Characterization of Fractures in the Brule Formation Surrounding Lodgepole Creek, Pumpkin Creek, and The North Platte River, Western Nebraska

State of Nebraska
Department of Natural Resources

June 29, 2011

Prepared at the request of the North and South Platte Natural Resource Districts
by Stephanie Ashley, Integrated Water Management Analyst

Introduction

In January 2011, Leonard Rice Engineers Inc. (LRE) completed a memo report for the North Platte and South Platte NRDs detailing the occurrence, extent and elevation of fractured Brule Formation within part of the Western Model Unit (WMU) area. When the NRDs requested the study, a map was provided showing five (5) priority areas along the North Platte River, Pumpkin Creek, and Lodgepole Creek (Figure 1). LRE's report covered only priority area one along Lodgepole Creek. The NRDs have requested that the Department of Natural Resources (DNR) conduct a similar study for the remaining priority areas. This report details the occurrence, extent, and elevation of fractured Brule Formation in priority areas two through five. Additional background on the Brule formation may be found in the original memo titled "Brule Formation Fractures in NRD Priority Area 1 – Preliminary Results" and dated January 3, 2011.

Methods

The same methods were used for this study as were used by LRE for their study. DNR examined 1,436 well logs from the COHYST database and 891 other well logs from the Nebraska Department of Natural Resources database. The logs were examined and the data were entered into an Excel spreadsheet that included the depth to the top of the Brule Formation, the depth to the top of the fractured zone, and the depth of the well along with other information. This spreadsheet is included in electronic format with this report. When the well logs were examined, they were assigned to one of the following categories:

- **Fractured** – the log describes the Brule formation as fractured, broken, or as having pedotubules.
- **Some Fractures** – the log describes the formation as having fractured zones with some distinct zones of unfractured Brule.
- **Probably Fractured** – The log lists areas of the Brule Formation as having lost circulation or no returns or the log does not indicate that the Brule is fractured, but the well is screened in and producing water from the Brule Formation.
- **Possibly Fractured** – The log does not indicate the Brule is fractured and there is no completion data for the well, but most of the well is drilled into the Brule Formation. If most of the well is in the Brule Formation, it is possibly producing from the Brule Formation and it is possible that the Brule is fractured. The drawback in this assumption is that the well may not be producing water. Many of the wells from the state database do not provide information on use or production. They may have been test holes or monitoring wells that were not intended to produce water.
- **Not Fractured** – These are logs from monitoring wells drilled into the Brule that do not indicate that the Brule is fractured or test holes that never produced water. It also includes wells that were barely drilled into the Brule Formation, indicating that it did not produce water from the Brule in that area. This assumes that the drillers creating the logs would

have included enough detail in their logs to mention fractures if fractures were present. In many instances, this may not be the case.

After the wells were categorized, they were plotted in ArcMap and elevations were extracted from the Nebraska 10 meter DEM (Figure 2). Then the depth to top of Brule and depth to fractures were subtracted from the surface elevation to provide elevations for the top of the Brule Formation and the top of the fractured zone. The elevation of the bottom of the well was already included in the database.

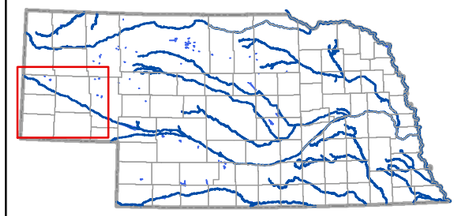
Maps were created showing the elevation of the top of the highest fractured zones in the wells where the Brule formation was completely fractured or had zones of fractures. In wells that were probably fractured or possibly fractured, the elevation of the top of the Brule Formation is shown. In wells that did not contain fractured Brule, the elevation of the bottom of the well is shown. This was done to see if these wells without fractured Brule were not deep enough to reach the fractured zone. It did not appear that this was the case. After these wells were plotted, the depth to the top of the fractured Brule zone was contoured by hand (See Figure 3).

Results

The results show that fracturing is not continuous throughout the Brule Formation. Fractures are not found in large zones either, but fracturing appears to more extensive than previously mapped by Cannia et al., 2006. The LRE report indicates that the elevation of fractures in Priority Area 1 generally decreases from west to east. The results of this study indicate that in priority areas two, three, and five the elevation of the zone of fractured Brule increases to both the north and south away from the North Platte River. Figures 4 through 7 show contouring in priority areas two through five. The pattern of fractures in priority areas two through five does not appear to be consistent with the fractures mapped in priority area one in the LRE report. It may be beneficial to re-examine priority area one in context of the larger area now that more data are available.

Figure 1

Priority Areas for Fractured Brule Study Identified by North and South Platte Natural Resource Districts



Legend

- NRD Priority Areas
- Extent of Brule fractures mapped by Cannia et al., 2006[1]

N

0 5 10 20

Miles

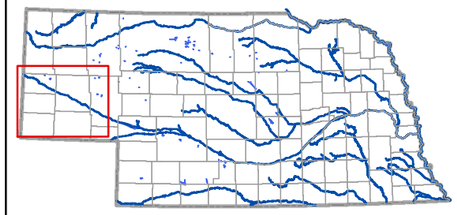
June 29, 2011

[1]Cannia, J. C., Woodward, D., and Cast, L. D., 2006, "Cooperative Hydrology Study COHYST Hydrostratigraphic Characterization Report."

Map produced for North and South Platte NRDs by Nebraska Department of Natural Resources

Figure 2

Wells Examined and Characterized for Brule Study



Legend

- NRD Priority Areas
- Extent of Brule fractures mapped for COHYST
- Fractured
- Some Fractures
- Probably Fractured
- Possibly Fractured
- Not Fractured

N

0 5 10 20

Miles

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Map produced for North and South Platte NRDs by Nebraska Department of Natural Resources

Figure 3

Elevation of Brule Fractures in all Priority Areas

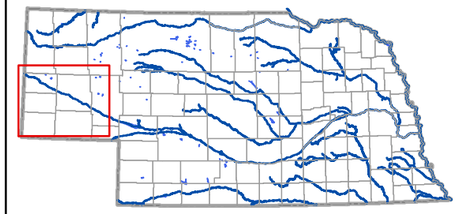

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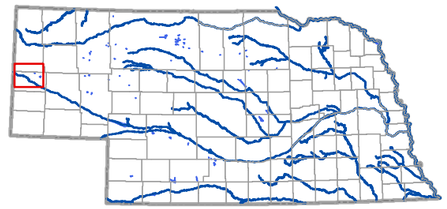
Figure 4a

Elevation of Brule Fractures in Priority Area Two



Legend

- NRD Priority Areas
- Extent of Brule fractures mapped by Cannia et al., 2006[1]
- Fractured - with elevation of fractures (ft)
- Some Fractures - with elevation of fractures (ft)
- Probably Fractured - with elevation of top of Brule (ft)
- Possibly Fractured - with elevation of top of Brule (ft)
- Not Fractured - with elevation of bottom of well (ft)
- Elevation of Brule fractures (ft)

N

0 1 2 4

Miles

June 29, 2011

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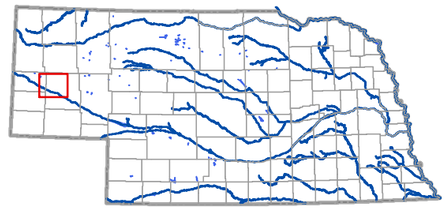
Figure 4b

Elevation of Brule Fractures in Priority Area Two



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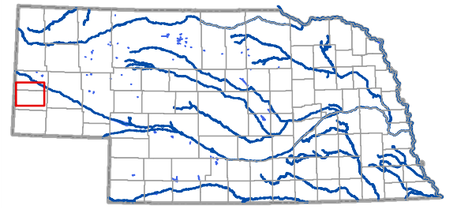
Map produced for North and South Platte NRDs by Nebraska Department of Natural Resources

Figure 5a

Elevation of Brule Fractures in Priority Area Three



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- Elevation of Brule fractures (ft)

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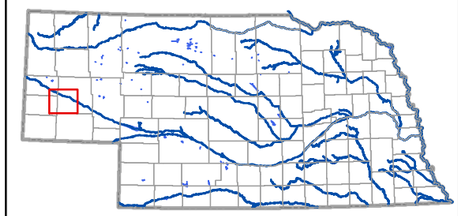
Figure 5b

Elevation of Brule Fractures in Priority Area Three



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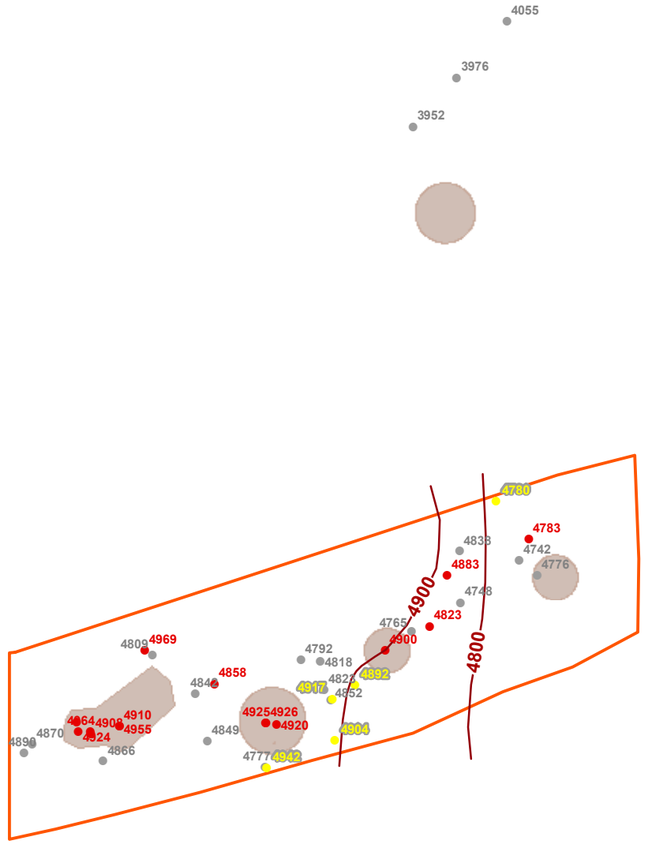
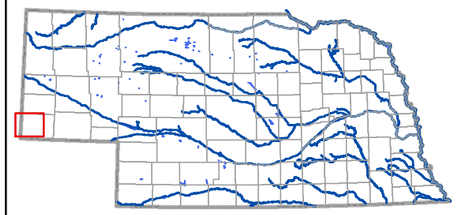


Figure 6

Elevation of Brule Fractures in Priority Area Four



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- Elevation of Brule fractures (ft)

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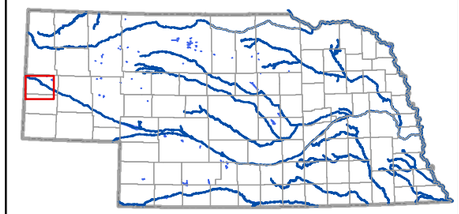
Figure 7a

Elevation of Brule Fractures in Priority Area Five



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N

0 1 2 4

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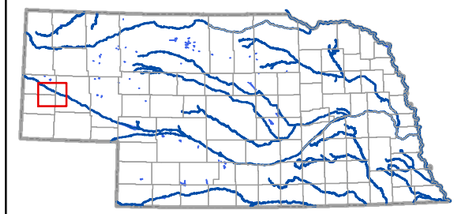
Figure 7b

Elevation of Brule Fractures in Priority Area Five



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- Possibly Fractured - with elevation of top of Brule (ft)
- Not Fractured - with elevation of bottom of well (ft)
- Elevation of Brule fractures (ft)

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