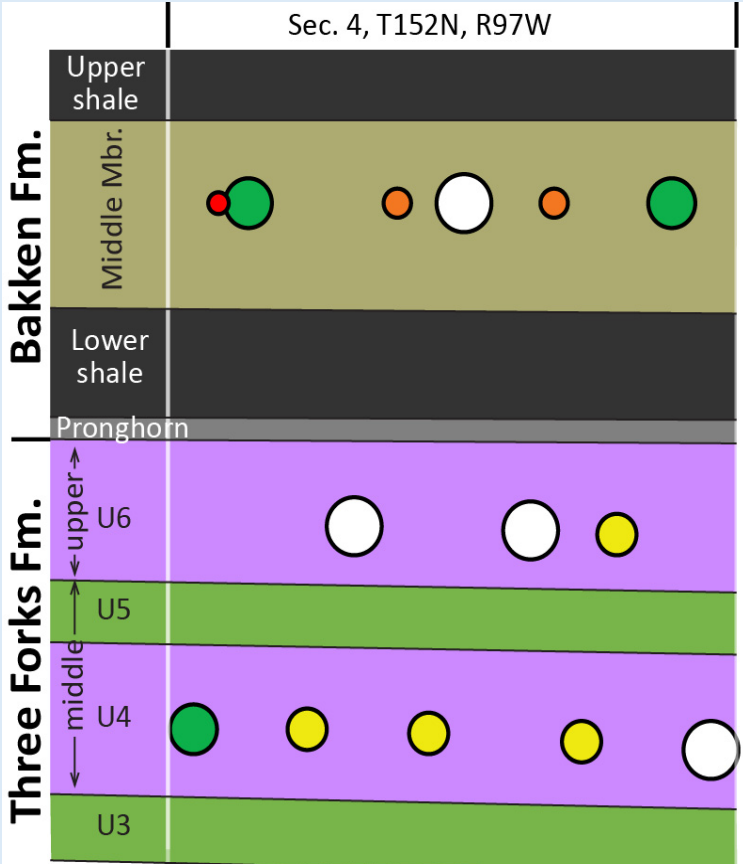
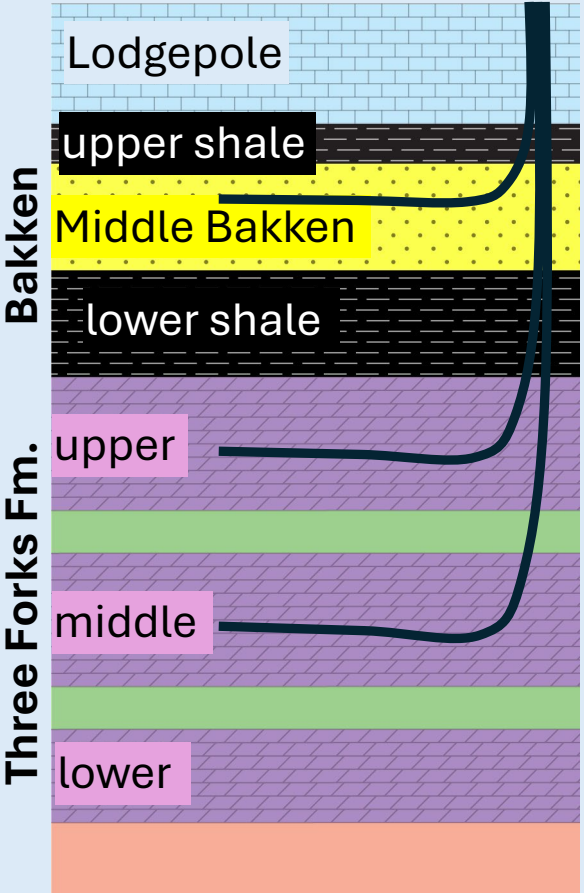


Evaluation Methods



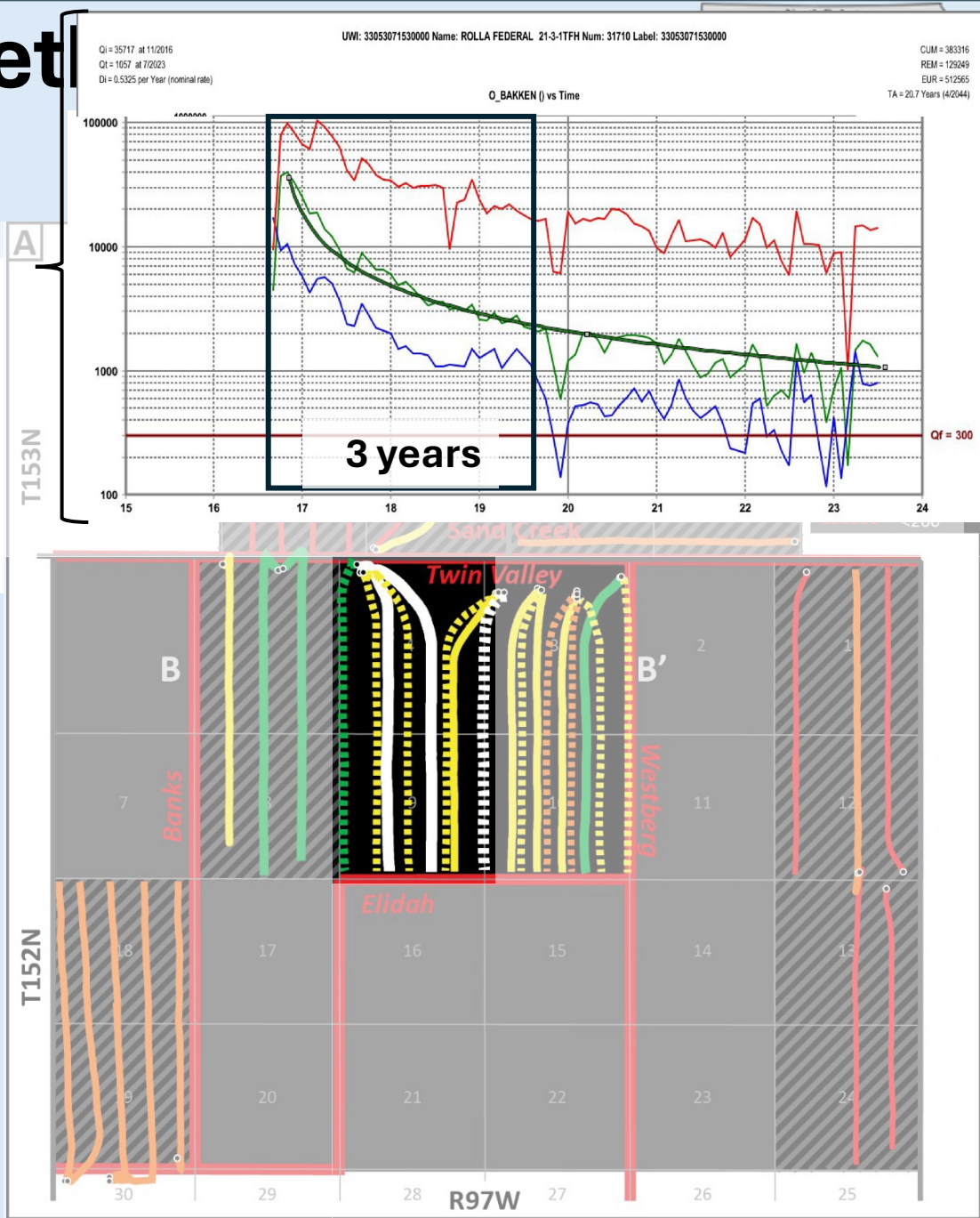
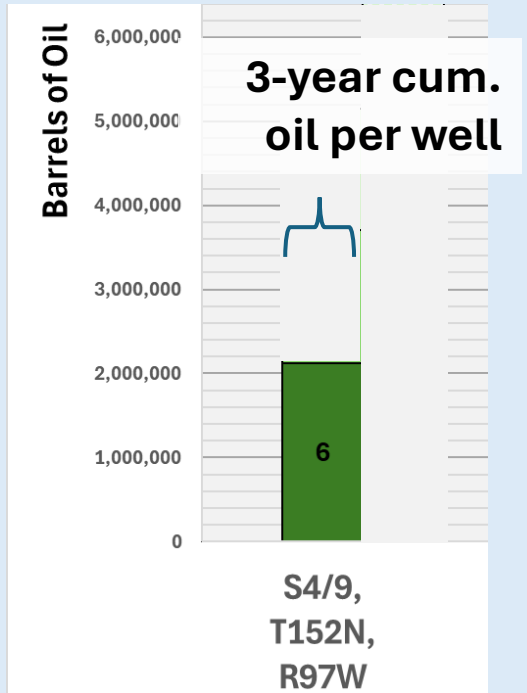
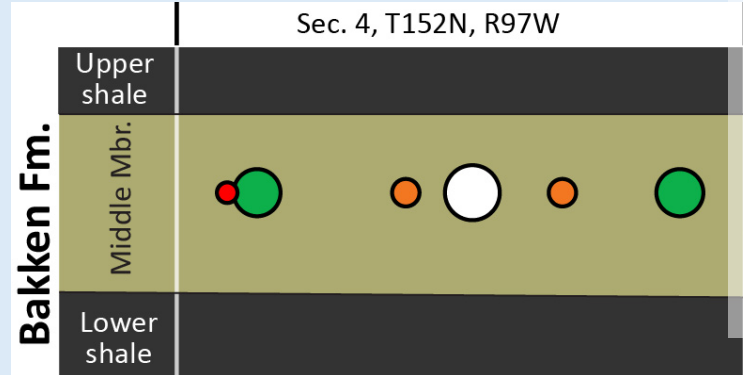
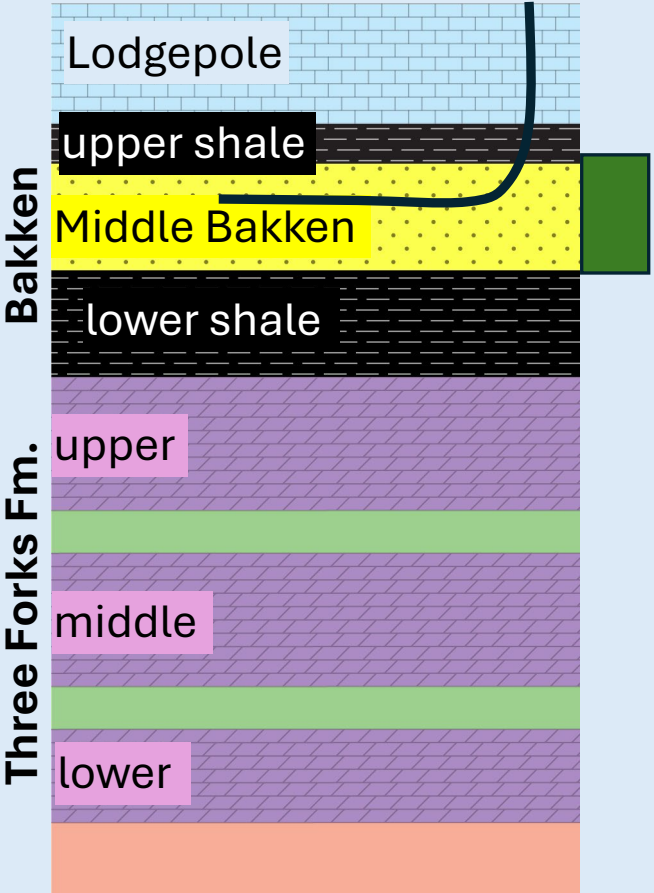


Evaluation Methods



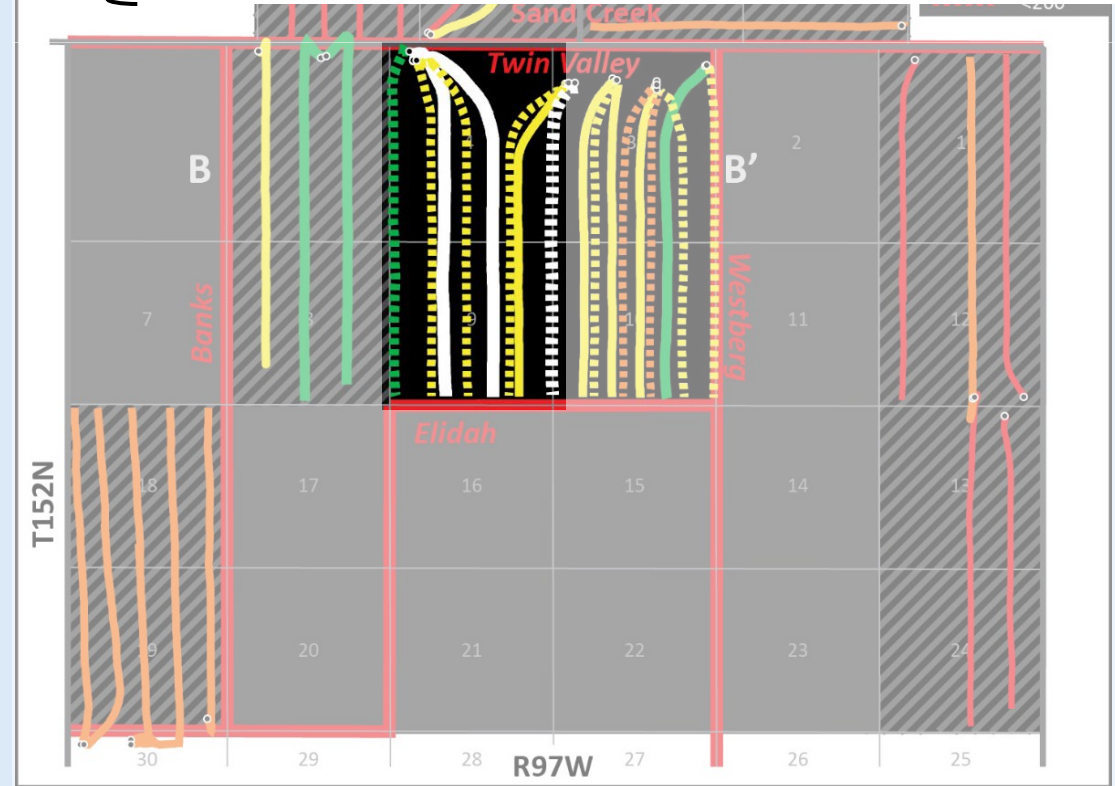
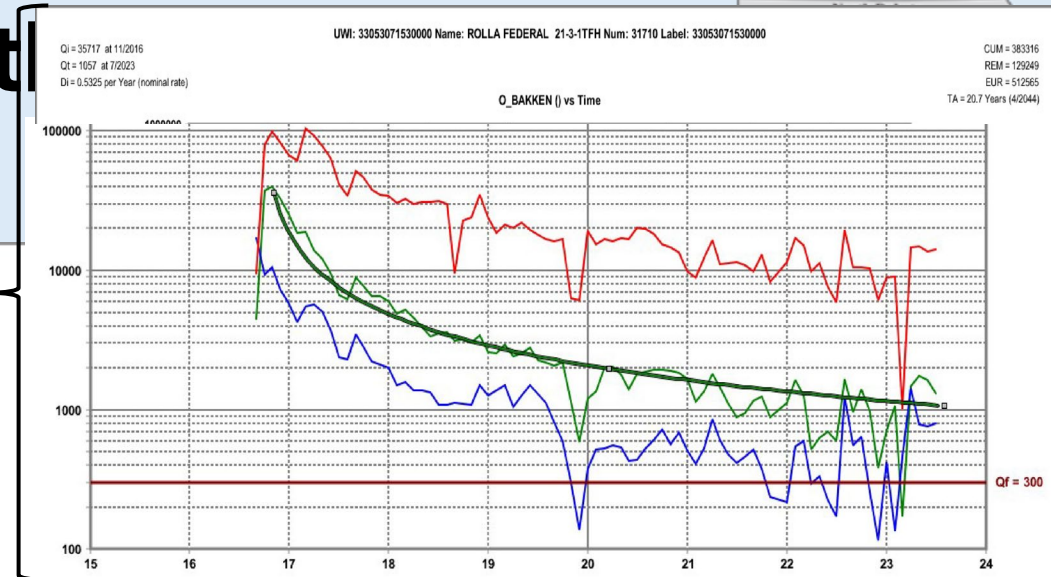
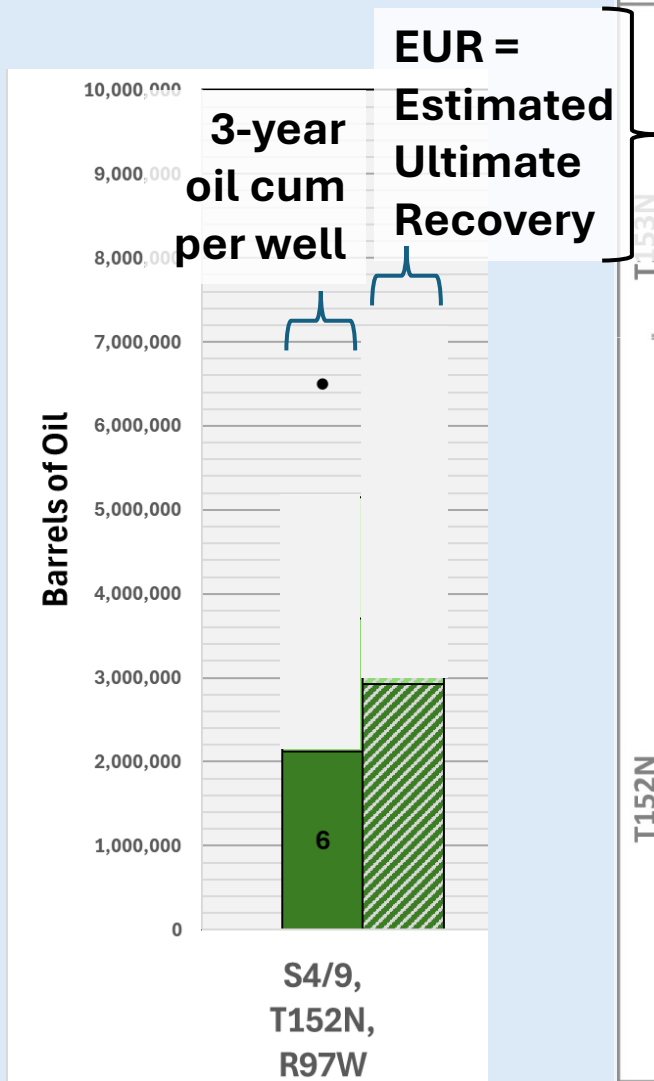
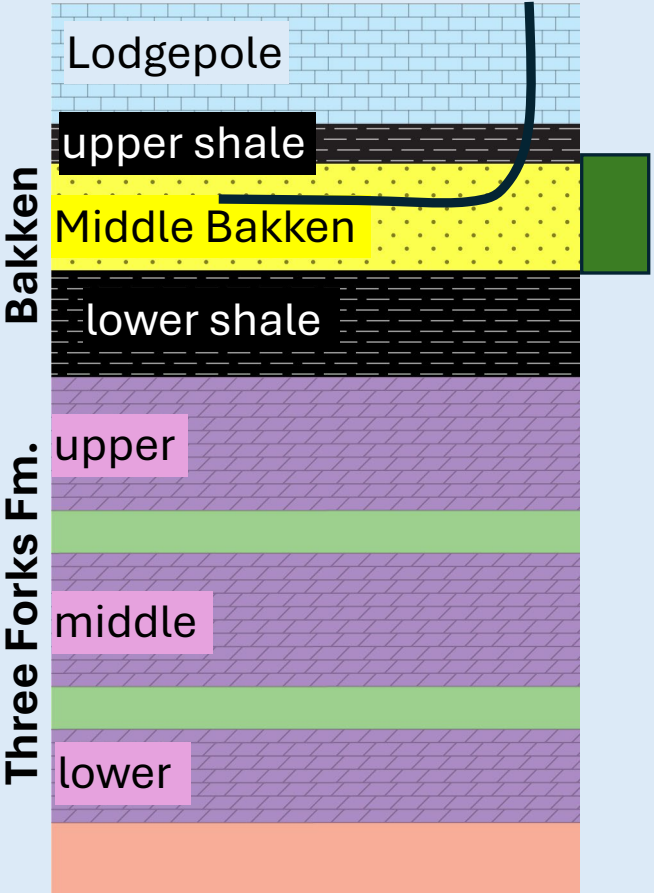


Evaluation Met



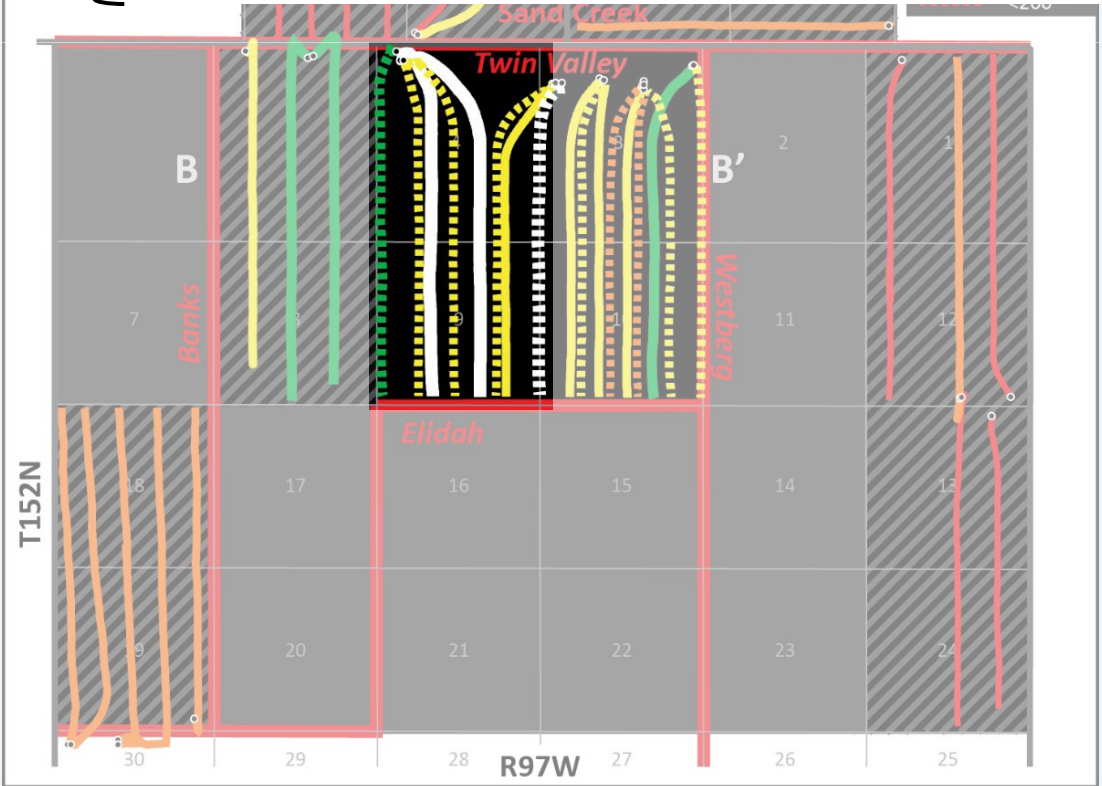
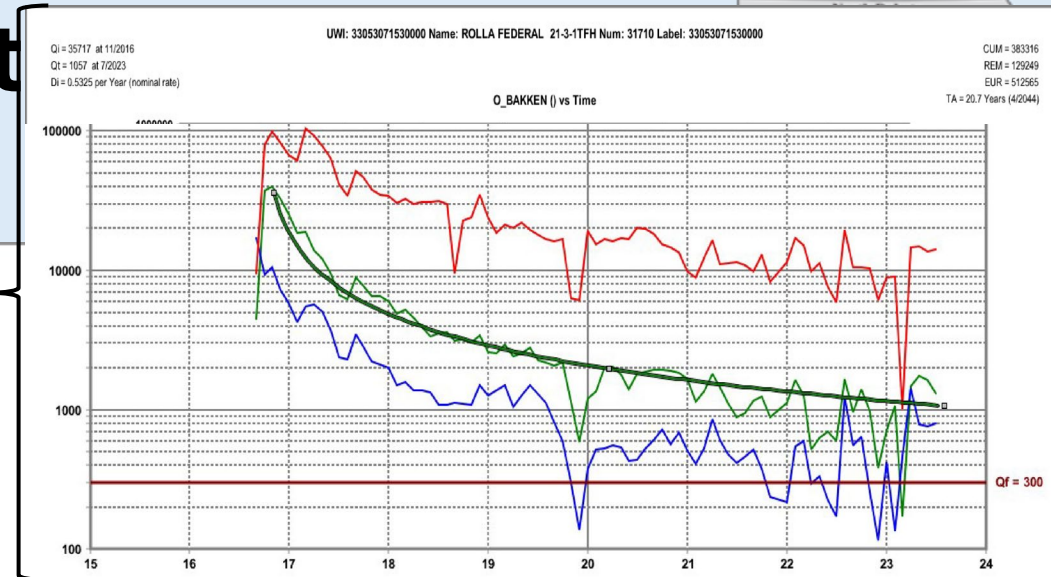
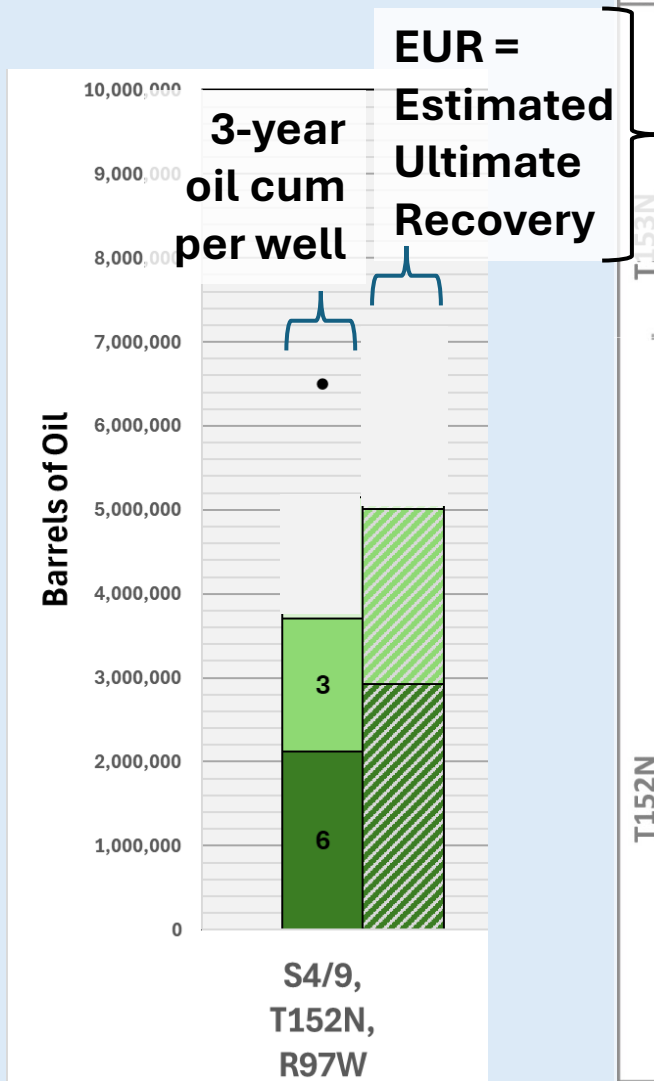
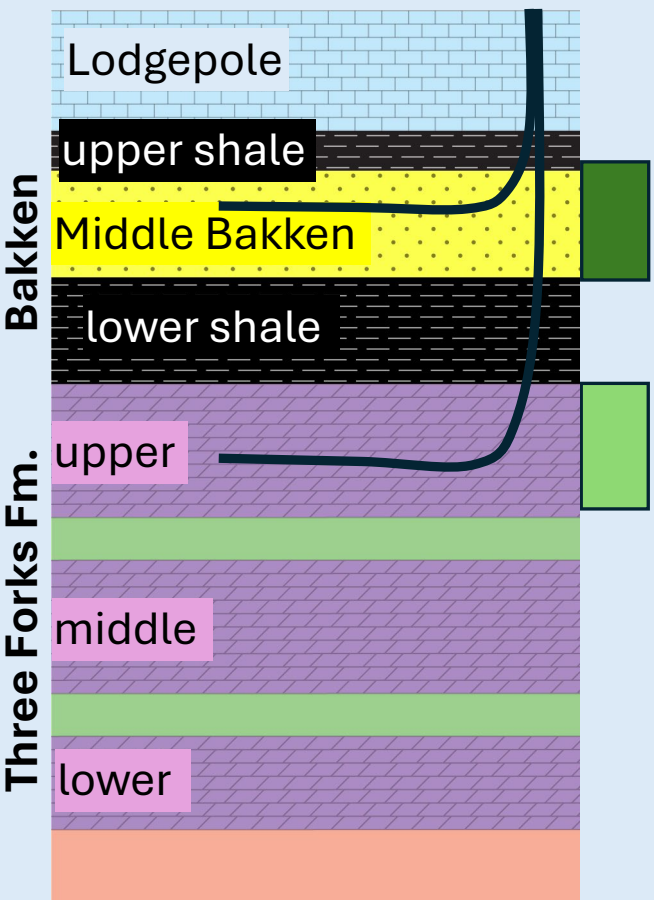


Evaluation Met



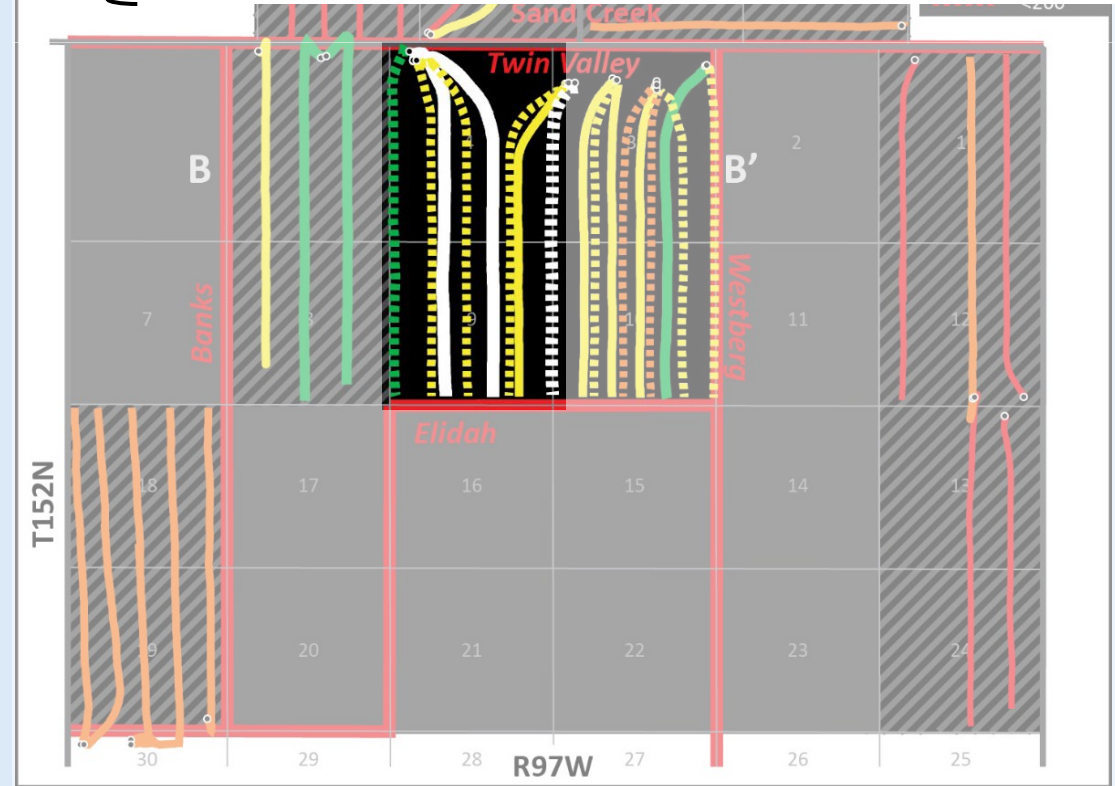
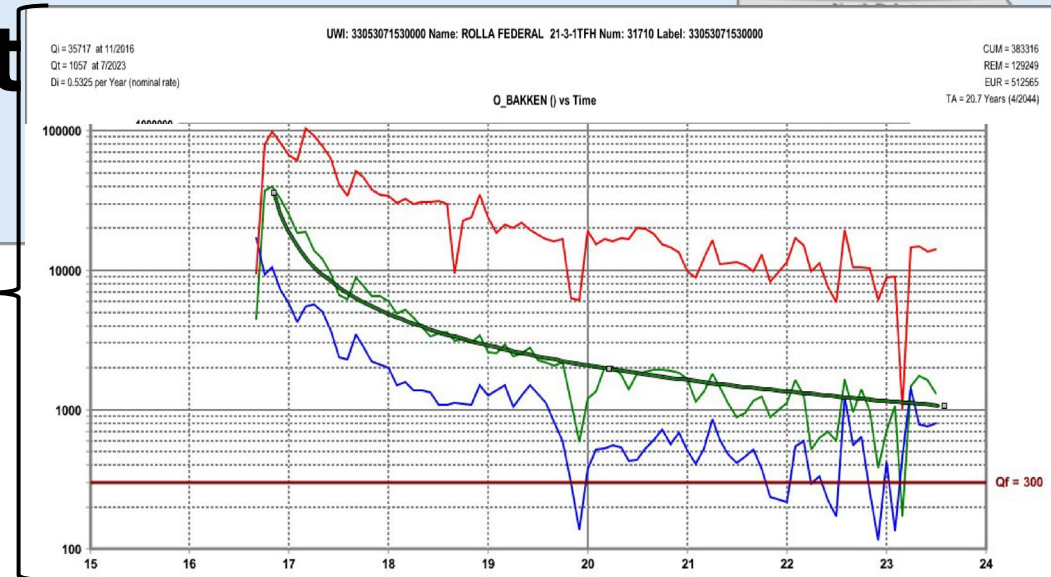
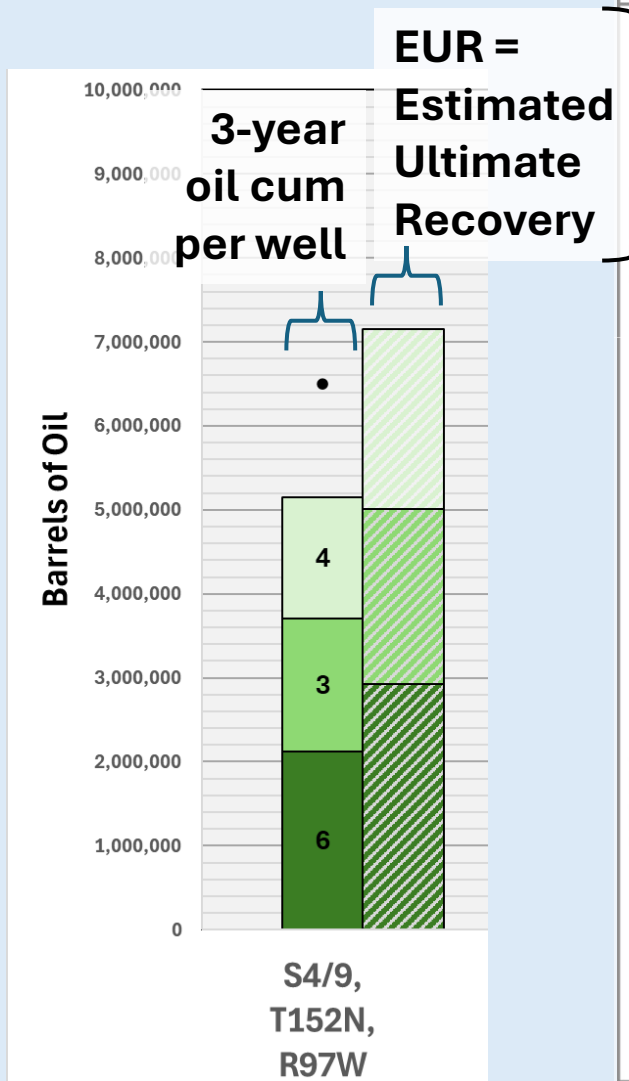
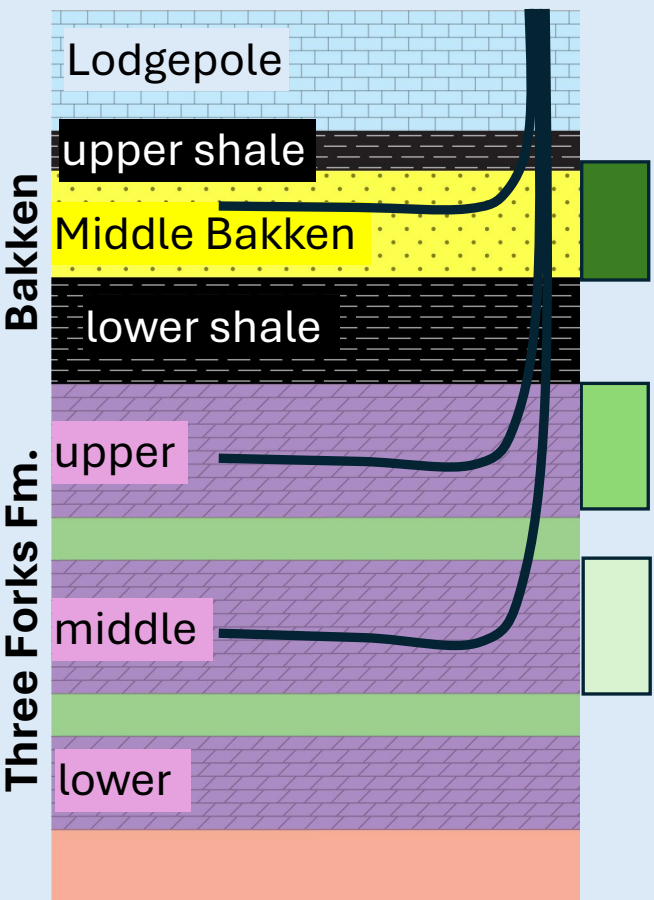


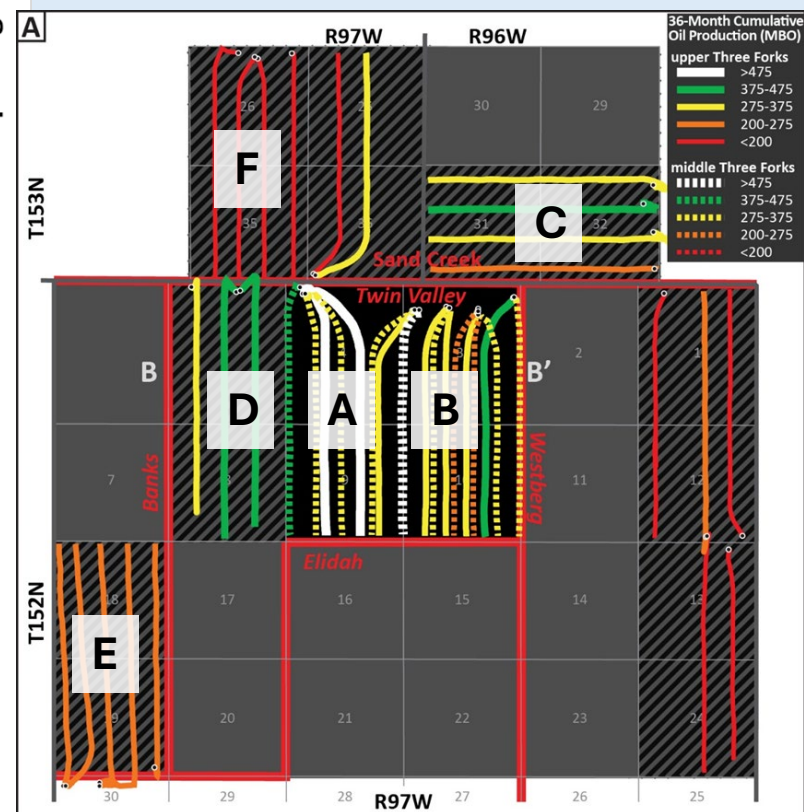
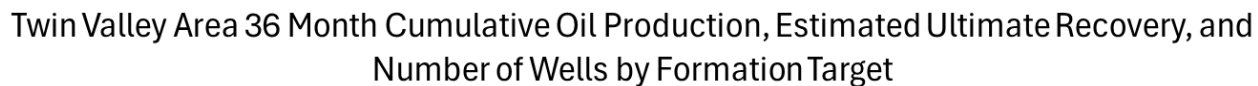
Evaluation Met



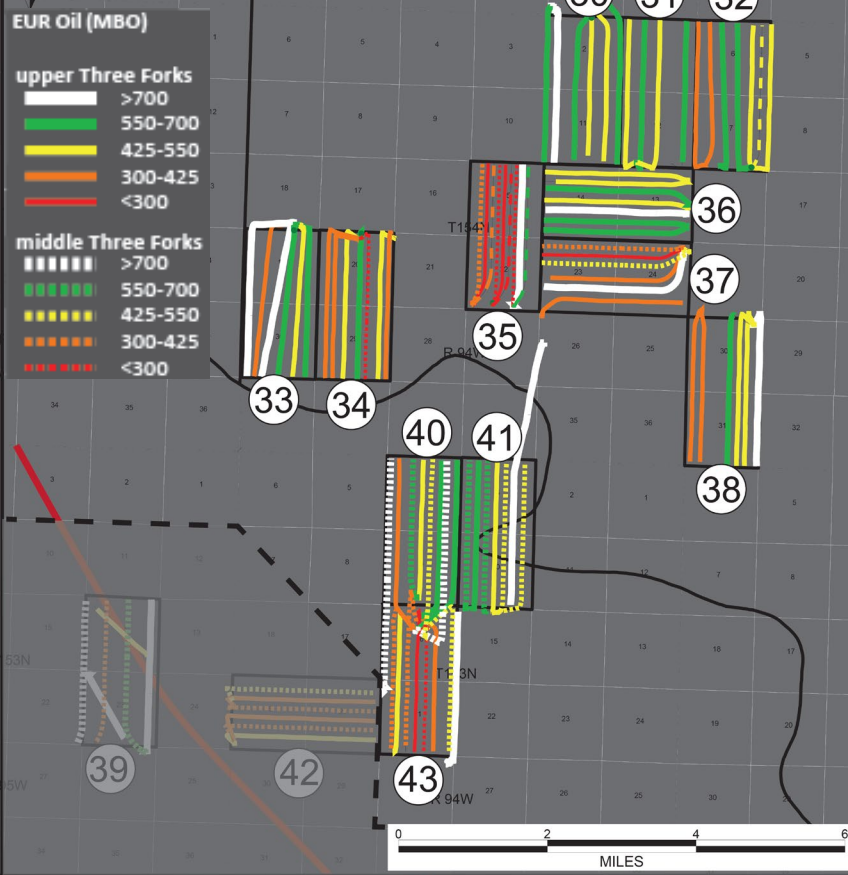
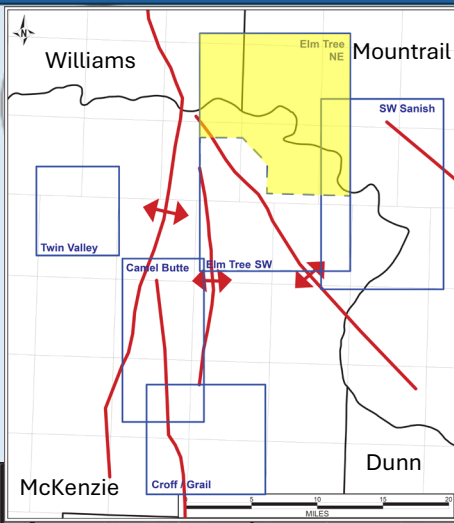


Evaluation Met

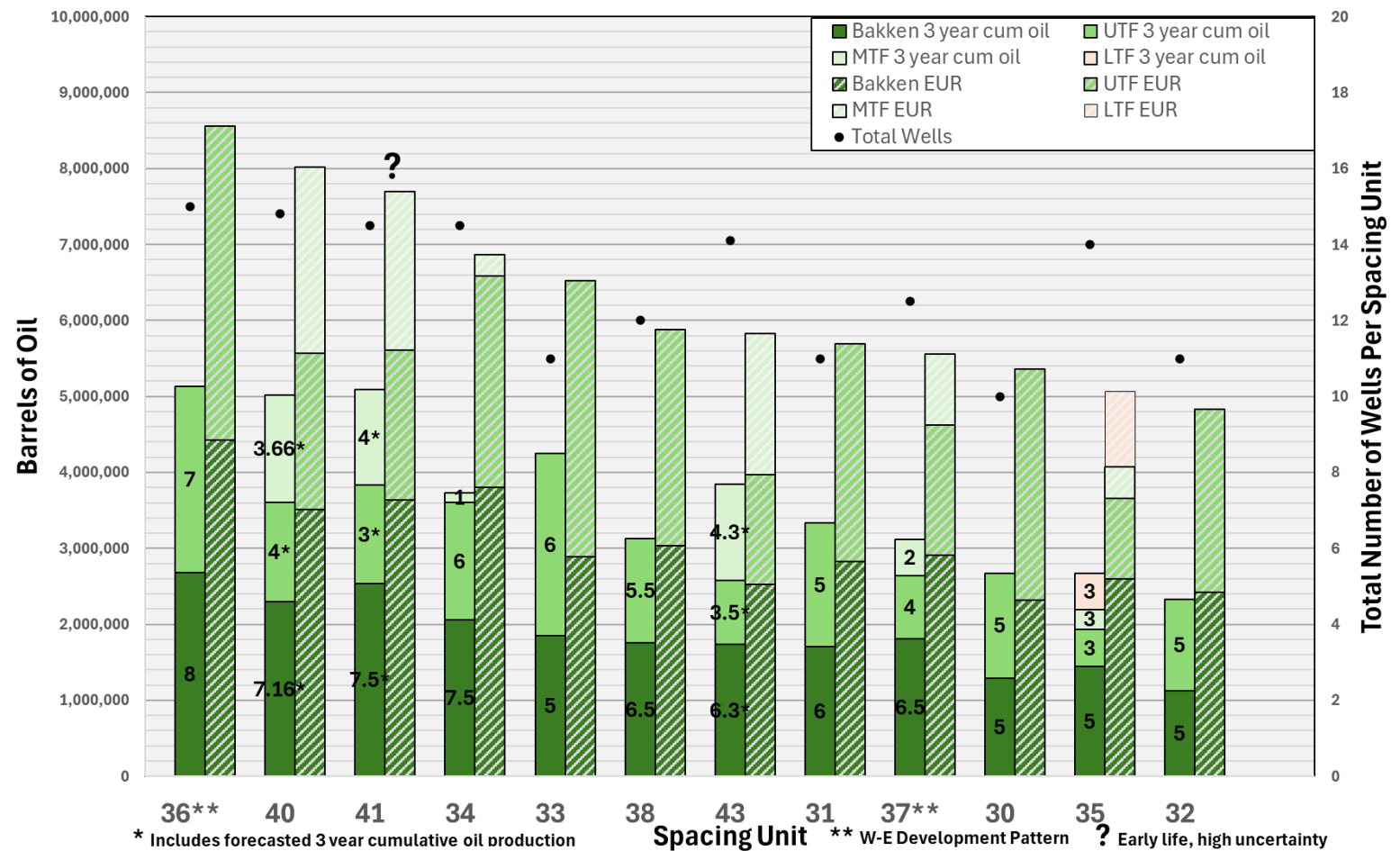




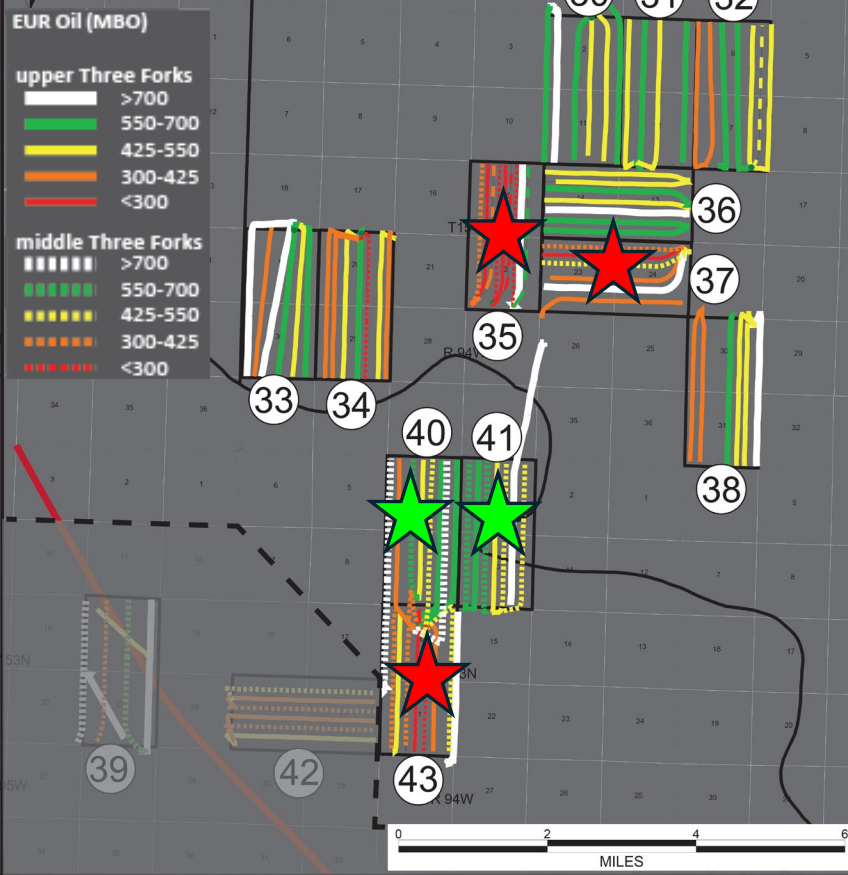
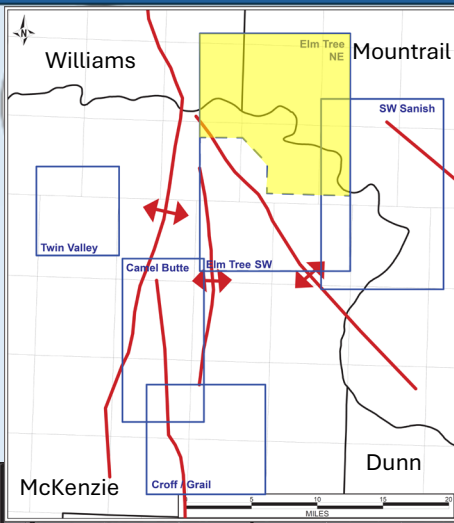
Results: NE Elm Tree



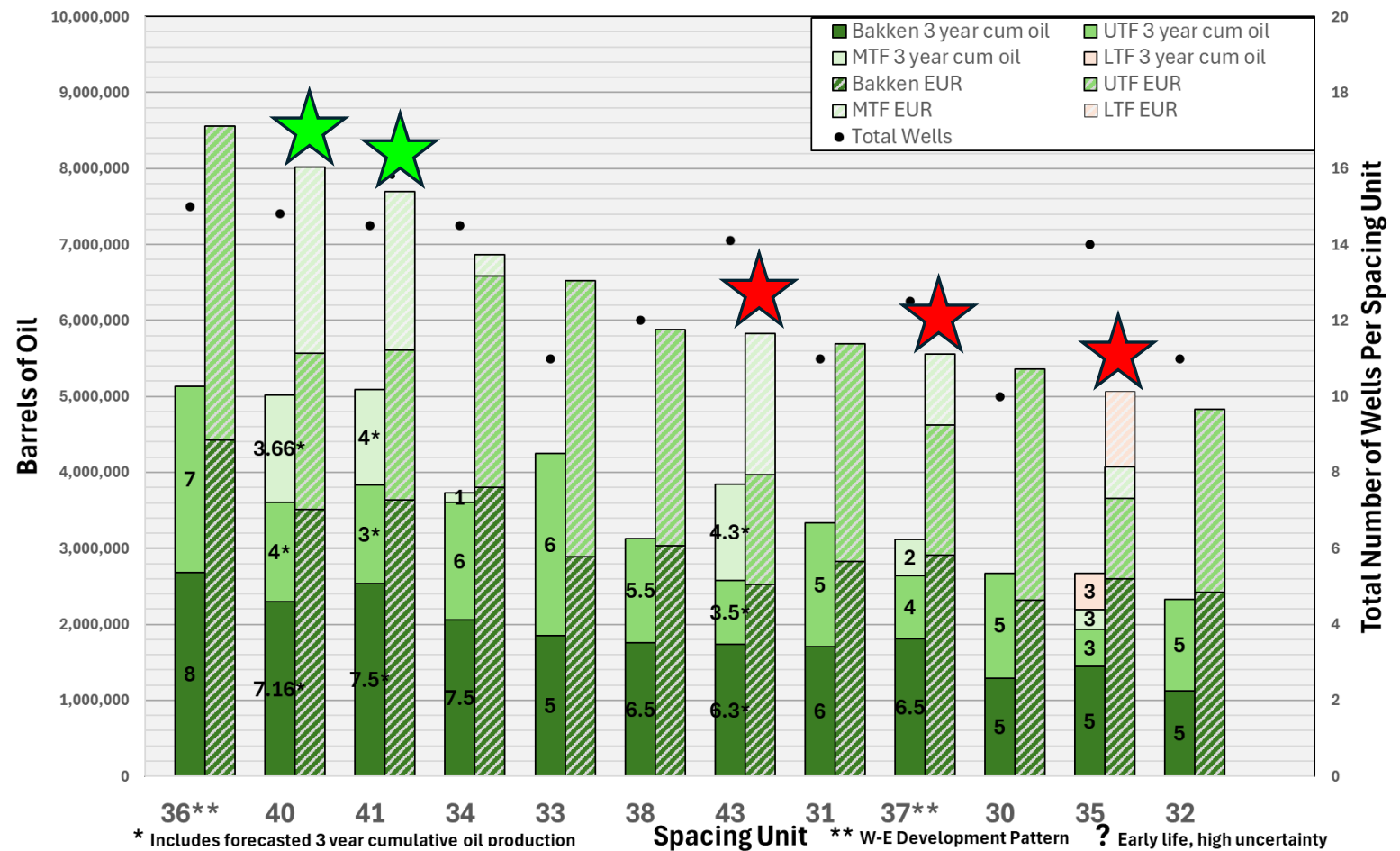
Elm Tree NE Area 36 Month Cumulative Oil Production, Estimated Ultimate Recovery, and Number of Wells by Formation Target



Results: NE Elm Tree



Elm Tree NE Area 36 Month Cumulative Oil Production, Estimated Ultimate Recovery, and Number of Wells by Formation Target

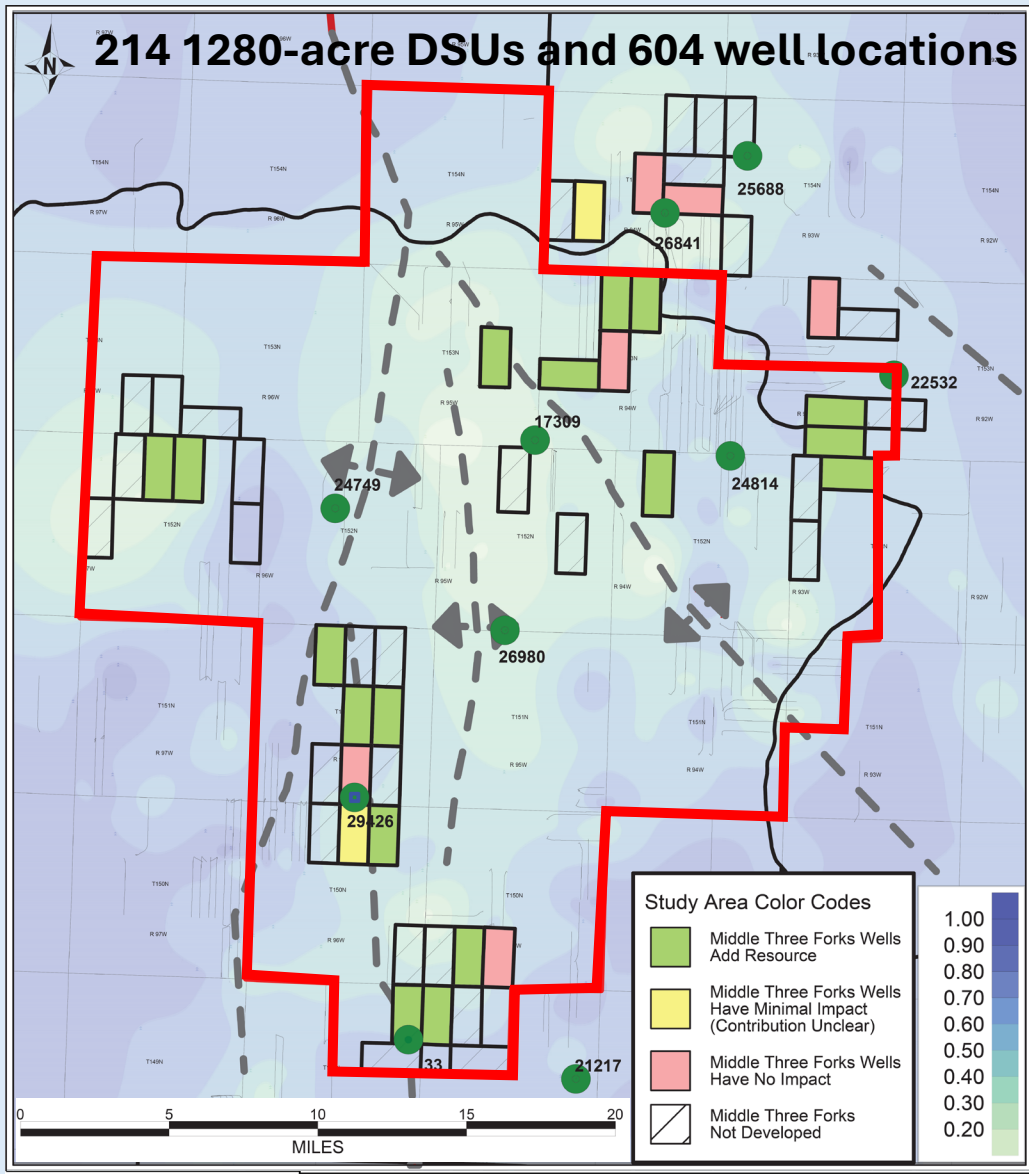




Middle Three Forks Remaining Resource Potential



~275,000 Contiguous Acres of Initial Development Potential



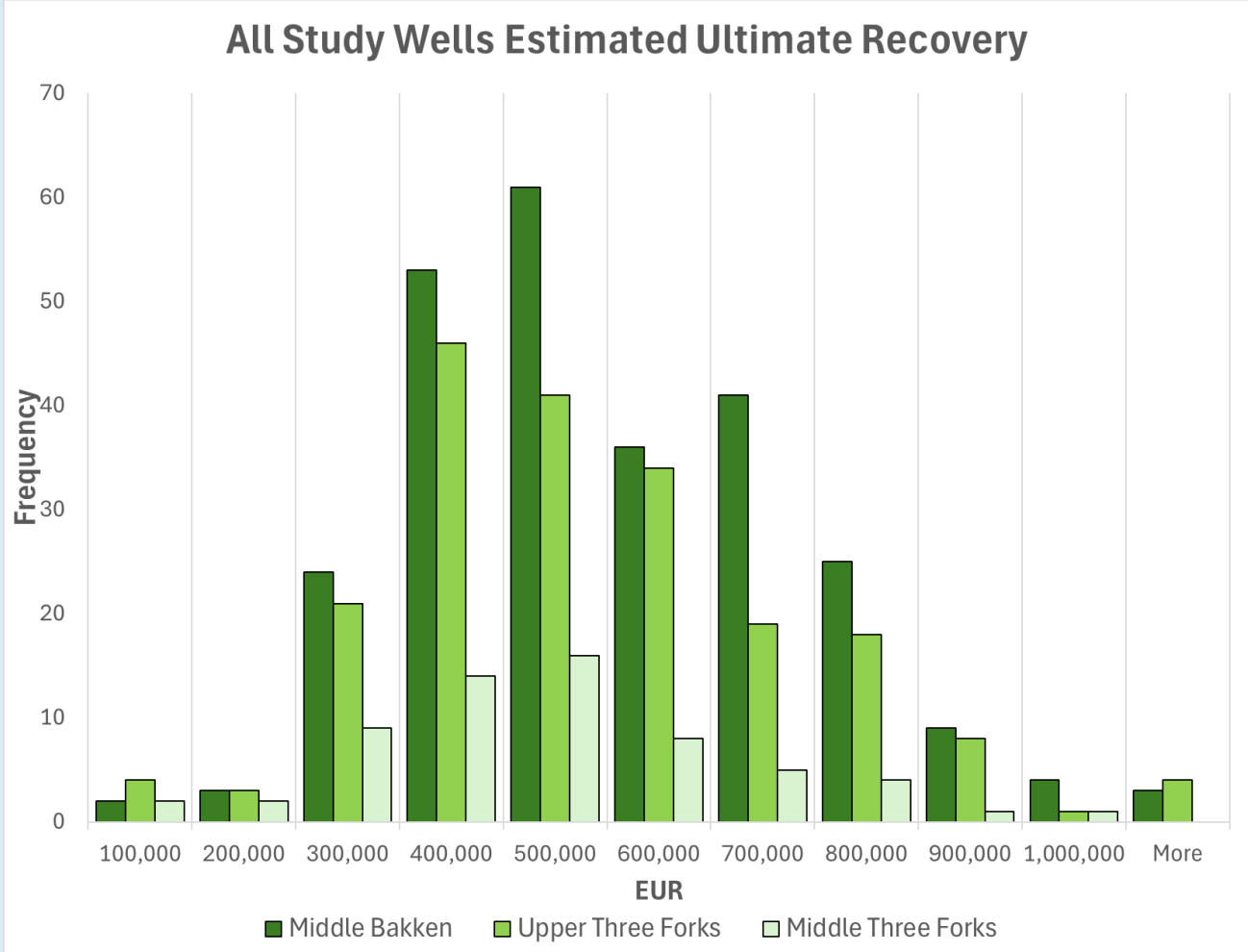
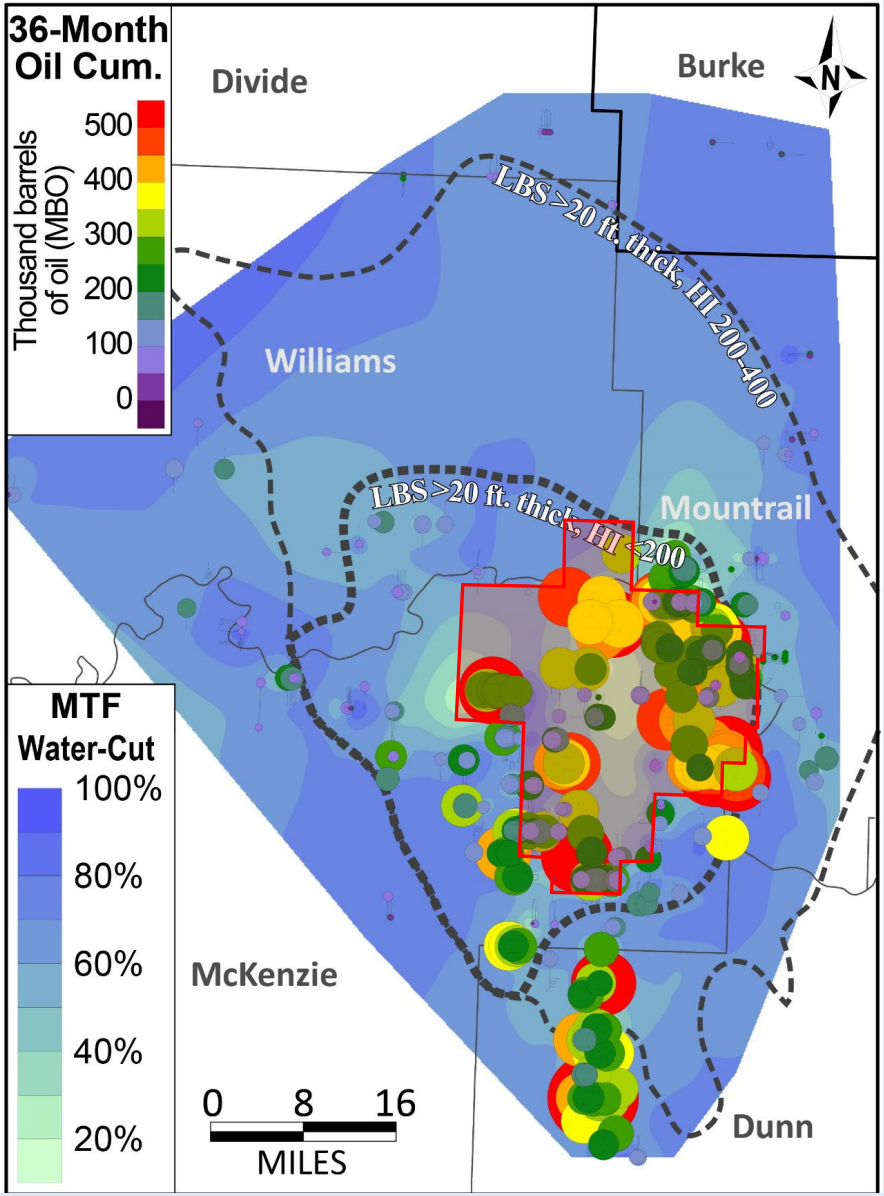
Number of Wells in Data Set	10th Percentile Middle Three Forks Well EUR (BO)	50th Percentile Middle Three Forks Well EUR (BO)	90th Percentile Middle Three Forks Well EUR (BO)
62	257,500	415,600	667,000
Number of Potential Drilling Locations	Prospective area 10th Percentile Middle Three Forks EUR (BO)	Prospective area 50th Percentile Middle Three Forks EUR (BO)	Prospective area 90th Percentile Middle Three Forks EUR (BO)
600	154,500,000	249,360,000	400,200,000

★ ~150 - 400 MMBO Recoverable Oil ★

- Investigated 532 wells in 45 DSUs (25 DSU's with MTF development)
- 17 DSU's displayed volumetric addition by developing MTF, 6 DSU's did not, and 2 DSU's were unclear.
- Middle Three Forks wells investigated average ~415,000 barrels EUR



Middle Three Forks Remaining Resource Potential



Percentile	10 th	50 th	90 th	sample set
Middle Bakken	296,525	479,337	766,702	261
upper Three Forks	273,795	470,303	755,192	199
middle Three Forks	257,498	415,594	667,007	62



Thank you for your Time!

Tim Nesheim: tonesheim@nd.gov

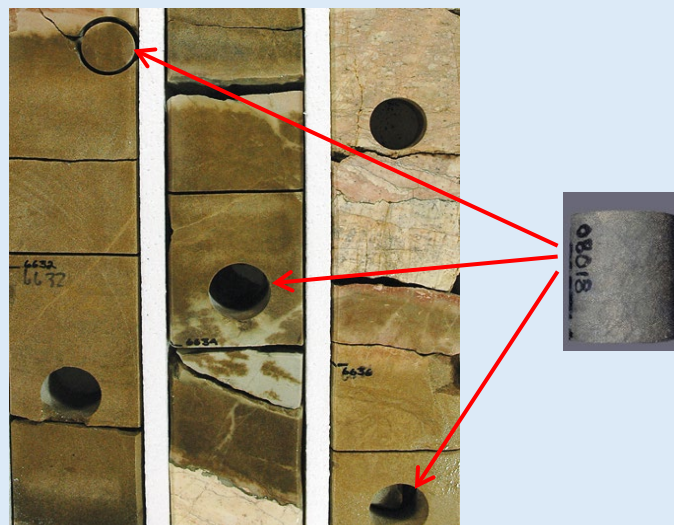
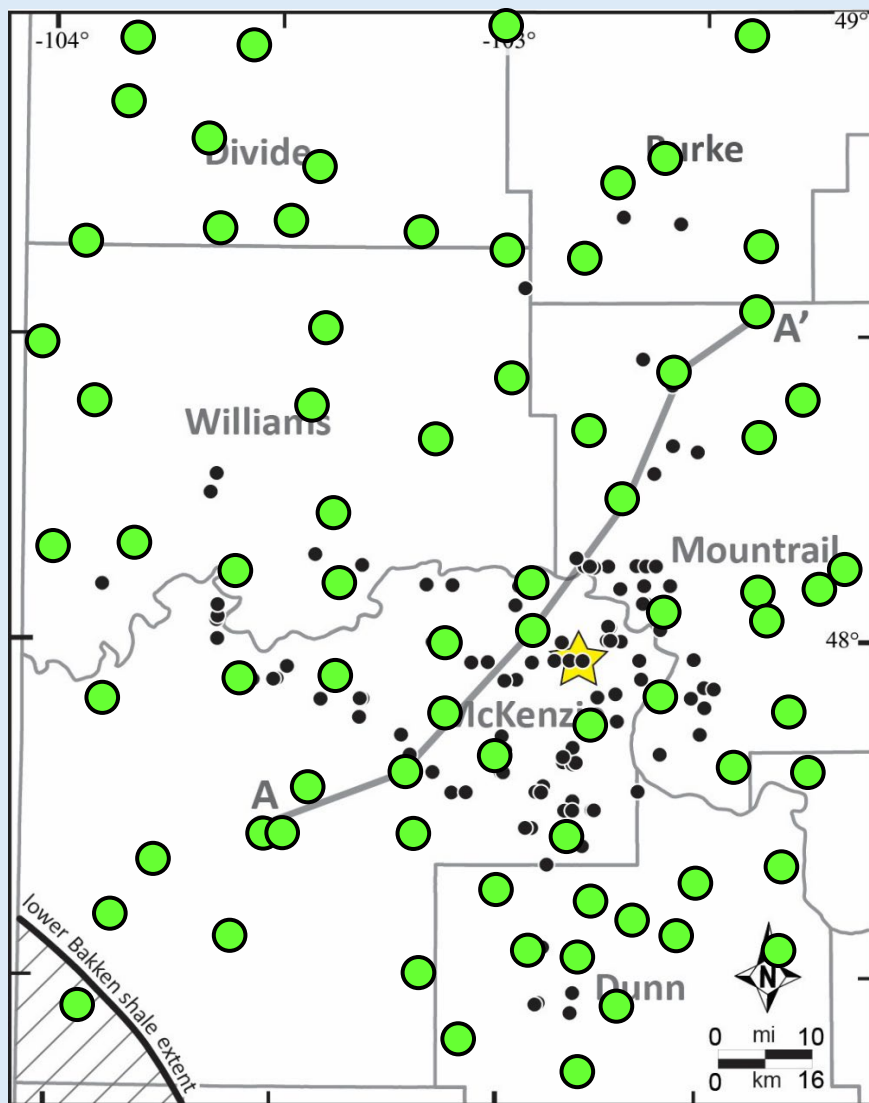
Ted Starns: ecstarns@nd.gov



Bakken-Three Forks Petroleum System: Core-Plug Fluid Saturation mapping

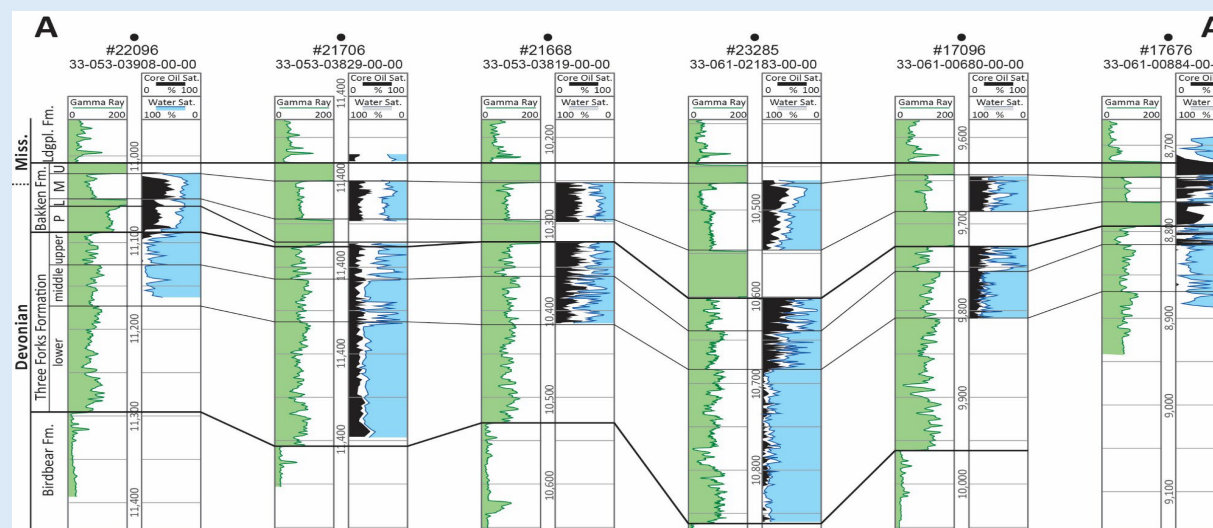


Three Forks cores with compiled core-plug fluid saturation and porosity data



● – core sample with oil saturations for the upper, middle, and/or lower Three Forks

60+ cores data sets compiled



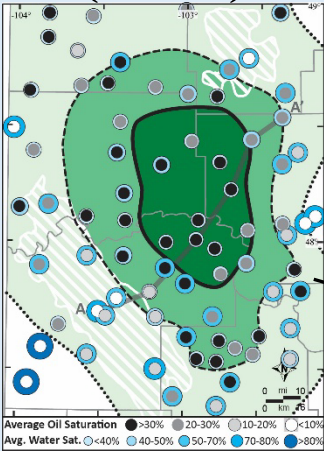


Bakken-Three Forks Petroleum System: Core-Plug Fluid Saturation mapping

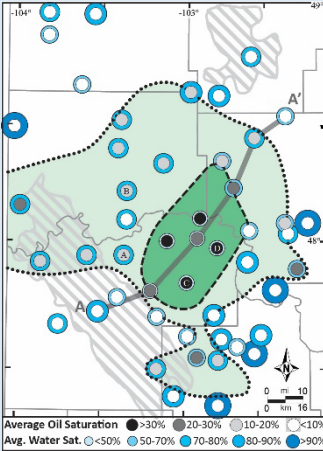


Three Forks Formation Oil Saturations

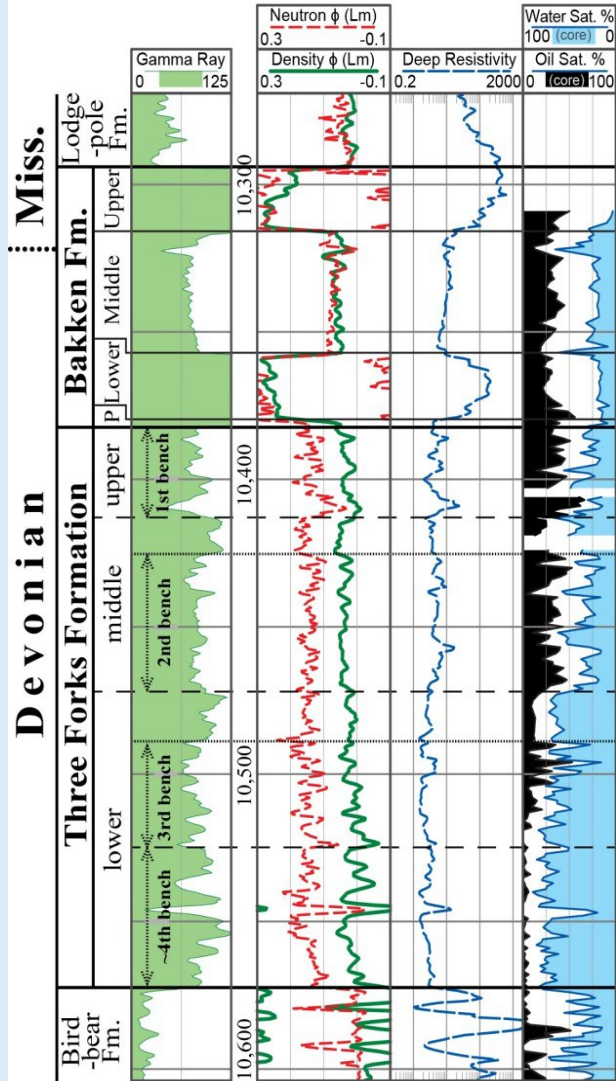
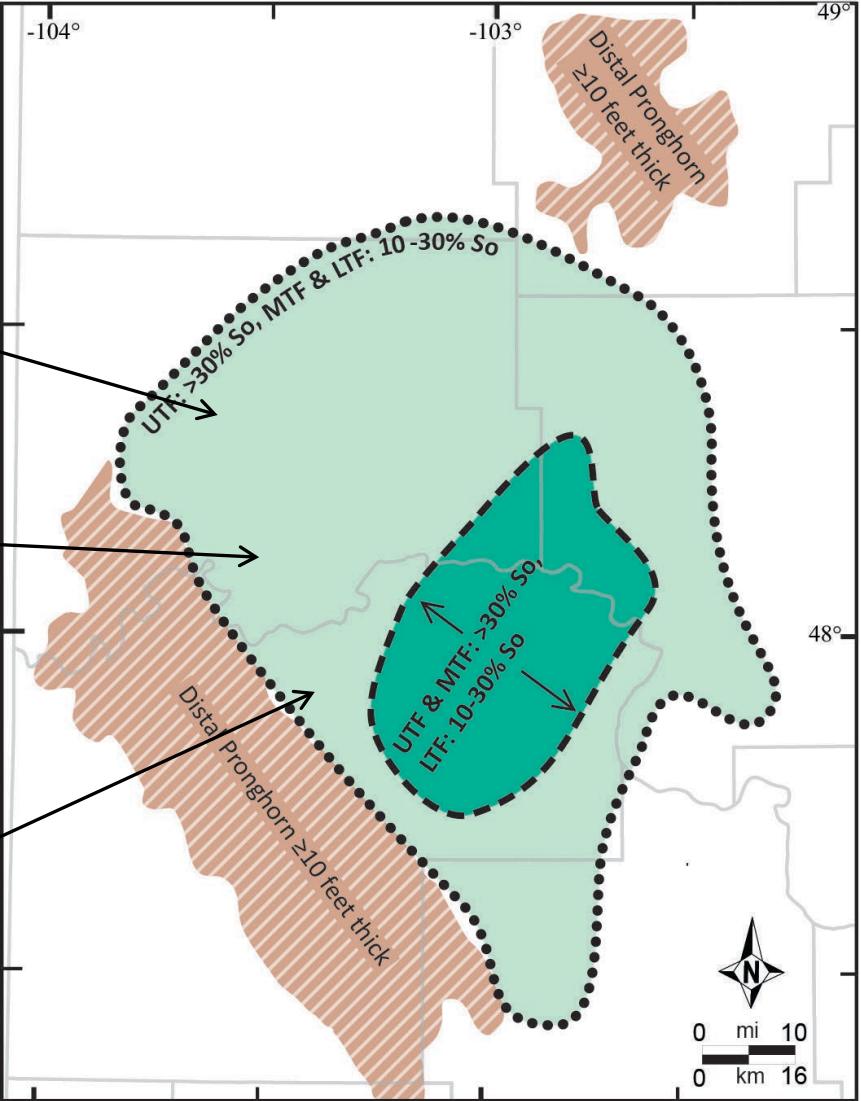
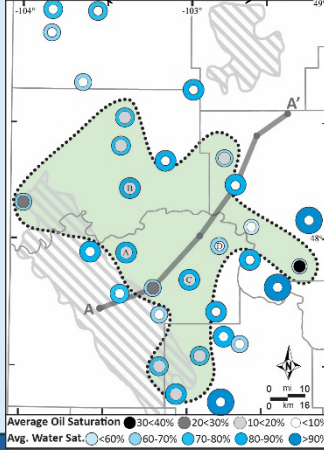
upper TF
(unit 6)



middle TF
(unit 4)



lower TF
(unit 2)



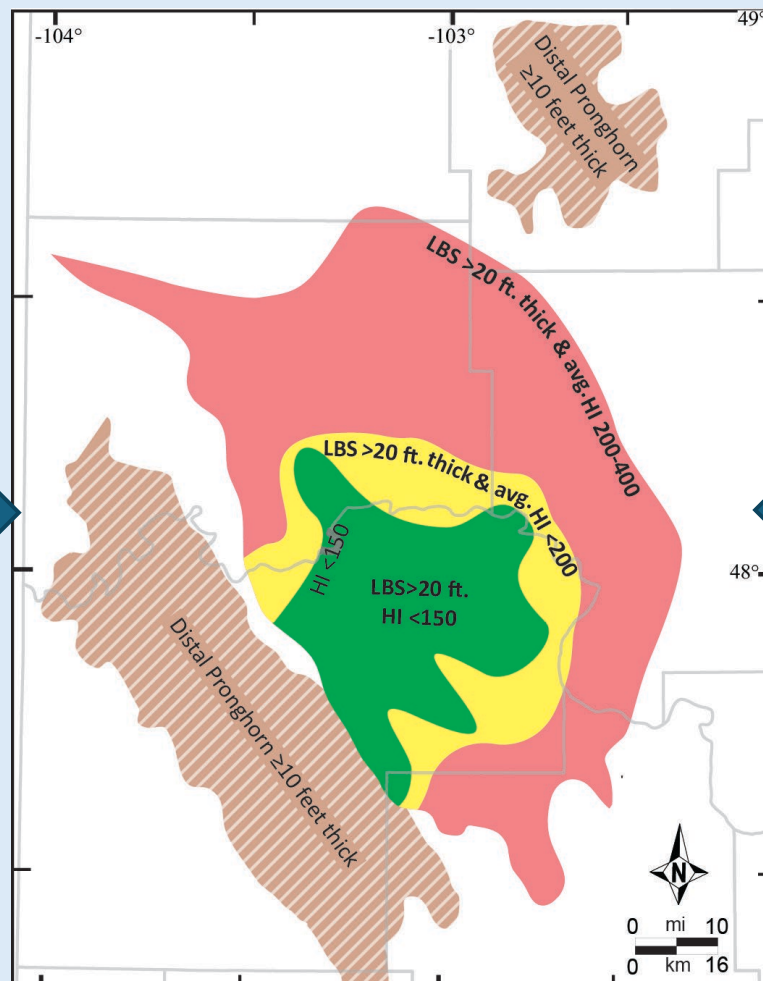
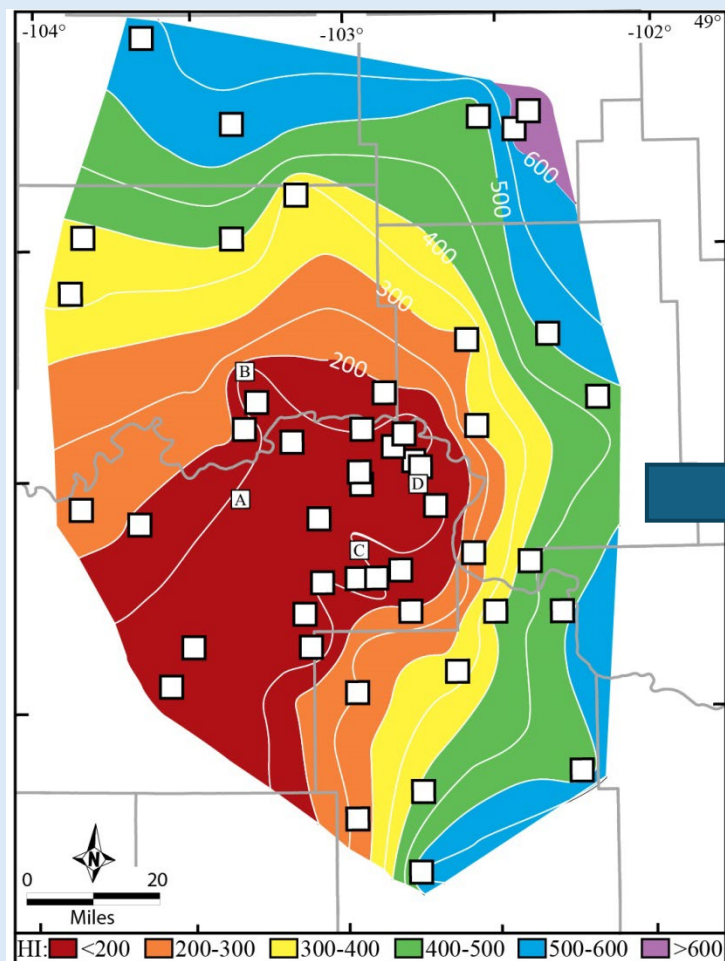


Bakken-Three Forks Petroleum System: Lower Bakken shale sourcing of Three Forks

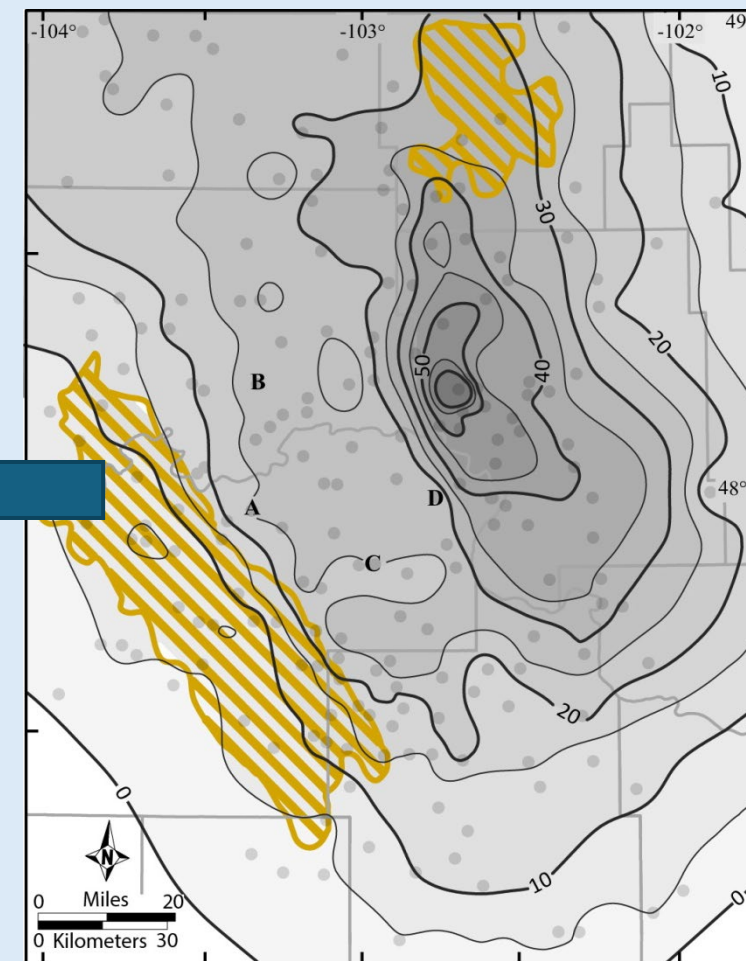


Lower Bakken Shale Thickness & Thermal Maturity (~Hydrocarbon Generation)

LBS average HI (thermal maturity)



LBS isopach (ft.)



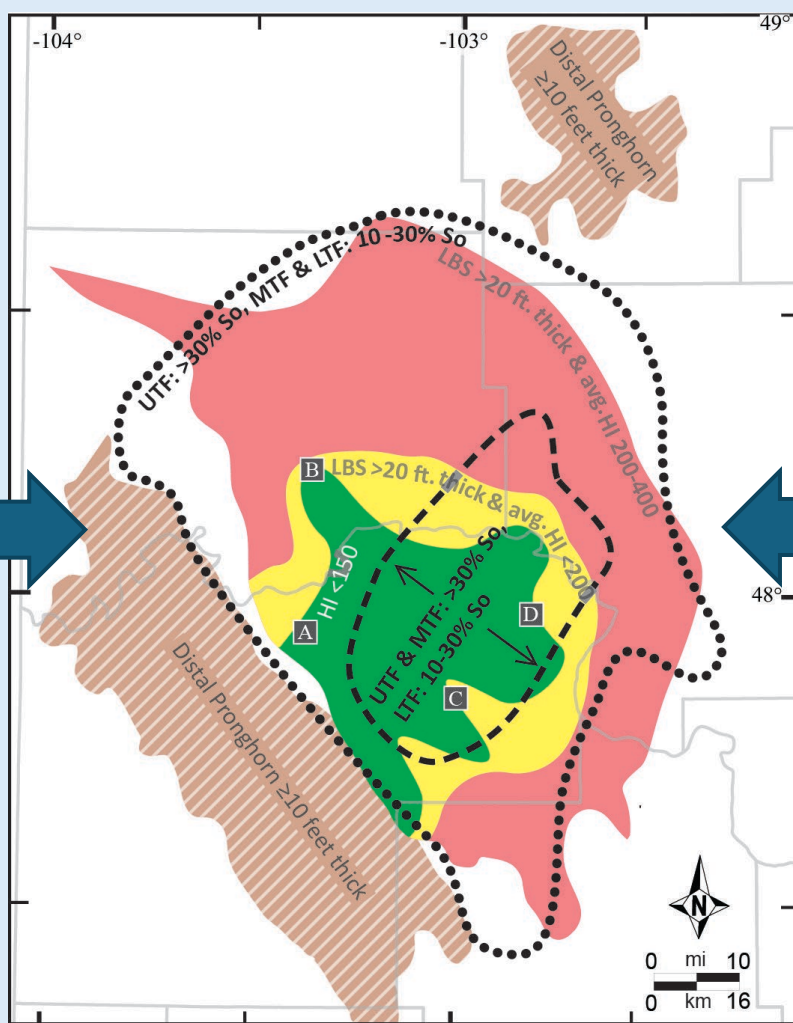
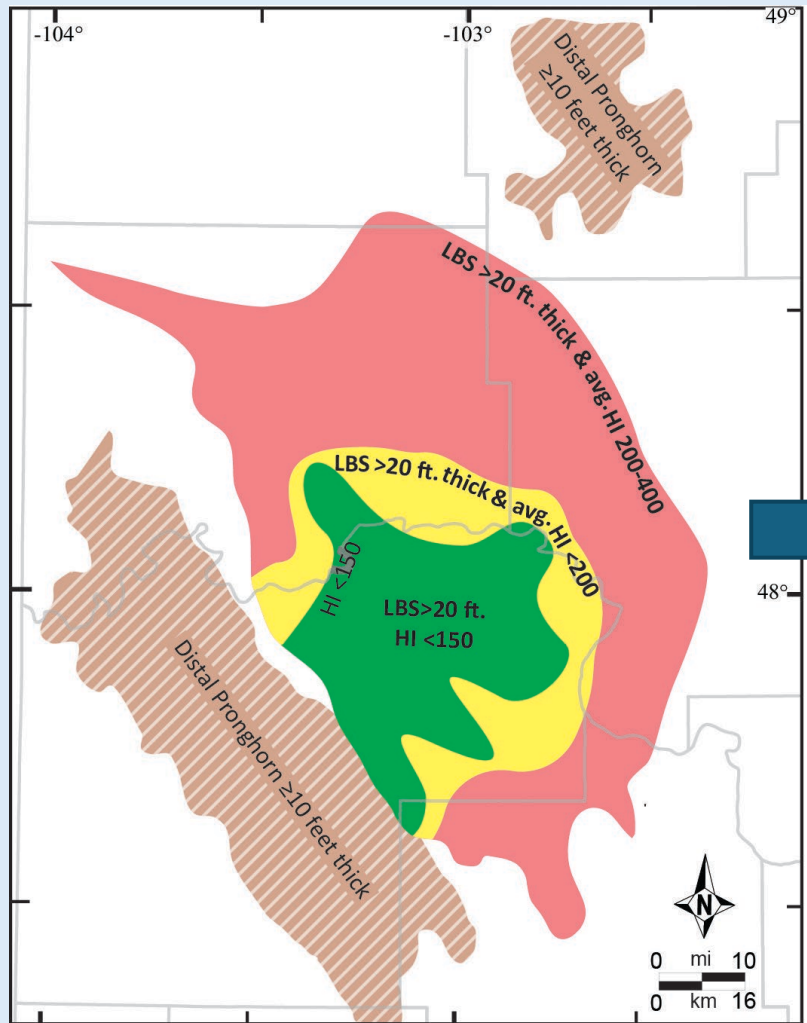


Bakken-Three Forks Petroleum System: Lower shale vs. Three Forks oil charge



Lower Bakken Shale Thickness & Thermal Maturity (~Hydrocarbon Generation)

Lower Shale Thickness + Thermal Maturity



Three Forks Oil Saturations

