GAM run 05-16

by Richard Smith, P.G.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
June 12, 2005

REQUESTOR:

Mr. Stefan Schuster with Freese and Nichols, Inc. on behalf of the Panhandle Regional Water Planning Group

DESCRIPTION OF REQUEST:

Mr. Schuster requested that we run the Groundwater Availability Model (GAM) for the southern part of the Ogallala aquifer for the period 1950 to 2060 and provide maps of saturated thicknesses for 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, and 2060 in Oldham, Potter, and Randall counties.

METHODS:

We used the Groundwater Availability Model (GAM) for the southern part of the Ogallala aquifer (Blandford and others, 2003). For the historical simulation (1950 to 1999), we used pumpage as included in the GAM. For the predictive simulation (2000 to 2060), we used the water demand projections for water user groups of the Llano Estacado Regional Water Planning Group, as approved by the Texas Water Development Board on September 17, 2003, for the period of record through 2060 (see GAM run 03-36). In GAM run 05-11, volumes in 2060 for Oldham and Randall counties were projected using polynomial trend line and linear analysis. This was done as a simplification and the resulting values are essentially the same as the GAM values for the same year using the pumpage from GAM run 03-36. Once we ran the GAM, we calculated saturated thickness by subtracting the bottom elevation of the Ogallala aquifer as included in the GAM from the GAM calculated water levels. We contoured the saturated thickness data on a cell-by-cell basis within PMWIN to create maps.

PARAMETERS AND ASSUMPTIONS:

- See Blandford and others (2003) for assumptions and limitations of the GAM. Root mean squared error for this model is 34 feet. This error will have more of an effect on model results where the aquifer is thin.
- Recharge represents average conditions for the predictive period.
- Assumed a uniform specific yield of 0.15 across the aquifer.

RESULTS:

We developed estimates for groundwater volumes for 2060 in GAM run 05-11 using polynomial trend line and linear analysis for Randall and Oldham counties. The estimates for 2060 are slightly different when the model was re-run to 2060 using the pumpage from GAM run 03-26 (Table 1). We have also included groundwater volumes for Potter County for the portion of Potter County located in the southern part of the Ogallala aquifer GAM. In addition, we have included the total groundwater volumes for Randall, Oldham, and Potter counties for the northern and southern part of the Ogallala aquifer GAMs combined (Table 2).

Figures 1 through 12 show GAM historic and predicted saturated thicknesses. Note that the white areas in these figures represent dry cells in the GAM. As the predictive run progresses, more white appears in the GAM. These white areas represent parts of the GAM that are going dry because the aquifer can not continue to support the pumping. In the GAM, once a part of the model goes dry, it stays dry, and the pumping is "shut off." This can result in water levels rising in nearby areas once the pumping in the area is stopped. This also results in less pumping in the model because the pumping has been stopped in these areas. In reality, the aquifer will probably not go dry because pumping will become uneconomical before the aquifer goes dry in any particular area. However, the GAM is suggesting that these areas may experience water supply problems sometime in the next 50 years.

REFERENCES:

Blandford, T. N., Blazer, D. J., Calhoun, K. C., Dutton, A. R., Naing, T., Reedy, R. C.,and Scanlon, B. R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico: Numerical simulations through 2050: Final Report prepared by D. B. Stephens & Assoc, for the Texas Water Development Board.

Table 1. Estimates of groundwater volumes for the portions of Oldham, Randall, and Potter counties located in the GAM of the southern part of the Ogallala aquifer.

County	GAM 2000 (acre-feet)	GAM 2010 (acre-feet)	GAM 2020 (acre-feet)	GAM 2030 (acre-feet)	GAM 2040 (acre-feet)	GAM 2050 (acre-feet)	GAM 2060 (acre-feet)
Oldham	2,220,000	2,120,000	2,100,000	2,070,000	2,050,000	2,050,000	2,040,000
Randall	4,840,000	4,370,000	4,100,000	4,040,000	4,140,000	4,220,000	4,210,000
Potter	294,000	241,000	213,000	204,000	203,000	202,000	200,000

- Values are rounded to three significant figures.

Table 2. Update to Table 1 in GAM run 05-10 for Oldham, Randall, and Potter counties reflecting the combination of aquifer volumes from the northern and southern parts of the GAMs of the Ogallala aquifer.

County	1.25% 2000 (acre-feet)	GAM 2000 (acre-feet)	1.25% 2010 (acre-feet)	GAM 2010 (acre-feet)	1.25% 2020 (acre-feet)	GAM 2020 (acre-feet)	1.25% 2030 (acre-feet)	GAM 2030 (acre-feet)	1.25% 2040 (acre-feet)	GAM 2040 (acre-feet)
Oldham*	2,580,000	2,660,000	2,310,000	2,560,000	2,080,000	2,530,000	1,870,000	2,490,000	1,690,000	2,470,000
Randall*	6,230,000	6,400,000	5,730,000	5,820,000	5,290,000	5,460,000	4,900,000	5,320,000	4,560,000	5,360,000
Potter	2,790,000	3,084,000	2,490,000	2,921,000	2,230,000	2,743,000	2,000,000	2,614,000	1,800,000	2,543,000

County	1.25% 2050 (acre-feet)	GAM 2050 (acre-feet)	1.25% 2060 (acre-feet)	GAM 2060 (acre-feet)
Oldham*	1,530,000	2,460,000	1,390,000	2,450,000
Randall*	4,250,000	5,390,000	3,990,000	5,340,000
Potter	1,620,000	2,262,000	1,460,000	2,390,000

- Values are rounded to three significant figures.

* Additional information on the method and assumptions used to calculate the 1.25% reduction can be found in GAM run 04-13 (Smith, 2004) and the method and assumptions used to estimate the portion of the counties in the northern portion of the Ogallala aquifer GAM can be found in GAM run 05-09 (Smith, 2005).

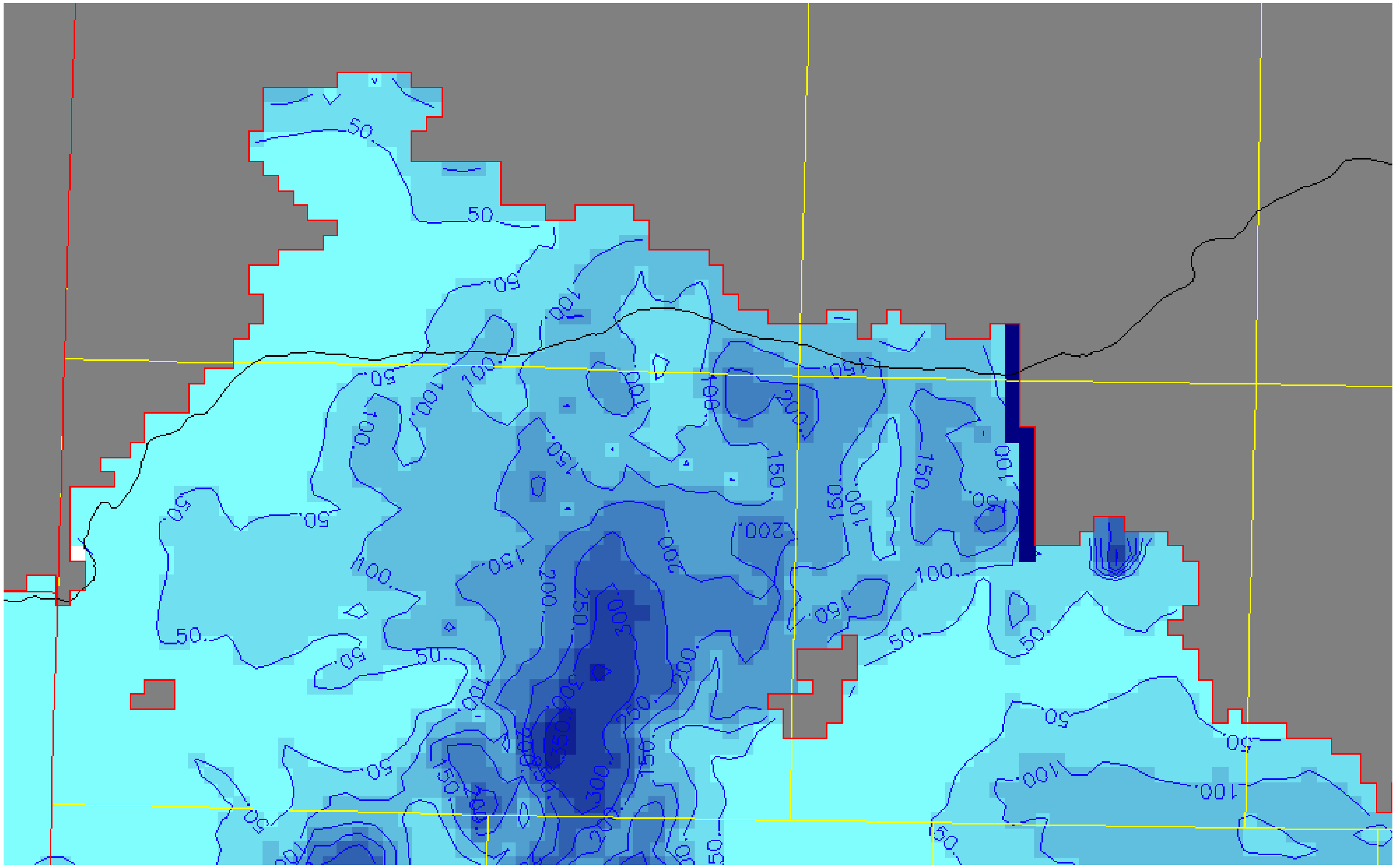

Figure 1: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 1950. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

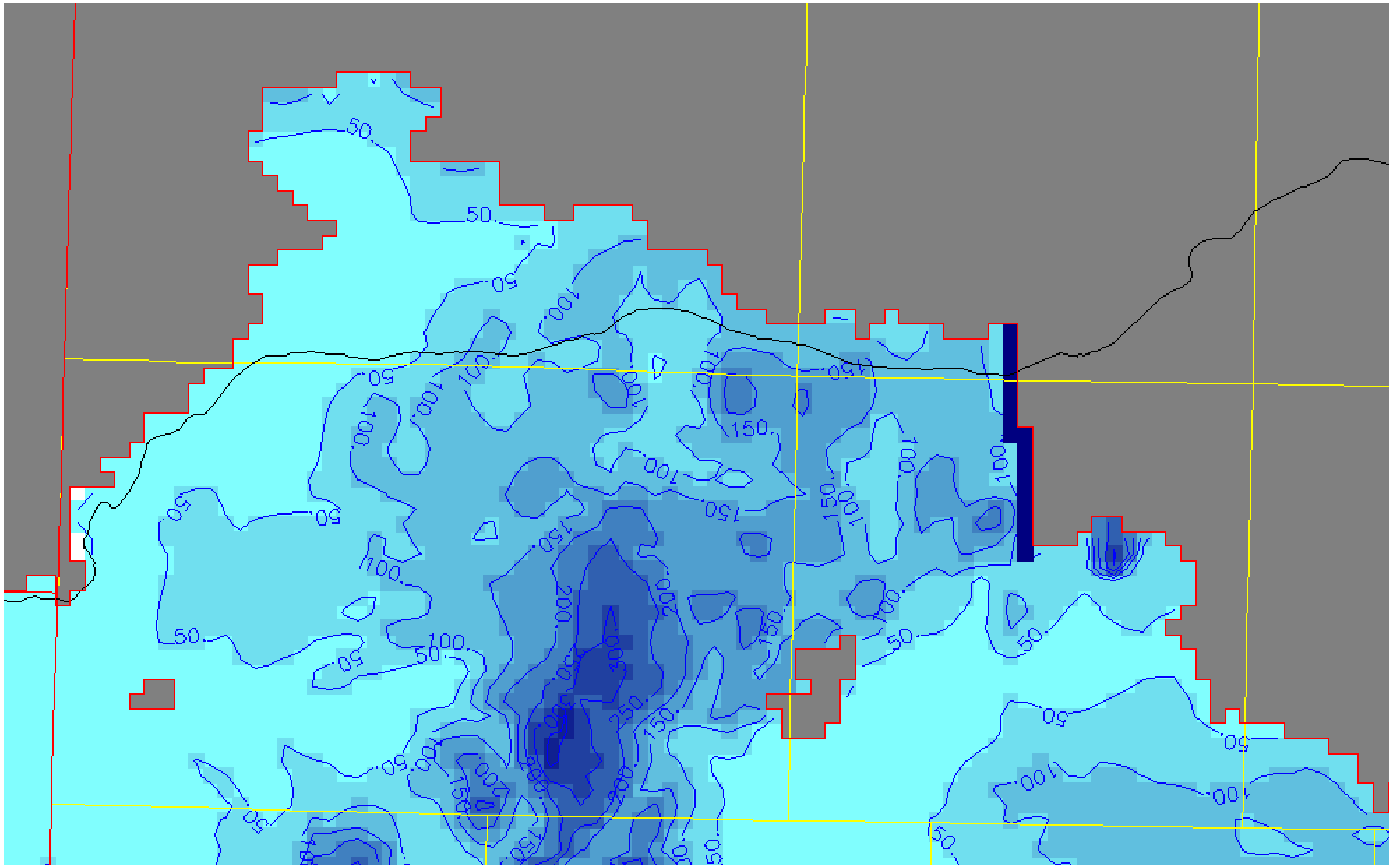

Figure 2: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 1960 North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

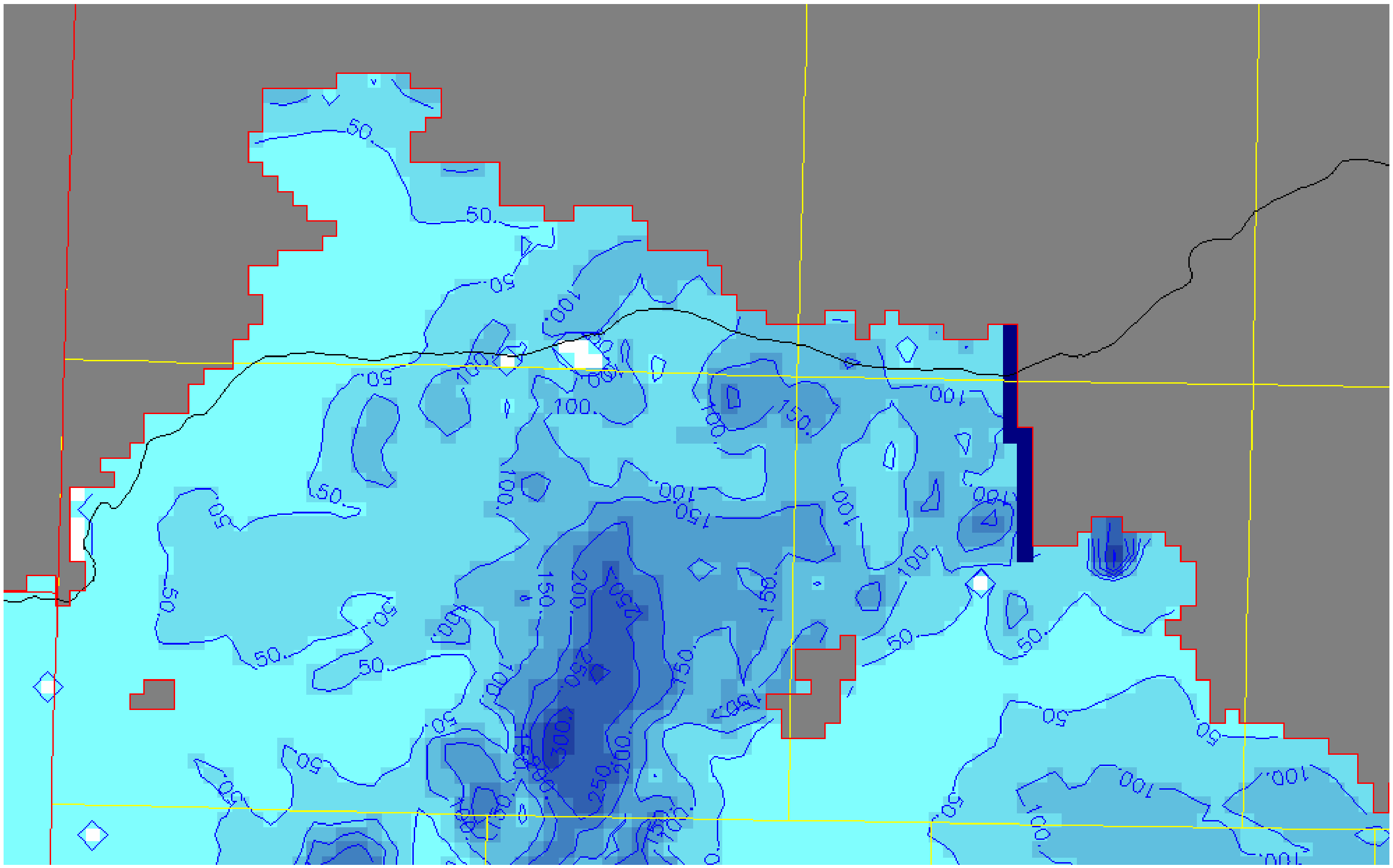

Figure 3: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 1970. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

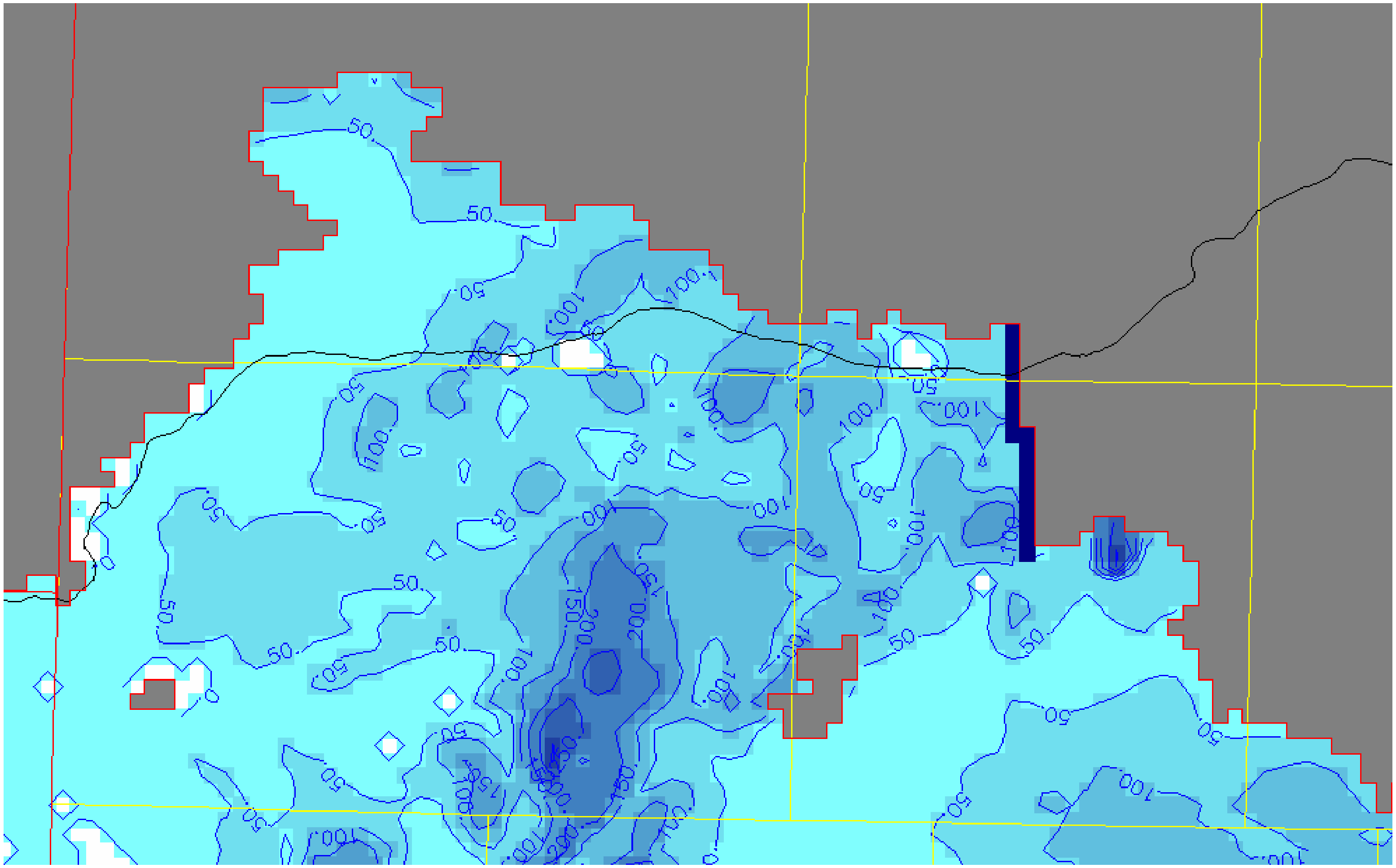

Figure 4: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 1980 North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

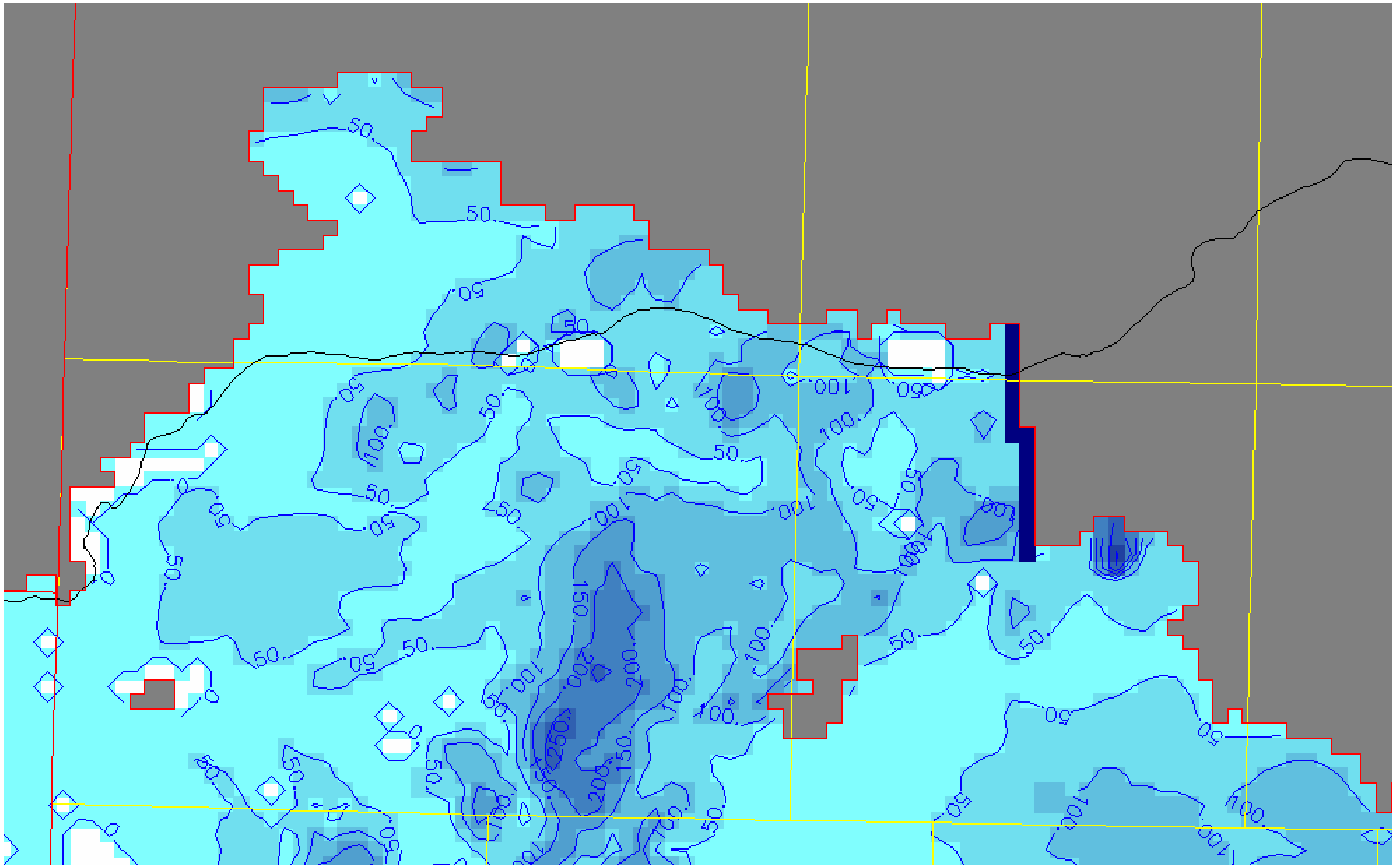

Figure 5: Northern Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 1990. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

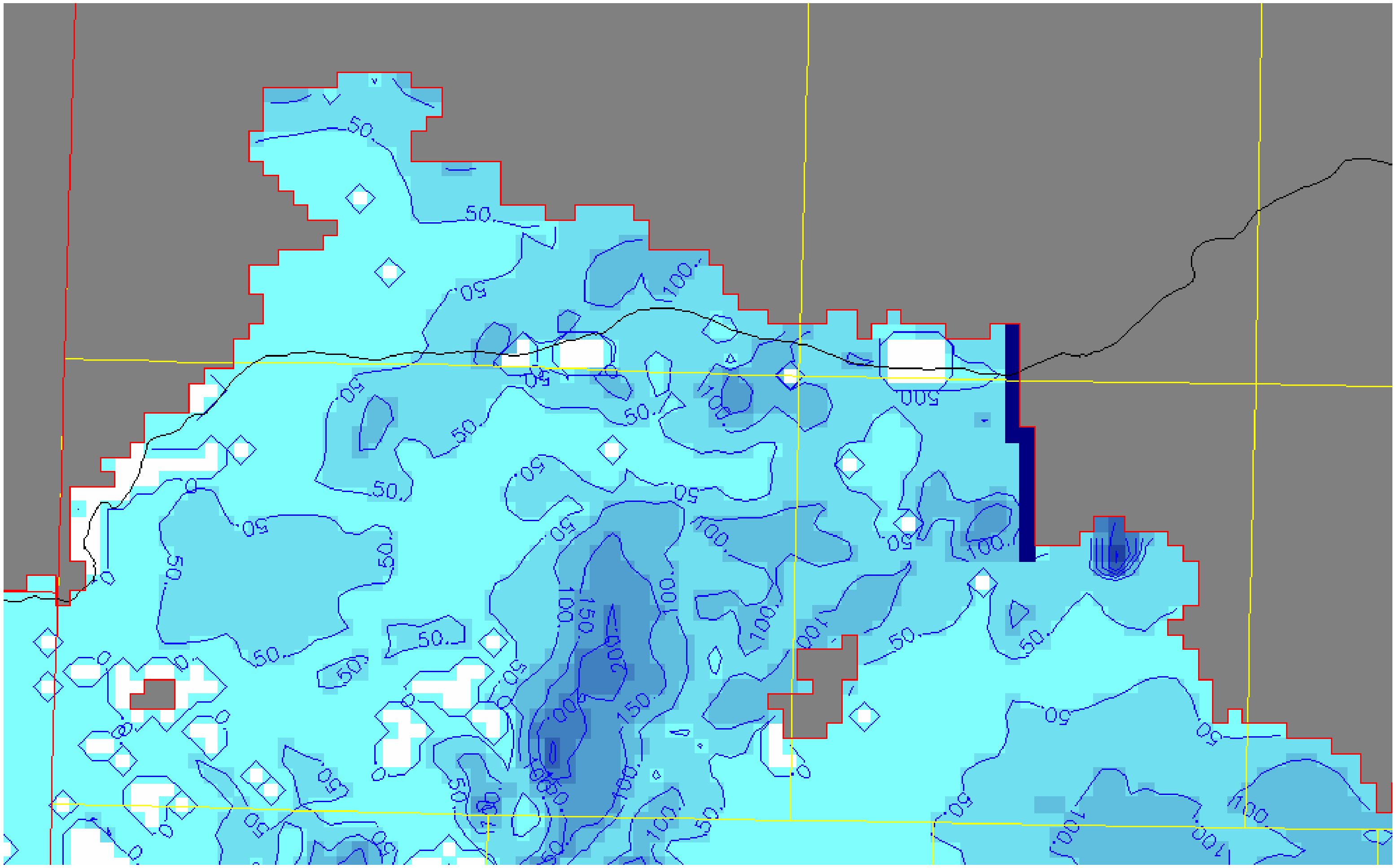

Figure 6: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2000. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

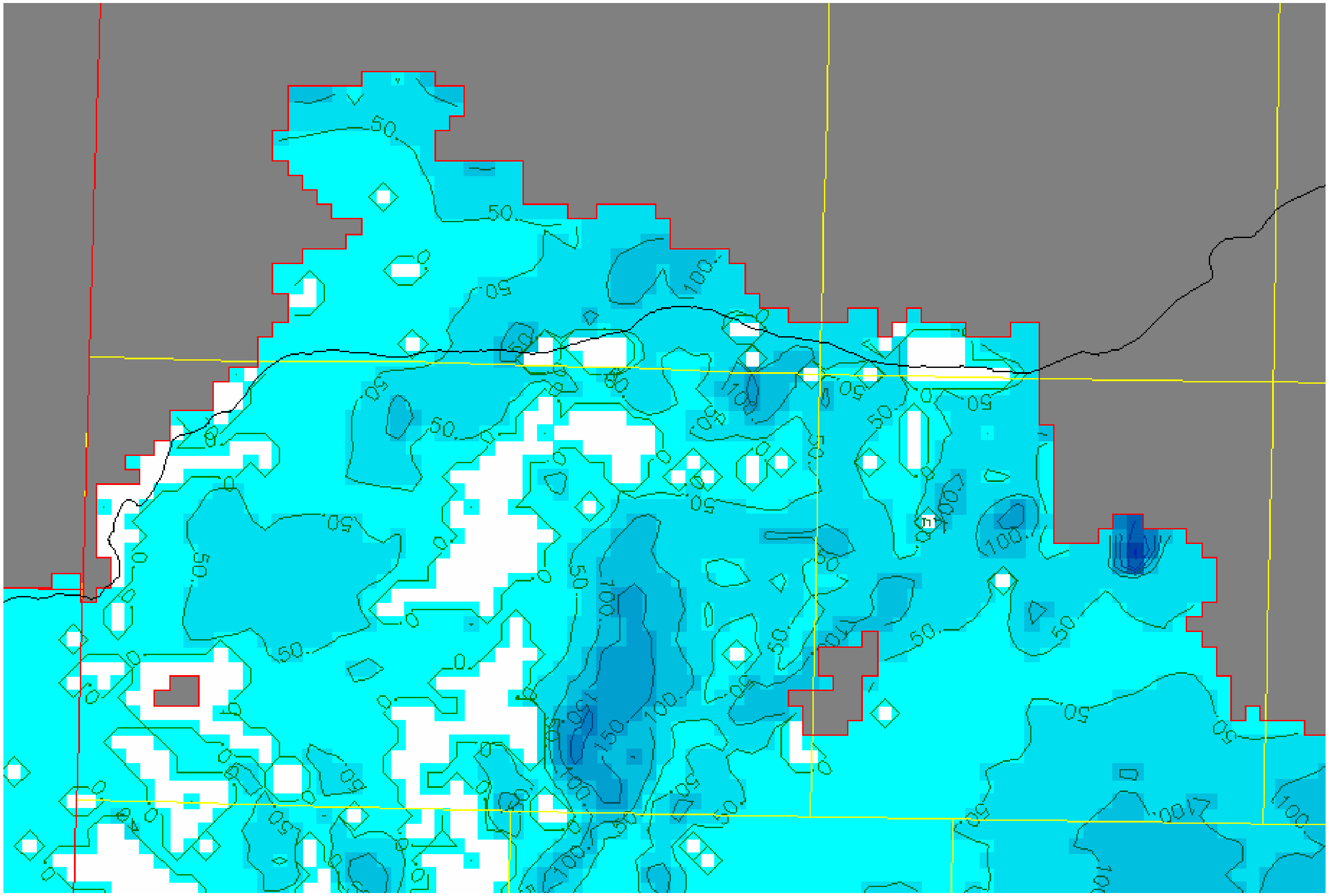

Figure 7: Northern Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2010. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

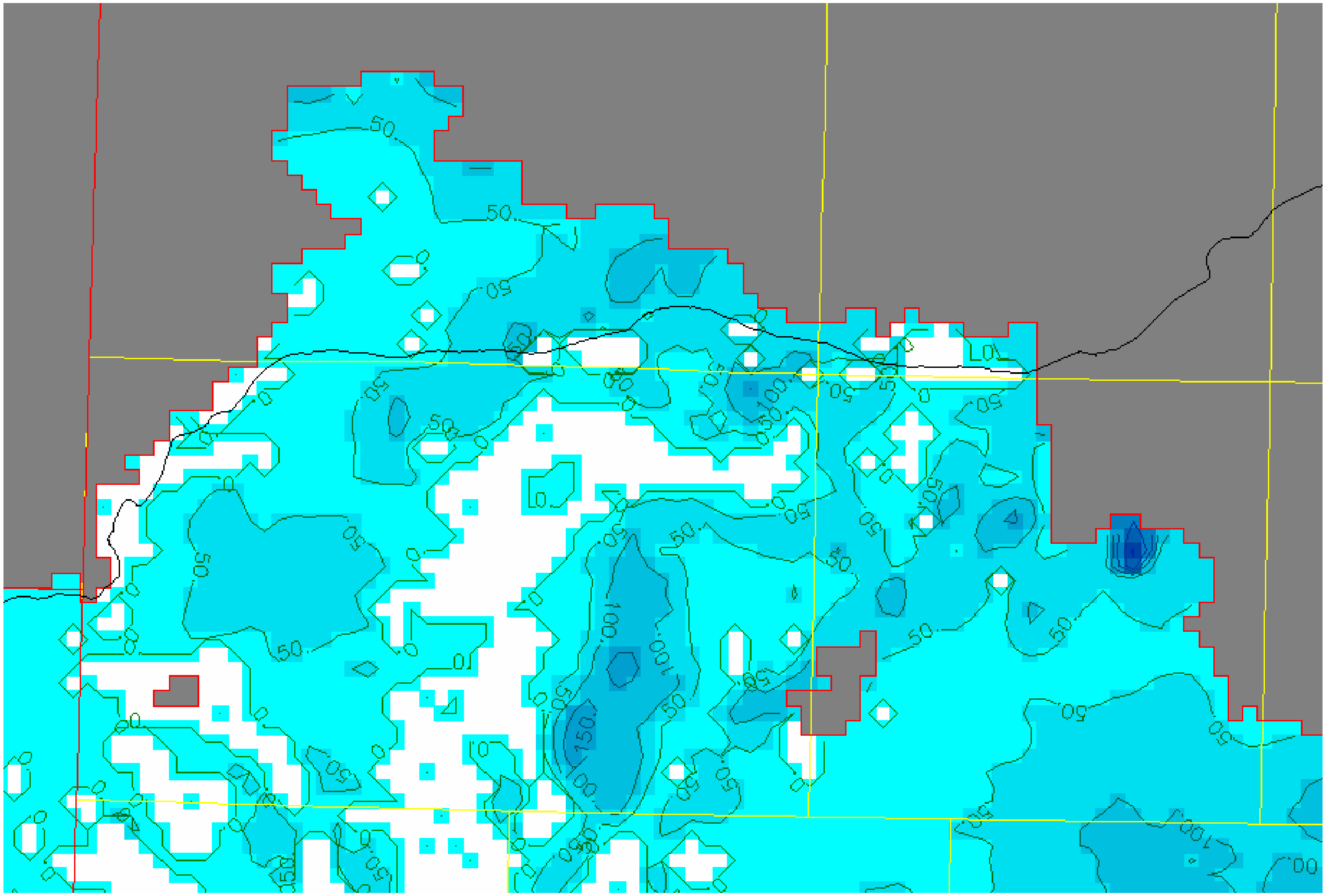

Figure 8: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2020. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

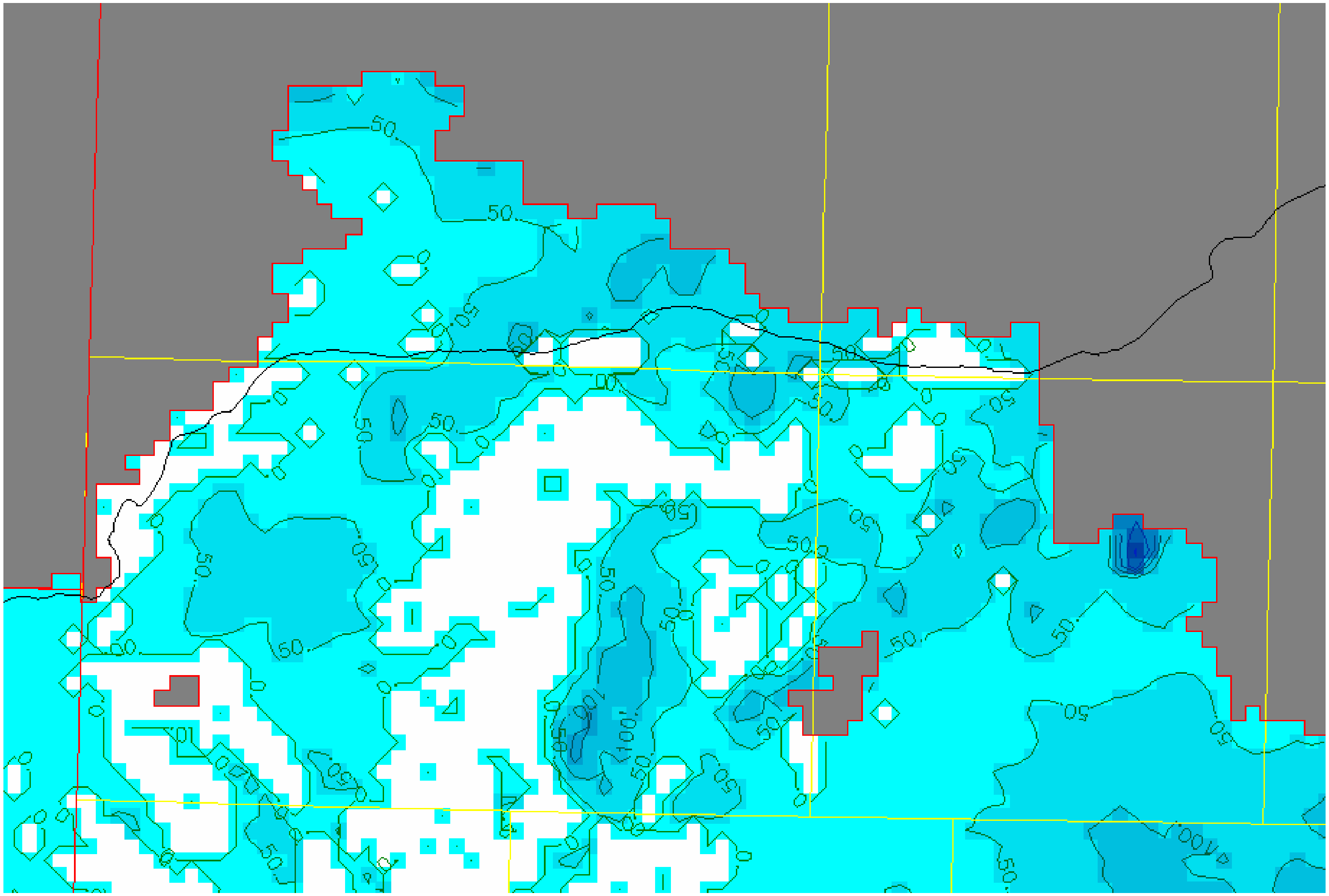

Figure 9: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2030. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

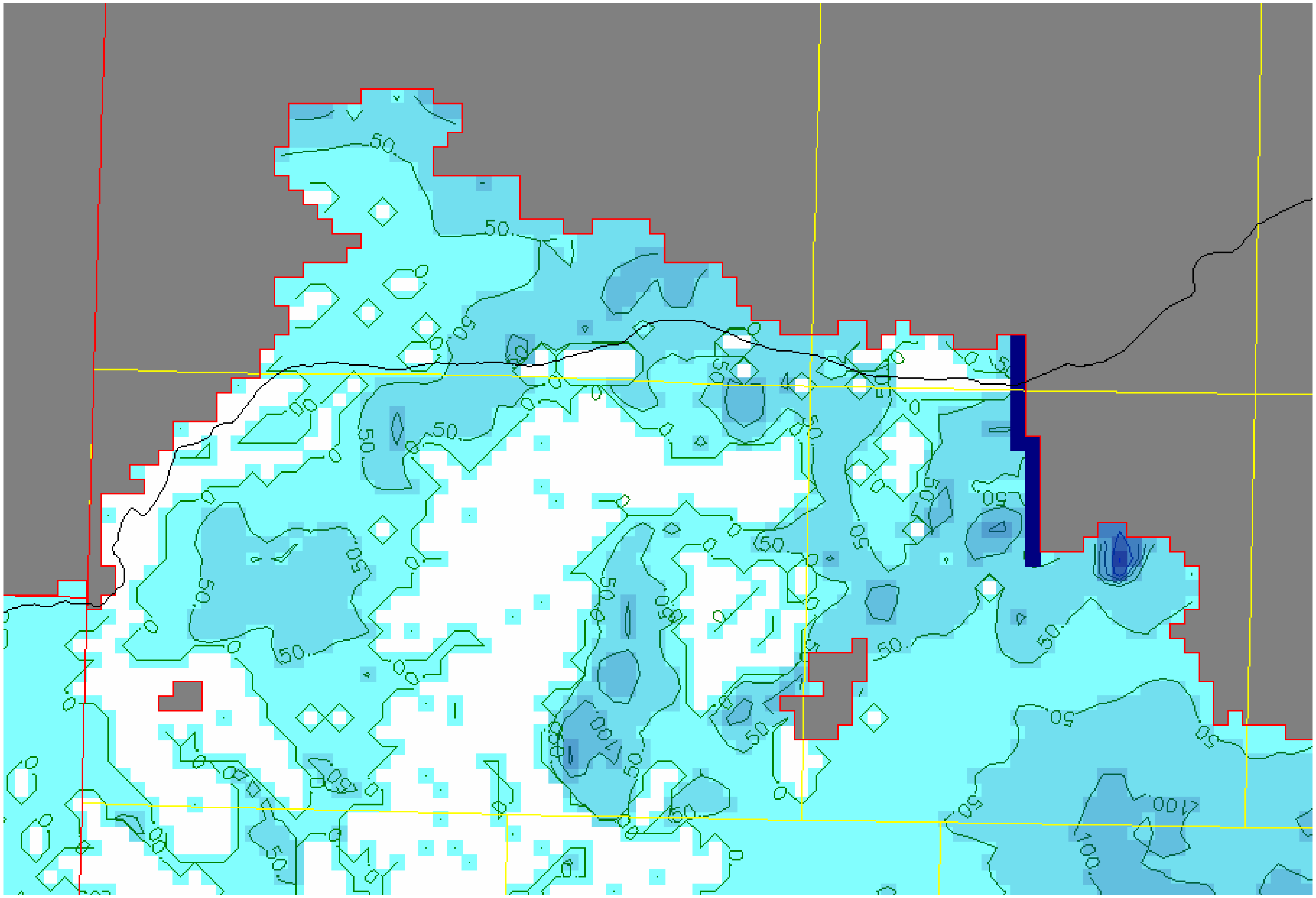

Figure 10: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2040. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

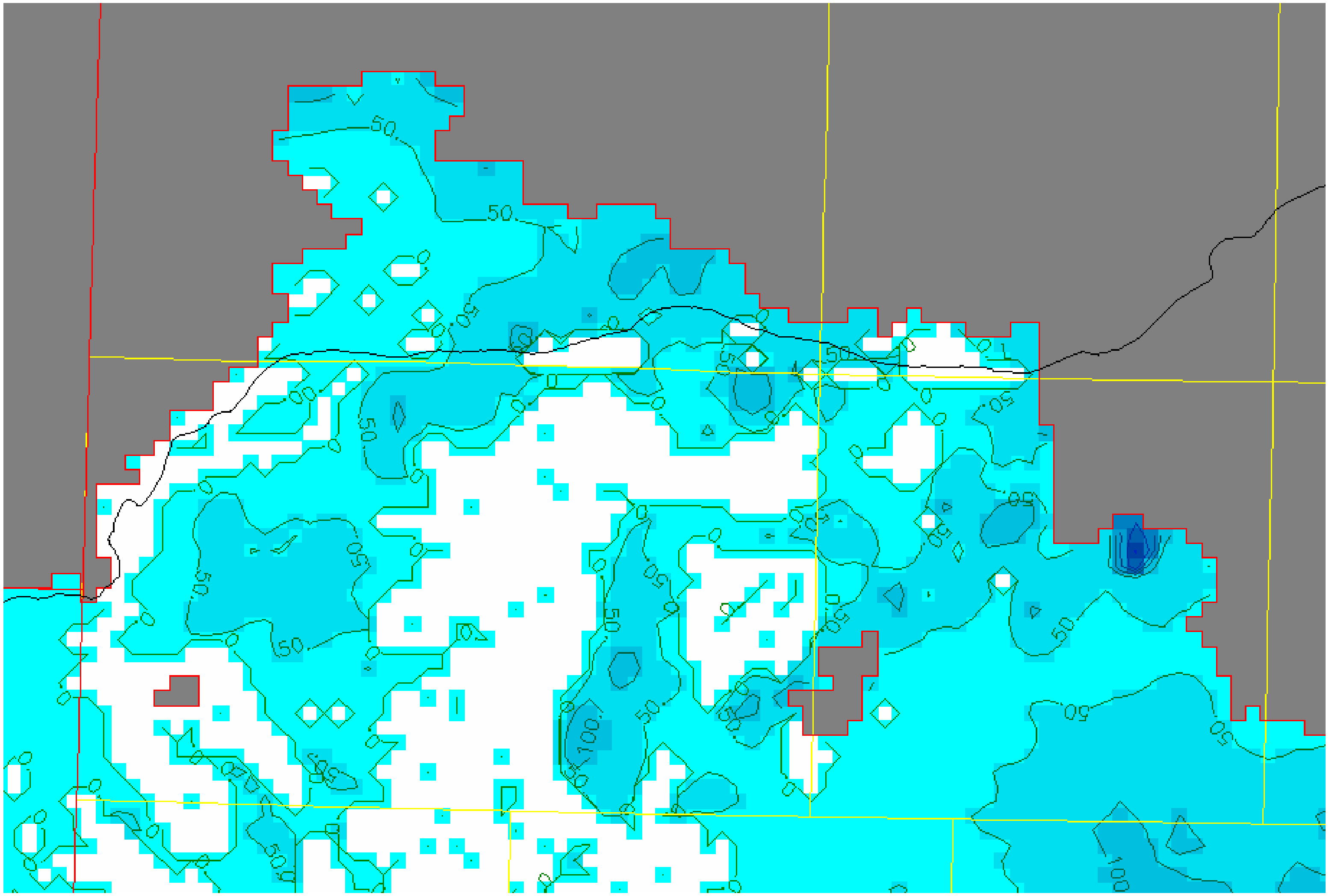

Figure 11: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2050. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.

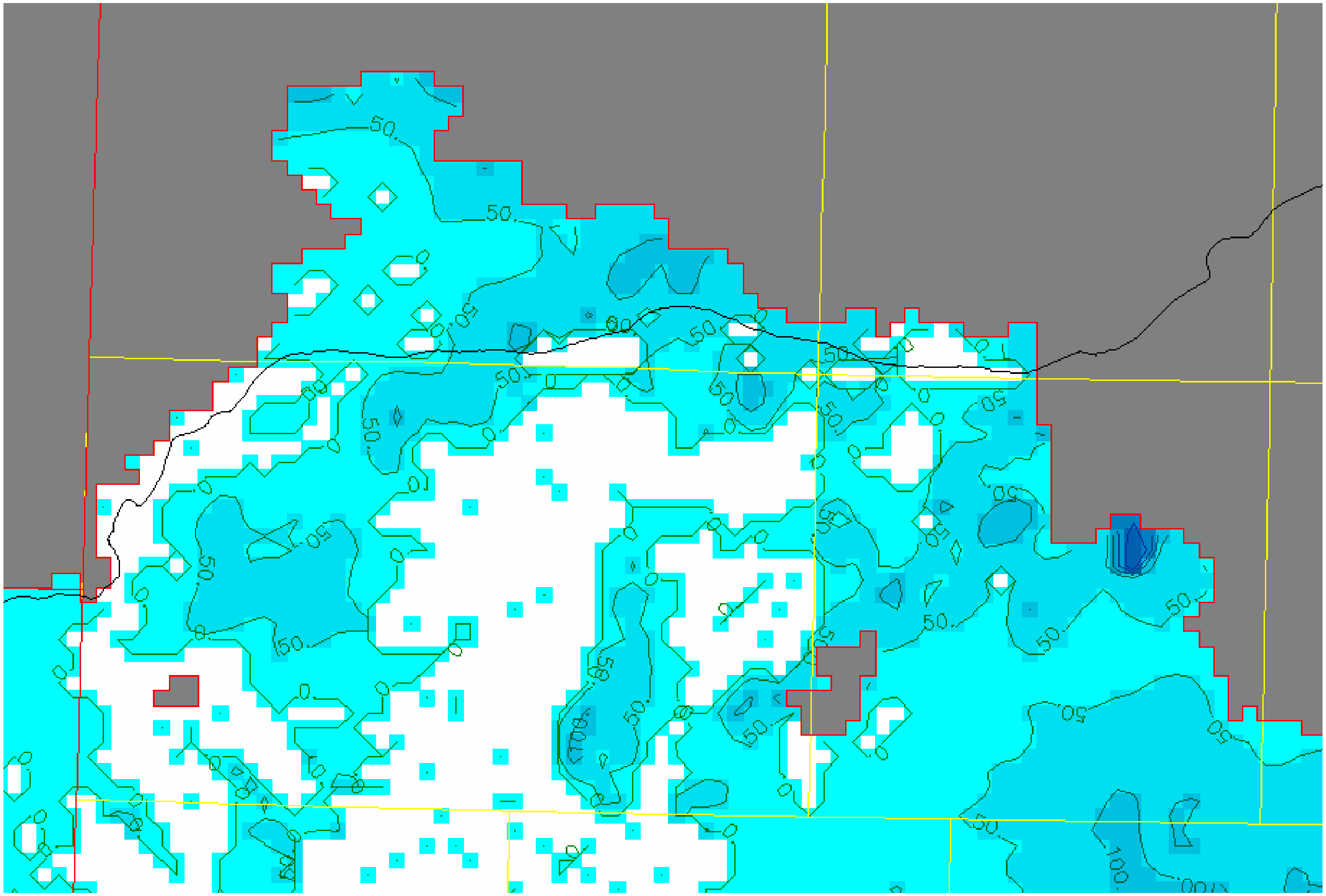

Figure 12: Simulated saturated thickness in feet of the Ogallala aquifer in Oldham, Potter, Deaf Smith, and Randall counties for 2060. North is at the top of the map, and county boundaries are shown in yellow. Inactive cells are in dark gray, and dry cells are white.