

Desired Future Conditions for the Ogallala Aquifer in Hemphill County



A Letter Report Prepared for:

Hemphill County Underground Water Conservation District

by:

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Desired Future Conditions Hemphill County UWCD

1. Introduction

With conservation of groundwater resources of the aquifer in mind, the Hemphill County Underground Water Conservation District (District) proposes to establish a Desired Future Condition (DFC) for the Ogallala Aquifer in Hemphill County, within Groundwater Management Area (GMA) 1. One of the primary objectives of this DFC is to maintain sustainable groundwater conditions for future generations within Hemphill County. Doing so should also keep groundwater levels high enough to allow continuing discharge to surface water within the county, which is an important future condition to the constituency of the District.

In order to develop a DFC for the Ogallala Aquifer within Hemphill County, the District evaluated a variety of factors, including the desires of local constituents, Ogallala Aquifer physical characteristics, estimated current and future demands, other DFC statements, the effects of different DFCs on adjacent counties/districts, and the resulting managed available groundwater (MAG) estimates based on proposed DFCs. The objective was to develop the most appropriate DFCs for the HCUWCD based on these factors.

2. Ogallala Aquifer

The Ogallala Aquifer is the primary aquifer within Hemphill County. Management of the Ogallala Aquifer is typically different than for most aquifer systems in Texas. The Ogallala Aquifer production is from unconfined storage, and the most common management approach is to allow for the long-term depletion of these groundwater resources from storage. Within Hemphill County, the impact of the Ogallala Aquifer on surface water is very important. Numerous surface water streams and rivers continuously flow within the county, even in times of drought, as the result of discharge from the Ogallala Aquifer.



Many aspects of the Ogallala Aquifer were included in the technical evaluation conducted to identify appropriate DFCs for Hemphill County. Some of the physical characteristics that were evaluated during this study included:

- *Water in storage:* Estimates of the volume of groundwater in storage within Hemphill County can vary considerably. The following are some of those different estimates:
 - *Texas Water Development Board (TWDB) groundwater availability model (GAM):* The estimated amount of water in storage in 2000 based on GAM runs conducted by the TWDB is approximately 15.5 million acre-feet (TWDB, 2001).
 - *HCUWCD:* HCUWCD assessed groundwater volumes using a net-saturated, stratigraphic approach based on more than 800 driller's and well logs and estimated a volume of 15.2 million acre-feet in storage (DBS&A 2009).
 - *Panhandle Water Planning Area (PWPA):* Based on the TWDB GAM, PWPA estimated that 15.63 million acre-feet of groundwater was available in storage in the Ogallala Aquifer in Hemphill County in 2000 and 15.38 million acre-feet in 2060 (TWDB 2006).

The importance of developing the best possible estimate of the volume of groundwater in storage cannot be understated as assumptions of specific yield, recharge, and other modeling parameters can significantly impact final volume estimates.

- *Saturated thickness:* The saturated thickness of the Ogallala Aquifer within Hemphill County changes substantially over the aquifer area and is dependent on location. According to 2007 water levels, average saturated thickness ranges from approximately 0 to more than 400 feet (Figure 1). Saturated thicknesses tend to be greater in the south and west parts of the county and the least in the eastern parts of the county.
- *Water levels:* Water levels tend to be higher along the northern and southern edges of the county and to decrease toward the Canadian River, where the Ogallala Aquifer regionally discharges (Figure 2).



- *Number of wells:* Currently, there are 2,451 known water wells within Hemphill County. The District is actively researching well data and locations to develop an accurate database of all registered and permitted wells in the county.
- *Recharge:* The estimated amount of recharge to the groundwater resources of the District is approximately 32,000 acre-feet per year (ac-ft/yr). This amount was derived from the Northern Ogallala GAM and is equal to a rate of approximately 0.75 inch per year (in/yr) over the entire county. Through local partners, including the District, the Panhandle Regional Water Planning Group has funded an interim study to better quantify recharge in the vicinity of Roberts County, including eastern portions of Hemphill County. The District asked Dr. Bridgett Scanlon to conduct a detailed geochemical and isotopic analysis of subsurface soil samples to help estimate recharge rates in Roberts and Hemphill counties. Preliminary results of this study indicate that a majority of the rangeland locations evaluated have essentially no recharge, and the remaining third of the locations have recharge rates of between 0.11 and 0.14 in/yr. Conversion of rangeland to dryland agriculture did not impact the low recharge rate in one soil profile, but did increase the rate to 0.41 in/yr in another. Recharge rates under irrigated agricultural sites were significantly higher—0.58 to 1.91 in/yr—with the irrigated site in Hemphill County being the lower of these estimates.

The results of these studies indicate that the recharge rate of approximately 0.75 in/yr used in the Northern Ogallala GAM is probably too high. Most of Hemphill County is rangeland, where the detailed study conducted for Region A showed recharge rates of essentially 0 to 0.14 in/yr. Somewhat higher rates were observed in agricultural areas, either dryland or irrigated, but these areas are fairly limited within the county. Based on these data, groundwater recharge in Hemphill County is estimated to be less than 9,000 ac-ft/yr. There is some concern about the long-term viability of a DFC that allows pumping that may exceed this estimate, as long-term depletion may take place.



3. Water Demands

Estimates of current and future demands played an important role in the determination of DFCs for Hemphill County. It is important to the District that both current and future water demands be met with the MAG estimates that result from the Groundwater Management Area (GMA) process. To do this, the District evaluated historical, current, and projected future water use in the county. A summary of these evaluations is provided below.

- Historical water use:** Estimates of the historical groundwater pumpage in Hemphill County were extracted from the TWDB Water Use Survey Database (<http://www.twdb.state.tx.us/wrpi/wus/wus.htm>) and are shown in Table 1. These data indicate that groundwater production from the aquifer has been very limited in the past, especially compared to other counties that use water from the Ogallala Aquifer.

Table 1. Historical Use from the Ogallala Aquifer in Hemphill County

Year	Pumpage (ac-ft/yr)						Total
	Municipal	Manufacturing	Power	Mining	Irrigation	Livestock	
1980	1,713	0	0	1	2,772	516	5,002
1984	1,984	1,287	125	0	0	5,180	8,576
1985	1,169	125	0	0	6,712	175	8,181
1986	860	125	0	0	7,500	565	9,050
1987	706	0	0	0	5,950	144	6,800
1988	777	0	0	0	4,300	401	5,478
1989	694	2	0	0	1,936	402	3,034
1990	729	3	0	0	2,700	435	3,867
1991	743	2	0	0	2,866	446	4,057
1992	662	1	0	0	2,866	872	4,401
1993	622	2	0	0	1,071	838	2,533
1994	713	2	0	0	1,641	761	3,117
1995	619	1	0	0	1,303	766	2,689
1996	656	0	0	0	1,815	968	3,439
1997	601	1	0	0	1,963	822	3,387
1998	600	2	0	0	1,857	939	3,398
1999	625	1	0	0	3,171	956	4,753
2000	608	1	0	0	3,373	592	4,574



2001	637	0	0	0	2,349	513	3,499
2002	627	1	0	0	4,560	567	5,755
2003	605	0	0	0	1,626	1,362	3,593

Source: TWDB Water Use Survey database, 03/13/2007

ac-ft/yr = Acre-feet per year

- Current annual water demands:** The District estimates the amount of groundwater being used annually within Hemphill County to be 11,667 ac-ft/yr (*Certified Hemphill County Groundwater Management Plan, 2008*). This estimate is derived from local information collected by the District, which is considered to be the best available data for irrigation and mining use and is the current water demand included in the certified *Groundwater Management Plan* for Hemphill County (2008). It is of critical importance to continue to improve existing demand estimates and develop improved estimates of future demands. The District does not anticipate water demand within the county to change significantly in the near future.
- Projected water demands:** According to demand estimates from the PWPA (TWDB 2006), demand within Hemphill County is predicted to remain relatively constant (Table 2).

Table 2. Future Demand Estimates for Hemphill County

RWPG	WUG	River Basin	Projected Water Demand (ac-ft/yr)					
			2010	2020	2030	2040	2050	2060
A	Canadian	Canadian	475	477	461	444	432	411
	County other	Canadian	110	111	107	103	100	96
		Red	48	48	46	45	43	41
	Manufacturing	Red	1	1	1	1	1	1
	Irrigation	Canadian	4,162	4,162	4,162	4,162	4,162	4,162
		Red	2,661	2,661	2,661	2,661	2,661	2,661
	Livestock	Canadian	964	1,068	1,114	1,163	1,216	1,271
		Red	671	743	775	809	845	884
	Mining	Red	2,575	2,575	2,575	2,575	2,575	2,575
	Total			11,667	11,846	11,902	11,963	12,035

ac-ft/yr = Acre-feet per year

RWPG = Regional water planning group

WUG = Water user group



4. Water Budget

The water budget within the county was also taken into consideration in the development of DFCs for Hemphill County. The following components of the water budget are based on TWDB Northern Ogallala groundwater availability modeling:

- *Groundwater discharge to surface water:* The estimated amount of discharge of water from the aquifer to surface water is approximately 45,000 ac-ft/yr (TWDB GAM run 05-26).
- *Annual groundwater flow into Hemphill County:* The estimated amount of lateral flow of water into the District is approximately 14,900 ac-ft/yr (TWDB GAM run 04-16).
- *Annual groundwater flow out of Hemphill County:* The estimated amount of lateral flow of water out of the District is approximately 3,000 ac-ft/yr (TWDB GAM run 05-26).

The exchange of water with the underlying permeable basin is considered negligible within Hemphill County.

5. Development of Desired Future Conditions Statement

The DFC of the Ogallala Aquifer within GMA 1 has been established in accordance with Chapter 36.108 of the Texas Water Code. According to the guidelines in this chapter, in establishing the DFCs of the aquifers, “Districts shall consider uses or conditions of an aquifer within the management area that differ substantially from one geographic area to another. The districts may establish different DFCs for each aquifer, or each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of the management area.”

The District proposed several different DFC statements based on the objective to conserve Hemphill County groundwater supplies in order to protect those supplies and groundwater discharge to surface water, and to provide adequate water supplies to future generations. The



considered DFC statements ranged from no net drawdown to the regional water plan's limit of 50 percent reduction in saturated thickness over a 50-year period. (PWPA, 2001)

At the December 2008 GMA 1 meeting, the District proposed a 10 percent reduction in saturated thickness (90 percent storage remaining after 50 years) for Hemphill County's DFC, based on estimates of future conditions by evaluating the previous GAM runs conducted by the TWDB. This goal was based on the desire to have minimal impact on surface water flows within the county and still allow for current and future water demands to be met. The North Plains Groundwater Conservation District (GCD) proposed 40 percent retention of storage volumes in the four western counties and 50 percent retention of storage volumes in 50 years for the four eastern counties. The Panhandle and High Plains GCD supported a 50 percent reduction in 50 years for their counties and the remaining unprotected portions of GMA 1.

The TWDB successfully ran a GAM simulation for the various subdivisions. However, in order to retain 90 percent of the storage in Hemphill County after 50 years, the model could include almost no pumpage within the county, which essentially meant that Hemphill County would have zero available groundwater. This result was due to the impacts of pumping in adjacent counties on water levels within Hemphill County.

Based on the Northern Ogallala GAM runs provided by the TWDB, the District modified its DFC proposal. GMA 1 then submitted a modified request to TWDB to consider the following subdivisions for the Ogallala Aquifer within GMA 1:

- Subdivision 1 would consist of Dallam, Hartley, Moore, and Sherman counties with a 40 percent storage volume remaining in 50 years.
- Subdivision 2 would consist of Hemphill County with an 80 percent storage volume remaining in 50 years.
- Subdivision 3 would consist of Armstrong, Carson, Donley, Gray, Hutchinson, Hansford, Lipscomb, Ochiltree, Oldham, Potter, Randall, Roberts, and Wheeler counties with a 50 percent storage volume remaining in 50 years.



Based on this submitted GMA 1 statement for the three subdivisions within the Ogallala Aquifer, the TWDB developed GAM run 09-001 and released a draft report on February 17, 2009. Based on this report, a DFC of 80 percent remaining in storage for Hemphill County will result in approximately 12,349,626 acre-feet of water remaining with a MAG volume for Hemphill County of 54,998 acre-feet. The MAG is greater than the current pumpage in Hemphill County and is influenced by the impacts of absorbing the depletion from pumping in adjacent counties.

6. Managed Available Groundwater

The MAG estimate for Hemphill County based on the most recent DFC of 80 percent remaining in 50 years is 54,998 ac-ft/yr. This amount is more than 400 percent above the current demand, meaning that there is no current need to adjust management of groundwater resources to address the MAG.

7. Effect on Other Districts

A conservative DFC for Hemphill County positively impacts adjacent GCDs, which are not impacted by the DFC proposed for Hemphill County. The proposed DFCs for the three GMA 1 subdivisions are physically compatible, as shown with the successful completion of GAM run 09-001. However, the 40 and 50 percent allowable reductions proposed in adjacent counties will impact groundwater levels in Hemphill County.

8. Conclusions

The District considered a variety of factors in the process of defining a DFC. The District proposes to establish a DFC for Hemphill County of at least 80 percent of the current saturated thickness of aquifer remaining in 50 years. This DFC is based on the District's desire to take a conservation approach to groundwater management based on sound science. The continuing effort to base management decisions on sound science focused on the desires of local stakeholders, an improved understanding of aquifer characteristics and structure, the amount of groundwater volume in storage, an understanding of current and future demands, and working with neighboring districts to manage groundwater for future generations. The MAG resulting



from this DFC will provide available groundwater for development above and beyond the current needs of users in Hemphill County, including oil and gas interests.

References

Certified Hemphill County UWCD Groundwater Management Plan, 2008

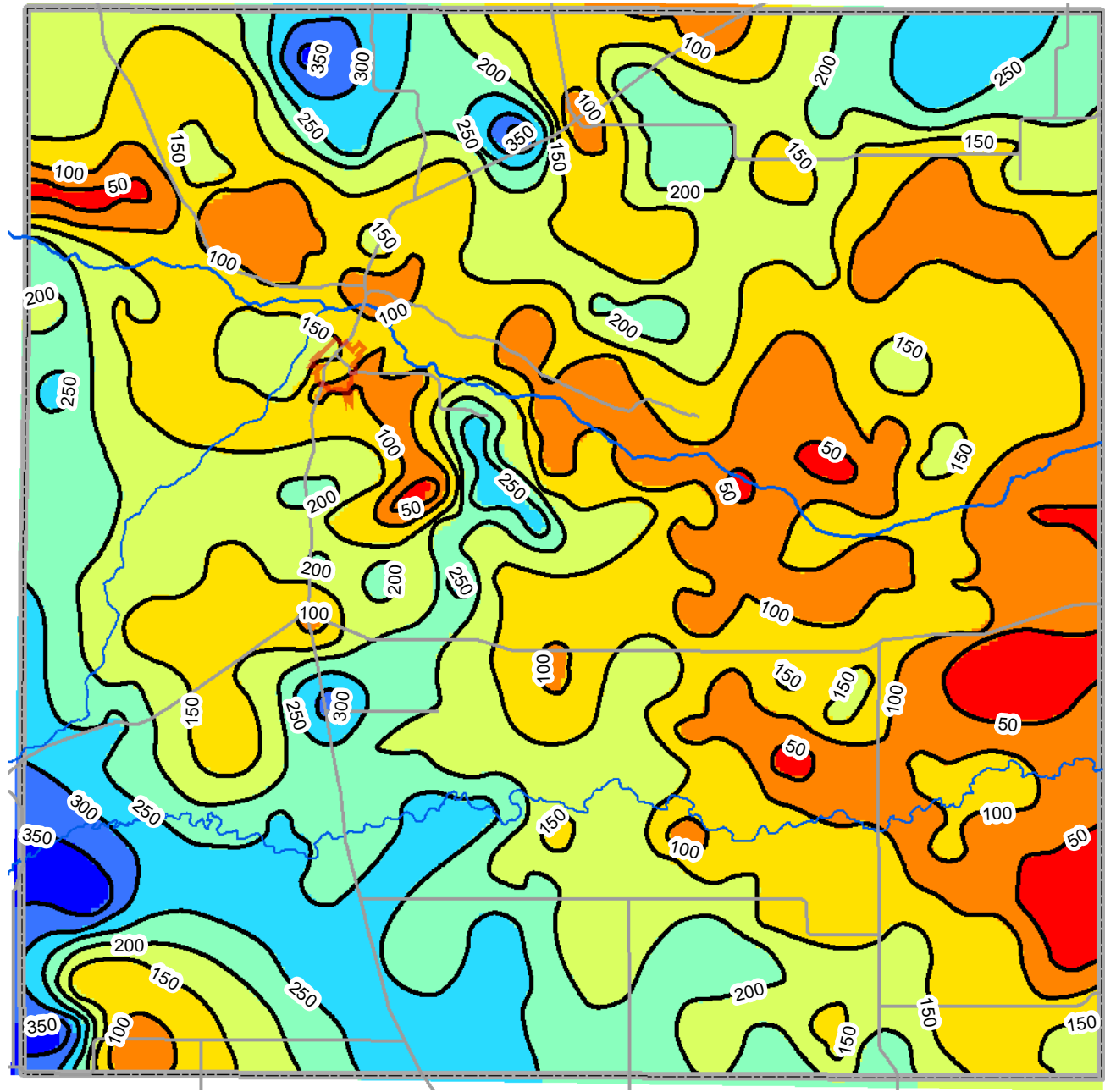
Groundwater Recharge in the Central High Plains of Texas: Roberts and Hemphill Counties. Scanlon, Bridget et. al. Bureau of Economic Geology, University of Texas at Austin. 2007

Texas Water Development Board (TWDB). 2009. (GAM run 09-001)

TWDB. 2005 (GAM run 05-26)

TWDB. 2004 (GAM run 04-16)

TWDB. 2005 (GAM run 05-26).



0 1 2 3 4 5 Miles



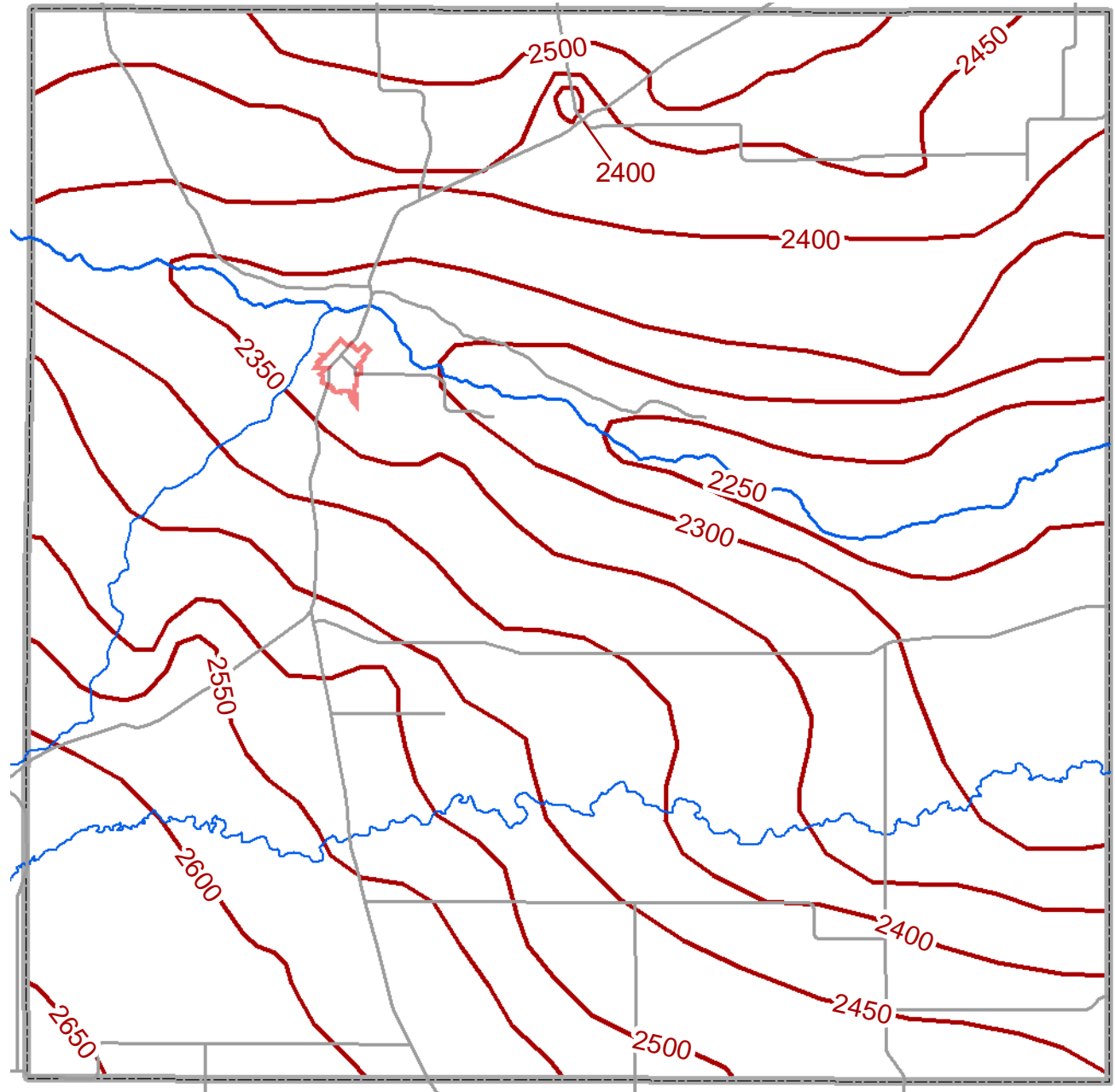
Explanation

— Saturated Thickness (feet)



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HEMPHILL COUNTY UWCD
2008 - 2009 Gross Saturated Thickness



0 1 2 3 4 5 Miles



Explanation

— 2008-09 Groundwater Elevation (feet)

HEMPHILL COUNTY UWCD

2008-09 Groundwater Elevations using HCUWCD Data

Figure 2



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