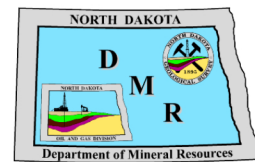




# Offshore Glaciolacustrine Deposits of Glacial Lake Agassiz: The Brenna Formation in Cass County, North Dakota

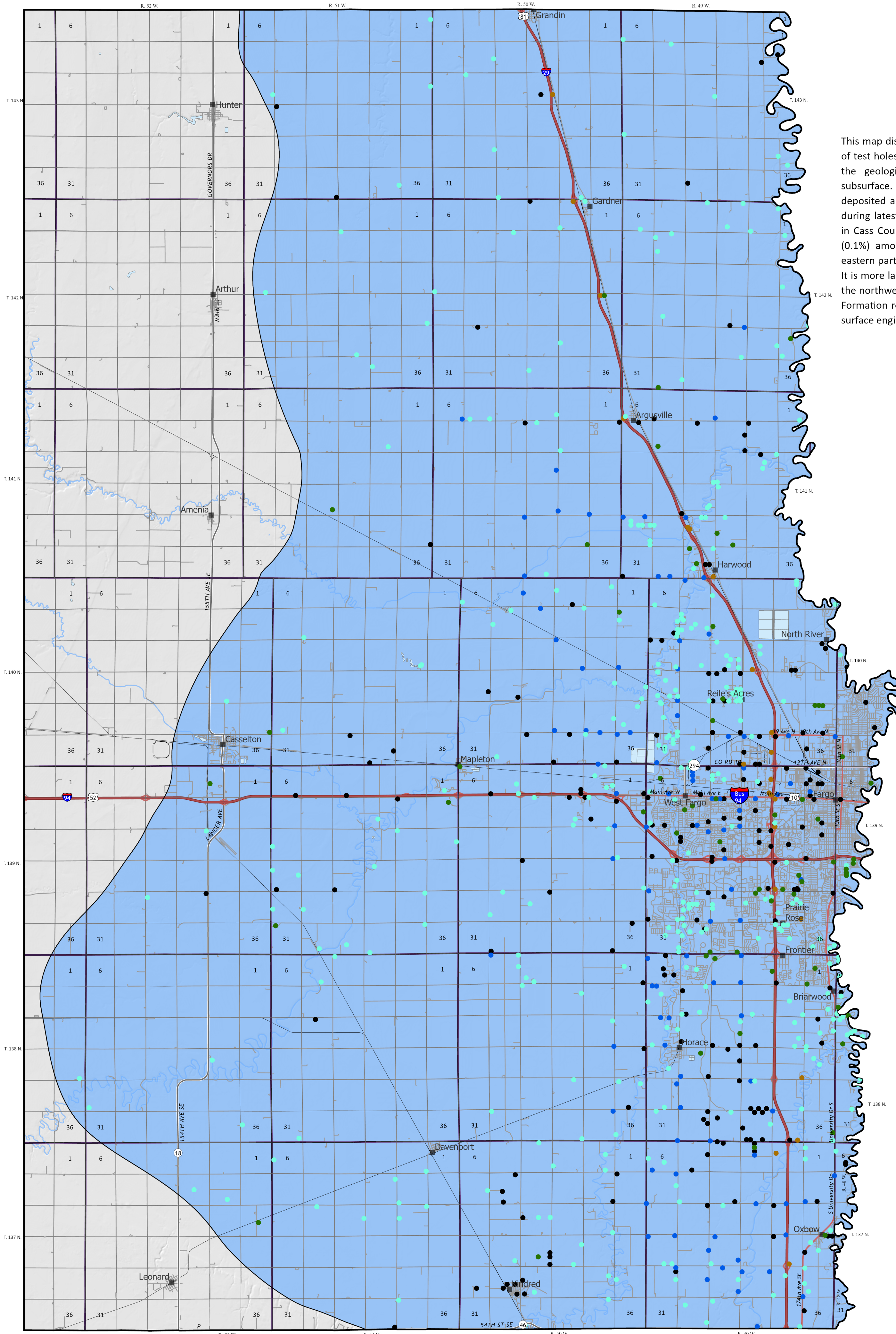


Fred J. Anderson

2023

## LOCATIONS OF DRILLHOLES

This map displays the locations of drillholes in Cass County consisting of test holes, water wells, and deep foundation borings, used to map the geologic extent of the Brenna Formation in the shallow subsurface. The Brenna Formation consists of smectitic clay that was deposited as offshore deep-water sediment into glacial Lake Agassiz during latest Wisconsinan time. Lithologically, the Brenna Formation in Cass County contains, on average, 85% clay, 15% silt, with minor (0.1%) amounts of sand (Figure 1). It was only deposited in the eastern part of the county and covers an area of 839 mi<sup>2</sup> (2,173 km<sup>2</sup>). It is more laterally extensive southwest of Fargo and less extensive to the northwest of the city. The smectitic clay mineralogy of the Brenna Formation results in a soft and expansive clay that is problematic for surface engineered works as it has low, load-bearing properties.



### Drillhole Locations

- Test Hole
- Observation Wells
- NDDOT Geotechnical Borings
- Private Well
- Water Supply Well
- Brenna Extent

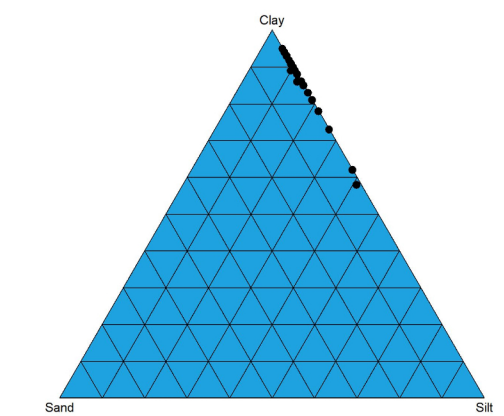
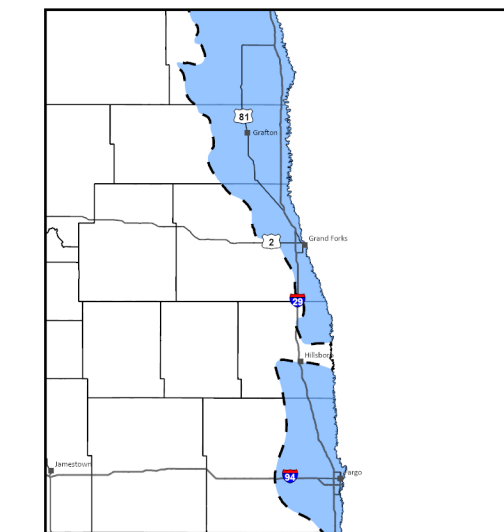
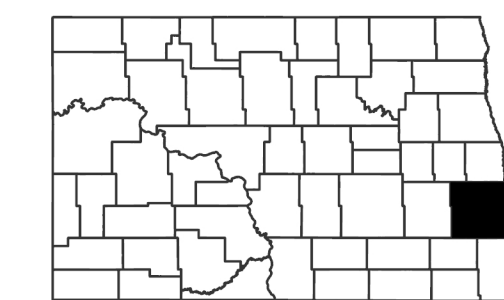


Figure 1. Ternary diagram of Brenna Formation lithology in Cass County.



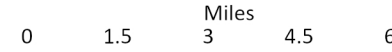
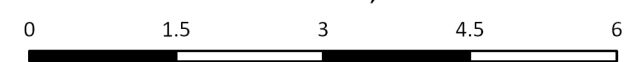
Location and extent of the offshore lake clays of the Brenna Formation in the Red River Valley of North Dakota.



Cass County, North Dakota



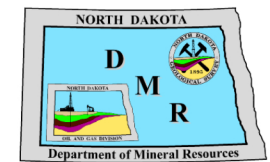
Scale 1:125,000



Mercator Projection  
Standard Parallel 46°37'30"N  
North American 1983 Datum  
Central Meridian 97°11'15"W



# Offshore Glaciolacustrine Deposits of Glacial Lake Agassiz: The Brenna Formation in Cass County, North Dakota



Fred J. Anderson

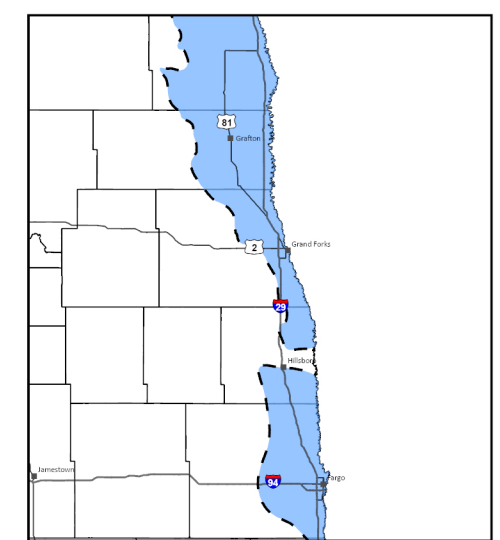
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## DEPTH TO BRENNA FORMATION

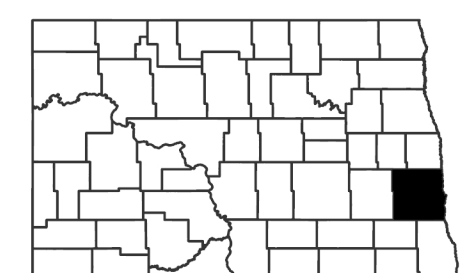
This map depicts the depth of the Brenna Formation in the shallow subsurface in Cass County. Depth to the top of the Brenna Formation is shown as colored contour intervals modeled from test hole, water well, and deep-foundation drilling data. The Brenna Formation was only deposited in the eastern part of the county and covers an area of 839 square miles (2,173 km<sup>2</sup>). It is more laterally extensive southwest of West Fargo and some what less extensive to the northwest of the city. The Brenna Formation generally occurs at depths of 10-20 feet (3.0 – 6.1 m) but may be as deep as 50 feet (15.2 m) northeast of Argusville.

### Depth Contour (feet bls)

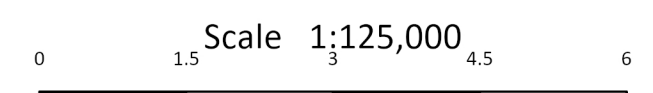
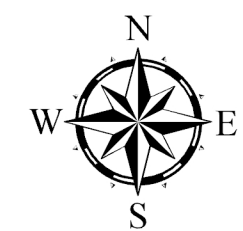
- < 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 80 >



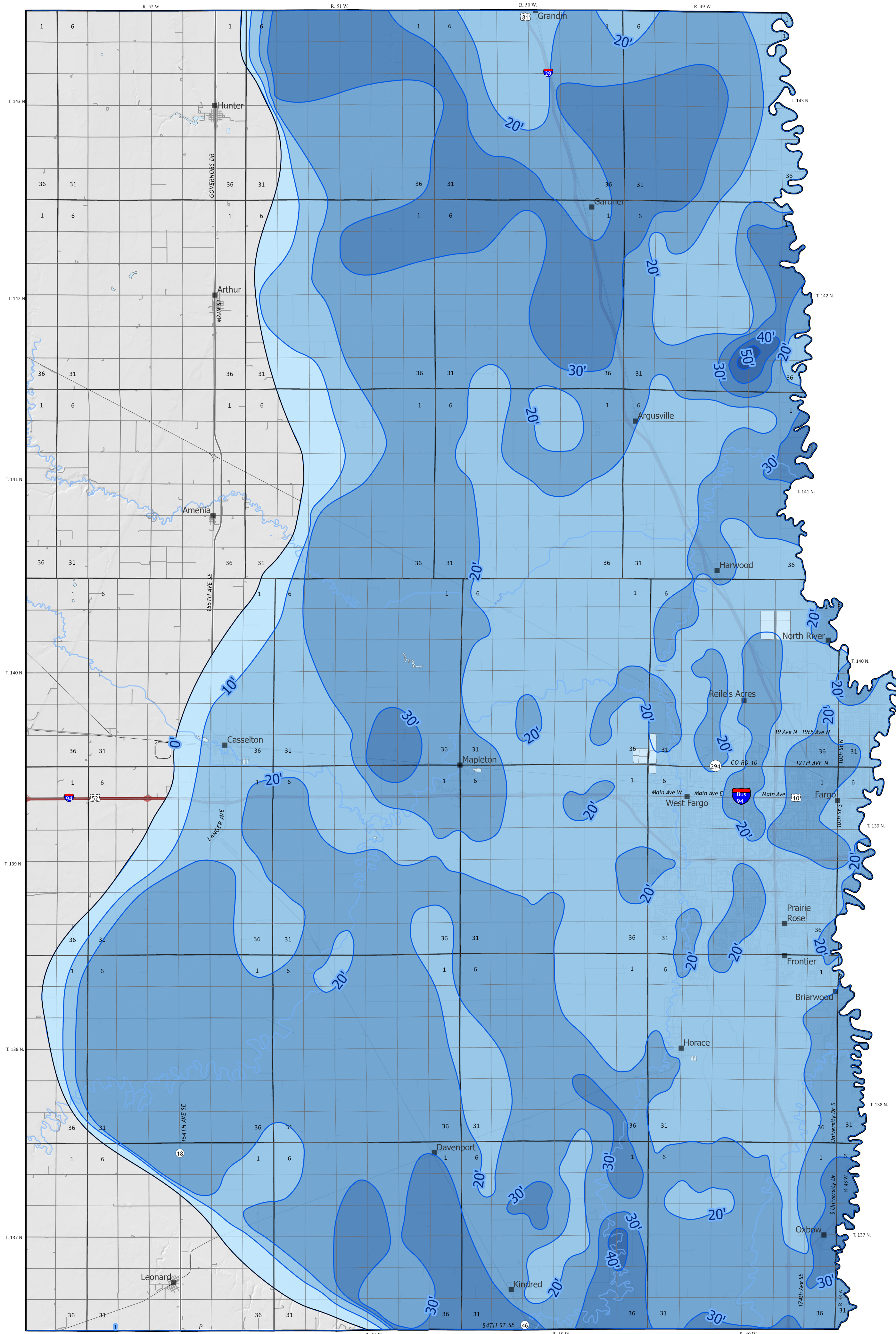
Location and extent of the offshore lake clays of the Brenna Formation in the Red River Valley of North Dakota.



Cass County, North Dakota

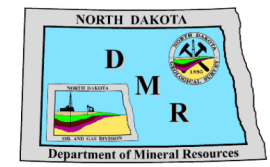


Scale 1:125,000  
Mercator Projection North American 1983 Datum  
Standard Parallel 46°37'30"N Central Meridian 97°11'15"W





# Offshore Glaciolacustrine Deposits of Glacial Lake Agassiz: The Brenna Formation in Cass County, North Dakota



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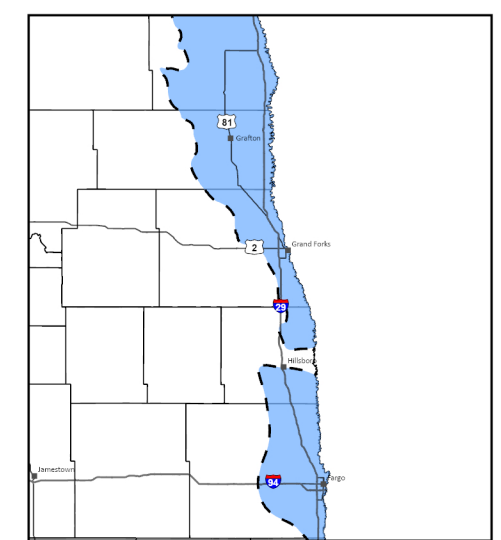
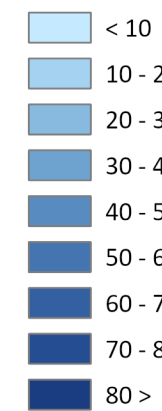
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## BRENNA FORMATION ISOPACH

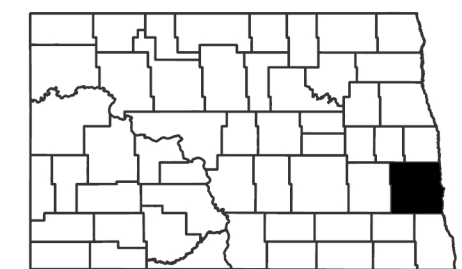
This map depicts the thickness of the offshore clay of the Brenna Formation in Cass County as colored isopach contour intervals modeled from test hole, water well, and deep-foundation drilling data. The Brenna Formation was only deposited in the eastern part of the county and covers an area of 839 square miles (2,173 km<sup>2</sup>). It is more laterally extensive southwest of Fargo and less extensive to the north. The Brenna Formation generally thickens from west to east and in areas underlying the Red River can be over 80 feet (24.4 m) thick.

The thickness of the Brenna Formation as depicted here also includes the soft offshore glaciolacustrine clay of the Argusville Formation which underlies the Brenna Formation in Cass County. The contact between these two units is difficult to distinguish from drilling records alone as additional sedimentological and engineering properties analysis is needed to differentiate the two. The Argusville Formation clays contain small amounts of sand and silt not found in the overlying Brenna Formation clay. From an engineering properties perspective however, these two units are similar and are modeled on this map as a single unit.

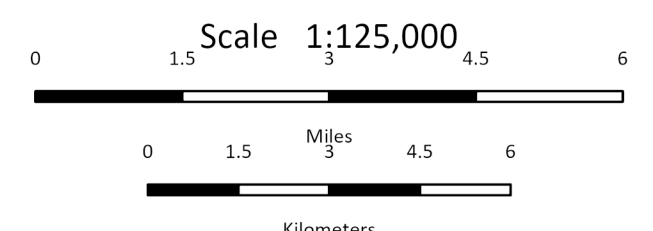
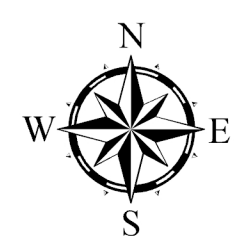
### Brenna Formation Isopach Contour (feet)



Location and extent of the offshore lake clays of the Brenna Formation in the Red River Valley of North Dakota.



Cass County, North Dakota



Mercator Projection North American 1983 Datum  
Standard Parallel 46°37'30"N Central Meridian 97°11'15"W

