Saturated Thickness Maps for GWMD#4, Northwestern Kansas, Using the Average 1980-82 Water Table

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"Saturated Thickness Maps for GWMD#4, Northwestern Kansas,

Using the Average 1980-82 Water Table"

The attached maps were compiled for Groundwater Management District #4 in northwestern Kansas. The Appendix contains a listing of computer files used to plot the maps. The primary objective of the project was to update the 1979 saturated thickness map of the Ogallala Formation made for the District by the Kansas Geological Survey.

Water Level Data

The 1979 saturated thickness map was made by using water-level data obtained during the winter of 1979. The updated maps were made by averaging the 1980, 1981, and 1982 water levels. 437 water level data points were used to arrive at an average water table. The averaging had the effect of smoothing abberations in the water table that may only show up during one year. Where data for all three years was available, all three measurements were averaged. If only two measurements were available, two were used. If only one measurement was available, one was used. Some areas on the edge of and within the District do not have sufficient observation wells to define the water table (and therefore, the saturated thickness) to the accuracy desired by the District. In these cases, the water table was estimated using data gathered during previous studies. Areas in which water-level data were estimated in order to achieve a reasonable water table were a total of 21 points in Cheyenne County (T1S, R37, 39W, T2S, R37, 38, 39W, and T3S, R40), Rawlins County (T1S, R34, 35, 36W), and in Sherman County (T9S, R37W, T10S, R38 W). Thirty pre-development water levels in Sheridan County (T8, 9, 10S, R26W) were used to calculate saturated thickness. After the data points were reviewed and put into a data file, they were machine contoured using the

SURFACE II contouring package developed at the Kansas Geological Survey. Specifications for contouring these data points are:

1) grid spacing of .5 miles
2) 5-foot contour interval for water table contouring
3) height of value posting is .075 inch on the bedrock maps and .1 inch on the water table and saturated thickness maps

In the case of Rawlins, Sherman, Cheyenne, and Wallace counties, pre-development water-table data were used and a reasonable amount of decline was assumed before using the values. In Sheridan County, no decline was assumed and the values were used directly. In general areas within the District where there are two or more observation wells per township, machine contouring was found to be very similar to hand contouring. That is, machine contoured maps and hand contoured maps produced the same results. However, in areas where observation wells are generally lacking or where the shape of the water table changes rapidly, machine contouring is inaccurate. Areas where this takes place are generally on the edges of the District along the northern and southern boundaries. Graham County has several examples. Townships 6 and 7 south, Ranges 21-25 west generally have enough data to form an accurate water table. The alluvium in the valley of the South Fork of the Solomon River Valley in Township 8 south, Ranges 21-25 west has sufficient observation wells to define the water table, but the alluvium is generally not connected hydrologically to the Ogallala to the north or south of the Valley.

When water-level data from the Ogallala and alluvium was used to machine contour the area, the contours were "exaggerated" in going from the Ogallala to the alluvium. So, data in the Solomon River Valley were deleted in order to make the contouring in the Ogallala more accurate. This resulted in an artificial sink hole or depression in the water table contours in Township 8

south, Ranges 25 and 26 west. Therefore, saturated thickness in this area was not calculated by using the 1980-82 average water table. The saturated thickness was calculated by using a 1950 pre-development water table because there were more data points available to better define the water table.

The depression or sink hole in southern Graham County, Township 10 south, Ranges 24 and 25 west is also an artificial feature made by the contouring program.

Bedrock Data

Cretaceous shales form a relatively impermeable bedrock base for the Ogallala aquifer in northwestern Kansas. Data points to define the bedrock are from logs of wells drilled in the area. The data points used in the 1980-82 update maps are generally the same ones used in the 1979 report. New data were available in Graham County, so, where possible, new data was used there to form a better bedrock map.

Bedrock data for both reports are derived from a number of sources:

1) bedrock data from previous geologic and hydrologic reports where wells were field checked
2) logs of test holes drilled by the Kansas Geological Survey and the U.S. Geological Survey
3) logs of seismic shot holes
4) logs of wells drilled since the passage of the Water Well Drillers Licensing Act in 1975

The quality of the data is generally good. Where possible, each data point has been field checked or cross-checked with another source in order to verify its altitude or location.

Saturated Thickness

The saturated thickness map is a derivative of the water-table map and the bedrock map. It was compiled by using two types of data. One is the saturated thickness data from 416 observation wells in the area. Saturated thickness at these data points is actually measured. Since a saturated thickness map based on these points would be too generalized, supplemental derived data were used. The supplemental data was derived by overlaying the water table and bedrock maps. Wherever there was a bedrock data point, a water table elevation was estimated from the water table contour map and the bedrock value subtracted from it. This provided a total of 3316 data points. After all the data points were calculated, they were put on tape, machine plotted on the map base and manually contoured. As expected, the contours for the 1980-82 saturated thickness map looked very similar to the 1979 saturated map. No major changes have taken place but many areas show a decline and a number of anomalies have occurred. A number of data points in the District show an increase in saturated thickness between 1979 and 1980-82. A possible reason for this is that the water table actually rose from one set of measurements to the next. What was actually found to have taken place was that a few 1979 measurements were abnormally low for some reason. Averaging the 1980-82 water levels produced a more normal water level which was higher than the 1979 reading and therefore indicated a rise in this area. This happened in several cases, but the rises were generally no more than a few feet and generally did not affect the contouring.

Some areas of the District were difficult to get an accurate saturated thickness. One was the small area in southwestern Thomas County and southeastern Sherman County (T10S, R36-37W). Available bedrock data in this area indicates a generally northwest to southeast trending erosional channel

cut into the bedrock and filled with Ogallala sediments. There are a number of irrigation wells in this area, but bedrock data is lacking on many of them. Not enough water-level measurements to accurately show the water-table contours are available for this area; therefore, saturated thickness in this area is based on estimates. Another area difficult to show accurately is in Cheyenne County (T8 and 9S, R42W). Again, some bedrock data is available and irrigation wells exist, but few observation wells exist to produce an accurate water table. Saturated thickness was estimated for this area using available data and some drillers' logs.

Graham County in general is a problem area. Not enough quality bedrock data are available so the contours are generalized taking into account the data available.

The contour interval on the saturated thickness map is 25 feet. However, the contouring generally starts at 50 feet and increases. A 25-foot contour and a 0-contour were not generally drawn because the areas that have the least saturated thickness have few observation wells and therefore an accurate water table is hard to portray. The southern edge of the District in northern Wallace, Logan, and Gove counties is a good example. Bedrock data is available in this area, but an accurate water table is difficult to construct. Therefore, very few 0- or 25-foot saturated thickness contours are shown on the map.

Summary

In spite of all the previous caveats with regard to water table, bedrock, and saturated thickness data, the published products can be considered to be of high quality. The proposed observation well location revisions of the groundwater observation well program should help considerably in defining the water table in areas where data is lacking. This will help in making a more accurate saturated thickness map for the District.

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GMD4NW.SECT.C:	Section Corners
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GMD4NW.TR.TTL.C
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GMD4NW.MAP.TTL.C
GMD4NW.CNTY.TTL.C
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GMD4NW.CREDIT.C
GMD4NW.SAT.CONT.SUB.TTL.C:
Sub-Title for Saturated Thickness Contour
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Legend Box for Saturated Thickness Contour

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GMD4NW.HYD.TTL.C
GMD4NW.MAP.TTL.C
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GMD4NW.CREDIT.C
GMD4NW.SAT.POST.SUB.TTL.C:
Sub-Title for Saturated Thickness Posting
GMD4NW.SAT.POST.LEG.C: Legend Box for Saturated Thickness Posting
GMD4NW.SAT.POSTPLOT.NW: Saturated Thickness Values Posting

NE QUADRANT

1. BEDROCK MAP:

GMD4NE.AQ.C:	Ogallala Boundary
GMD4NE.TR.C:	Township Range Boundary
GMD4NE.GMD.C:	District Boundary
GMD4NE.HYD.C:	Streams
GMD4NE.CNTY.C:	County Boundary
GMD4NE.SECT.C:	Section Corners
GMD4NE.TR.TTL.C:	Township Range Title
GMD4NE.HYD.TTL.C:	Stream Names
GMD4NE.MAP.TTL.C:	Main Title & Scale Bar
GMD4NE.CNTY.TTL.C:	County Names
GMD4NE.BDR.C:	Neat Line
GMD4NE.CREDIT.C:	Credit Box
GMD4NE.BDR.SUB.TTL.C:	Sub-Title for Bedrock
GMD4NE.BDR.LEG.C:	Legend Box for Bedrock

GMD4.BDR_125.EX3.POSTPLOT.NE:
Bedrock Elevation Posting

2. WATER TABLE MAP:

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GMD4NE.GMD.C
GMD4NE.HYD.C
GMD4NE.CNTY.C
GMD4NE.SECT.C
GMD4NE.TR.TTL.C
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GMD4NE.MAP.TTL.C
GMD4NE.CNTY.TTL.C
GMD4NE.BDR.C
GMD4NE.CREDIT.C

GMD4NE.WT.SUB.TTL.C:	Sub-Title for Water Table
GMD4NE.WT.LEG.C:	Legend Box for Water Table

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GMD4NE.GMD.C
GMD4NE.HYD.C
GMD4NE.CNTY.C
GMD4NE.SECT.C
GMD4NE.TR.TTL.C
GMD4NE.HYD.TTL.C
GMD4NE.MAP.TTL.C
GMD4NE.CNTY.TTL.C
GMD4NE.BDR.C
GMD4NE.CREDIT.C
GMD4NE.SAT.CONT.SUB.TTL.C:
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GMD4SW.AQ.C:	Ogallala Boundary
GMD4SW.TR.C:	Township Range Boundary
GMD4SW.GMD.C:	District Boundary
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GMD4SW.MAP.TTL.C:	Main Title & Scale Bar
GMD4SW.CNTY.TTL.C:	County Names
GMD4SW.BDR.C:	Neat Line
GMD4SW.CREDIT.C:	Credit Box
GMD4SW.BDR.SUB.TTL.C:	Sub-Title for Bedrock
GMD4SW.BDR.LEG.C:	Legend Box for Bedrock

GMD4.BDR_125.EX3.POSTPLOT.SW:
Bedrock Elevation Posting

2. WATER TABLE MAP:

GMD4SW.AQ.C	
GMD4SW.TR.C	
GMD4SW.GMD.C	
GMD4SW.HYD.C	
GMD4SW.CNTY.C	
GMD4SW.SECT.C	
GMD4SW.TR.TTL.C	
GMD4SW.HYD.TTL.C	
GMD4SW.MAP.TTL.C	
GMD4SW.CNTY.TTL.C	
GMD4SW.BDR.C	
GMD4SW.CREDIT.C	
GMD4SW.WT.SUB.TTL.C:	Sub-Title for Water Table
GMD4SW.WT.LEG.C:	Legend Box for Water Table

GMD4.AVG_125.EX3.POSTPLOT.SW:
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GMD4.AVG_125.EX3.PLOTFILE.SW:
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GMD4SW.HYD.C
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GMD4SW.HYD.C
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GMD4SE.BDR.SUB.TTL.C:	Sub-Title for Bedrock
GMD4SE.BDR.LEG.C:	Legend Box for Bedrock

GMD4.BDR_125.EX3.POSTPLOT.SE:
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2. WATER TABLE MAP:

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GMD4SE.GMD.C	
GMD4SE.HYD.C	
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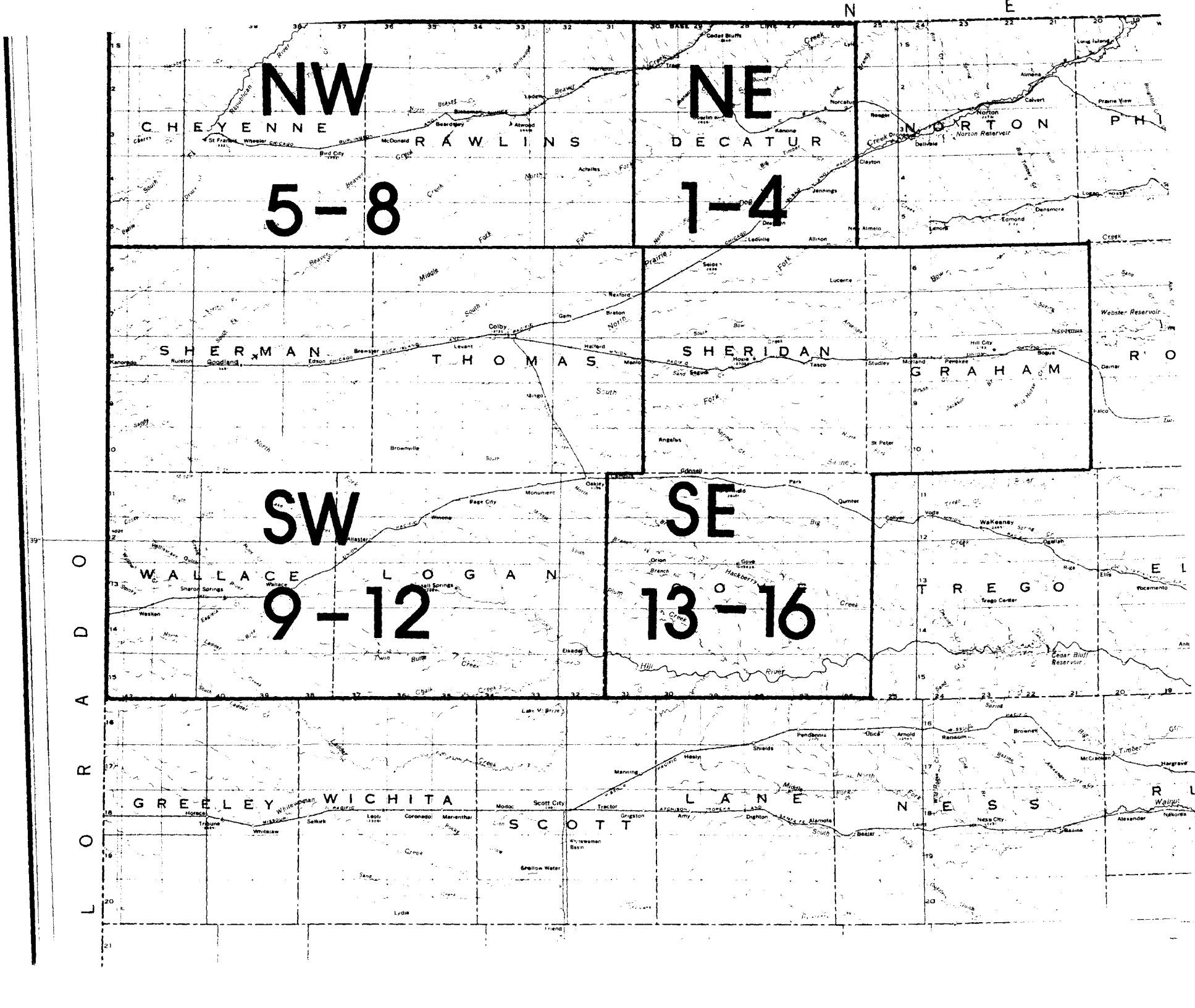
Kansas Geological Survey Open-File Report 83-19, "Saturated Thickness Maps for GWMD#4, Northwestern Kansas, Using the Average 1980-82 Water Table"

The 16 maps contained in this report are divided into quadrants, not individual counties. The attached map indicates the appropriate numbers of the maps covering the quadrants. Each map is priced at $2.00 per sheet, or may be purchased as a set for $14.00 each. Please mail your order to the attention of the Publication Sales Department.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