North Dakota Geological Survey
Geologic Investigation No. 275
2024

Opeche A Salt Extent and Thickness

Williston Basin, North Dakota

Steve Chittick

Edward C. Murphy, State Geologist
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Summary: More than 5,000 wells with petrophysical well logs were examined to determine the lateral extent and thickness of the A salt of the Opeche Formation (Permian). A total of 4,343 wells were determined to contain the Opeche A salt, with thickness ranging from near 0 to over 100 feet. The total net thickness of salt in the Opeche Formation was not determined in this exercise as there are several occurrences of salt throughout the Opeche Formation, including the Opeche B salt. The B salt top and bottom were picked during this exercise, but the B salt mapping will be presented in a subsequent publication.

Methodology: The A salt was picked based on a combination of different logs throughout the study area. Log responses to the A salt are as follows: low gamma ray (GR) response (track 1, figures 2 & 3), low density and a large spread between the neutron (NPHI) and density (RHOZ), green shading in track 2 (Figures 2 & 3). The photo-electric factor (PEFZ), in brown, (track 1, figures 2 & 3) tracks to the left of center in a salt when scaled 7 on the left and 2 on the right. The acoustic log in blue (DTCO), tracks down the center in salt when scaled left to right, 100 – 40 us/ft. The resistivity (RT) is high (track 3). The A salt is picked as the top and base of clean salt across several wells in cross section (Figure 3).

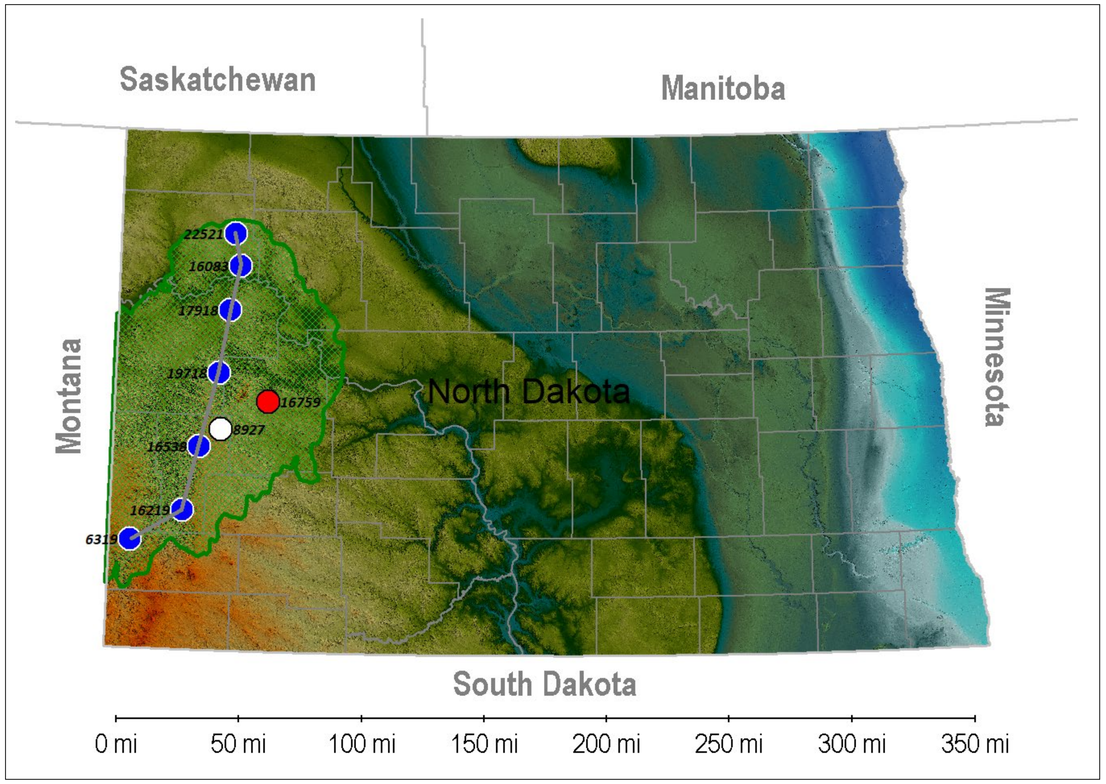

Figure 1

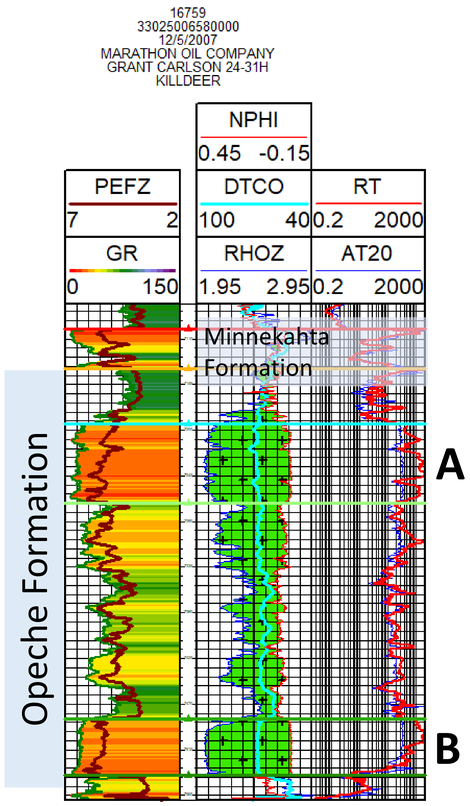

Figure 2

Figure 1: Location map of the Opeche A salt areal extent (shaded in light green cross-hatch) and the wells (blue dots) used in the cross-section of the Opeche Formation in Figure 3 below (NDIC numbers in black). The red dot indicates the location of the type well and the white dot is the location of well NDIC# 8927 (API 33007007480000) which has nearly 300 feet of core across the Opeche Formation.

Figure 2: Type wireline log of the Opeche Formation in Dunn County. Neutron/density crossover (green shading) indicates halite across most of the Opeche. The top red line represents the top of the Minnekahta Formation followed by the Opeche top in dark mustard yellow. The A salt top is shown by a light blue line across the wireline log and is used for calculating the A isopach. The A base is in light green and is also used to calculate the A isopach. The large letter A is presented beside the A salt interval. As can be seen in Figure 2, the salt gets dirtier (indicated by higher GR and lower density) below the A base. The top of the B salt is shown with a moderate green line and the base is indicated by a darker green line. A large letter B is shown beside the B salt interval.

Figure 3: Cross section across the Opeche Formation in the North Dakota portion of the Williston Basin. The wells are indicated on Figure 1. The Opeche A salt is indicated by cyan shading across the tracks and between the wells and the combination of the orangish-red shading of the GR in the 1st track and the green shading between the neutron and density curves in the 2nd track, as well as the high resistivity in the 3rd track. The third and fourth wells from the left have a significant B salt interval. The B salt can be observed as the orangish-red shading on the GR in the first track and the green shading between the neutron and density curves in the second track. The B salt tends to occur in the areas where the Opeche A salt is the thickest.

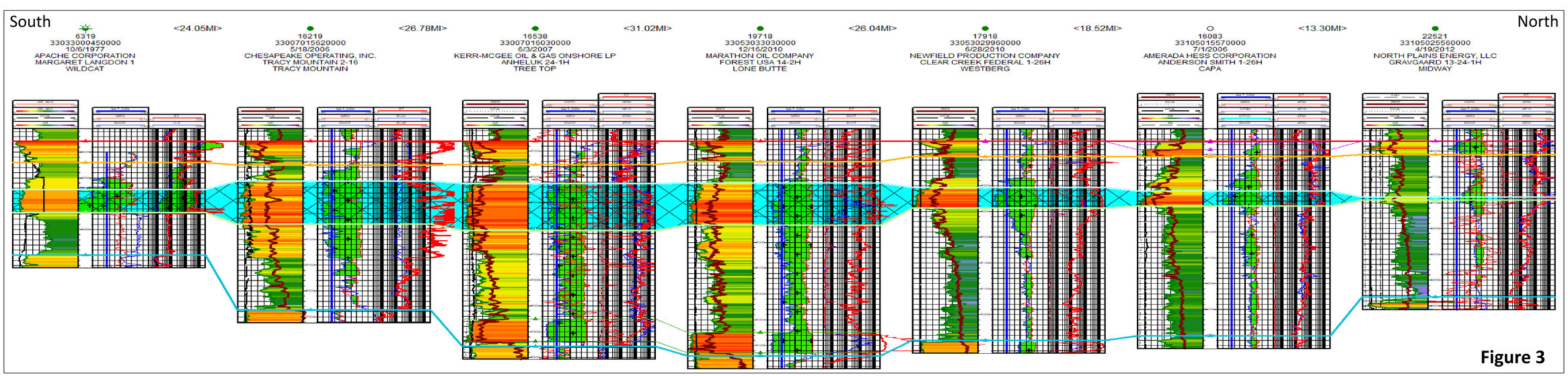

Figure 3

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Opeche A Salt Isopach

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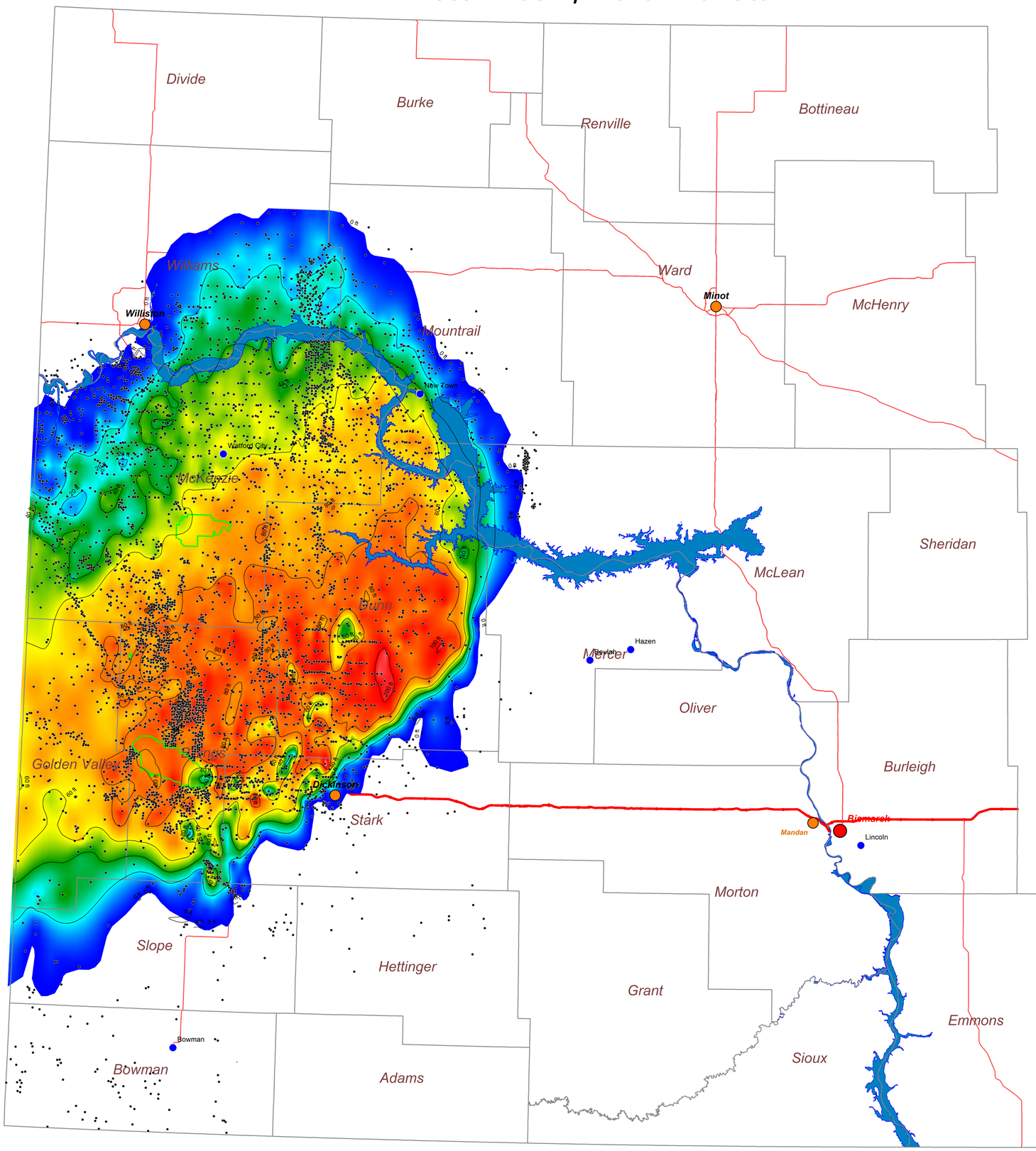

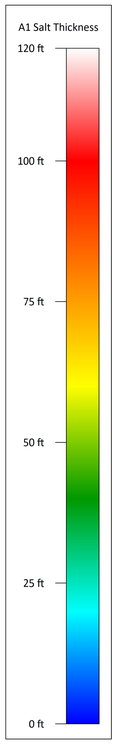

Map Legend

- Missouri River
- Theodore Roosevelt National Park boundaries
- Western_North_Dakota_Counties
- Opeche A1 Salt Contours (20 ft)
- Western North Dakota Interstate
- Western North Dakota US Highways
- Large Cities
- Moderate Cities
- Opeche A Salt wells
- Small Cities

MAP PROJECTION

North Dakota North 3301
North American Datum 1927 (NAD27)
XY in US Feet
Blue Marble Projection Details
Datum: North American Datum 1927 (NAD27)
Ellipsoid: Clarke 1866
Projection: Lambert Conformal Conic (2-Parallel)
Central Meridian: -100.5
False Easting: 2000000 US Survey Feet (usft)
False Northing: 0 US Suvey Feet (usft)
Latitude of Origin: 47.0000000
Standard Parallel 1: 47.4333333
Standard Parallel 2: 48.4333333
Scale Factor at Origin: 1
EPSG: 32020

Scale: 1:506880 1" = 8 mi 1" = 13 km

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Opeche A Salt Structure Surface (SSTVD)

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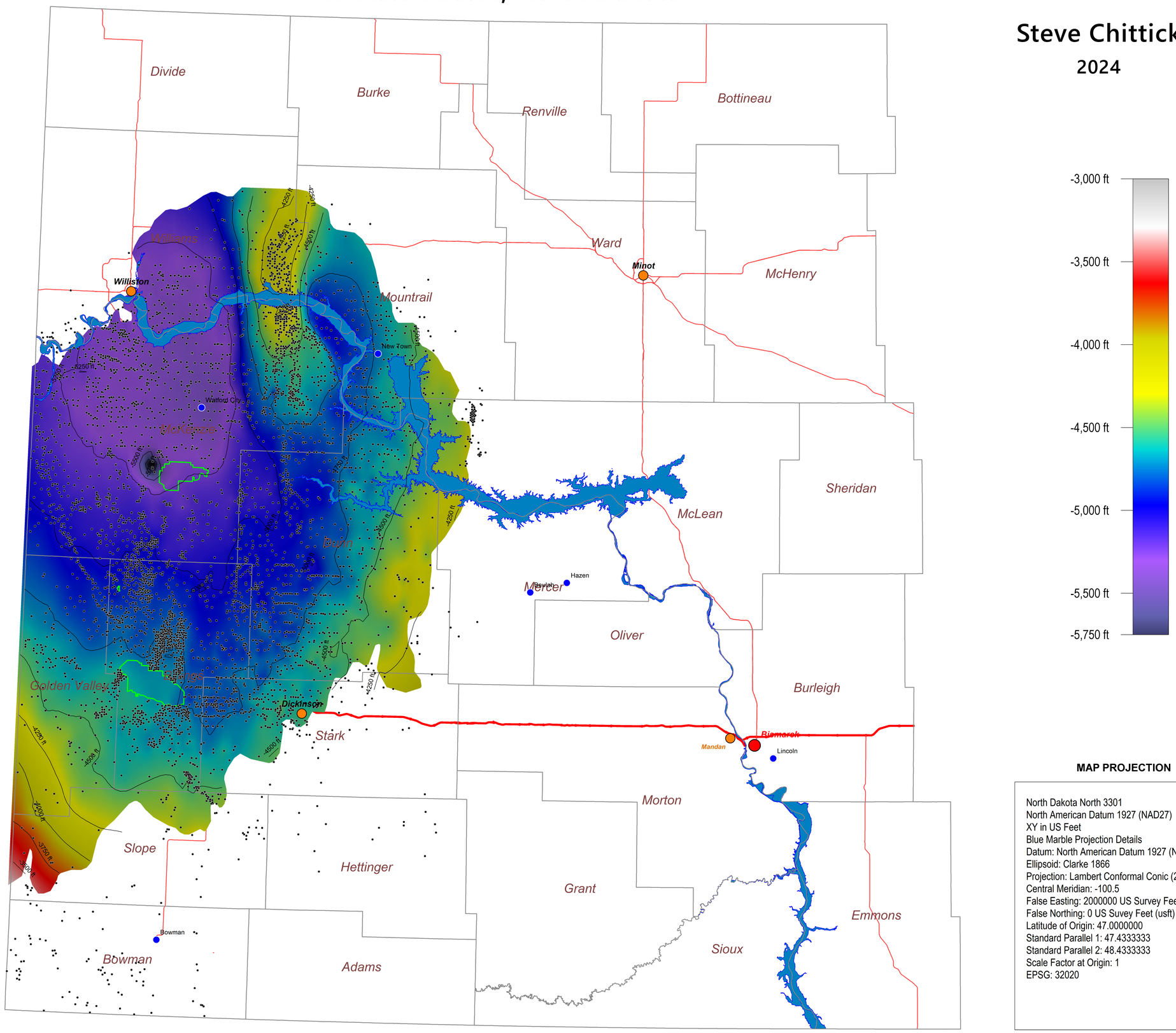

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