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Evaluating the Hydrogeology of Meade County, Kansas, Using Vertical Variability Methods and Numerical Modeling

by

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Golden, Colorado

Date 10/27/88

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ABSTRACT

Meade County, in southwestern Kansas, is underlain by a part of the central High Plains aquifer. Bedrock configuration, and hence saturated thickness of the aquifer, is controlled by evaporite dissolution in Permian strata underlying the aquifer. Vertical variability analysis, a numerical technique where the center of distribution of hydraulic conductivity is calculated for wells or test holes based on driller's lithologic logs, was used to determine if vertical components of flow within the aquifer are significant. The predevelopment (1940) potentiometric surface in Meade County was then simulated with the McDonald-Harbaugh computer model, and sensitivity of the model to variations in hydraulic conductivity and recharge rate was examined.

Results of the vertical variability analysis indicate that vertical components of flow are negligible, and that a two-dimensional flow system exists in the aquifer, allowing use of vertically-averaged, thickness-weighted estimates of hydraulic conductivity. Zones of relatively large hydraulic conductivity, which are controlled by pre-existing fracture zones (lineaments), were identified; which may provide favorable sites for water wells. The computer simulation, which accounted for inflow at study area boundaries, recharge by precipitation, outflow at study area boundaries, and discharge to perennial streams, was calibrated to a maximum head difference (residual) of approximately ± 18 feet (5.5 meters) with a mass-balance discrepancy of 0.01 percent. Aquifer discharge to streams was compared with published streamflow data. Sensitivity analysis results indicate that the model was more sensitive to variations in hydraulic conductivity than to variations in recharge rate. Greater confidence is placed in hydraulic conductivity estimates than recharge rate estimates because hydraulic conductivity estimates are based on experience in Meade County and adjoining areas whereas recharge rates are based on estimation techniques such as water budget methods and numerical modeling.

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Foremost, I am indebted to my wife Rebecca for her spiritual support and cheerfulness during minor crises, and to my daughter Erica for her smile when it was most needed.

Chapter 1
INTRODUCTION

The High Plains aquifer, comprised predominantly of unconsolidated Tertiary and Quaternary deposits, underlies 174,050 square miles (mi) (450,790 square kilometers (km); Gutentag and others, 1984) in parts of South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico, and Texas (Fig. 1). The aquifer is the primary source of water for agricultural, municipal, industrial, and domestic use throughout much of this area. An understanding of the occurrence and nature of flow of ground water within the High Plains aquifer is necessary for effective water-use management.

1.1 Purpose

The major objectives of this study were:

1) To collect and integrate hydrogeologic data for a part of the High Plains aquifer located in Meade County, Kansas;
2) To evaluate the effectiveness of the vertical variability (VV) analysis technique (Gutentag and others, 1984; Kolm and others, in press) for analyzing the ground-water flow system in the study

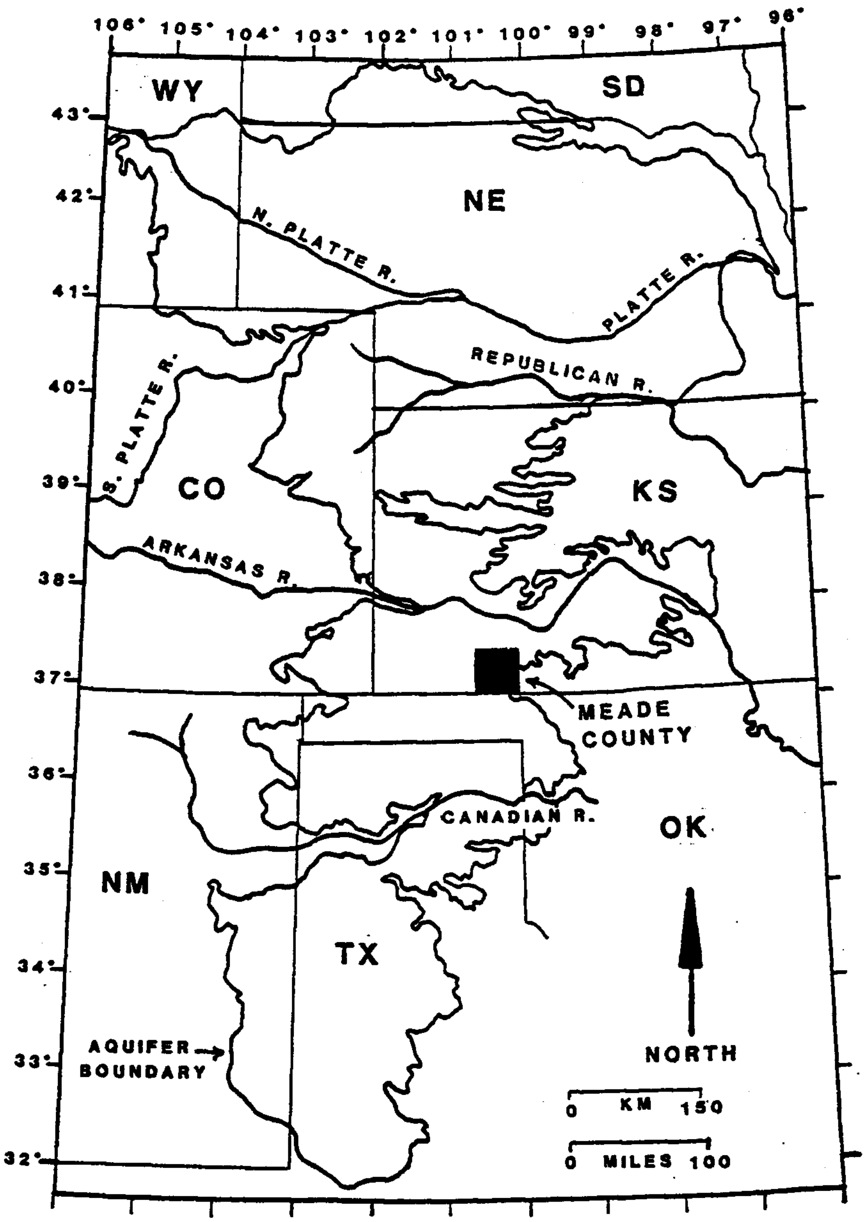

Figure 1 -- Position of Meade County, Kansas, in High Plains aquifer (after Gutentag and others, 1984).

area and for choosing model configurations;

3) To simulate steady-state, predevelopment (1940) ground-water flow conditions in the High Plains aquifer in Meade County, Kansas, using a personal computer; and

4) To evaluate the sensitivity of the calibrated computer model to variations in hydraulic conductivity and recharge.

Data compiled in this report may serve as a basis for future studies in the area, including computer simulation of transient flow conditions, and usage of vertical variability methods to solve other ground-water flow problems.

1.2 Location and Physiography

Meade County, Kansas, is located approximately 80 miles (129 km) east of the southwest corner of the state, just north of the Kansas-Oklahoma state boundary (Fig. 2). The county comprises an area of about 974 mi^2 (2523 km^2) and lies between 37^o, 0' and 37^o, 29' north latitude and 100^o, 4' and 100^o, 36' west longitude.

Meade County, located within the High Plains and Plains Border sections of the Great Plains physiographic province (Fenneman, 1931), is characterized by gently

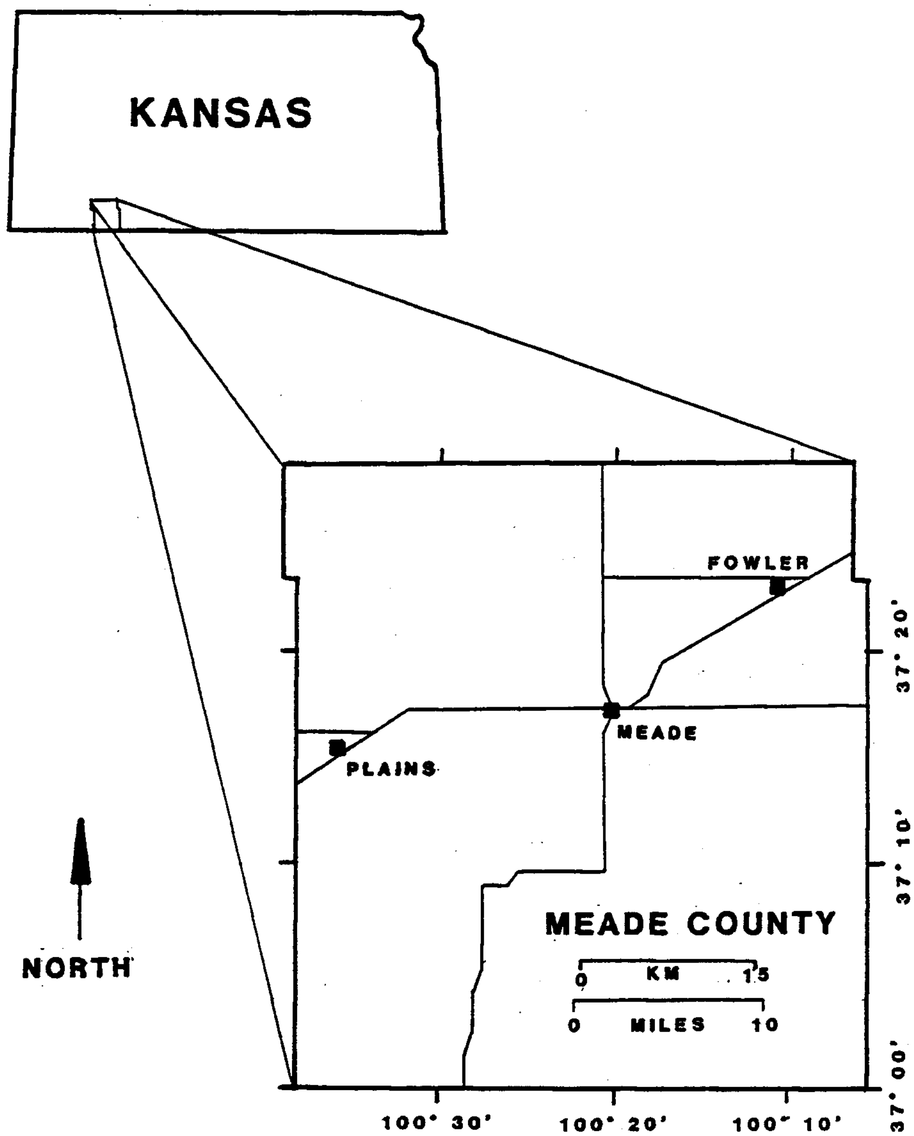

Figure 2 -- Location of Meade County in Kansas.

sloping to undulating upland surfaces dissected locally by small, ephemeral drainages. These drainages, when flowing, appear to headwardly erode top soil. Larger, more steeply sided valleys exist along the perennial Crooked Creek and Cimarron River (Fig. 3) where resistant bedrock is exposed locally. Overall, the land surface slopes from an elevation of 2800 feet (853 m) in the northwest corner to 2100 feet (640 m) in the southeast corner of the county resulting in a total relief of 700 feet (213 m). The average slope from northwest to southeast is about 16 feet per mile (3.0 m/km). The Crooked Creek-Fowler fault (solution front) is characterized as a prominent topographic rise in the central and south-central parts of the county (Fig. 3).

Vegetative cover in Meade County consists mainly of native grasses and pasture land with cultivated areas of wheat, milo, sorghum, and hay. Cottonwood trees and other phreatophytes are abundant along perennial drainages and some ground-water discharge areas.

The county population was 5,522 in 1940 (Frye, 1942); however, this figure has declined to 4,677 in 1987 (Meade County Clerk, interview, 21 March 1988). Many of the county's inhabitants reside in the towns of Fowler, Plains, and Meade, the county seat (Fig 3). The local economy is

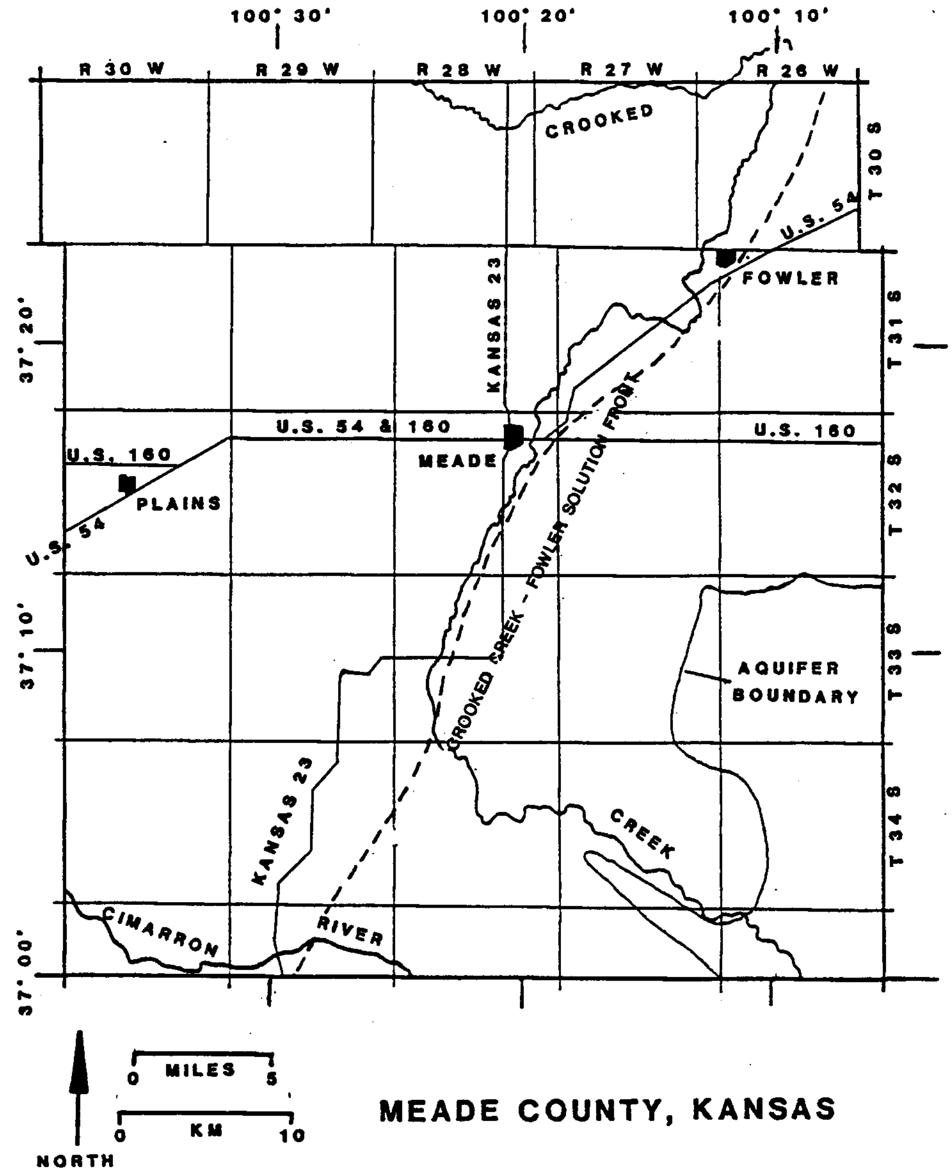

Figure 3 -- Locations of cultural, geologic, and hydrologic features in Meade County, Kansas.

based on agriculture and petroleum production.

1.3 Previous Work

Haworth (1896; 1897), one of the earliest workers in Meade County, studied both the deformation of strata and the occurrence of ground water. Frye (1942) provides a detailed investigation of the hydrogeology of the county, including surficial geologic, potentiometric, and depths-to-water maps. A regional study of the geology and hydrology of southwestern Kansas, including Meade County, was completed by Gutentag, Lobmeyer, and Slagle (1981). This work includes maps showing the configuration and geology of bedrock and the 1975 potentiometric surface.

The U.S Geological Survey (USGS) began a regional, 5-year study of the High Plains aquifer system in 1978 to assess the impacts of ground-water development (Weeks, 1978). Two of the reports produced by this project include Gutentag and others (1984), which addresses the general hydrogeology of the aquifer, and Luckey and others (1986), which presents results of a computer simulation of the hydrology of the High Plains aquifer system. Both papers contain data applicable to Meade County from a regional perspective.

1.4 Methods of Investigation

Hydrologic and geologic data pertinent to the project area were obtained from Federal, State, and local agencies. Hydrologic data consisted of precipitation maps, stream base-flow values, evapotranspiration rates, the locations and approximate flow rates of springs, configuration of the predevelopment (1940) potentiometric surface, and estimates of aquifer parameters such as hydraulic conductivity. Geologic data comprised areal structure and stratigraphy, bedrock surface configuration and geology, thickness, extent, and stratigraphy of water-bearing unconsolidated deposits, and properties and distribution of soil types.

The hydrologic and geologic data were interpreted through the use of vertical variability analysis (Chap. 4), contoured, and input into a modular, finite-difference ground-water flow model (McDonald and Harbaugh, 1984) for unconfined aquifer simulation. The model was calibrated for steady-state, predevelopment (1940) conditions by adjusting hydrologic parameters such as hydraulic conductivity, recharge, and leakage to streams. Calibration was achieved when the difference between potentiometric surfaces from computed and observed heads was minimized. Sensitivity of the calibrated model to hydraulic conductivity and recharge rate was analyzed.

Chapter 2

GEOLOGY

Meade County is underlain by 0 to about 500 feet (0 to 152 m) of unconsolidated deposits of Tertiary and Quaternary age. These surficial deposits are in turn underlain by bedrock units of Permian, Jurassic, and Cretaceous age. In this study, the term aquifer refers to the saturated, unconsolidated material overlying bedrock. Plate 1 shows the configuration of the bedrock surface in the study area and the approximate locations of structural features and contacts between bedrock units. Control points shown on Plate 1 are based on driller's lithologic logs (App. A) and unpublished data obtained from the Garden City, Kansas, office of the U. S. Geological Survey. A generalized stratigraphic section of Meade County is shown on Table 1.

2.1 Bedrock Units

Rocks of Permian age (290 to 230 million years before unconsolidated deposits in the study area and include, from oldest to youngest, the Blaine, Dog Creek, Whitehorse, Day Creek, and Big Basin formations. Permian strata range from 135 to 800 feet (41 to 244 m) in total thickness and

Table 1 -- Generalized stratigraphic section of Meade County, Kansas (after Gutentag, Lobmeyer, and Slagle, 1981).

System	Series	Strat. unit	Thickness (ft)	Physical character
Quaternary	Pleistocene	Alluvium	0-80	Stream-laid deposits ranging from silt and clay to sand and gravel that occur along principal stream valleys.
		Dune sand	0-75	Fine to medium quartzose sand with minor clay, silt, and coarse sand formed into mounds and ridges by the wind.
		Loess	0-45	Silt with minor very fine sand and clay deposited as windblown dust.
		Undiff. deposits	0-550	Sand, gravel, silt, clay, and caliche overlie Ogallala Fm. when both are present; composite of fluvial and eolian deposits.
Tertiary	Miocene	Ogallala Formation	0-500	Poorly-sorted silt, sand, and gravel; generally calcareous; when cemented by calcium carbonate, forms caliche or mortar beds.
Cretaceous	Lower Cretaceous	Undiff. rocks	0-450	Dakota Fm.: brown to gray fine to med.-grained sandstone with shale and lignite interbeds. Kiowa Fm.: gray to black shale with interbedded yellow and brown sandstone Cheyenne Sandstone: gray and brown very fine- to med.-grained sandstone interbedded with dark shale.

(continued)

Table 1 -- (continued)

System	Series	Strat. unit	Thickness (ft)	Physical character
Jurassic	Upper Jurassic	Undiff. rocks	0-350	Dark-gray shale interbedded with green calcareous shale; contains thin silty sandstone and limestone beds in the basal portion.
Permian	Upper Permian	Big Basin Formation	0-160	Brick to maroon siltstone and shale; contains very fine-grained sandstone.
		Day Creek Dolomite	0-80	White to pink anhydrite and gypsum with interbedded dark red shale.
		Whitehorse Formation	100-350	Red to maroon fine-grained silty sandstone, siltstone, and shale.
	Lower Permian	Dog Creek Formation	15-60	Maroon silty shale, siltstone, very fine sandstone, and thin layers of dolomite and gypsum.
		Blaine Formation	20-150	Generally consists of four gypsum and anhydrite beds separated by red shale; locally contains bedded halite.

generally comprise red, silty sandstones, siltstones, and shales with interbeds of gypsum, halite, and anhydrite. Thinning of these evaporitic interbeds by ground-water dissolution is a major mechanism for structural development in southwestern Kansas (Gutentag, Lobmeyer, and Slagle, 1981).

Unconformably overlying the Permian strata locally are undifferentiated units of Late Jurassic age (150 to 135 mybp). These rocks generally consist of dark grey and green calcareous shales and vary from 0 to 350 feet (0 to 107 m) in thickness.

Strata of Lower Cretaceous age (135 to 100 mybp) overly Jurassic units in the northern part of the study area. These units include, from oldest to youngest, the Cheyenne Sandstone, Kiowa, and Dakota formations. Lower Cretaceous rocks generally consist of 0 to 450 feet (0 to 137 m) of brown to gray, fine- to medium-grained sandstone with interbeds of varicolored shale.

2.2 Unconsolidated Units

Deposits of Tertiary age (65 to 2 mybp) and younger in Meade County are generally unconsolidated. The Ogallala Formation, deposited in the Miocene Epoch (26 to 12 mybp; Gutentag and others, 1984), and overlying fluvial and eolian deposits form the principal water-bearing unit in the High Plains aquifer in southwestern Kansas (Gutentag, Lobmeyer, and Slagle, 1981). In the study area, the Ogallala Formation ranges from 0 to approximately 500 feet (0 to 152 m) in thickness and generally comprises cross-stratified silts, sands, and gravels (Figs. 4 and 5) deposited by streams; the source area of these sediments was the Rocky Mountains to the west (Gutentag and others, 1984). Dense, hard, white to grey sand and gravel layers (mortar beds) are present locally where material has been cemented with calcium carbonate.

Pleistocene- to Holocene-aged deposits (2 mypb to present) overly the Ogallala Formation locally. Deposits of dune sand and loess generally lie above the water table in Meade County. Where present, dune sand locally may facilitate recharge to the aquifer (Gutentag, Lobmeyer, and Slagle, 1981). Alluvium along major drainages, such as the Cimarron River, generally is in hydraulic connection with the underlying aquifer. Alluvial deposits comprise sands and gravels with a silty to clayey matrix ranging in thickness from 0 to 80 feet (0 to 24 m).

Soils mantling the study area are predominantly silty to sandy loams, but include clays, silts, and relatively clean dune sands. Hydraulic conductivities range from less

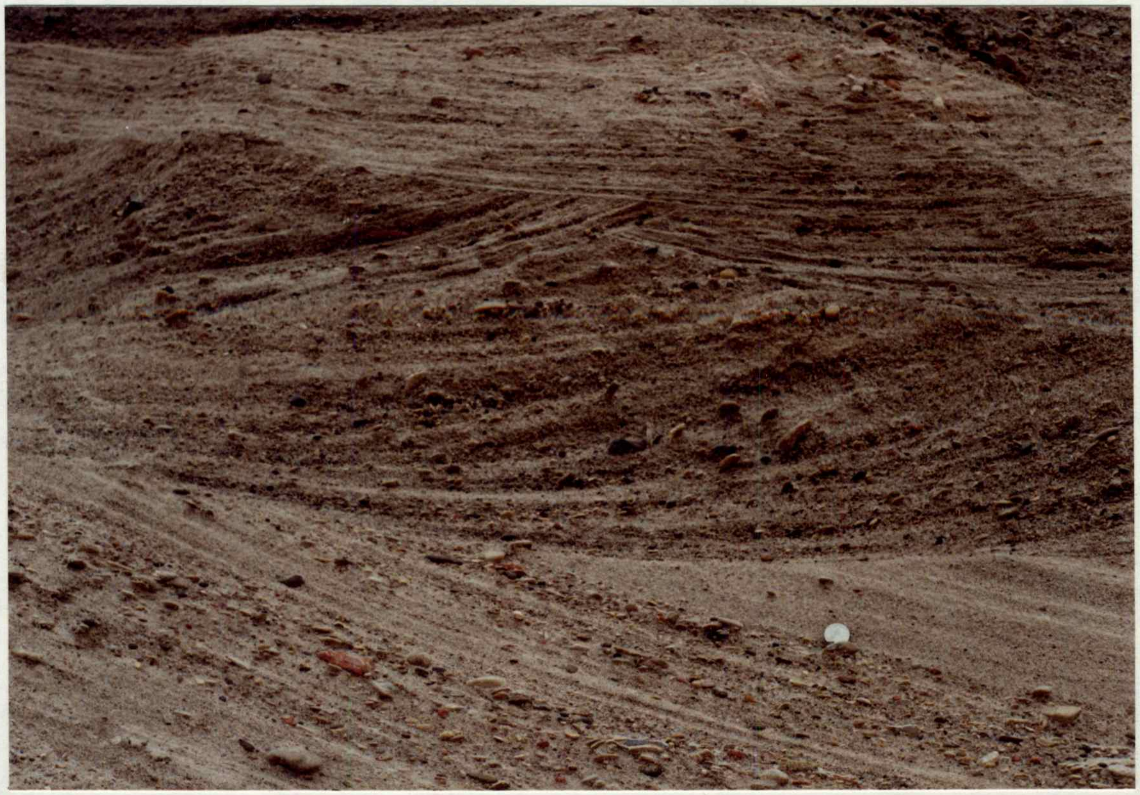

Figure 4 -- Cross-stratification in the Ogallala Formation at the Meade County gravel pit (sec. 20, T.33S, R.28W).

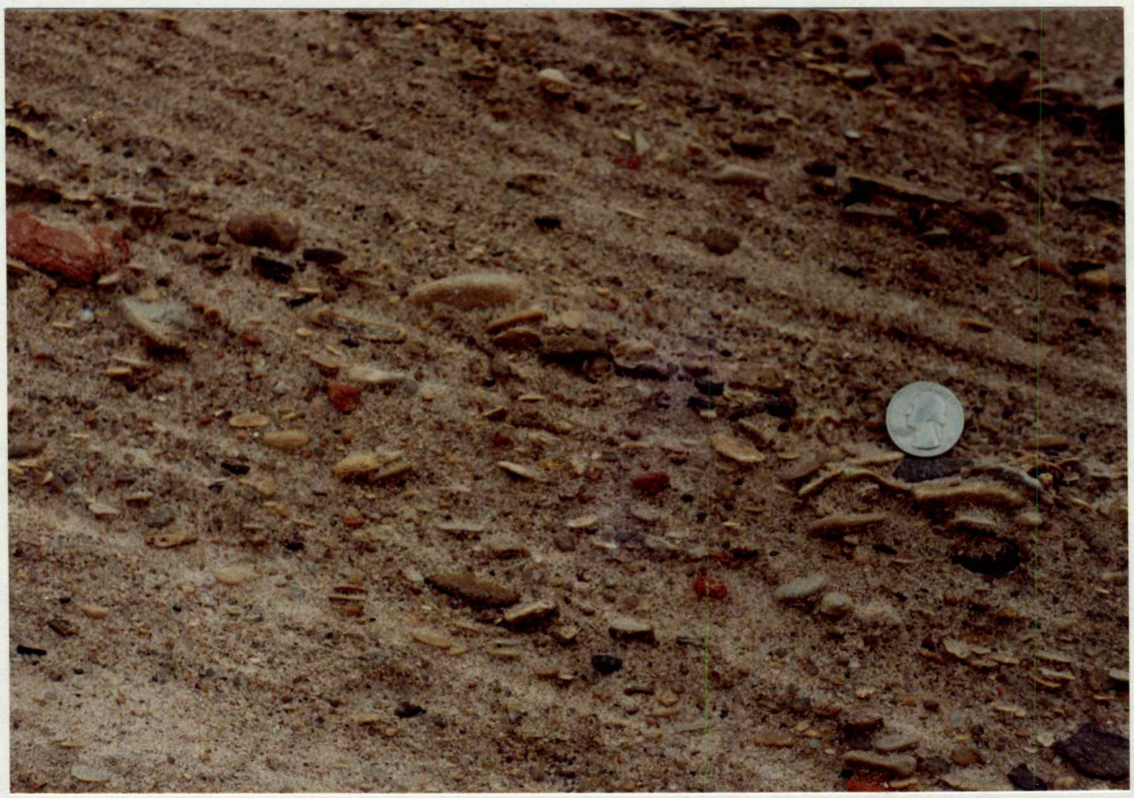

Figure 5 -- Sands and gravels comprising the Ogallala Formation at the Meade County gravel pit (sec. 20, T.33S, R.28W).

than 0.06 to 20.0 inches/hour (in./hr) (4.23 X 10^{-5} to 1.41 X 10^{-2} centimeters/second (cm/sec); Tomasu, 1977). The majority of soils (silty to sandy loams) have permeabilities in the range of 0.2 to 2.0 in./hr (1.41 X 10^{-4} to 1.41 X 10^{-3} cm/sec).

2.3 Structure

The major structural feature in Meade County is the Crooked Creek-Fowler fault (Gutentag, Lobmeyer, and Slagle, 1981), which will be referred to as the Crooked Creek-Fowler retreating solution front (Fig. 3; Pl.1) since this feature has migrated nearly six miles to the southeast in the last one million years (E. D. Gutentag, interview, 28 August, 1988). The migration rate was estimated using stream salinity measurements and estimation of volume of evaporite dissolved. The solution front strikes approximately N 30^{o} E in the study area and shows normal displacement down to the west of up to 250 feet (76 m; Gutentag, Lobmeyer, and Slagle, 1981). The dominant mechanism for movement along this feature is believed to be the solution of Permian evaporite beds by ground water. Formation of the Crooked Creek-Fowler solution front has resulted in a relatively thick sequence of unconsolidated deposits to the front's northwest (downthrown side) which thins to its southeast (upthrown side). The Crooked Creek-Fowler solution front controls local drainage; Crooked Creek parallels the front on its downthrown side throughout most of Meade County.

Sinkholes are other structural phenomena in the study area resulting from evaporite dissolution. Some of these sinkhole features are recent, such as the Meade salt sink (Fig. 6). Older sinks may exist in the subsurface which are infilled with younger loose material (Gutentag and others, 1984), locally thickening the unconsolidated deposits.

Fracture zones (lineaments) in bedrock formations underlying the aquifer in Meade County may have influenced the courses of ancient and modern streams. Such control of surface drainage during deposition of the Ogallala Formation and overlying younger deposits could have resulted in the formation of linear zones of coarse material (sand and gravel) with relatively large hydraulic conductivities.

Structural control of the thickness of surficial deposits affects correspondingly the saturated thickness of the aquifer in the study area. In addition, tilted and disrupted bedding in surficial deposits along the margins of dissolution and collapse features probably decreases locally the effective hydraulic conductivity of aquifer

Figure 6 -- Meade salt sink, located 1.5 miles (2.4 kilometers) south of Meade, Kansas.

materials (Luckey and others, 1986). Tilted Ogallala Formation beds exist along the perimeter of a large sink near Saint Jacob's Well in Clark County, east of the study area (Fig. 7). The hydrogeology of Meade County may therefore be partially controlled by structural phenomena resulting from evaporite dissolution.

Figure 7 -- Tilted mortar beds in the Ogallala Formation along the margin of a large sinkhole near Saint Jacob's Well, Clark County, Kansas.

Chapter 3
HYDROLOGY

The 1940 potentiometric surface in Meade County (Pl. 2) is assumed to represent equilibrium between recharge by infiltration, inflow from areas to the north and west, outflow to areas to the south and east and at the natural aquifer boundary to the southeast, and leakage to Crooked Creek and the Cimarron River. General ground-water flow paths can be characterized as trending S 60° E.

3.1 Recharge

The primary source of recharge to the aquifer in the study area is infiltration of water from rain and snowfall (Frye, 1942). Annual precipitation ranges from approximately 18.5 in. (467 millimeters (mm)) in the western part of the county to nearly 20.0 in. (508 mm) in the east (Fig. 8). The majority of precipitation, however, returns to the atmosphere by direct evapotranspiration. Mean annual pan evaporation in Meade County exceeds 90 in. (2286 mm; Fig. 8). Soil moisture deficiency and runoff to streams also decrease the amount of water infiltrating to the aquifer.

Various estimates have been made concerning the

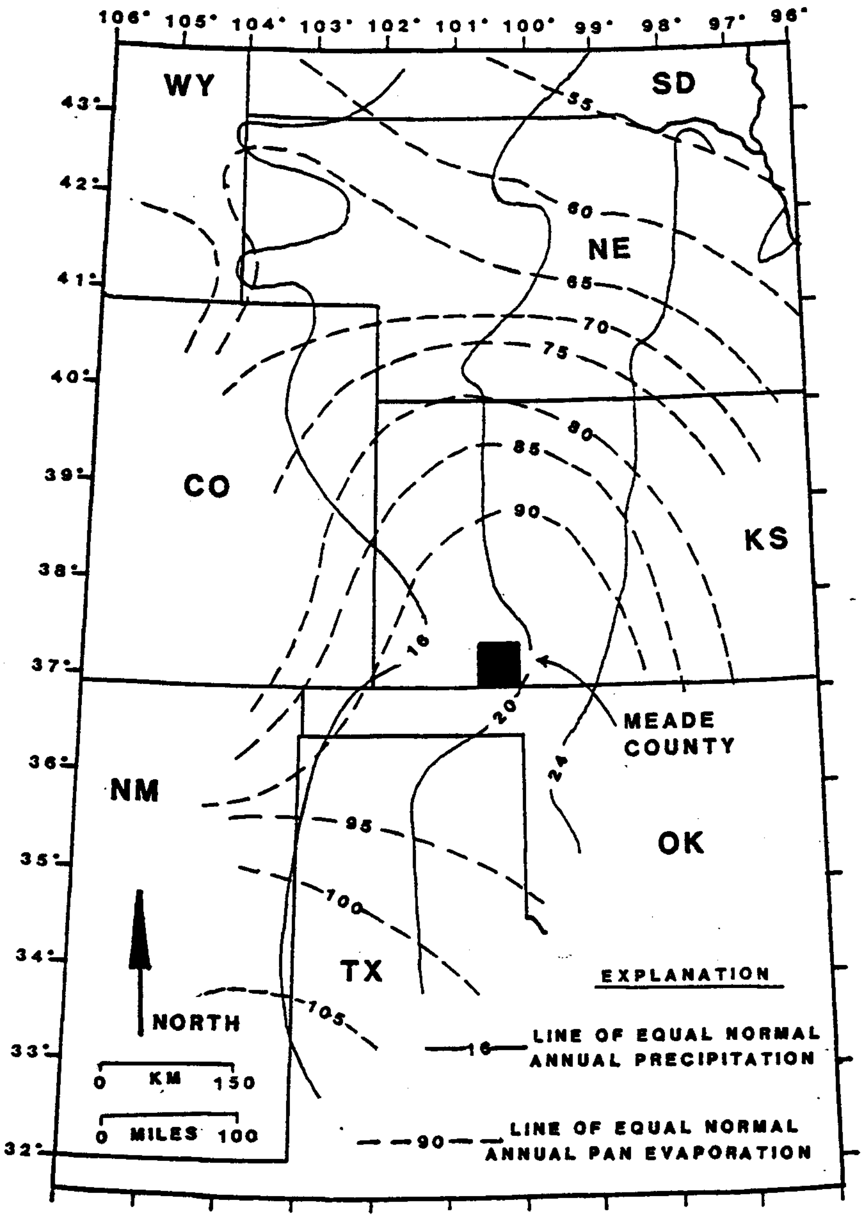

Figure 8 -- Distribution of normal annual rainfall and Class A pan evaporation in the High Plains (after Gutentag and others, 1984).

percentage of annual precipitation recharging the aquifer in southwestern Kansas: (1) Fader and others (1964) estimated 2 percent in Grant and Stanton counties using the water-budget method; (2) Meyer, Gutentag, and Lobmeyer (1970) estimated 8 percent (1940-52 wet period; water-budget method) and 0.3 percent (long-term; from well hydrographs) in Finney County; (3) Gutentag and Stullken (1976) estimated 1 percent in Lane and Scott counties using the water budget method for dryland areas; and (4) Sophocleous (1980) estimated 3 percent in a computer-model analysis of the Pawnee River valley. Barker, Dunlap, and Sauer (1983) estimated 11 percent using a computer simulation of the Arkansas River valley and adjoining sand hills.

3.2 Discharge

Except for areas near aquifer boundaries, discharge by evapotranspiration from the High Plains aquifer in southwestern Kansas is negligible because the water table is generally too far below the land surface (Gutentag, Lobmeyer, and Slagle, 1981). Withdrawal of ground water by pumping wells was negligible prior to the late 1940's. However, well withdrawals are currently the source of greatest discharge (Gutentag, Lobmeyer, and Slagle, 1981).

Some aquifer discharge occurs at the aquifer boundary in southeastern Meade County in the form of springs, seeps, and evapotranspiration.

A major source of ground-water discharge in the study area is leakage to Crooked Creek and the Cimarron River. These streams are perennial, indicating that the aquifer discharges water and sustains surface-water flow during periods of low precipitation. A 20-year average base flow (ground-water contribution) of 46.1 ft^3/sec (1.3 m^3/sec) has been estimated for the Cimarron River at Mocane, Oklahoma, downstream of the study area, for the period 1942-1962 (Busby and Armentrout, 1965), with base flow extremes of 100 and 4.8 ft^3/sec (2.8 and 0.1 m^3/sec). The 20-year average base flow of Crooked Creek at Nye, Kansas, is estimated to be 12.2 ft^3/s (0.4 m^3/sec) for the same time period (Busby and Armentrout, 1965), with base flow extremes of 74 and 0 ft^3/sec (2.1 and 0 m^3/sec). These estimates are based on separation of total flow into direct runoff and base flow components using analysis of discharge hydrographs. Gutentag, Lobmeyer, and Slagle (1981) report the measured November, 1974 discharge of the Cimarron River at the Kansas Highway 23 bridge (Fig. 3) as 56.5 ft^3/sec. This measurement was made after a killing frost to minimize the effects of evapotranspiration on aquifer discharge to the river and during a period of negligible surface-water inflow.

3.3 Potentiometric Surface

The predevelopment (1940) potentiometric surface in Meade County (Pl. 2) was contoured from plotted head values published by Frye (1942); the Crooked Creek-Fowler solution front (fault), as located by Gutentag, Lobmeyer, and Slagle (1981) affected the potentiometric contours. The highest heads (greater than 2,660 ft (811 m)) occur in the northwest corner of the study area, and the lowest heads (less than 2,140 ft (652 m)) occur in the southeast corner of the study area at the natural aquifer boundary, indicating a regional southeasterly ground-water flow direction. The natural aquifer boundary was defined by overlaying potentiometric surface and bedrock configuration maps and delineating areas where bedrock elevations exceed heads.

Lower hydraulic gradients are observed in the northwestern part of the study area and higher hydraulic gradients are located near the Crooked Creek-Fowler solution front. This sharp increase in gradient may be attributed to abrupt changes in lateral lithologies by disrupted bedding adjacent to the front, and by decreases in saturated thickness or permeability from the downthrown to upthrown sides of the front. Down-gradient potentiometric contour deflections in the northeast and south-central portions of Meade County may indicate recharge in areas where dune sands are present (Frye, 1942). Where potentiometric contours cross Crooked Creek and the Cimarron River, upstream deflections indicate ground-water flow from the aquifer into the stream or stream banks. This discharged water either contributes to stream base flow or is evapotranspired to the atmosphere.

3.4 Saturated Thickness

Thickness of the unconsolidated deposits in Meade County, and therefore saturated thickness of the aquifer, is controlled largely by structural features such as the Crooked Creek-Fowler solution front, sink holes, and bedrock fracture zones (lineaments). Cross-section A-A' (Pl. 3) shows the greatest saturated thickness (approximately 380 feet (116 m)) on the northwest (downthrown) side of the front which decreases to zero on the southeast (upthrown) side of the front. Locally, infilled paleosinkholes may cause saturated thickness to exceed 400 feet (122 m).

3.5 Confined Conditions

There are several areas in Meade County where confined (artesian) ground water conditions prevail (Fig. 9). The Meade artesian basin, located in the northeastern area of the county, is the largest of these and has an areal extent of approximately 33 mi^2 (85 km^2). As depicted on cross-section B-B' (Pl. 3), a thick sequence of clay caps coarser saturated material in the Meade artesian natural discharge area along Crooked Creek adjacent to the Crooked Creek-Fowler solution front, creating confined conditions. Configuration of equipotential lines that indicate discharge on cross-section B-B' are based on well data published by Frye (1942). A thin, saturated sandy layer exists near the land surface above the confining clay cap. Artesian head beneath the clay cap is 5 to 15 feet (1.5 to 4.6 m) greater than the water table elevation of the sandy zone above the cap (Frye, 1942).

The confining clay cap in the Meade artesian basin probably was deposited in the bed of a Pleistocene lake. Frye (1942) cites evidence for the existence of this lake based on geomorphology. Analysis of well logs used in the current study (App. A) shows anomalously thick (80 to 150 feet; 24 to 46 m) blue clay deposits in the uppermost part of the unconsolidated aquifer in the Meade artesian

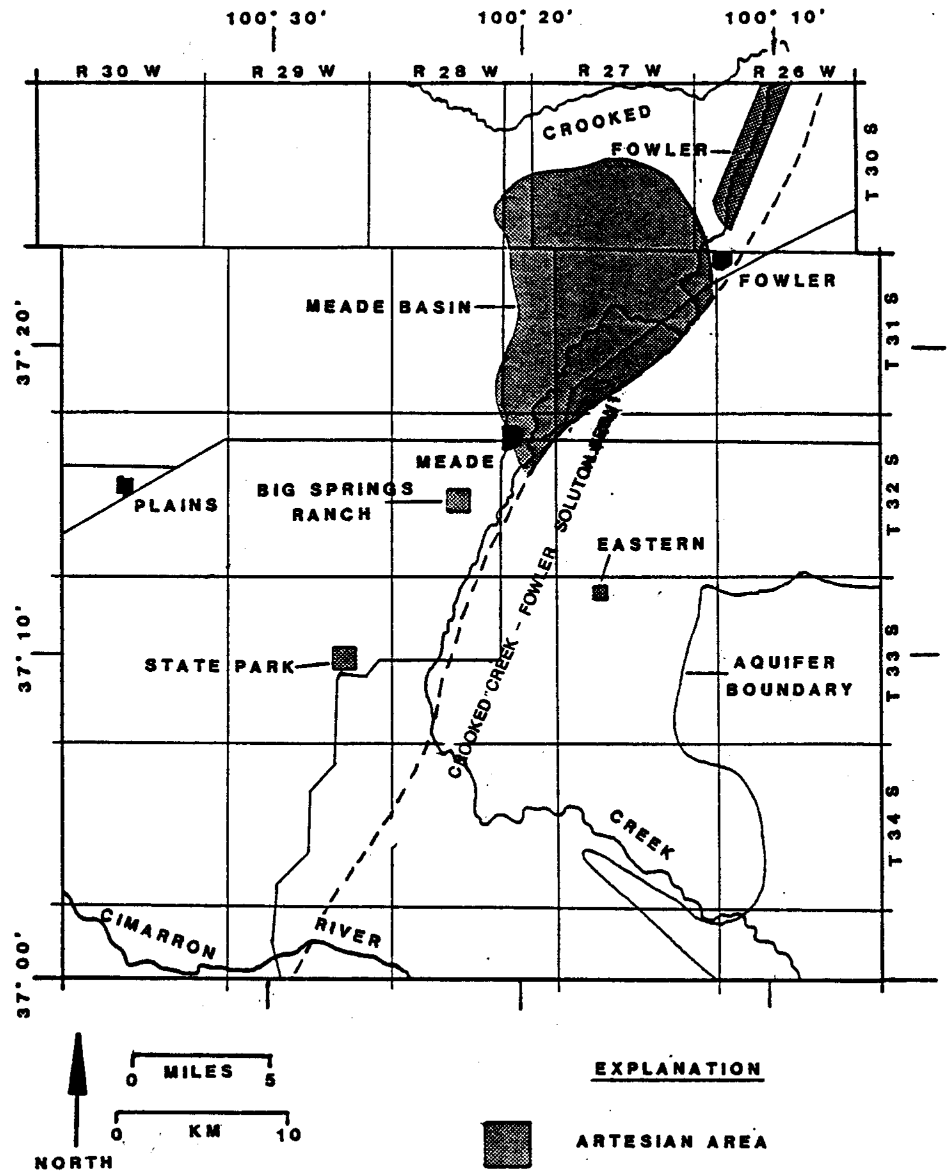

Figure 9 -- Artesian Areas in Meade County, Kansas.

basin. The blue color noted in well logs is consistent with anoxic conditions normally associated with lacustrine deposition.

Other areas with artesian ground water conditions in Meade County include the Fowler, State Park, Big Springs Ranch, and Eastern districts (Frye, 1942). With the exception of the Fowler district, these areas are each less than one square mile (2.6 km^2) in area. All of these areas were assumed negligibly small for the purposes of this study. Although many wells in these areas were flowing in 1940, large withdrawals by pumping wells in surrounding areas since that time have probably decreased artesian head such that some wells no longer flow. This is especially true in the State Park district where Meade Lake was formerly sustained in times of low precipitation by natural ground-water discharge upward through the lake bed. Reduction of artesian head by pumping wells located up-gradient has caused upward flow into the lake to cease, and water impounded in the lake now leaks downward through the lake bed to the underlying aquifer. Thus, completion of new wells in the vicinity of Meade Lake to augment its depletion may actually exacerbate its water loss.

Chapter 4

VERTICAL VARIABILITY ANALYSIS

The unconsolidated aquifer in Meade County is comprised predominantly of fluvially deposited layers of clay, silt, sand, and gravel. This layering causes vertical variations in hydrogeologic parameters, such as hydraulic conductivity and specific yield. Vertical variability (VV) analysis is a numerical method by which the first moment (center) of distribution of a given parameter within a vertical section of aquifer may be determined (Gutentag and others, 1984; Kolm and others, in press). A relative center of distribution (RCOD) of 0.5 indicates: (1) the parameter of interest is uniformly or randomly distributed throughout the column, and (2) the distribution of differing parameter values within the column may be accurately represented by a thickness-weighted average value. If the mean RCOD for a population of wells and test holes is not significantly different from 0.5, the formation may be considered lithologically homogeneous. For hydrologic parameters, use of thickness-weighted average values implies the existence of a horizontal, two-dimensional flow system where vertical components of flow are negligible.

Data necessary for VV analysis are driller's lithologic logs and estimates of hydrologic parameters for materials represented in the logs. The center of distribution (COD) of any parameter (P) can be calculated using the following formula:

$$COD(P) = \sum_{i=1}^{n} (P_i t_i M_i) / \sum_{i=1}^{n} (P_i t_i)$$

where:

P_i = the value of the parameter of interest for the i-th geologic unit.

t_i = thickness of the i-th geologic unit. The sum of individual layer thicknesses equals the saturated thickness of aquifer in a given well or test hole.

M_i = the distance (moment arm) from a reference point (usually the aquifer base) to the center of the i-th geologic unit.

The center of distribution has the dimension of length. It can be made dimensionless by dividing by the total thickness of the aquifer, giving the relative center of distribution (RCOD):

$$RCOD(P) = COD(P) \Big/ \sum_{i=1}^{n} t_i$$

The thickness-weighted average value for a parameter of interest (Pw) is given by the following equation:

$$Pw = \sum_{i=1}^{n} (P_i t_i) \Big/ \sum_{i=1}^{n} t_i$$

4.1 Data Acquisition and Reduction

Data used in the VV analysis of Meade County were acquired from water well contractors in southwestern Kansas and from the Garden City, Kansas office of the U.S. Geological Survey. A description of the well-numbering system used in locating wells and test holes and vertical variability data for 277 wells and test holes are presented in Appendix A.

Raw data were obtained in the form of driller's lithologic logs. Interpretation of the driller's nonmenclature was necessary to standardize unit descriptions for assigning hydraulic conductivity values. Because only steady state conditions were assumed for this study, specific yield distribution was not determined. Values of hydraulic conductivity assigned to various geologic units were based on Table 2. After hydraulic

Table 2 -- Hydraulic conductivity values assigned to lithologic descriptions of the aquifer in Meade County, Kansas (after Gutentag and others, 1984).

Driller's lithologic description	Vertical variability unit	Hydraulic conductivity (ft/day)	Hydraulic conductivity (cm/sec)
Caliche	CEMT SILT	10	3.53×10^{-3}
Clay	CLAY	5	1.76×10^{-3}
Limey clay	LIMY CLAY	10	3.53×10^{-3}
Clay and sandstone	CLSS	10	3.53×10^{-3}
Sandy clay	SDY CLAY	10	3.53×10^{-3}
Sandy clay, some gravel	SDGL CLAY	15	5.29×10^{-3}
Limestone	LIME	10	3.53×10^{-3}
Limestone and sand	LISD	30	1.06×10^{-2}
Clayey sand	CLY SAND	50	1.76×10^{-2}
Cemented sand	CEMT SAND	20	7.06×10^{-3}
Fine sand	FINE SAND	50	1.76×10^{-2}
Medium sand	MED SAND	80	2.82×10^{-2}
Fine to medium sand	FIME SAND	80	2.82×10^{-2}
Fine to medium coarse sand	FIMC SAND	80	2.82×10^{-2}
Coarse sand	CORS SAND	90	3.17×10^{-2}
Cemented sand and gravel	CEMT SDGL	30	1.06×10^{-2}
Clayey sand and gravel	CLY SDGL	100	3.53×10^{-2}
Sand and gravel	SDGL	160	5.64×10^{-2}
Sand and sandstone	SDSS	50	1.76×10^{-2}
Sandstone	SS	10	3.53×10^{-3}
Top soil	TOP SOIL	5	1.76×10^{-3}

conductivity values were assigned, RCODs of hydraulic conductivity for the saturated section in each well or test hole were computed manually (App. A).

4.2 Results

The mean RCOD of hydraulic conductivity for saturated sections of the 277 wells and test holes analyzed in Meade County is 0.46 with a standard deviation of 0.12. These values indicate that hydraulic conductivity is randomly distributed about a point located just below the center of the aquifer.

Because of the closeness of the computed mean RCOD of hydraulic conductivity to 0.5, ground-water flow in the study area is assumed to be horizontal and two-dimensional. The presence of two-dimensional flow conditions implies that hydraulic conductivity within the stratified aquifer may be represented accurately by thickness-weighted average values. Such values were computed for the saturated section in each of the 277 wells analyzed (App. A). Thickness-weighted hydraulic conductivity values (Kw) for the saturated section in each well or test hole were plotted on a base map of Meade County and contoured manually (Pl. 4). Kws ranged from 11 feet/day (ft/day; 0.0039 cm/sec) to 160 ft/day (0.056 cm/sec) with a mean of

64 ft/day (0.023 cm/sec). This value is close to the average value of 61 ft/day (0.022 cm/sec) initially estimated for the central High Plains aquifer (Luckey and others, 1986).

Chapter 5
MODEL SIMULATION

McDonald and Harbaugh (1984) developed a modular, finite-difference computer model for simulating two- or three-dimensional ground-water flow in unconfined, confined, or combination aquifers. The model is designed to simulate various natural recharge and discharge functions, such as boundary inflow, infiltration, leakage from and to rivers, evapotranspiration, and boundary outflow. In addition, the model can simulate artificial, transient stresses, such as extraction or injection wells, and flow into linear drain systems. The aquifer being modeled may be heterogeneous and anisotropic and have irregular boundaries. Output obtained from model simulation are hydraulic heads and, optionally, deviations (residuals) from initial head values.

5.1 Model Application

A conceptual model of the aquifer system in Meade County was developed. Data from this model were used in the computer simulation to produce the final model.

5.1.1 Conceptual Model. The conceptual model of the aquifer system in Meade County is based on analyses of aquifer characteristics discussed in chapters 2, 3, and 4. In summary, the aquifer system in the study area comprises unconsolidated deposits of the Miocene Ogallala Formation and overlying Pleistocene- to Holocene-aged fluvial and eolian deposits. Bedrock units of Permian, Late Jurassic, and Early Cretaceous age define the base of the aquifer. Recharge to the aquifer is primarily by infiltration of precipitation through the unsaturated zone to the underlying aquifer. Discharge from the aquifer occurs primarily by leakage to the Cimarron River and Crooked Creek and in the form of springs, seeps, and evapotranspiration at the natural aquifer boundary in the southeastern part of the county. Evapotranspiration from the aquifer in areas distant from natural aquifer boundaries is assumed negligible because of the generally great depth to the water table below the land surface. Because the predevelopment (1940) water table was simulated, the effects of withdrawal by pumping wells was assumed negligible, and the aquifer was assumed to be in a steady-state condition.

Vertical components of ground-water flow were assumed to be small compared to horizontal components based on the results of the VV analysis (Chap. 4), therefore two-dimensional flow conditions were assumed in Meade County. Unconfined, isotropic aquifer conditions were assumed, except for the 33 mi^2 (85 km^2) area of the Meade artesian basin where confined conditions are observed.

5.1.2 <u>Data Preparation</u>. Four maps were prepared or used to display the following: (1) configuration of the bedrock surface and structural features (Pl.1); (2) 1940 potentiometric surface (Pl. 2); (3) precipitation (Fig. 8); and (4) hydraulic conductivity (Pl. 4). Except for precipitation, each map consisted of point values that were contoured manually at selected intervals. An average value of each parameter was estimated from these contoured maps for each block in the computer model grid. These average parameter values were used as initial input to the computer model.

5.1.3 <u>Grid Orientation and Geometry</u>. The direction of maximum ground-water flow gradient (transmissivity tensor) in Meade County, determined from Pl. 2, is generally S 60° E. The Crooked Creek-Fowler solution front is oriented approximately N 30° E - S 30° W, perpendicular to the regional ground-water flow direction. The block-centered, finite-difference computer model grid was oriented to coincide with these directions. Model grid orientation and geometry are shown on Fig. 10.

Three nodal sizes were established (Fig. 10): 2 X 2 miles (3.2 X 3.2 km) in the northwestern part of the study area where gradients are gentle, 2 X 1.5 miles (3.2 X 2.4 km) where gradients steepen near the Crooked Creek-Fowler solution front and in the southeastern part of the study area, and 2 X 1 miles (3.2 X 1.6 km) in the vicinity of the front where gradients are steepest and transmissivity is relatively small. In all cases the short dimension of a given block was oriented parallel to the regional flow direction (transmissivity tensor) and perpendicular to the Crooked Creek-Fowler solution front. Nodal change ratios along the S 60^{o} E flow direction are less than or equal to 1.5 to avoid large truncation errors and convergence problems (Trescott, Pinder, and Larson, 1976).

5.1.4 Boundaries, Recharge, and River Leakage. Forty-one constant-head nodes were located around the area of study to simulate the regional southeasterly ground-water flow direction (Fig. 10). Ground-water inflow occurs along the western and northern boundaries of Meade County, and outflow occurs along the eastern and southern boundaries.

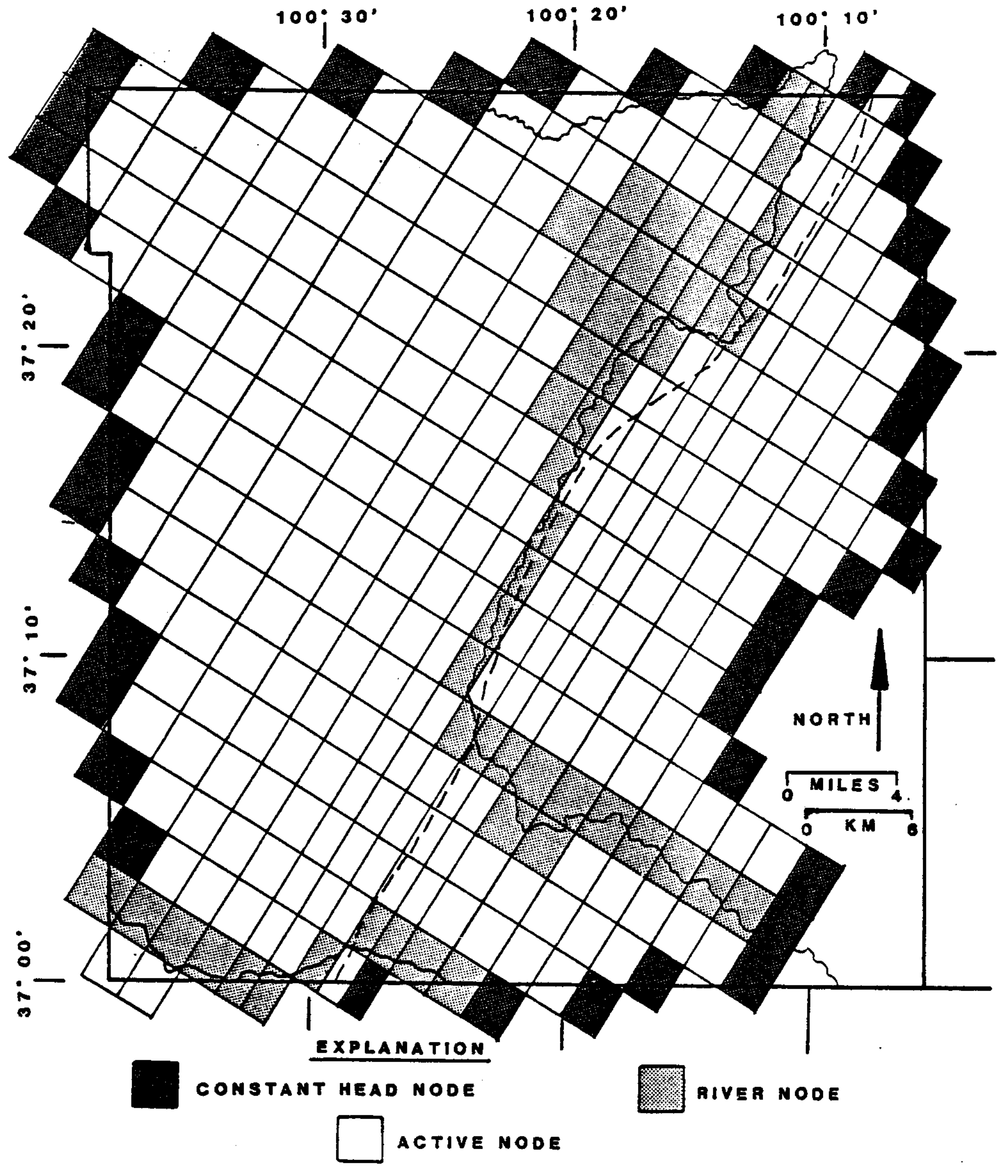

Figure 10 -- Computer-model grid orientation and location of constant-head and river nodes used in the aquifer simulation of Meade County, Kansas.

Constant-head nodes were also used to simulate natural discharge to springs and seeps at the geologically-defined aquifer boundary in the southeastern part of the study area (Pl. 2).

Annual recharge to the aquifer system was estimated initially to be 1 percent of the precipitation (Gutentag and Stullken, 1976) . Recharge values of 0.185 in./yr (4.70 mm/yr) were estimated for nodes on the western boundary of the study area, and increased incrementally to 0.200 in./yr (5.08 mm/yr) for nodes on the eastern boundary. These estimates are net recharge rates and account for evapotranspiration of precipitation during times of infiltration to the water table. Variations in soil permeability and the effects on infiltration rates were assumed to be small.

Average nodal stages (heads) for the Cimarron River and Crooked Creek were determined from USGS 7.5 minute topographic maps. Because upland surfaces in the areas drained by these streams are mantled with silt and sand, bed material was assigned a hydraulic conductivity of approximately 0.8 ft/day (2.8×10^{-5} cm/sec), a typical value for silty sand (U.S. Bureau of Reclamation, 1977; Freeze and Cherry, 1979). Bed material thickness for the Cimarron River and Crooked Creek was assumed to be 10 feet.

Ground-water leakage in the Meade artesian basin was simulated using river nodes. Tight lacustrine clays confining ground water in the basin were assigned an estimated hydraulic conductivity of 0.5 ft/day (1.8×10^{-4} cm/sec), an order of magnitude smaller than other clays in the study area (Table 2). Thickness of confining clays (Cross Section B-B', Pl. 3) were determined from VV data (App. A) and ranged from 25 to 150 feet (7.6 to 45.7 m). The 52 model nodes used to simulate leakage to and from streams and the Meade artesian basin are shown on Fig. 10.

5.2 Model Calibration

The model was calibrated by adjusting model parameters using a trial and error method. Calibration was achieved when (1) the best match of computed heads to measured predevelopment (1940) heads was obtained, and (2) leakage to the Cimarron River and Crooked Creek were reasonably close to measured base flows. Input to and output from the calibrated model are presented in Appendix B.

The Strongly Implicit Procedure (SIP) was used to solve the finite-difference flow equations, with the iteration parameter set to 1.00. Eleven iterations were necessary to obtain the final solution. The closure error of computed heads between successive iterations was set to 0.01 feet (0.003 m). A total of 333 active nodes (including constant-head nodes) were used in the computer simulation.

5.2.1 Mass Balance. The model computed an annual recharge to the aquifer underlying Meade County of 108,000 acre-feet (149 ft^3/sec; 4.22 m^3/sec). Of this total, 95,300 acre-feet (132 ft^3/sec; 3.74 m^3/sec) were inflow from constant-head nodes, 8,750 acre-feet (12 ft^3/sec; 0.34 m^3/sec) were recharge from precipitation, and 3,950 acre-feet (5 ft^3/sec; 0.14 m^3/sec) were inflow from streams.

Annual aquifer discharge by constant-head nodes was computed to be 22,000 acre-feet (30 ft^3/sec; 0.85 m^3/sec). Discharge attributable to stream leakage and leakage in the Meade artesian basin was 86,200 acre-feet per year (119 ft^3/sec; 3.37 m^3/sec). Therefore, total annual discharge from the aquifer in Meade County is 108,200 acre-feet (149 ft^3/sec; 4.22 m^3/sec). The difference between computed recharge and discharge is 0.01 percent.

5.2.2 Potentiometric Surface. Computed heads from the calibrated model were contoured manually as shown on Pl. 5. The potentiometric surface drawn from calculated heads compares well with the potentiometric surface constructed from measured heads (Pl. 2). A plot of computed heads versus measured heads is shown in Fig. 11.

The distribution of head residuals (difference between computed and measured heads) is shown on Fig. 12. A positive residual indicates that the computed head was less than the measured or observed head (draw down) and a negative residual indicates that the computed head was greater than the measured or observed head (draw up). The maximum positive residual was 18.52 feet (5.64 m) and the maximum negative residual was -17.79 feet (-5.42 m). Both values are less than the 20-foot (6.10 m) contour interval used in Plates 2 and 5. The mean of residuals was +2.18 feet (+0.66 m) with a standard deviation of 8.95 feet (2.73 m), indicating that 67 percent of computed heads were between +11 feet (+3.35 m) and -7 feet (-2.13 m) of measured heads.

One area of disagreement between calculated and measured heads was identified. Plate 2 shows a prominent ground water "high" or nose in the extreme south-central part of the study area. This nose is based on a single data point provided by Frye (1942), who attributed the relatively high equipotential configuration to higher recharge rates facilitated by dune sands overlying the area. The computer simulation failed to produce the

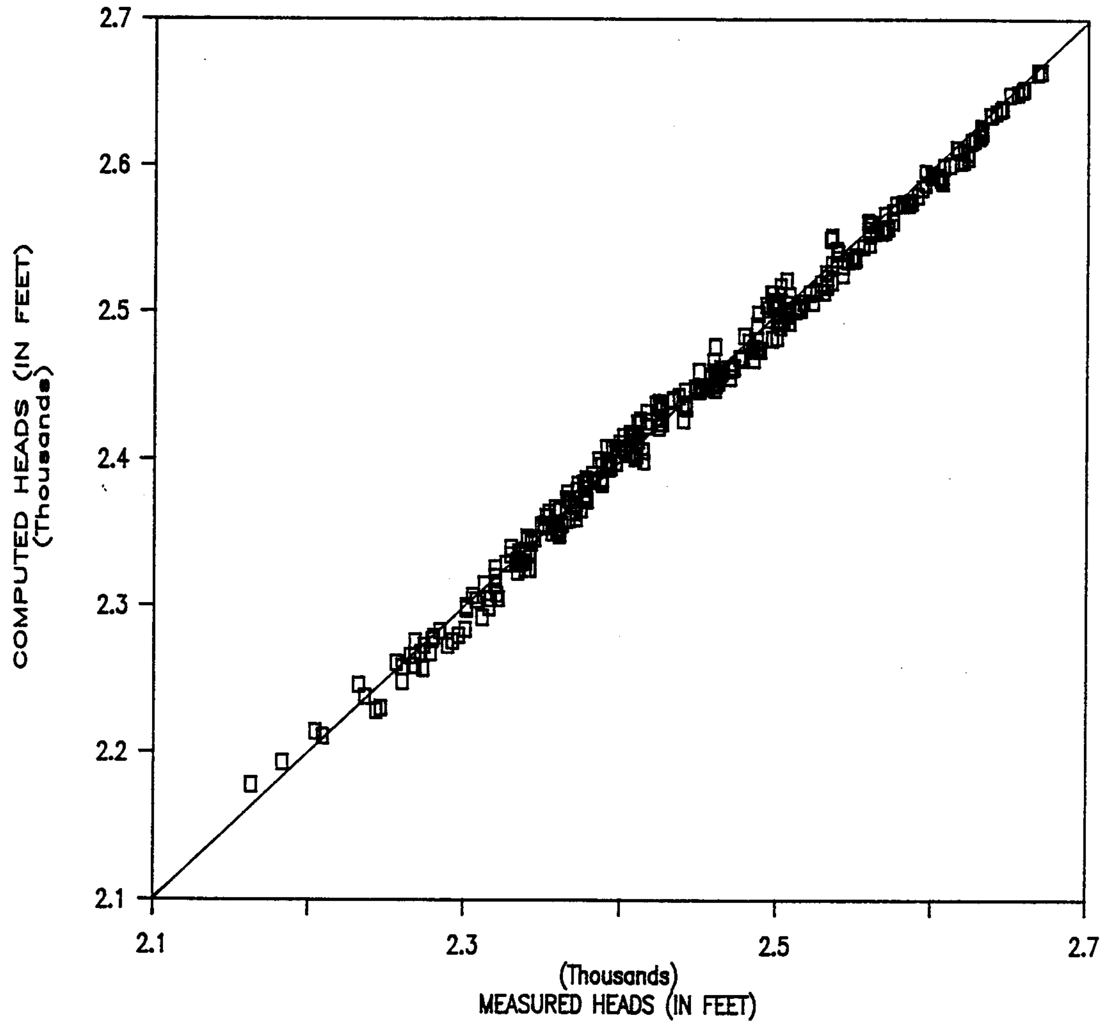

Figure 11 -- Comparison between computed heads and measured heads from the calibrated model of the aquifer in Meade County, Kansas.

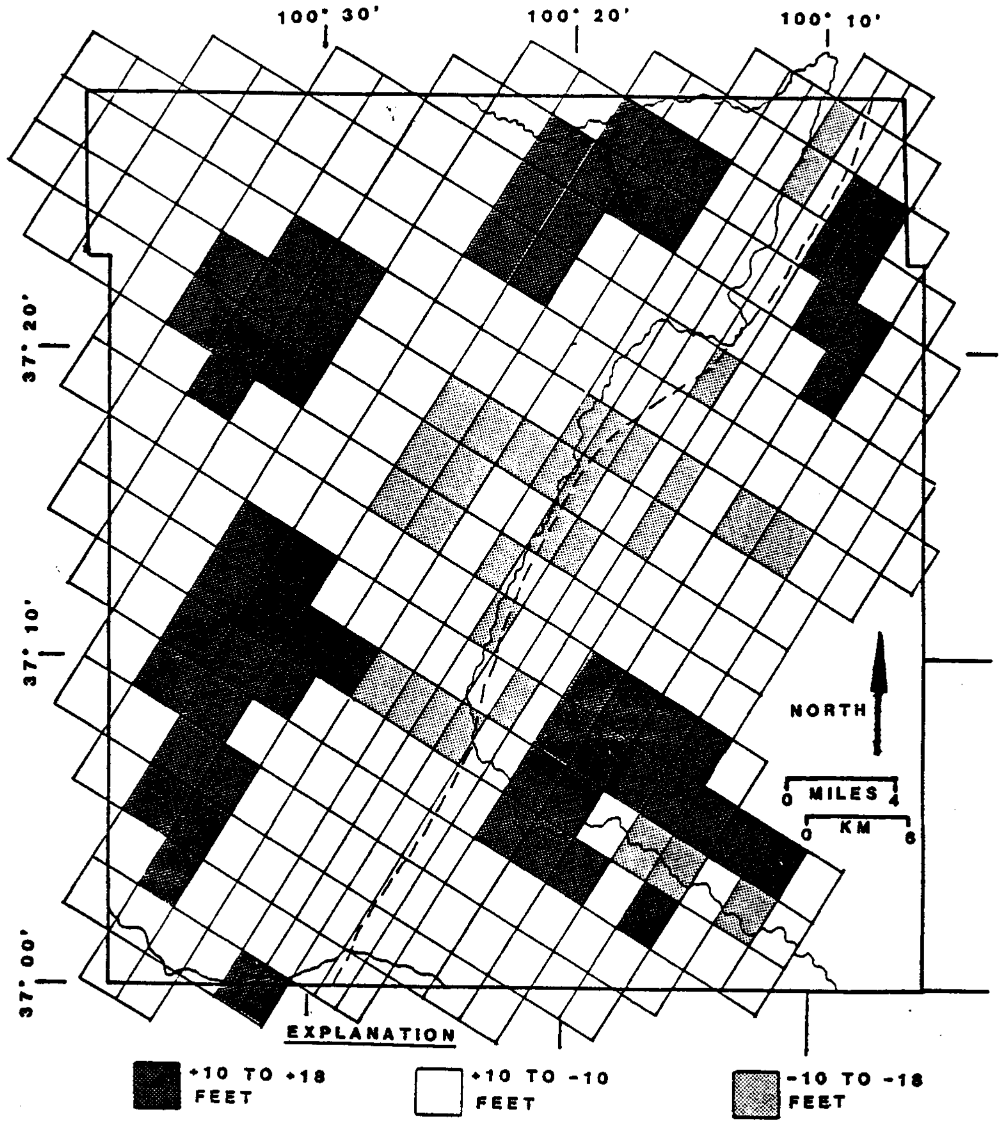

Figure 12 -- Distribution of residuals between computed and measured heads from the calibrated model of the aquifer in Meade County, Kansas.

equipotential "high", even when recharge to the area was increased by one order of magnitude. For this reason, the data point of Frye was questioned. It is possible that equipotential "highs" formerly attributed to locally large recharge rates are in fact caused by upward leakage of ground water from underlying bedrock units. Quantification of such inflow was not attempted in this study.

5.2.3 Boundary Conditions. Discharge calculated by the model at constant-head nodes at the natural aquifer boundary in the southeastern part of Meade County was less than or equal to 2.0 ft^3/sec (0.61 m^3/sec) per node. This discharge, which occurs over a minimum area of approximately 423,000 ft^2 (39,312 m^2; side area of node), represents a net value of about 1800 in./yr (45,700 mm/yr). Because the pan-evaporation rate in the study area exceeds only 90 inches (2286 mm) annually, natural discharge probably occurs primarily as springs and seeps; direct evapotranspiration also occurs.

The perennial streams in Meade County are the Cimarron River and Crooked Creek. Equipotential configuration in southwestern Kansas (Gutentag, Lobmeyer, and Slagle, 1981) indicates that the Cimarron River gains water from the aquifer at the western boundary of Meade County.

Examination of river heads versus nodal heads for Crooked Creek shows that aquifer leakage to the stream begins in the northeastern part of the study area. Because inflow to both streams occurs entirely within Meade County, base flows at the down-gradient county boundary are assumed to represent minimum total net stream leakages from the aquifer.

The model predicted a baseflow for the Cimarron River of 47.5 ft^3/sec (1.35 m^3/sec), which compares well with the 20-year average baseflow of 46.1 ft^3/sec (1.31 m^3/sec; Busby and Armentrout, 1965). The predicted value, however, shows only minor effects of evapotranspiration. The baseflow of Crooked Creek was predicted to be 28.1ft^3/sec (0.80 m^3/sec), which is more than twice the 20-year average baseflow of 12.2 ft^3/sec (0.35 m^3/sec; Busby and Armentrout, 1965). This discrepancy is easily accounted for by vigorous phreatophyte activity along the stream banks and the relatively high pan-evaporation rate (greater than 90 inches (2286 mm) annually) in the study area.

The maximum leakage from a river node used to simulate outflow in the Meade artesian basin (Fig. 10) is approximately 6.5 ft^3/sec (0.18 m^3/sec). This aquifer discharge occurs over an area of 3.0 mi^2 (7.8 km^2) and represents a net value of less than 30 in./yr (762 mm/yr).

Because of the high pan-evaporation rate in Meade County, it is hypothesized that the majority of this leakage is evapotranspired.

5.2.4 Hydraulic Conductivity. Thickness-weighted hydraulic conductivity values were calculated for each of the 277 VV data points (App. A) using the values presented in Table 2. These values were plotted and contoured (Pl. 4) and estimates of nodal hydraulic conductivities were made. Based on Plate 4, several zones of relatively large hydraulic conductivity were identified. These zones are sub-linear and parallel the regional ground-water flow direction.

During the steady-state calibration process, large positive residuals were observed on the northwestern (downthrown) side of the Crooked Creek-Fowler solution front and large negative residuals were noted on the front's southeastern (upthrown) side. Because of these areal discrepancies, hydraulic conductivities along the front were decreased by 50 to 88 percent of original estimates to provide a ground-water flow barrier, permitting an increase in saturated thickness northwest of the front while restricting flow to areas of southeast of the front. For example, if a given node adjacent to the

Crooked Creek-Fowler solution front had originally been assigned a hydraulic conductivity of 35 ft/day ($1.2 X 10^{-2}$ cm/sec), an approximate 88 percent decrease to 5 ft/day ($1.8 X 10^{-3}$ cm/sec) was necessary. Nodal hydraulic conductivity decreases ranged between 50 and 88 percent to allow close calibration on a node-by-node basis. Hydraulic conductivity decreases in this area are due to tilted and disrupted bedding within the aquifer along the Crooked Creek-Fowler solution front (see Chap. 2.3).

5.3 Sensitivity Analysis

Computer models produce nonunique solutions to simulate ground-water flow systems. Therefore, a measure of model sensitivity to adjustment of aquifer parameters was completed to qualitatively measure potential error. After model calibration, hydraulic conductivity and recharge rate were adjusted separately while other variables remained constant. The sensitivity of the model to these parameters is indicated by the magnitude of residuals between computed and measured heads.

5.3.1 Hydraulic Conductivity. The sensitivity of the model to changes in hydraulic conductivity was tested by comparing the mean residual and standard deviation of residuals (as based on 292 active, non-constant-head nodes) between the calibrated model and simulations in which hydraulic conductivity was uniformly increased or decreased by an order of magnitude (Fig. 13 and 14). For example, if a given node in the calibrated model had a thickness-weighted hydraulic conductivity of 50 ft/day (1.76×10^{-2} cm/sec), a value of 500 ft/day (1.76×10^{-1} cm/sec) was used in a separate simulation to test the effect of increased hydraulic conductivity, and a value of 5 ft/day (1.76×10^{-3} cm/sec) was used in a separate simulation to test the effect of decreased hydraulic conductivity. In both cases all other hydrologic parameters were held constant.

When hydraulic conductivity was uniformly increased by one order of magnitude (Fig. 13), the mean residual was +6.75 feet (+2.06 m) with a standard deviation of 21.63 feet (6.59 m). When hydraulic conductivity was decreased by one order of magnitude (Fig. 14), the mean residual was -23.24 feet (-7.08m), the standard deviation was 32.82 feet (10.00m), and a linear cluster of outlying data points was produced (Fig. 14) where computed heads exceeded measured heads by over 100 feet (30.5 m). This data cluster corresponds to a linear segment of nodes immedeately north of and parallel to Crooked Creek in the southeastern part

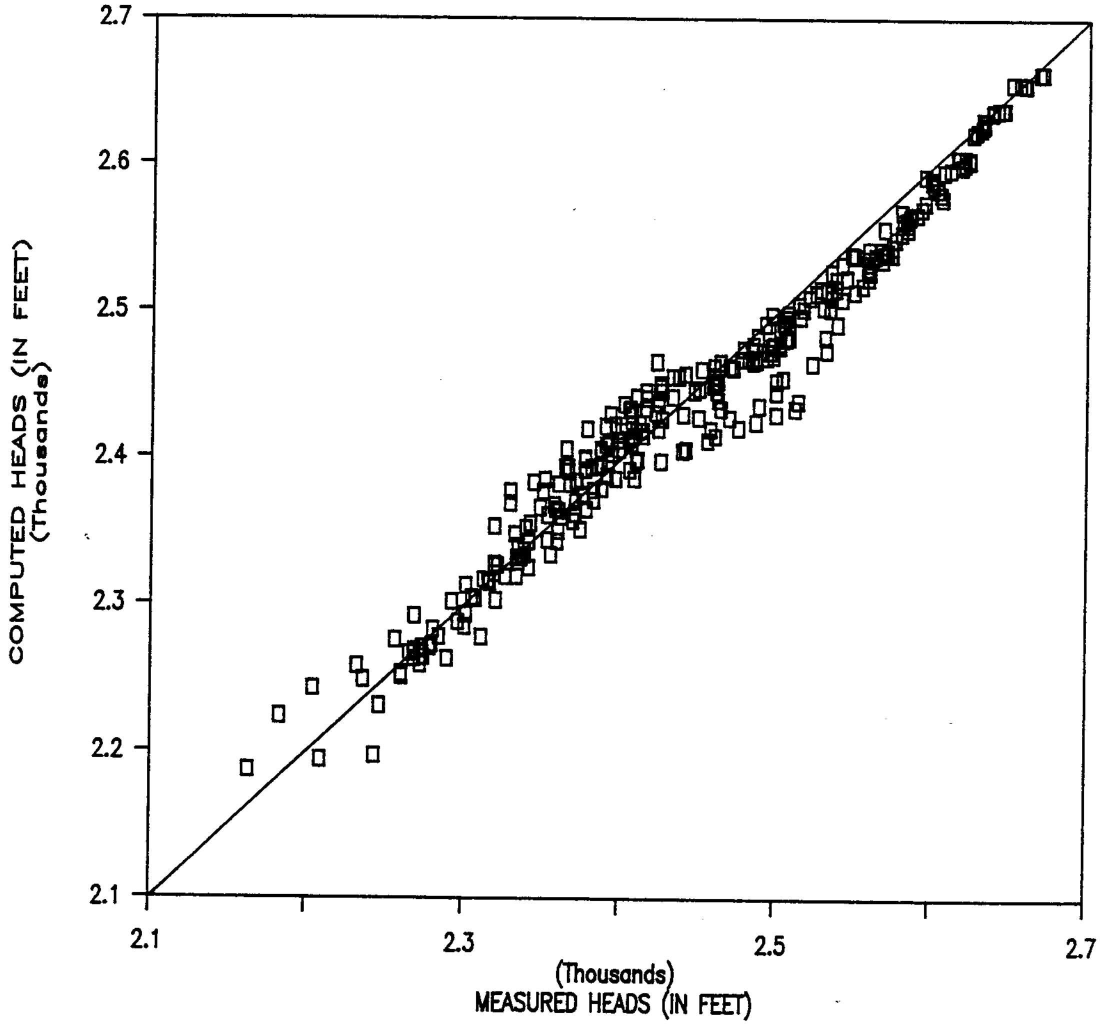

Figure 13 -- Sensitivity of the model to changes in hydraulic conductivity noted as a comparison between computed and measured heads for the aquifer in Meade County, Kansas: hydraulic conductivity uniformly increased by one order of magnitude.

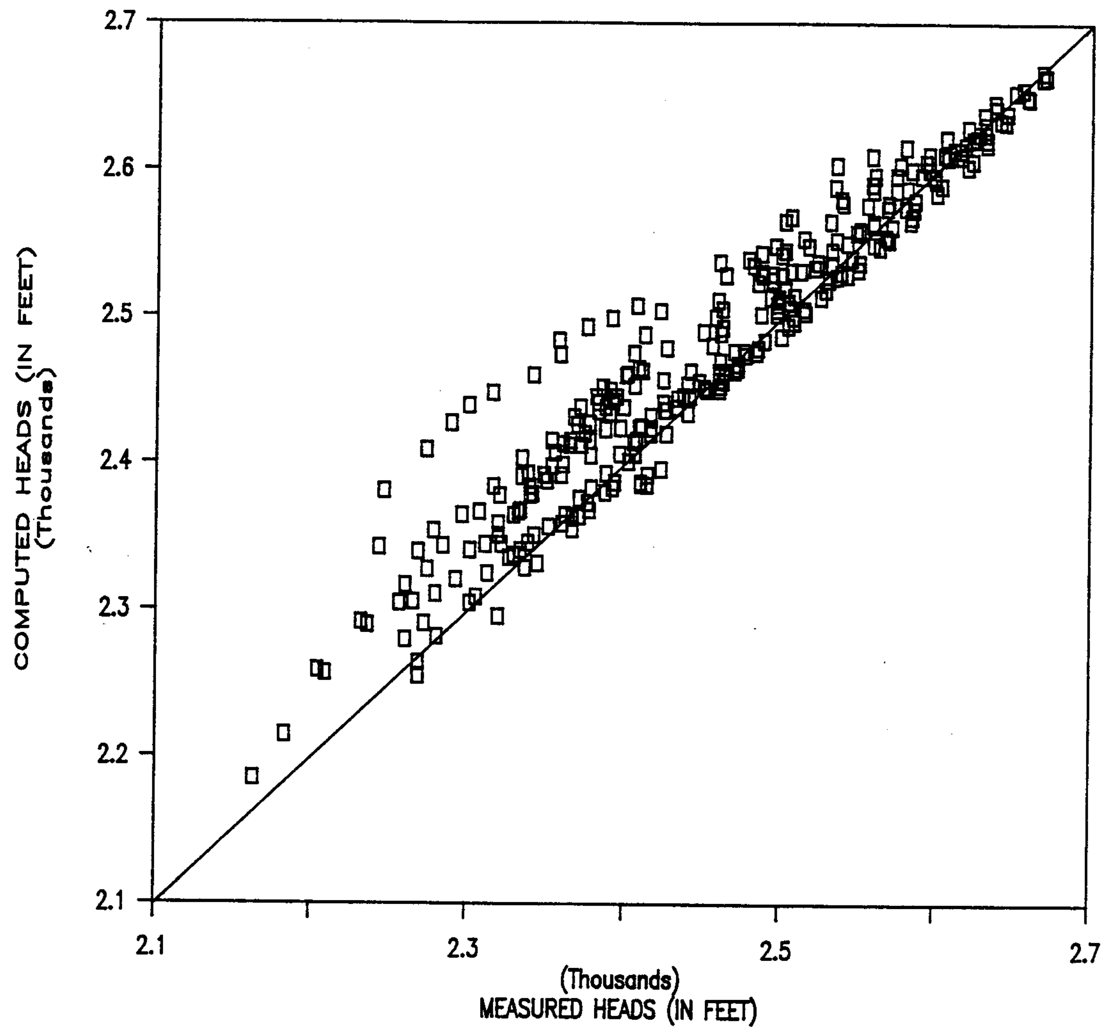

Figure 14 -- Sensitivity of the model to changes in hydraulic conductivity noted as a comparison between computed and measured heads for the aquifer in Meade County, Kansas: hydraulic conductivity uniformly decreased by one order of magnitude.

of the study area (Fig. 10) where decreased hydraulic conductivity has prevented leakage to the stream and resulted in large negative residuals. In general, these significant changes indicate that the model is relatively sensitive to hydraulic conductivity variations and that the initial hydraulic conductivity estimates assigned to aquifer materials (Table 2) are reasonably accurate. The accuracy of estimated hydraulic conductivities for aquifer materials is further supported by experience in the study area (Gutentag and others, 1984).

5.3.2 Recharge. The sensitivity of the model to recharge rate was tested by comparing the mean residual and standard deviation of residuals (as based on 292 active, non-constant-head nodes) between the calibrated model and simulations in which the recharge rate was uniformly increased or decreased (Fig. 15 and 16). To test the effect of increased recharge, a change from 1 percent to 11 percent of annual precipitation was used. To test the effect of decreased recharge, a change from 1 percent to 0.3 percent of annual precipitation was used. The 11 percent and 0.3 percent values represent the range of various recharge estimates as listed in Chap. 3.1. For example, if a given node in the calibrated model had a

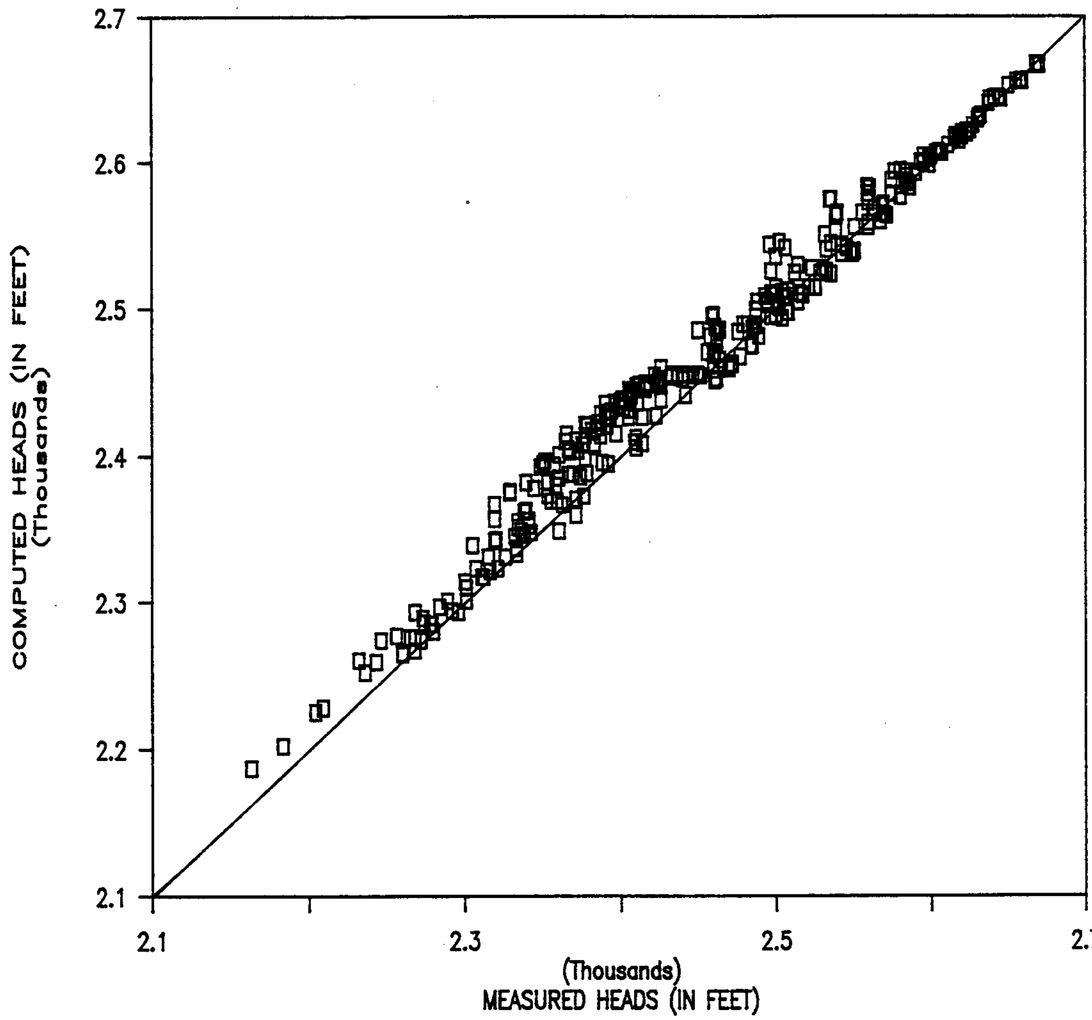

Figure 15 -- Sensitivity of the model to changes in recharge rate noted as a comparison between computed and measured heads for the aquifer in Meade County, Kansas: recharge rate uniformly increased from 1% to 11% of annual precipitation.

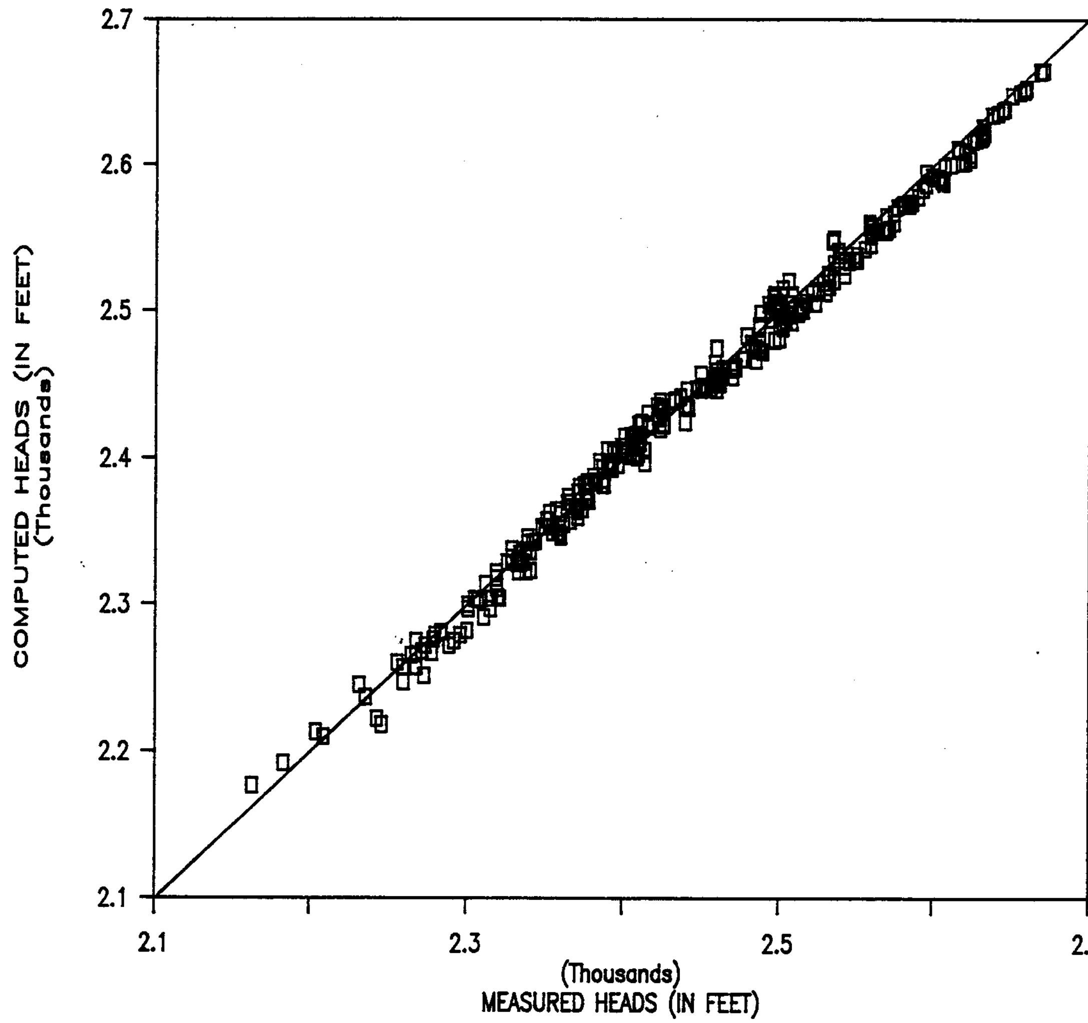

Figure 16 -- Sensitivity of the model to changes in recharge rate noted as a comparison between computed and measured heads for the aquifer in Meade County, Kansas: recharge rate uniformly decreased from 1% to 0.3% of annual precipitation.

recharge value of 0.200 in./yr (5.08 mm/yr), 2.20 in./yr (55.9 mm/yr) was used in a separate simulation to test the effect of increased recharge, and 0.06 in./yr (1.52 mm/yr) was used in a separate simulation to test the effect of decreased recharge. In both cases all other hydrologic parameters were held constant.

When recharge rate was uniformly increased from 1 percent to 11 percent of annual precipitation (Fig. 15), the mean residual was -13.67 feet (-4.17 m) and the standard deviation of residuals was 15.69 feet (4.78 m). When recharge rate was uniformly decreased from 1 percent to 0.3 percent of annual precipitation (Fig. 16), the mean residual was +3.42 feet (+1.04 m) and the standard deviation of residuals was 9.11 feet (2.78 m). These minor changes indicate that the model is much less sensitive to variations in recharge rate, where estimates may have a large magnitude of error, than to variations in hydraulic conductivity, where estimates based on experience and vertical variability analysis are more accurate.

Chapter 6

LARGE PERMEABILITY ZONES

Because the mean vertical center of distribution of hydraulic conductivity in Meade County is below the center of the aquifer, the lateral distribution of hydraulic conductivity is nearly uniform. Therefore, this distribution could be represented by a contour map of thickness-weighted hydraulic conductivity values (Pl. 4). Using Plate 4 as a basis, zones of relatively large permeability were identified (Fig. 17). These zones are linear and parallel the existing ground-water and surface-water flow directions in the study area, indicating that zones of relatively large permeability may coincide with buried paleochannels or the courses of the modern Cimarron River and Crooked Creek. New water wells located in these large permeability zones may have better well yields than wells located in other areas.

The northwest-most zone of large permeability, as shown on Fig. 17, roughly parallels the modern Crooked Creek drainage, indicating that this course may have been used by the ancestral Crooked Creek throughout deposition of the Ogallala Formation and overlying Pleistocene and Holocene deposits. This large permeability zone is not

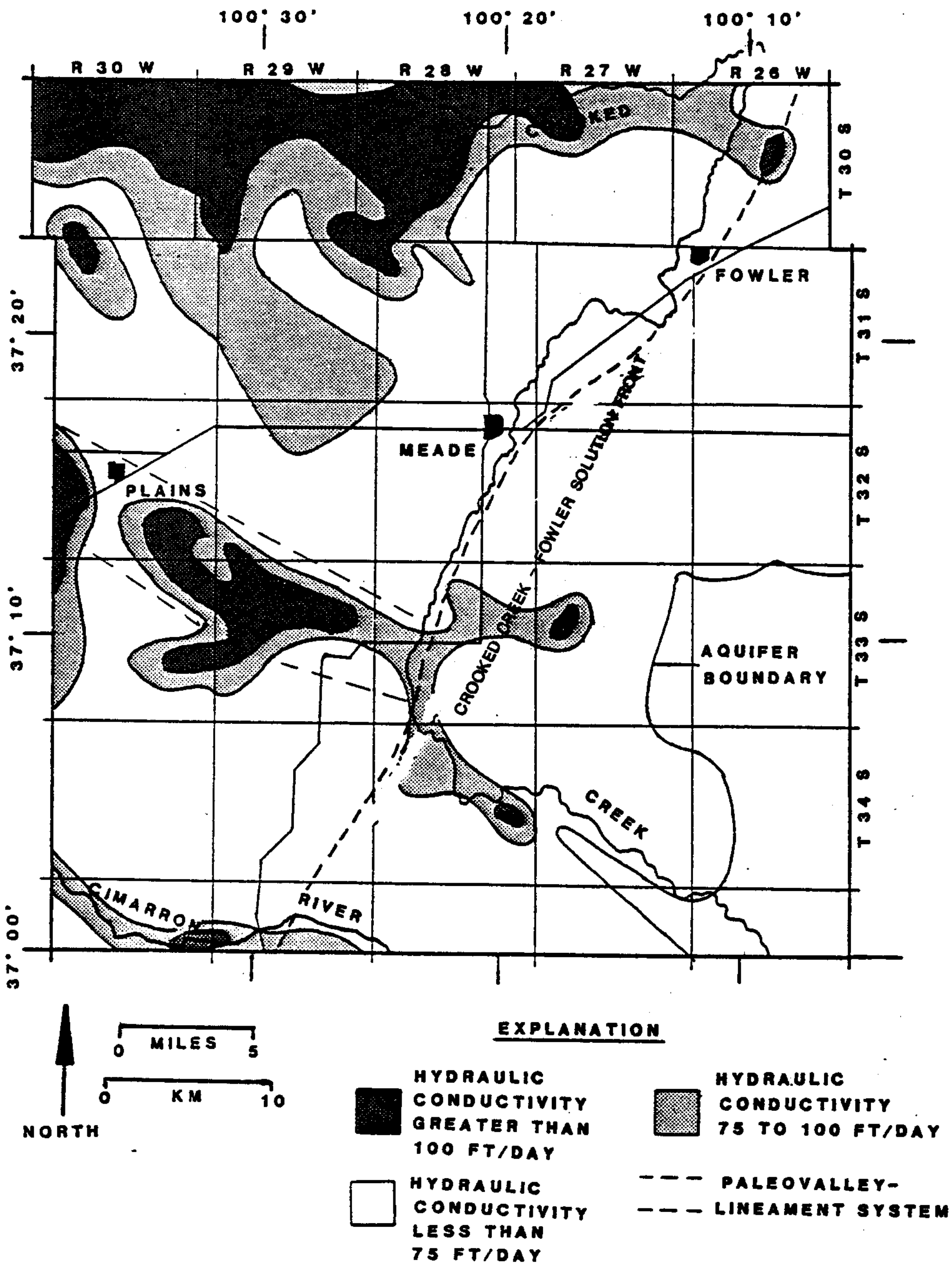

Figure 17 -- Zones of relatively large aquifer material permeability in Meade County, Kansas.

traceable to the east of the Crooked Creek-Fowler solution front, suggesting that the ancestral Crooked Creek turned sharply to the southwest and paralleled the front, similar to the modern stream. This indicates that the front may have been active during the deposition of the Ogallala Formation. This northwestern zone of large permeability is probably controlled by a bedrock fracture zone (lineament), a zone of erosional weakness that may have served as a perferred path for streamflow.

There is a large permeability zone in the west-central part of the study area that does not contain a modern stream. This zone is traceable to the east of the Crooked Creek-Fowler solution front. The modern Crooked Creek flows into this pre-existing feature, which is probably also controlled by a bedrock fracture zone, to leave the front and return to the regional southeastern flow direction.

The presence of large permeability zones is confirmed by the configuration of the bedrock surface underlying the aquifer in the study area (Pl. 1). Southeasterly trends coincident with large permeability zones suggest the presence of preexisting lineaments which may have controlled the locations of ancient and modern streams. The most prominent of these is an infilled valley incised in bedrock in the southeastern part of the study area underlying the modern course of Crooked Creek. Large permeability zone existence is further confirmed by the computer simulation: calibration was achieved using the large hydraulic conductivity values shown on Figure 17.

The relative center of distribution of hydraulic conductivity within the aquifer in Meade County is slightly less than 0.5, suggesting that relatively coarser material is concentrated in the lower half of the aquifer and that aquifer material generally decreases in grain size vertically toward the potentiometric surface. Therefore, wells located in zones of large permeability may need to be screened in the bottom half of the aquifer to optimize well yield.

Chapter 7

SUMMARY AND CONCLUSIONS

Meade County, in southwestern Kansas, is underlain by a part of the central High Plains aquifer that is comprised of the Miocene-aged Ogallala Formation and overlying Pleistocene- and Holocene-aged fluvial and eolian deposits. A vertical variability analysis was conducted on 277 driller's lithologic logs from the study area to determine the distribution of hydrogeologic units within the aquifer. Results of the vertical variability analysis indicate that hydraulic conductivity is randomly or uniformly distributed about a point located just below the aquifer center (mean relative center of distribution of 0.46 with a standard deviation of 0.12). Because the mean vertical distribution is near the aquifer center, thickness-weighted values of hydraulic conductivity were used to represent the vertically-stratified aquifer. Therefore, the areal distribution of hydraulic conductivity was considered uniform for buried channel analysis and a two-dimensional horizontal flow system was considered valid.

Zones of relatively large permeability which may provide favorable sites for water wells were identified using a contour map of thickness-weighted hydraulic conductivities. A mean relative center of distribution of hydraulic conductivity located just below the aquifer center (center of saturated thickness) indicates that relatively coarser material is present in the lower half of the aquifer and that, in general, the overall aquifer sequence fines upward. New water wells in the study area may therefore produce higher yields if located in the identified zones of large permeability and screened near the aquifer bottom. The existence of large permeability zones is confirmed by computer simulation and the presence of fracture zones or lineaments in the bedrock surface underlying the aquifer.

Based on the results of the vertical variability analysis, the aquifer system underlying Meade County was simulated using the McDonald-Harbaugh modular computer model. The predevelopment (1940) potentiometric surface was modeled and was assumed to represent equilibrium between inflow at the study area boundaries, recharge from precipitation, outflow at the study area and natural aquifer boundaries, and leakage to streams. A two-dimensional flow system was validated by the vertical variability analysis and assumed for the computer simulation.

Satisfactory calibration of the model was achieved by adjusting hydrologic parameters using a trial and error method. The calibrated model had a mean head residual (difference between computed and measured head) of +2.18 feet (+0.66 m) with a standard deviation of 8.95 feet (2.73 m), indicating that computed heads in two-thirds of the 292 active nodes were between +11 feet (+3.35 m; draw down) and -6 feet (-1.83 m; draw up) of measured heads. The maximum positive residual was 18.52 feet (5.65 m) and the maximum negative residual was 17.79 feet (5.42 m); both values are less than the 20-foot (6.10 m) contour interval used in the equipotential map from which measured nodal heads were assigned. The model computed a mass-balance discrepancy of 0.01 percent.

Leakages calculated by the model for the Cimarron River and Crooked Creek compared well with 20-year average base flows described in the literature (Busby and Armentrout, 1965); the effects of evaporation and phreatophyte activity along stream banks accounted for the discrepancy between calculated and estimated base flows. Leakage from the 33 mi^2 (85.5 km^2) Meade artesian basin was simulated using river nodes. The amount of leakage through these nodes was compared with evapotranspiration rates.

A sensitivity analysis was performed where recharge rate and hydraulic conductivity were varied as other parameters remained unchanged. A relatively higher level of confidence was placed in the accuracy of hydraulic conductivity values than in recharge rate used in the computer simulation. Hydraulic conductivity values were assigned based on experience in Meade County and adjoining areas; recharge rate, however, is based on estimation techniques and is difficult to evaluate. Results of the sensitivity analysis show that the model was more sensitive to changes in hydraulic conductivity than to changes in recharge rate. Confidence in values assigned to the more sensitive variable (hydraulic conductivity) is confirmed by successful model calibration.

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APPENDIX A

VERTICAL VARIABILITY DATA

Vertical variability data for 277 wells in Meade County, Kansas are listed below. An example is presented to illustrate the data format. Datum for all elevations is National Geodetic Vertical Datum of 1929 (mean sea level).

EXAMPLE OF VV DATA FOR A WELL OR TEST HOLE

```
LINE 1:     30-26-15ADD, 2565, 2496, 2438
LINE 2:             SDY CLAY,    0,   15          RCOD=0.67
LINE 3:            FINE SAND,   15,   30          Kw=30.8
     .             FIME SAND,   30,   60
     .             FINE SAND,   60,  100
     .                   SS,  100,  120
LINE n-1:              CLAY,  120,  127
LINE n:     /
```

EXPLANATION OF LINES IN EXAMPLE

LINE 1: well location (see explanation below), elevation of land surface, elevation of 1940 potentiometric surface, and elevation of bedrock surface respectively. All elevations are listed in feet, to obtain elevations in meters, multiply by 0.3048.

LINE 2: first lithologic unit with depths (feet) to top and bottom of unit, and relative center of distribution (RCOD) of hydraulic conductivity of the saturated portion of the column (between 1940 potentiometric surface and bedrock surface) respectively. To obtain depths in meters, multiply by 0.3048. A double star symbol (**) for RCOD indicates that the 1940 potentiometric surface is below the bedrock elevation, and therefore unconsolidated materials are unsaturated.

LINE 3: second lithologic unit with depths (feet) to top and bottom of unit, and thickness-weighted hydraulic conductivity (Kw) in ft/day respectively. To obtain Kw in cm/sec, multiply by 3.53×10^{-4}. A double star symbol (**) for Kw indicates that the 1940 potentiometric surface is below the bedrock elevation, and therefore unconsolidated materials are unsaturated.

LINE n-1: last lithologic unit with depths (feet) to top and bottom of unit respectively.

LINE n: end-of-data flag for the given well or test hole.

WELL LOCATION SYSTEM

The well numbers in this report give the locations of wells and test holes according to the Bureau of Land Management's system of land subdivision (Fig. A-1). The first number denotes township; the second number denotes range west of the sixth principal meridian; the third number denotes the section in which the given well or test hole is located. The first letter indicates the quarter section (160-acre tract); the second letter indicates the quarter-quarter section (40-acre tract); the third letter indicates the quarter-quarter-quarter section (10-acre tract). These tracts are designated A, B, C, and D in a counterclockwise direction from the northeast quadrant.

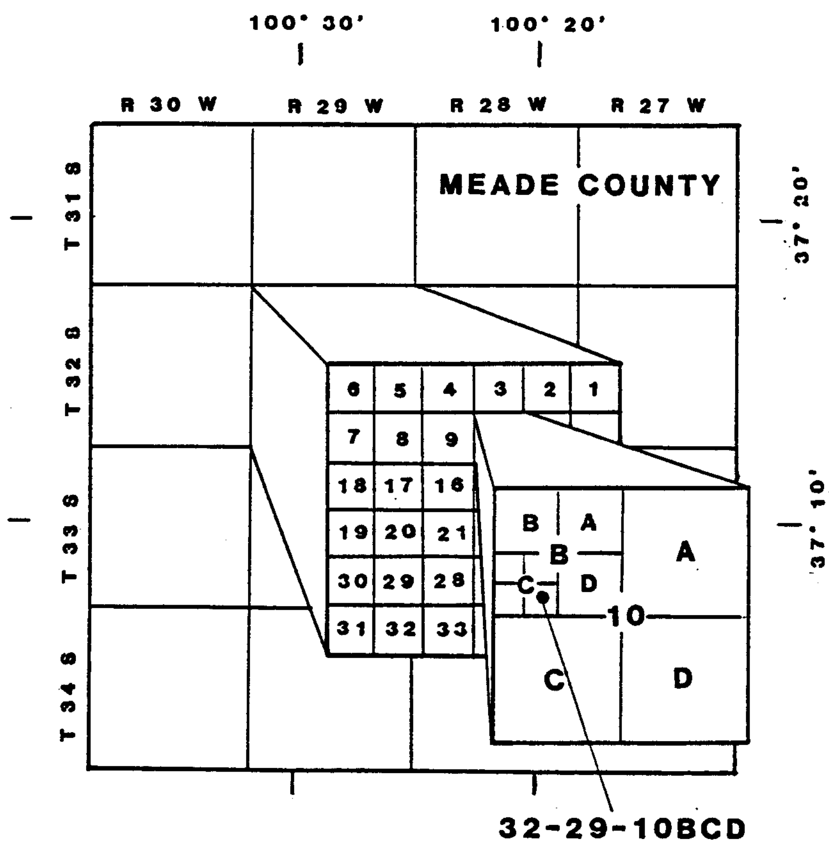

Figure A1 -- System of numbering wells and test holes in Kansas.

```
30-26-1BDB.   2535. 2505. 2457
          TOP SOIL,    0.    2          RCOD=0.39
         FINE SAND,    2.   16          Kw=24.6
         FIME SAND,   16.   23
              CLAY,   23.   50
         FINE SAND,   50.   70
                SS,   70.   78
/
30-26-9A.     2490. 2488. 2136
              CLAY.    0.   43          RCOD=0.49
          MED SAND.   43.   46          Kw=47.0
              CLAY,   46.   77
              SDGL,   77.  110
              CLAY,  110.  168
              SDGL,  168.  177
              CLAY,  177.  182
              SDGL,  182.  194
              CLAY,  194.  208
              SDGL,  208,  211
              CLAY,  211,  214
          CLY SAND,  214,  240
              SDGL,  240,  258
              CLAY,  258,  260
              SDGL,  260,  263
          SDY CLAY,  263,  300
                SS,  300,  322
         FINE SAND,  322,  333
          SDY CLAY,  333,  341
              SDGL,  341,  344
              CLAY,  344.  354
/
30-26-15ADD.  2565. 2496. 2438
          SDY CLAY,    0.   15          RCOD=0.67
         FINE SAND,   15,   30          Kw=30.8
         FIME SAND,   30,   60
         FINE SAND,   60,  100
                SS,  100,  120
              CLAY,  120.  127
/
30-26-15BBD.  2520. 2492, 2400
          TOP SOIL,    0,    5          RCOD=0.50
         FIMC SAND,    5,   15          Kw=99.6
              CLAY,   15,   20
         FIMC SAND,   20,   30
          CLY SDGL,   30,  120
/
```

```
30-26-20CA.  2480. 2495. 2240
        TOP SOIL.     0.     2          RCOD=0.33
            CLAY.     2,    54          Kw=71.9
       FIMC SAND,    54.    82
            CLAY.    82,    96
       FIMC SAND,    96,   112
        SDY CLAY.   112,   115
       FIME SAND,   115,   133
       FIMC SAND,   133,   156
            CLAY,   156,   163
       FINE SAND,   163.   168
            SDGL,   168.   230
            CLAY,   230,   240
/
30-26-30DDD, 2492, 2471, 2315
        TOP SOIL,     0,     6          RCOD=.45
        SDY CLAY,     6.    12          Kw=44.7
        CLY SAND,    12,    60
            SDGL,    60,    70
        CLY SAND,    70,   133
        SDY CLAY.   133,   155
        CLY SAND,   155,   160
       FIMC SAND,   160.   177
/
30-26-31B.   2483. 2470, 2068
        TOP SOIL,     0.     4          RCOD=0.50
            CLAY.     4.    20          Kw=40.4
            SDGL,    20.    37
        CLY SAND,    37,    75
            CLAY,    75,    95
       FIME SAND,    95.   115
        SDY CLAY.   115.   140
            CLAY.   140.   268
            SDGL,   268.   280
       CORS SAND,   280.   300
            CLAY,   300,   307
            SDGL,   307,   317
            CLAY,   317,   327
            SDGL,   327,   332
            CLAY,   332.   360
        MED SAND,   360,   380
       FINE SAND,   380.   404
            CLAY.   404,   415
/
30-26-31CD,  2470. 2467, 2128
        TOP SOIL,     0,     6          RCOD=0.57
```

```
          FINE SAND,     6,    70          Kw=36.4
           SDY CLAY,    70,    93
          FIMC SAND,    93,   105
           CLY SAND,   105,   131
          FIME SAND,   131,   160
               CLAY,   160,   180
               SDGL,   180,   190
           SDY CLAY,   190,   269
               CLSS,   269,   318
           CLY SDGL,   318,   334
          FINE SAND,   334,   342
/
30-26-33DDD, 2535, 2480, 2355
           TOP SOIL,     0,     3          RCOD=0.32
               CLAY,     3,    14          Kw=59.4
           MED SAND,    14,    25
           SDY CLAY,    25,    37
               SDGL,    37,    42
               CLAY,    42,    45
               SDGL,    45,    54
           CLY SAND,    54,    63
           MED SAND,    63,    72
           SDY CLAY,    72,    85
           CLY SAND,    85,    92
               CLAY,    92,   115
           CLY SAND,   115,   118
               CLAY,   118,   126
           CLY SAND,   126,   138
           SDY CLAY,   138,   150
               SDGL,   150,   180
/
30-26-36DDD, 2578, 2480, 2395
           TOP SOIL,     0,     4          RCOD=0.25
           CLY SAND,     4,    37          Kw=22.6
          FINE SAND,    37,    70
               SDGL,    70,    78
           SDY CLAY,    78,   170
           CLY SAND,   170,   178
               SDGL,   178,   183
/
30-27-3BCC,  2568, 2540, 2292
               CLAY,     0,    32          RCOD=0.43
           SDY CLAY,    32,    72          Kw=67.0
          FIME SAND,    72,   116
               SDGL,   116,   136
               CLAY,   136,   146
```

```
          FIMC SAND,  146,  160
               CLAY,  160,  168
          FIMC SAND,  168,  276
/
30-27-7BBD,    2582, 2562, 2346
           TOP SOIL,    0,    7          RCOD=0.31
               CLAY,    7,   52          Kw=82.7
          FINE SAND,   52,   60
           SDY CLAY,   60,   79
          FIME SAND,   79,  168
               SDGL,  168,  236
/
30-27-8ADA,    2622, 2548, 2194
           TOP SOIL,    0,    3          RCOD=0.55
               CLSS,    3,   16          Kw=71.3
          FINE SAND,   16,   30
               CLAY,   30,   34
               SDGL,   34,   45
           CLY SAND,   45,   75
               SDGL,   70,   90
          FINE SAND,   90,  172
               CLAY,  172,  175
               SDGL,  175,  193
           SDY CLAY,  193,  200
           CLY SDGL,  200,  300
           SDY CLAY,  300,  339
               SDGL,  339,  350
               CLSS,  350,  368
               SDGL,  368,  388
               CLAY,  388,  428
/
30-27-9BBB,    2610, 2547, 2268
               CLAY,    0,   12          RCOD=0.58
               SDGL,   12,  278          Kw=131.3
          FIMC SAND,  278,  288
               CLAY,  288,  316
           CLY SAND,  316,  342
/
30-27-12DB,    2537, 2523, 2141
           TOP SOIL,    0,    3          RCOD=0.53
               CLAY,    3,   35          Kw=76.0
               SDGL,   35,   80
           SDY CLAY,   80,  105
          FIME SAND,  105,  157
          FIMC SAND,  157,  225
               CLAY,  225,  230
```

```
                SDGL,  230,  260
            SDY CLAY,  260,  276
                CLAY,  276,  290
                SDGL,  290,  298
                CLAY,  298,  301
                SDGL,  301,  305
                CLAY,  305,  316
                SDGL,  316,  338
                CLAY,  338,  350
                SDGL,  350,  360
                CLAY,  360,  396
/
30-27-15AAB, 2568, 2537, 2196
            TOP SOIL,    0,    2          RCOD=0.34
                CLAY,    2,   31          Kw=74.5
                CLSS,   31,  111
                CLAY,  111,  155
           FINE SAND,  155,  158
                CLAY,  158,  161
           FINE SAND,  161,  170
                SDGL,  170,  190
                CLAY,  190,  202
            CLY SAND,  202,  215
                SDGL,  215,  255
                  SS,  255,  261
                SDGL,  261,  335
                CLAY,  335,  338
           FIME SAND,  338,  356
                CLSS,  356,  372
/
30-27-18C.      2625, 2560, 2267
            TOP SOIL,    0,    2          RCOD=0.52
                CLAY,    2,    7          Kw=65.1
            SDY CLAY,    7,   14
            CLY SAND,   14,   26
           FINE SAND,   26,   28
                CLAY,   28,   58
           FINE SAND,   58,   83
                CLAY,   83,   87
            SDY CLAY,   87,   96
           FINE SAND,   96,  108
                SDGL,  108,  132
                CLAY,  132,  182
           FINE SAND,  182,  191
                CLAY,  191,  200
                SDGL,  200,  224
```

```
              CLAY,  224,  225
              SDGL,  225,  238
          CLY SAND,  238,  242
         CEMT SAND,  242,  245
              CLAY,  245,  250
              SDGL,  250,  258
              CLAY,  258,  270
              SDGL,  270,  300
              CLAY,  300,  305
         CEMT SAND,  305,  315
              CLAY,  315,  358
/
30-27-22DCB, 2519, 2530, 2136
          TOP SOIL,    0,    3            RCOD=0.37
          SDY CLAY,    3,   42            Kw=35.5
         FINE SAND,   42,   51
              CLAY,   51,  146
         FINE SAND,  146,  150
              CLAY,  150,  154
          CLY SAND,  154,  199
              CLAY,  199,  203
              SDGL,  203,  211
                SS,  211,  212
              SDGL,  212,  223
          SDY CLAY,  223,  246
         FINE SAND,  246,  255
          SDY CLAY,  255,  264
         FIME SAND,  264,  271
              CLAY,  271,  274
         FINE SAND,  274,  276
          SDY CLAY,  276,  297
              SDGL,  297,  306
          CLY SDGL,  306,  317
          SDY CLAY,  317,  336
          CLY SAND,  336,  355
              SDGL,  355,  363
          SDY CLAY,  363,  383
/
30-27-23DCB, 2515, 2515, 2190
          TOP SOIL,    0,   20            RCOD=0.38
         FIME SAND,   20,   22            Kw=56.2
              CLAY,   22,   70
          CLY SAND,   70,   85
          SDY CLAY,   85,   94
          CLY SAND,   94,  100
              CLAY,  100,  135
```

```
     CLY SAND,  135,  142
    FINE SAND,  142,  162
     SDY CLAY,  162,  173
     CLY SAND,  173,  177
         SDGL,  177,  265
    SDGL CLAY,  265,  290
           SS,  290,  295
    SDGL CLAY,  295,  305
           SS,  305,  315
         CLAY,  315,  325
/
30-27-28CBB, 2509, 2520, 2114
     TOP SOIL,    0,    3          RCOD=0.29
         CLAY,    3,  142          Kw=28.6
    FINE SAND,  142,  150
         CLAY,  150,  155
    FINE SAND,  155,  159
     SDY CLAY,  159,  173
     MED SAND,  173,  184
         CLAY,  184,  218
    FINE SAND,  218,  224
         CLAY,  224,  253
         SDGL,  253,  266
    CEMT SILT,  266,  281
         SDGL,  281,  288
         CLSS,  288,  330
     CLY SAND,  330,  362
         CLAY,  362,  377
         SDGL,  377,  395
/
30-27-28DAA, 2500, 2515, 2143
     SDY CLAY,    0,  195          RCOD=0.28
    CEMT SILT,  195,  204          Kw=28.7
    FINE SAND,  204,  211
     MED SAND,  211,  227
    FINE SAND,  227,  231
    CEMT SILT,  231,  251
         SDGL,  251,  261
     SDY CLAY,  261,  266
         SDGL,  266,  290
     SDY CLAY,  290,  357
/
30-27-31DDD, 2504, 2510, 2166          RCOD=0.45
     TOP SOIL,    0,    6          KW=30.9
    FINE SAND,    6,   22
         CLSS,   22,   36
```

```
                 CLAY.   36.  134
            FIME SAND.  134.  174
             CLY SAND.  174.  227
                 CLSS.  227.  240
            FINE SAND.  240.  270
            CEMT SAND.  270.  289
            FINE SAND.  289.  300
                 CLSS.  300.  333
             CLY SAND.  333.  338
/
30-27-32D,       2475, 2503, 2114
             TOP SOIL,    0,    1             RCOD=0.37
                 CLAY,    1,  130             Kw=34.6
                 SDGL,  130,  155
                 CLAY,  155,  229
                 SDGL,  229,  233
                 CLAY,  233,  272
                 SDGL,  272,  311
             SDY CLAY,  311,  337
                 CLAY,  337,  361
/
30-27-33BCA,     2483, 2504, 2118
             TOP SOIL,    0,    3             RCOD=0.30
                 CLAY,    3,  114             Kw=34.3
                 CLSS,  114,  125
                 SDGL,  125,  135
                 CLAY,  135,  150
             CLY SAND,  150,  157
            LIMY CLAY,  157,  190
             CLY SAND,  190,  197
                 CLAY,  197,  211
            FINE SAND,  211,  216
            LIMY CLAY,  216,  237
                 SDGL,  237,  240
            LIMY CLAY,  240,  251
                 SDGL,  251,  264
            LIMY CLAY,  264,  274
                 SDGL,  274,  280
            LIMY CLAY,  280,  309
            FINE SAND,  309,  325
             SDY CLAY,  325,  335
             CLY SAND,  335,  345
                 SDGL,  345,  365
/
30-27-35DDD,     2485, 2467, 2180
             TOP SOIL,    0,    8             RCOD=0.40
```

```
       SDY CLAY,    8,   40          Kw=42.2
      FINE SAND,   40,   59
       SDY CLAY,   59,  128
      FINE SAND,  128,  157
      FIME SAND,  157,  179
           SDGL,  179,  200
      CEMT SAND,  200,  222
           CLSS,  222,  253
      CEMT SAND,  253,  290
           SDGL,  290,  305
/
30-27-36CBB. 2468, 2477, 2260
       TOP SOIL,    0,    3          RCOD=0.40
           CLAY,    3,   16          Kw=32.4
      FIME SAND,   16,   22
           CLAY,   22,   26
      FIME SAND,   26,   32
           CLAY,   32,   93
           SDGL,   93,  105
       SDY CLAY,  105,  122
           SDGL,  122,  128
       SDY CLAY,  128,  167
           CLSS,  167,  197
           SDGL,  197,  208
/
30-28-7CBB,  2722, 2606, 2286
       TOP SOIL,    0,    4          RCOD=0.63
           CLAY,    4,   33          Kw=103.3
      FINE SAND,   33,   81
           CLAY,   81,   98
           SDGL,   98,  151
           CLAY,  151,  156
           SDGL,  156,  191
           CLAY,  191,  205
           SDGL,  205,  338
           CLAY,  338,  436
/
30-28-19CD,  2725, 2585, 2182
       TOP SOIL,    0,    3          RCOD=0.55
           CLSS,    3,   40          Kw=94.4
      FIMC SAND,   40,   50
           SDGL,   50,   80
           CLSS,   80,  120
           SDGL,  120,  170
           CLAY,  170,  177
           SDGL,  177,  220
```

```
        SDY CLAY,  220,  227
            SDGL,  227,  245
            CLAY,  245,  278
            SDGL,  278,  305
            CLSS,  305,  313
       FIMC SAND,  313,  330
            CLAY,  330,  340
            SDGL,  340,  351
        SDY CLAY,  351,  360
       FIMC SAND,  360,  370
            CLAY,  370,  385
            SDGL,  385,  420
            CLAY,  420,  426
       FIMC SAND,  426,  460
            CLAY,  460,  467
              SS,  467,  500
            SDGL,  500,  537
            CLAY,  537,  543
/
30-28-20CAC, 2695, 2590, 2260
        TOP SOIL,    0,    2          RCOD=0.50
            CLAY,    2,   36          Kw=124.2
       FIME SAND,   36,   41
            CLAY,   41,   52
            SDGL,   52,   80
        CLY SDGL,   80,   95
            CLAY,   95,  125
            SDGL,  125,  185
        CLY SAND,  185,  215
            SDGL,  215,  335
        CLY SDGL,  335.  350
            SDGL,  350,  410
        SDY CLAY,  410,  435
/
30-28-25BAD, 2577, 2558, 2161
        TOP SOIL,    0,    4          RCOD=0.41
            CLAY,    4,  172          Kw=31.9
            SDGL,  172,  191
            CLAY,  191,  232
            SDGL,  232,  244
            CLAY,  244,  280
            SDGL,  280,  306
            CLAY,  306,  314
            SDGL,  314,  321
            CLAY,  321,  326
            SDGL,  326,  331
```

```
                CLAY,  331,  416
/
30-28-27BCB, 2645, 2576, 2282
            TOP SOIL,    0,    3          RCOD=0.46
            SDY CLAY,    3,   52          Kw=105.9
           FINE SAND,   52,   70
                CLAY,   70,  100
            CLY SAND,  100,  125
                SDGL,  125,  231
            SDY CLAY,  231,  259
                SDGL,  259,  293
                CLAY,  293,  317
                SDGL,  317,  360
                CLAY,  360,  363
/
30-28-29AC,  2680, 2570, 2184
            TOP SOIL,    0,    1          RCOD=0.51
                CLAY,    1,    4          Kw=70.2
            SDY CLAY,    4,   54
           FINE SAND,   54,   75
           FIMC SAND,   75,   90
                CLAY,   90,   96
           FIMC SAND,   96,  101
                CLAY,  101,  127
           FIMC SAND,  127,  176
                CLAY,  176,  212
           FIMC SAND,  212,  226
                CLAY,  226,  236
                SDGL,  236,  291
                CLAY,  291,  295
                SDGL,  295,  307
            SDY CLAY,  307,  320
                SDGL,  320,  336
            SDY CLAY,  336,  345
                SDGL,  345,  358
                CLAY,  358,  367
           FIMC SAND,  367,  387
            SDY CLAY,  387,  399
                  SS,  399,  430
           FINE SAND,  430,  470
           FIMC SAND,  470,  496
/
30-28-31BB,  2725, 2596, 2255
            TOP SOIL,    0,    3          RCOD=0.56
                CLAY,    3,   37          Kw=129.3
           FINE SAND,   37,   64
```

```
              SDGL,   64,   77
              CLAY,   77,   93
              SDGL,   93,  260
          CLY SDGL,  260,  275
              CLAY,  275,  290
              SDGL,  290,  358
              CLAY,  358,  366
              SDGL,  366,  386
          SDY CLAY,  386,  395
              SDGL,  395,  440
              CLAY,  440,  470
/
30-28-35BB,   2637, 2558, 2153
          TOP SOIL,    0,    3          RCOD=0.63
              CLSS,    3,   20          Kw=44.3
              LIME,   20,   28
              CLSS,   28,   64
         FIME SAND,   64,  100
         FIMC SAND,  100,  175
              CLAY,  175,  180
         FIME SAND,  180,  191
              CLAY,  191,  200
         FIME SAND,  200,  218
              CLAY,  218,  245
          CLY SAND,  245,  260
              CLAY,  260,  271
              SDGL,  271,  289
              CLAY,  289,  301
         FIME SAND,  301,  318
              CLAY,  318,  366
         FIMC SAND,  366,  399
              CLAY,  399,  484
/
30-28-35BCC,  2640, 2546, 2159
          TOP SOIL,    0,    3          RCOD=0.51
              CLAY,    3,    8          Kw=46.7
              LIME,    8,   34
              CLAY,   34,   60
          SDY CLAY,   60,   69
         FIME SAND,   69,   90
         FIMC SAND,   90,  155
              CLAY,  155,  171
         FIME SAND,  171,  179
          SDY CLAY,  179,  200
         FIME SAND,  200,  215
              CLAY,  215,  240
```

```
       CLY SAND,  240,  251
           CLAY,  251,  330
           SDGL,  330,  341
           CLAY,  341,  350
           SDGL,  350,  392
       SDY CLAY,  392,  400
           LIME,  400,  421
           CLAY,  421,  440
      FIME SAND,  440,  457
           CLAY,  457,  481
/
30-28-36C,   2590, 2530, 2199
       TOP SOIL,    0,    4           RCOD=0.53
           CLAY,    4,  127           Kw=43.4
     FINE, SAND,  127,  141
       CLY SDGL,  141,  171
           SDGL,  171,  195
       SDY CLAY,  195,  213
           CLAY,  213,  231
           SDGL,  231,  248
           CLAY,  248,  298
           SDGL,  298,  316
           CLAY,  316,  391
/
30-29-1ABC,  2665, 2615, 2328
       TOP SOIL,    0,    5           RCOD=0.56
           CLAY,    5,   11           Kw=90.4
       SDY CLAY,   11,   86
       CLY SAND,   86,   95
           SDGL,   95,  167
           CLAY,  167,  179
           SDGL,  179,  226
       CLY SDGL,  226,  231
           SDGL,  231,  251
       CLY SDGL,  251,  258
       SDY CLAY,  258,  274
           SDGL,  274,  283
             SS,  283,  285
           SDGL,  285,  290
           CLSS,  290,  337
/
30-29-8D,    2782, 2635, 2336
       TOP SOIL,    0,    2           RCOD=0.50
           CLAY,    2,    5           Kw=158.2
       SDY CLAY,    5,   47
           SDGL,   47,   79
```

```
       SDY CLAY,   79,  143
           SDGL,  143,  391
       CLY SDGL,  391,  400
           SDGL,  400,  446
/
30-29-15C,     2745, 2618, 2221
       TOP SOIL,    0,    3        RCOD=0.67
       SDY CLAY,    3,   12        Kw=97.4
      FINE SAND,   12,   38
      FIME SAND,   38,   47
           SDGL,   47,   56
       SDY CLAY,   56,  103
           SDGL,  103,  157
           SDGL,  157,  292
           CLAY,  292,  306
           SDGL,  306,  351
       SDY CLAY,  351,  357
      FIME SAND,  357,  368
       SDY CLAY,  368,  384
           SDGL,  384,  389
      FIME SAND,  389,  409
       SDY CLAY,  409,  416
      FIME SAND,  416,  424
       SDY CLAY,  424,  454
      FINE SAND,  454,  458
       SDY CLAY,  458,  476
             SS,  476,  516
           LIME,  516,  524
/
30-29-26ABC,   2748, 2624, 2227
       TOP SOIL,    0,    2        RCOD=0.59
           CLAY,    2,   65        Kw=76.2
           SDGL,   65,   77
           CLAY,   77,  108
           SDGL,  108,  162
           CLAY,  162,  195
      FIMC SAND,  195,  200
           SDGL,  200,  260
      FIMC SAND,  260,  282
           CLAY,  282,  291
      FIMC SAND,  291,  355
           CLAY,  355,  373
      CEMT SAND,  373,  380
           CLAY,  380,  390
      FIMC SAND,  390,  401
           CLAY,  401,  462
```

```
     FIME SAND,  462,  475
          CLAY,  475,  492
          SDGL,  492,  521
/
30-29-32CC,  2744, 2640, 2254
      TOP SOIL,    0,    2          RCOD=0.61
          CLSS,    2,   40          Kw=104.3
     FIME SAND,   40,   51
          CLSS,   51,   78
          SDGL,   78,  133
          CLAY,  133,  141
          SDGL,  141,  166
     CEMT SAND,  166,  180
     FIMC SAND,  180,  186
      SDY CLAY,  186,  191
          SDGL,  191,  365
      SDY CLAY,  365,  375
          SDGL,  375,  380
      SDY CLAY,  380,  390
     FIMC SAND,  390,  407
          LIME,  407,  416
      SDY CLAY,  416,  436
          CLAY,  436,  485
          LIME,  485,  490
/
30-29-33CCC, 2744, 2615, 2310
      TOP SOIL,    0,    2          RCOD=0.59
          CLAY,    2,   50          Kw=87.0
     FIMC SAND,   50,   70
      SDY CLAY,   70,   74
          SDGL,   74,   99
          CLAY,   99,  115
      CLY SAND,  115,  158
          SDGL,  158,  206
          CLAY,  206,  212
          SDGL,  212,  250
          CLAY,  250,  270
     CORS SAND,  270,  310
          SDGL,  310,  340
     FINE SAND,  340,  360
          CLSS,  360,  372
          CLAY,  372,  410
     FIME SAND,  410,  424
      CLY SAND,  424,  434
/
30-29-36BBB, 2743, 2600, 2277
```

```
           TOP SOIL,    0,    6           RCOD=0.57
           SDY CLAY,    6,   68           Kw=95.0
               SDGL,   68,   81
               SDGL,   81,   95
           SDY CLAY,   95,  104
               SDGL,  104,  131
                 SS,  131,  133
           SDY CLAY,  133,  151
               SDGL,  151,  154
           SDY CLAY,  154,  165
               SDGL,  165,  178
                 SS,  178,  181
               SDGL,  181,  186
               CLAY,  186,  199
               SDGL,  199,  298
               CLAY,  298,  300
               SDGL,  300,  316
                 SS,  316,  318
               CLAY,  318,  331
               SDGL,  331,  336
           CLY SDGL,  336,  350
               CLAY,  350,  380
               SDGL,  380,  397
           CLY SDGL,  397,  428
           SDY CLAY,  428,  466
/
30-30-5CCC,    2820, 2675, 2365
           TOP SOIL,    0,    6           RCOD=0.56
           SDY CLAY,    6,   50           KW=127.1
          FIME SAND,   50,   64
               SDGL,   64,   70
           SDY CLAY,   70,  100
               SDGL,  100,  146
           CLY SDGL,  146,  155
               SDGL,  155,  216
           CLY SDGL,  216,  236
               SDGL,  236,  350
               CLAY,  350,  365
           CLY SDGL,  365,  400
               SDGL,  400,  411
           CLY SDGL,  411,  440
           SDY CLAY,  440,  455
/
30-30-10B,     2803, 2664, 2353
           TOP SOIL,    0,    4           RCOD=0.49
           SDY CLAY,    4,   65           Kw=112.0
```

```
          SDGL,    65,   91
      CLY SDGL,    91,  112
          SDGL,   112,  200
          CLAY,   200,  232
      CLY SDGL,   232,  260
          CLAY,   260,  277
          SDGL,   277,  320
      CLY SDGL,   320,  333
          SDGL,   333,  350
      CLY SDGL,   350,  370
          CLAY,   370,  387
          SDGL,   387,  443
      SDY CLAY,   443,  450
/
30-30-15B,    2812, 2660, 2392
      TOP SOIL,     0,    2            RCOD=0.40
          CLAY,     2,   35            Kw=81.8
      SDY CLAY,    35,   80
          SDGL,    80,  147
      SDY CLAY,   147,  179
          SDGL,   179,  215
          CLAY,   215,  232
      CLY SDGL,   232,  245
          SDGL,   245,  260
          CLAY,   260,  274
          SDGL,   274,  299
          CLAY,   299,  367
      CLY SDGL,   367,  380
          SDGL,   380,  420
/
30-30-17CAC,  2820, 2667, 2333
      TOP SOIL,     0,    1            RCOD=0.64
          CLAY,     1,   37            Kw=103.4
      CLY SAND,    37,   65
      CLY SDGL,    65,   81
      SDY CLAY,    81,   95
          SDGL,    95,  113
      CLY SDGL,   113,  151
      SDY CLAY,   151,  155
          SDGL,   155,  325
          CLAY,   325,  362
          SDGL,   362,  380
      CLY SDGL,   380,  404
      SDY CLAY,   404,  410
          SDGL,   410,  419
          CLAY,   419,  487
```

```
/
30-30-19BAA, 2820, 2668, 2296
             CLAY,    0,   45          RCOD=0.51
        SDGL CLAY,   45,   66          Kw=108.1
             SDGL,   66,   73
         SDY CLAY,   73,   79
             SDGL,   79,   86
         SDY CLAY,   86,  153
        CEMT SAND,  153,  156
        FIMC SAND,  156,  226
        CEMT SILT,  226,  227
             SDGL,  227,  253
        LIMY CLAY,  253,  255
        FINE SAND,  255,  270
             SDGL,  270,  356
        CEMT SAND,  356,  357
             SDGL,  357,  370
             CLAY,  370,  393
             SDGL,  393,  400
             CLAY,  400,  404
             SDGL,  404,  430
         CLY SDGL,  430,  495
         CLY SAND,  495,  515
        FIMC SAND,  515,  524
/
30-30-27C,   2785, 2647, 2279
         TOP SOIL,    0,    2
             CLAY,    2,   93 RCOD=0.62
        FIMC SAND,   93,  162 Kw=46.8
        FIME SAND,  162,  170
             CLAY,  170,  173
        FIME SAND,  173,  198
         SDY CLAY,  198,  203
        FINE SAND,  203,  222
        FIME SAND,  222,  312
        CEMT SAND,  312,  313
             CLAY,  313,  342
        FIME SAND,  342,  387
        FIMC SAND,  387,  402
        FIME SAND,  402,  421
             CLAY,  421,  439
             LIME,  439,  458
             CLAY,  458,  506
/
30-30-28AB,  2801, 2654, 2452
         TOP SOIL,    0,    2 RCOD=0.49
```

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          CLAY,     2,     8 Kw=63.6
      SDY CLAY,     8,    28
      CLY SAND,    28,    39
          CLAY,    39,    47
     FINE SAND,    47,    78
          CLAY,    78,    92
      SDY CLAY,    92,   106
      MED SAND,   106,   124
          CLAY,   124,   132
     FINE SAND,   132,   139
          CLAY,   139,   156
      MED SAND,   156,   196
          CLAY,   196,   207
     FIME SAND,   207,   227
          LIME,   227,   228
      SDY CLAY,   228,   235
      MED SAND,   235,   327
          LISD,   327,   338
     FINE SAND,   338,   345
          CLAY,   345,   349
/
30-30-30BDD, 2815, 2661, 2401
      TOP SOIL,     0,     4 RCOD=0.47
          CLAY,     4,    14 Kw=50.3
      SDY CLAY,    14,    46
     FIME SAND,    46,    54
          CLAY,    54,    82
      CLY SAND,    82,   240
      SDY CLAY,   240,   256
          CLAY,   256,   280
     FIMC SAND,   280,   340
      CLY SAND,   340,   398
     FINE SAND,   398,   414
/
30-30-30CC,  2820, 2661, 2311
      TOP SOIL,     0,     2 RCOD=0.65
          CLAY,     2,    40 Kw=61.8
     FIMC SAND,    40,    46
          CLAY,    46,    74
     FIMC SAND,    74,    85
          CLAY,    85,    94
     FIMC SAND,    94,   124
          CLAY,   124,   133
     FIMC SAND,   133,   162
          CLAY,   162,   169
     FIMC SAND,   169,   200
```

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          SDGL,  200,  205
          CLAY,  205,  215
     FIMC SAND,  215,  235
          CLAY,  235,  240
     FIMC SAND,  240,  280
          CLAY,  280,  332
      CLY SDGL,  332,  421
      CLY SAND,  421,  430
     FIMC SAND,  430,  471
          CLAY,  471,  482
            SS,  482,  509
/
30-30-31BCC, 2825, 2625, 2285
      TOP SOIL,    0,    2 RCOD=0.50
          CLSS,    2,   72 Kw=52.4
          CLAY,   72,  100
     FIMC SAND,  100,  120
          CLAY,  120,  190
     FIMC SAND,  190,  205
          CLAY,  205,  215
     FIME SAND,  215,  292
          CLAY,  292,  363
          SDGL,  363,  414
          CLAY,  414,  504
          SDGL,  504,  524
            SS,  524,  540
/
30-30-34ACC, 2773, 2643, 2259
      TOP SOIL,    0,    2 RCOD=0.65
          CLAY,    2,   26 Kw=55.2
      SDY CLAY,   26.   74
     FIMC SAND,   74,   98
          CLAY,   98,  102
          SDGL,  102,  162
     FIMC SAND,  162,  232
          CLAY,  232,  236
     FINE SAND,  236,  242
     FIME SAND,  242,  276
          CLAY,  276,  294
     FIME SAND,  294,  330
          CLAY,  330,  334
      CLY SAND,  334,  352
          CLAY,  352,  368
     FINE SAND,  368,  373
          CLAY,  373,  380
     FINE SAND,  380,  382
```

CLAY,	382,	383
FINE SAND,	383,	412
LISD,	412,	514

31-26-6B.	2485.	2463.	2247	
	TOP SOIL.	0.	2	RCOD=0.43
	CLAY.	2.	15	Kw=33.0
	SDY CLAY.	15.	21	
	FIME SAND.	21.	30	
	CLAY.	30.	112	
	SDGL.	112.	136	
	SDY CLAY.	136.	140	
	FIMC SAND.	140.	145	
	SS.	145.	153	
	SDY CLAY.	153.	190	
	CEMT SAND.	190.	221	
	FIME SAND.	221.	231	
	LIME.	231.	238	
/				
31-26-13BBA.	2550.	2440.	2420	
	TOP SOIL.	0.	10	RCOD=0.27
	CEMT SAND.	0.	40	Kw=82.5
	SDGL.	40.	50	
	CEMT SAND.	50.	80	
	CLAY.	80.	120	
	SDGL.	120.	130	
/				
31-26-16BCB.	2525.	2457.	2345	
	TOP SOIL.	0.	8	RCOD=0.27
	FINE SAND.	8.	21	Kw=24.6
	CLAY.	21.	43	
	SDY CLAY.	43.	125	
	MED SAND.	165.	180	
/				
31-26-23BBB.	2545.	2430.	2390	
	FINE SAND.	0.	40	RCOD=0.31
	CLSS.	40.	140	Kw=25.0
	FINE SAND.	140.	155	
/				
31-26-25ABD.	2457.	2365.	2321	
	TOP SOIL.	0.	1	RCOD=0.20
	CLY SAND.	1.	11	Kw=52.3
	SS.	11.	20	
	SDY CLAY.	20.	35	
	FIMC SAND.	35.	40	
	SDY CLAY.	40.	125	
	SDGL.	125.	136	
/				
31-26-26ACC.	2475.	2380.	2300	
	TOP SOIL.	0.	5	RCOD=0.22

FIMC SAND.	5.	25		Kw=56.9
CLAY.	25.	38		
SS.	38.	150		
SDGL.	150.	175		
/				
31-26-27CBC.	2490.	2402.	2315	
TOP SOIL.	0.	6		RCOD=0.26
FINE SAND.	6.	30		Kw=51.0
CLAY.	30.	80		
SDGL.	80.	85		
CEMT SAND.	85.	148		
CLAY.	148.	155		
SDGL.	155.	175		
/				
31-26-30B.	2521.	2415.	2291	
TOP SOIL.	0.	3		RCOD=0.39
CLAY.	3.	97		Kw=23.0
FIMC SAND.	97.	110		
CLAY.	110.	130		
FIMC SAND.	130.	134		
CLAY.	134.	198		
FIMC SAND.	198.	219		
SS.	219.	230		
/				
31-26-31AD.	2503.	2396.	2298	
TOP SOIL.	0.	3		RCOD=0.33
CLAY.	3.	158		Kw=39.1
SDGL.	158.	164		
CLAY.	164.	169		
CORS SAND.	169.	181		
SDGL.	181.	190		
CLAY.	190.	205		
/				
31-26-31BA.	2498.	2402.	2306	
TOP SOIL.	0.	3		RCOD=0.34
SDY CLAY.	3.	20		Kw=55.5
CLAY.	20.	40		
MED SAND.	40.	60		
CLAY.	60.	70		
SDGL.	70.	76		
CLSS.	76.	80		
SDGL.	80.	92		
CLAY.	92.	100		
CLSS.	100.	120		
CEMT SDGL.	120.	155		
SDGL.	155.	180		

```
               CLAY.  180.  192
/
31-26-31DD.    2505. 2393. 2295
       TOP    SOIL.     0.    2        RCOD=0.45
       SDY    CLAY.     2.   20        Kw=70.2
       FIME   SAND.    20.   40
              CLAY.    40.   60
       FIMC   SAND.    60.  100
              CLSS.   100.  120
       FIME   SAND.   120.  160
       FIMC   SAND.   160.  210
/
31-27-4DBB.    2475. 2475. 2183
       TOP.   SOIL.     0.    3        RCOD=0.40
              CLAY.     3.  100        Kw=45.0
       SDY    CLAY.   100.  105
              SDGL.   105.  142
              CLAY.   142.  156
              SDGL.   156.  165
              CLAY.   165.  175
       CLY    SAND.   175.  185
              CLAY.   185.  190
       CLY    SAND.   190.  204
              CLSS.   204.  230
       CLY    SAND.   230.  270
       MED    SAND.   270.  288
              SDGL.   288.  292
/
31-27-5CDD.    2467. 2480. 2103
       TOP    SOIL.     0.    3        RCOD=0.41
              CLAY.     3.  184        Kw=36.5
       FINE   SAND.   184.  186
       SDY    CLAY.   186.  199
              SDGL.   199.  224
       SDY    CLAY.   224.  229
              SDGL.   229.  241
       CEMT   SDGL.   241.  247
       SDY    CLAY.   247.  258
              SDGL.   258.  261
       SDY    CLAY.   261.  287
              SDGL.   287.  296
       SDY    CLAY.   296.  315
       CLY    SAND.   315.  357
              SDGL.   357.  360
       SDY    CLAY.   360.  364
/
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```
31-27-6A.     2480. 2485. 2130
          TOP SOIL.    0.    7        RCOD=0.43
         FINE SAND.    7.   16        Kw=47.7
              CLAY.   16.  126
         FINE SAND.  126.  131
              SDGL.  131.  178
          CLY SAND.  178.  187
         FINE SAND.  187.  201
              CLAY.  201.  239
              SDGL.  239.  246
              CLAY.  246.  254
              SDGL.  254.  263
          CLY SAND.  263.  339
              CLAY.  339.  350
/
31-27-7CCC.   2470. 2485. 2100
          TOP SOIL.    0.    3        RCOD=0.36
              CLAY.    3.   91        Kw=34.2
                SS.   91.   98
              CLAY.   98.  129
         FINE SAND.  129.  135
              CLSS.  135.  153
                SS.  153.  154
          CLY SAND.  154.  179
              CLAY.  179.  184
         FIME SAND.  184.  194
              CLAY.  194.  196
         FIME SAND.  196.  204
          SDY CLAY.  204.  221
              CLSS.  221.  233
              SDGL.  233.  246
          CLY SDGL.  246.  261
              SDGL.  261.  263
          CLY SDGL.  263.  268
              SDGL.  268.  286
              CLSS.  286.  318
                SS.  318.  353
          SDY CLAY.  353.  364
          CLY SDGL.  364.  370
/
31-27-10BDD.  2468. 2465. 2145
          TOP SOIL.    0.    3        RCOD=0.42
              CLAY.    3.  158        Kw=26.8
              SDGL.  158.  184
              CLAY.  184.  200
         FIME SAND.  200.  215
```

```
             CLAY.  215.  218
        FIME SAND.  218.  242
             LIME.  242.  255
         SDY CLAY.  255.  323
/
31-27-12ABA. 2470. 2457. 2195
         TOP SOIL.    0.    3        RCOD=0.28
             CLAY.    3.  137        Kw=29.9
        FINE SAND.  137.  140
         SDY CLAY.  140.  177
             SDGL.  177.  185
         CLY SAND.  185.  193
             SDGL.  193.  206
         CLY SDGL.  206.  210
         SDY CLAY.  210.  241
         CLY SAND.  241.  259
             SDGL.  259.  267
             CLAY.  267.  275
/
31-27-14B.   2460. 2447. 2162
         TOP SOIL.    0.    3        RCOD=0.31
             CLAY.    3.   53        Kw=39.1
         CLY SAND.   53.   57
             CLAY.   57.   77
         SDY CLAY.   77.   85
             CLAY.   85.  109
        FIME SAND.  109.  113
         SDY CLAY.  113.  115
        FIME SAND.  115.  120
             CLAY.  120.  147
        FIME SAND.  147.  154
             CLAY.  154.  192
             SDGL.  192.  225
         SDY CLAY.  225.  248
         CLY SAND.  248.  275
             CLAY.  275.  277
             SDGL.  277.  290
             CLAY.  290.  298
/
31-27-14BB.  2460. 2448. 2228
         TOP SOIL.    0.    3        RCOD=0.32
             CLAY.    3.  118        Kw=55.6
             SDGL.  118.  163
         SDY CLAY.  163.  180
         CLY SAND.  180.  205
             SDGL.  205.  224
```

CLAY.		224.	232	
/				
31-27-18ACB.	2450.	2474.	2151	
TOP SOIL.		0.	3	RCOD=0.34
CLAY.		3.	80	Kw=29.5
CLY SAND.		80.	87	
CLAY.		87.	158	
SDGL.		158.	163	
CLAY.		163.	167	
SDGL.		167.	171	
SDY CLAY.		171.	190	
SDGL.		190.	211	
CLY. SAND.		211.	217	
SDY CLAY.		217.	240	
CEMT SAND.		240.	252	
CLY SAND.		252.	275	
CLAY.		275.	292	
CLY SDGL.		292.	299	
/				
31-27-24CDD.	2502.	2421.	2294	
CLAY.		0.	24	RCOD=0.59
CLY SAND.		24.	37	Kw=42.6
SDY CLAY.		37.	81	
SDGL.		81.	96	
CLAY.		96.	112	
MED SAND.		112.	115	
SDY CLAY.		115.	160	
CLY SAND.		160.	195	
SDY CLAY.		195.	199	
CLY SAND.		199.	208	
/				
31-27-27CAC.	2483.	2425.	2305	
TOP SOIL.		0.	2	RCOD=0.31
FIME SAND.		2.	8	Kw=36.6
SDY CLAY.		8.	16	
CLAY.		16.	87	
CLY SDGL.		87.	98	
CLAY.		98.	140	
CEMT SAND.		140.	158	
SDGL.		158.	174	
CLAY.		174.	178	
/				
31-27-28CC.	2477.	2425.	2292	
TOP SOIL.		0.	3	RCOD=0.59
SDY CLAY.		3.	30	Kw=58.7
CLAY.		30.	50	

```
               SDGL.   50.    56
               CLSS.   56.    60
               SDGL.   60.    80
          CEMT SAND.   80.    90
               CLSS.   90.   106
               CLAY.  106.   120
          FIMC SAND.  120.   126
               CLAY.  126.   135
          FINE SAND.  135.   160
               SDGL.  160.   170
                 SS.  170.   180
               CLAY.  180.   185
/
31-27-28D.     2483. 2430.  2295
           TOP SOIL.    0.     2          RCOD=0.55
           SDY CLAY.    2.    25          Kw=82.1
               CLAY.   25.    45
               CLSS.   45.    53
               SDGL.   53.    77
          FIMC SAND.   77.    90
               LIME.   90.   100
          FIME SAND.  100.   117
               LIME.  117.   140
          FIMC SAND.  140.   160
               SDGL.  160.   179
               CLAY.  179.   188
/
31-27-33D.     2497. 2420.  2283
           TOP SOIL.    0.    12          RCOD=0.30
           SDY CLAY.   12.   160          Kw=19.8
               CLAY.  160.   190
           CLY SDGL.  190.   207
               CLAY.  207.   214
/
31-28-4BBB.    2640. 2554.  2212
           SDY CLAY.    0.     8          RCOD=0.39
          FIME SAND.    8.    34          Kw=91.8
           CLY SAND.   34.    40
           MED SAND.   40.    96
               CLAY.   96.   101
          FIME SAND.  101.   119
          FIMC SAND.  119.   150
               CLAY.  150.   245
               SDGL.  245.   263
               CLAY.  263.   290
          FIME SAND.  290.   340
```

	SDGL.	340.	374	
	CLAY.	374.	381	
	CLY SDGL.	381.	420	
	SDGL.	420.	428	
/				
31-28-5D.	2670.	2553.	2175	
	TOP SOIL.	0.	3	RCOD=0.39
	CLAY.	3.	10	Kw=69.8
	CLSS.	10.	21	
	FIME SAND.	21.	56	
	CLAY.	56.	72	
	SDGL.	72.	168	
	CLAY.	168.	175	
	SDGL.	175.	226	
	FINE SAND.	226.	243	
	CLAY.	243.	290	
	FIME SAND.	290.	317	
	CLAY.	317.	321	
	FIME SAND.	321.	334	
	CLAY.	334.	341	
	FIME SAND.	341.	360	
	SDGL.	360.	368	
	FIME SAND.	368.	382	
	CLAY.	382.	387	
	FIME SAND.	387.	397	
	SDY CLAY.	397.	401	
	FINE SAND.	401.	421	
	SS.	421.	459	
	LIME.	459.	475	
	SS.	475.	495	
/				
31-28-5DB.	2680.	2555.	2185	
	TOP SOIL.	0.	3	RCOD=0.67
	CLAY.	3.	10	Kw=68.5
	CLSS.	10.	21	
	FIME SAND.	21.	56	
	CLAY.	56.	72	
	SDGL.	72.	168	
	CLAY.	168.	175	
	SDGL.	175.	226	
	FINE SAND.	226.	243	
	CLAY.	243.	290	
	FIME SAND.	290.	317	
	CLAY.	317.	321	
	FIME SAND.	321.	334	
	CLAY.	334.	341	

FIME SAND.	341.	360		
SDGL.	360.	368		
FIMC SAND.	368.	382		
CLAY.	382.	387		
FIMC SAND.	387.	397		
SDY CLAY.	397.	401		
FINE SAND.	401.	421		
SS.	421.	495		
/				
31-28-8BBC.	2685.	2557.	2200	
TOP SOIL.	0.	5		RCOD=0.59
SDY CLAY.	5.	43		Kw=107.5
SDGL.	43.	48		
SDY CLAY.	48.	71		
SDGL.	71.	199		
CLAY.	199.	201		
SDGL.	201.	234		
CLY SDGL.	234.	246		
CLAY.	246.	260		
SDGL.	260.	277		
CLAY.	277.	303		
SDGL.	303.	320		
CLY SDGL.	320.	334		
SDGL.	334.	361		
SS.	361.	362		
SDGL.	362.	402		
CLY SDGL.	402.	412		
CLY SAND.	412.	425		
SDY CLAY.	425.	440		
CLAY.	440.	456		
SS.	456.	458		
CEMT SAND.	458.	471		
FINE SAND.	471.	482		
SDY CLAY.	482.	485		
/				
31-28-10BAA.	2635.	2530.	2135	
TOP SOIL.	0.	3		RCOD=0.54
SDY CLAY.	3.	90		Kw=82.3
CLY SDGL.	90.	100		
SDGL.	100.	155		
SDY CLAY.	155.	170		
SDGL.	170.	225		
SDY CLAY.	225.	250		
CLAY.	250.	320		
SDGL CLAY.	320.	345		
CLY SDGL.	345.	490		

```
          SDY CLAY.  490.  500
/
31-28-28ACC. 2612. 2507. 2327
          TOP SOIL.    0.    1          RCOD=0.50
          SDY CLAY.    1.   25          Kw=57.4
         FINE SAND.   25.   50
              CLAY.   50.   55
         FINE SAND.   55.   70
              CLAY.   70.  120
         FIME SAND.  120.  220
         FINE SAND.  220.  285
/
31-28-35A.   2455. 2460. 2085
          TOP SOIL.    0.    2          RCOD=0.44
              CLAY.    2.    5          Kw=29.1
         FINE SAND.    5.   20
         FIME SAND.   20.   37
              CLAY.   37.  120
          SDY CLAY.  120.  125
         FIME SAND.  125.  165
              CLAY.  165.  217
          SDY CLAY.  217.  260
         FIMC SAND.  260.  267
          SDY CLAY.  267.  280
              LIME.  280.  300
         FINE SAND.  300.  345
          SDY CLAY.  345.  350
              SDGL.  350.  360
              CLAY.  360.  370
/
31-29-4A.    2735. 2605. 2207
          TOP SOIL.    0.    4          RCOD=0.64
              CLAY.    4.   23          Kw=49.1
         FINE SAND.   23.   54
              CLAY.   54.   84
         FIMC SAND.   84.  109
              CLAY.  109.  123
         FIMC SAND.  123.  156
              CLAY.  156.  161
         FIMC SAND.  161.  245
              CLAY.  245.  261
         FIMC SAND.  261.  294
              CLAY.  294.  306
         FIMC SAND.  306.  367
              CLAY.  367.  377
         FIMC SAND.  377.  398
```

```
           CLAY.  398.  400
      FIMC SAND.  400.  408
           CLAY.  408.  528
/
31-29-4B.  2732. 2608. 2207
       TOP SOIL.    0.    4           RCOD=0.67
       SDY CLAY.    4.   30           Kw=58.4
      FINE SAND.   30.   46
       SDY CLAY.   46.   63
           CLAY.   63.   92
      FIMC SAND.   92.  109
           CLAY.  109.  121
           SDGL.  121.  152
           CLAY.  152.  155
      FIMC SAND.  155.  280
           CLAY.  280.  294
      FIME SAND.  294.  370
      FIMC SAND.  370.  404
           CLAY.  404.  480
       SDY CLAY.  480.  519
           CLAY.  519.  525
/
31-29-6A.  2737. 2615. 2267
       TOP SOIL.    0.    2           RCOD=0.62
       SDY CLAY.    2.   26           Kw=103.9
      FINE SAND.   26.   50
       SDY CLAY.   50.   70
           SDGL.   70.  106
       SDY CLAY.  106.  120
           SDGL.  120.  230
      FIMC SAND.  230.  260
           SDGL.  260.  290
       SDY CLAY.  290.  315
           CLAY.  315.  320
           SDGL.  320.  370
       SDY CLAY.  370.  380
      FIME SAND.  380.  386
       CLY SAND.  386.  393
       SDY CLAY.  393.  404
           LISD.  404.  432
      FINE SAND.  432.  454
           LISD.  454.  470
/
31-29-6BA. 2738. 2618. 2263
       TOP SOIL.    0.    3           RCOD=0.64
           CLSS.    3.   30           Kw=77.7
```

	FIMC SAND.	30.	47	
	CLAY.	47.	60	
	SDGL.	60.	110	
	CLAY.	110.	126	
	FIME SAND.	126.	133	
	CLAY.	133.	145	
	SDGL.	145.	240	
	FIMC SAND.	240.	296	
	CLAY.	296.	300	
	FIMC SAND.	300.	345	
	SDY CLAY.	345.	348	
	FIMC SAND.	348.	365	
	SDY CLAY.	365.	376	
	FIMC SAND.	376.	390	
	LIME.	390.	417	
	FINE SAND.	417.	426	
	SDY CLAY.	426.	430	
	SS.	430.	450	
	CLAY.	450.	475	
/				
31-29-9C.	2729.	2603.	2187	
	TOP SOIL.	0.	4	RCOD=0.61
	CLSS.	4.	83	Kw=50.7
	SDGL.	83.	110	
	FIME SAND.	110.	125	
	CLAY.	125.	130	
	FIME SAND.	130.	140	
	SDGL.	140.	160	
	FIME SAND.	160.	181	
	FINE SAND.	181.	191	
	CLAY.	191.	202	
	FIME SAND.	202.	225	
	CLAY.	225.	231	
	FIME SAND.	231.	244	
	CLAY.	244.	249	
	FIME SAND.	249.	268	
	CLAY.	268.	278	
	FIME SAND.	278.	302	
	CLAY.	302.	311	
	FINE SAND.	311.	317	
	CLAY.	317.	338	
	FIME SAND.	338.	360	
	FIMC SAND.	360.	382	
	FINE SAND.	382.	396	
	CLAY.	396.	401	
	FINE SAND.	401.	407	

```
             CLAY.  407.  418
        FIMC SAND.  418.  434
             CLAY.  434.  441
        FIME SAND.  441.  454
             CLAY.  454.  458
        FIMC SAND.  458.  465
             CLAY.  465.  490
         SDY CLAY.  490.  520
             CLAY.  520.  542
/
31-29-27BBB. 2702. 2588. 2231
         TOP SOIL.    0.    8          RCOD=0.65
         SDY CLAY.    8.   72          Kw=-98.2
             SDGL.   72.   91
         SDY CLAY.   91.  103
             SDGL.  103.  132
        CEMT SDGL.  132.  136
             SDGL.  136.  149
             CLAY.  149.  166
             SDGL.  166.  258
         CLY SDGL.  258.  267
        FIME SAND.  267.  275
             SDGL.  275.  334
             CLAY.  334.  348
             SDGL.  348.  355
             CLAY.  355.  361
             SDGL.  361.  366
         SDY CLAY.  366.  377
             SDGL.  377.  382
         SDY CLAY.  382.  417
        FINE SAND.  417.  427
         SDY CLAY.  427.  471
/
31-29-30DCC. 2735. 2604. 2272
         TOP SOIL.    0.    3          RCOD=0.51
             CLAY.    3.  101          Kw=91.3
        CEMT SAND.  101.  115
             SDGL.  115.  141
         SDY CLAY.  141.  150
        FIMC SAND.  150.  190
         SDY CLAY.  190.  231
        FIMC SAND.  231.  240
             SDGL.  240.  359
         SDY CLAY.  359.  362
             SDGL.  362.  371
         SDY CLAY.  371.  380
```

SDGL.	380.	386	
SDY CLAY.	386.	410	
FINE SAND.	410.	438	
SDY CLAY.	438.	442	
FINE SAND.	442.	463	
/			
31-29-36ACC. 2692.	2551.	2206	
TOP SOIL.	0.	4	RCOD=0.64
CLAY.	4.	83	Kw=92.3
SDGL.	83.	137	
CLAY.	137.	156	
SDGL.	156.	202	
CLY SDGL.	202.	213	
SDGL.	213.	337	
CLAY.	337.	405	
SDGL.	405.	412	
SDY CLAY.	412.	417	
CLY SDGL.	417.	431	
SDY CLAY.	431.	486	
/			
31-30-3CD. 2757.	2633.	2264	
TOP SOIL.	0.	2	RCOD=0.62
CLSS.	2.	10	Kw=82.1
CLAY.	10.	45	
SDY CLAY.	45.	72	
FIME SAND.	72.	86	
SDY CLAY.	86.	95	
FIME SAND.	95.	115	
SDGL.	115.	188	
CLAY.	188.	192	
FIME SAND.	192.	291	
CLAY.	291.	296	
FIMC SAND.	296.	305	
SDGL.	305.	320	
FIME SAND.	320.	340	
SDGL.	340.	367	
CLAY.	367.	371	
SDGL.	371.	383	
SDY CLAY.	383.	400	
CLAY.	400.	455	
SDY CLAY.	455.	475	
SDGL.	475.	485	
CLAY.	485.	493	
/			
31-30-4BB. 2783.	2642.	2261	
TOP SOIL.	0.	2	RCOD=0.70

	CLSS.	2.	82	Kw=66.4
	MED SAND.	82.	98	
	CLAY.	98.	101	
	SDGL.	101.	186	
	SDGL.	186.	261	
	CLAY.	261.	270	
	FIME SAND.	270.	410	
	CLAY.	410.	502	
	SDGL.	502.	522	
/				
31-30-5BB.	2792.	2648.	2279	
	TOP SOIL.	0.	3	RCOD=0.64
	CLSS.	3.	96	Kw=78.8
	SDGL.	96.	116	
	CLAY.	116.	120	
	SDGL.	120.	187	
	CLAY.	187.	209	
	FIMC SAND.	209.	249	
	SDGL.	249.	297	
	CLAY.	297.	300	
	FIMC SAND.	300.	320	
	SDGL.	320.	353	
	CLAY.	353.	360	
	FIMC SAND.	360.	380	
	SDY CLAY.	380.	389	
	FIMC SAND.	389.	394	
	SDY CLAY.	394.	400	
	FIMC SAND.	400.	414	
	SDY CLAY.	414.	478	
	SS.	478.	500	
	LIME.	500.	513	
/				
31-30-6BBB.	2805.	2653.	2275	
	TOP SOIL.	0.	1	RCOD=0.65
	SDY CLAY.	1.	8	Kw=99.7
	FIME SAND.	8.	12	
	CLY SAND.	12.	97	
	SDGL.	97.	108	
	CLAY.	108.	110	
	SDGL.	110.	342	
	CLY SAND.	342.	360	
	CLAY.	360.	391	
	FIMC SAND.	391.	412	
	CLY SAND.	412.	420	
	FIMC SAND.	420.	431	
	CLY SAND.	431.	450	

CLAY.	450.	470	
CLY SAND,	470.	513	
CLAY.	513,	530	
/			
31-30-7C, 2792,	2644,	2280	
TOP SOIL,	0.	4	RCOD=0.58
CLAY,	4,	40	Kw=67.1
CLSS,	40,	105	
SDGL,	105,	116	
CLAY,	116,	130	
FIME SAND.	130,	163	
CLAY,	163,	169	
SDGL,	169.	192	
FIMC SAND,	192,	216	
CLAY,	216,	230	
FIMC SAND,	230,	300	
SDGL,	300,	325	
CLAY,	325,	340	
FIMC SAND,	340.	356	
SDY CLAY.	356,	360	
FIMC SAND,	360,	387	
SDY CLAY,	387,	396	
FIMC SAND,	396,	400	
SDY CLAY,	400,	440	
CLAY,	440,	460	
FINE SAND,	460.	475	
SDY CLAY.	475,	480	
SDGL.	480,	497	
CLAY,	497,	500	
SDY CLAY,	500,	512	
/			
31-30-8BAB. 2787,	2643,	2273	
TOP SOIL,	0.	2	RCOD=0.56
CLAY,	2,	60	Kw=97.2
CLSS,	60,	72	
FIMC SAND,	75,	90	
CLAY,	90,	95	
SDGL,	95,	110	
CLAY,	110,	119	
SDGL,	119,	137	
SDY CLAY,	137,	158	
SDGL,	158,	206	
SDY CLAY,	206,	210	
FIMC SAND,	210,	220	
SDGL,	220,	246	
SDY CLAY,	246,	251	

	CEMT SDGL,	251,	258	
	SDGL,	258,	278	
	SDY CLAY,	278,	289	
	FIMC SAND,	289,	310	
	SDGL,	310,	335	
	SDY CLAY,	335,	345	
	SDGL,	345,	396	
	SDY CLAY,	396,	420	
	FINE SAND,	420,	475	
	SDGL,	475,	490	
	SDY CLAY,	490,	500	
	LIME,	500,	514	
/				
31-30-16A,	2760,	2632,	2255	
	TOP SOIL,	0,	2	RCOD=0.56
	CLAY,	2,	67	Kw=69.3
	FIMC SAND,	67,	117	
	SDGL,	117,	152	
	CLAY,	152,	166	
	FIME SAND,	166,	207	
	CLAY,	207,	221	
	FIME SAND,	221,	250	
	FIMC SAND,	250,	359	
	SDGL,	359,	380	
	FIMC SAND,	380,	411	
	SDY CLAY,	411,	420	
	FINE SAND,	420,	440	
	CLAY,	440,	452	
	FINE SAND,	452,	460	
	CLAY,	460,	473	
	FINE SAND,	473,	484	
	FIME SAND,	484,	489	
	SDY CLAY,	489,	501	
	SS,	501,	505	
/				
31-30-16DCB,	2762,	2630,	2265	
	TOP SOIL,	0,	2	RCOD=0.43
	CLAY,	2,	75	Kw=53.0
	FIMC SAND,	75,	85	
	SDGL,	85,	95	
	CLAY,	95,	107	
	FIME SAND,	107,	142	
	CLAY,	142,	151	
	FIME SAND,	151,	197	
	CLY SDGL,	197,	300	
	SDGL,	300,	327	

```
             CLAY,  327,  334
         CLY SDGL,  334,  345
         SDY CLAY,  345,  367
             SDGL,  367,  393
         SDY CLAY,  393,  397
        FIMC SAND,  397,  405
         SDY CLAY,  405,  426
         CLY SAND,  426,  470
        FIMC SAND,  470,  480
             CLAY,  480,  482
             SDGL,  482,  490
         SDY CLAY,  490,  497
/
31-30-23DCB, 2754, 2617, 2298
         TOP SOIL,    0,    3         RCOD=0.60
             CLAY,    3,   81         Kw=67.3
         CLY SDGL,   81,  119
         SDY CLAY,  119,  146
         CLY SDGL,  146,  161
         SDY CLAY,  161,  171
         CLY SDGL,  171,  241
             CLAY,  241,  247
        FIMC SAND,  247,  261
             SDGL,  261,  318
             CLAY,  318,  391
         SDY CLAY,  391,  420
        FIME SAND,  420,  445
         SDY CLAY,  445,  456
/
31-30-17DDB, 2775, 2634, 2284
         TOP SOIL,    0,    2         RCOD=0.57
         SDY CLAY,    2,   80         Kw=92.3
             SDGL,   80,  160
             CLAY,  160,  198
             SDGL,  198,  231
             CLAY,  231,  248
             SDGL,  248,  258
         SDY CLAY,  258,  261
             SDGL,  261,  394
             LIME,  394,  402
             CLAY,  402,  474
        FINE SAND,  474,  480
             CLAY,  480,  491
/
31-30-20B,   2760, 2634, 2283
         TOP SOIL,    0,    3         RCOD=0.60
```

SDY CLAY,	3,	59		Kw=55.1
SDGL,	59,	487		
CLAY,	64,	71		
FIMC SAND,	71,	78		
SDY CLAY,	78,	81		
FIME SAND,	81,	97		
SDY CLAY,	97,	102		
FIMC SAND,	102,	137		
CLY SAND,	137,	156		
SDGL,	156,	175		
SDY CLAY,	175,	189		
FIMC SAND,	189,	196		
SDY CLAY,	196,	202		
FIMC SAND,	202,	269		
SDY CLAY,	269,	281		
CLAY,	281,	304		
FIMC SAND,	304,	342		
SDGL,	342,	361		
SDY CLAY,	361,	395		
LIME,	395,	412		
SDY CLAY,	412,	432		
FINE SAND,	432,	454		
LIME,	454,	477		
/				
31-30-21DCC,	2757,	2626,	2272	
TOP SOIL,	0,	2		RCOD=0.64
SDY CLAY,	2,	42		Kw=63.5
FIME SAND,	42,	45		
CLSS,	45,	100		
FIMC SAND,	100,	107		
CLAY,	107,	138		
FIMC SAND,	138,	185		
SDY CLAY,	185,	196		
FIMC SAND,	196,	220		
SDY CLAY,	220,	245		
SDGL,	245,	340		
SDY CLAY,	340,	360		
SDGL,	360,	370		
SDY CLAY,	370,	420		
CLAY,	420,	440		
SDY CLAY,	440,	470		
SDGL,	470,	485		
/				
31-30-24CBC,	2750,	2615,	2255	
TOP SOIL,	0,	4		RCOD=0.56
CLAY,	4,	80		Kw=86.6

FIMC SAND,	80.	94		
SDY CLAY,	94,	110		
FIMC SAND,	110,	142		
SDY CLAY,	142,	158		
FIMC SAND,	158,	192		
CEMT SAND,	192,	212		
FIMC SAND,	212,	223		
SDGL,	223,	358		
SDY CLAY,	358,	380		
SDGL,	380,	394		
SDY CLAY,	394,	455		
FINE SAND,	455,	474		
SDY CLAY,	474,	480		
FINE SAND,	480,	495		
/				
31-30-28C,	2754,	2625,	2277	
TOP SOIL,	0,	6		RCOD=0.45
CLAY,	6,	91		Kw=44.3
CLY SAND,	91,	152		
SDY CLAY,	152,	198		
FIMC SAND,	198,	208		
CLAY,	208,	232		
FIMC SAND,	232,	260		
CLAY,	260,	270		
FIMC SAND,	270,	317		
CLAY,	317,	340		
CLY SAND,	340,	410		
SDY CLAY,	410,	460		
SDGL,	460,	477		
/				
31-30-29CBA,	2765,	2631,	2259	
TOP SOIL,	0.	2		RCOD=0.42
CLY SAND,	2,	26		Kw=60.2
CLSS,	26,	53		
CLAY,	53,	94		
SDGL,	94,	124		
CLAY,	124,	163		
FINE SAND,	163,	165		
FIME SAND,	165,	191		
CEMT SAND,	191,	193		
FINE SAND,	193,	194		
CLAY,	194,	212		
FINE SAND,	212,	218		
CLAY,	218,	224		
FIME SAND,	224,	233		
CLAY,	233,	253		

```
         FINE SAND,  253,  262
         FIMC SAND,  262,  288
              CLAY,  288,  293
         FIME SAND,  293,  302
              CLAY,  302,  312
         FIMC SAND,  312,  331
         FIME SAND,  331,  362
              SDGL,  362,  413
         FIME SAND,  413,  422
              LIME,  422,  442
              CLAY,  442,  472
              SDGL,  472,  490
              LIME,  490,  506
/
31-30-30BCC, 2773, 2634, 2274
          TOP SOIL,    0,    2          RCOD=0.55
              CLAY,    2,   74          Kw=52.7
              SDGL,   74,   81
              CLAY,   81,   86
         FIME SAND,   86,   96
              CLAY,   96,  105
              SDGL,  105,  140
          SDY CLAY,  140,  150
         FIME SAND,  150,  178
              CLAY,  178,  181
         FIMC SAND,  181,  255
              CLAY,  255,  261
         FIME SAND,  261,  304
              CLAY,  304,  322
          SDY CLAY,  322,  332
         FIME SAND,  332,  372
          SDY CLAY,  372,  378
         FIMC SAND,  378,  383
          SDY CLAY,  383,  396
              SDGL,  396,  402
          SDY CLAY,  402,  419
              CLAY,  419,  470
              SDGL,  470,  488
              CLAY,  488,  499
/
31-30-32D,    2760, 2623, 2242
          TOP SOIL,    0,    3          RCOD=0.49
          SDY CLAY,    3,  122          Kw=51.6
              CLAY,  122,  134
         FIMC SAND,  134,  176
              CLAY,  176,  186
```

```
           SDY CLAY.  186.  220
           CLY SAND,  220.  360
               CLAY.  360,  376
               SDGL,  376,  400
           CLY SAND.  400,  480
          FIME SAND.  480,  496
               CLAY.  496,  518
/
31-30-34BD.    2763, 2616, 2320
           TOP SOIL,    0,    2        RCOD=0.56
               CLAY,    2,  100        Kw=92.8
           SDY CLAY,  100,  120
               CLAY,  120,  126
               SDGL,  126,  145
               CLAY,  145,  176
               SDGL,  176,  215
               CLAY,  215.  226
               SDGL,  226,  264
               CLAY,  264,  270
               SDGL,  270,  337
               CLAY,  337,  360
               SDGL,  360,  379
           SDY CLAY,  379,  407
          FINE SAND,  407,  420
               CLAY.  420,  443
/
31-30-35BBB.   2760. 2515. 2264
           TOP SOIL,    0.   22        RCOD=0.62
           SDY CLAY,   22.  143        Kw=40.4
          FIMC SAND,  143.  198
           SDY CLAY.  198,  218
          FIMC SAND.  218,  262
           SDY CLAY.  262.  286
          FIMC SAND.  286,  348
           SDY CLAY,  348,  390
          FIMC SAND,  390,  420
               CLAY,  420,  496
/
```

32-26-4AAB.	2470.	2379.	2314	
TOP SOIL.		0.	4	RCOD=0.38
LIMY CLAY.		4.	5	Kw=68.4
CEMT SILT.		5.	8	
CLAY.		8.	23	
SDGL CLAY.		23.	32	
SDGL.		32.	43	
CEMT SILT.		43.	53	
SDGL.		53.	56	
CLAY.		56.	57	
CEMT SILT.		57.	117	
SDGL.		117.	124	
CLY SDGL.		124.	156	
CLAY.		156.	159	
/				
32-26-9ACA.	2430.	2360.	2254	
TOP SOIL.		0.	2	RCOD=0.34
CLAY.		2.	20	Kw=62.5
CEMT SAND.		20.	72	
CLAY.		72.	114	
MED SAND.		114.	132	
SDGL.		132.	161	
CEMT SAND.		161.	176	
/				
32-26-9BDD.	2450.	2362.	2374	
FIME SAND.		0.	8	RCOD=**
SDY CLAY.		8.	65	Kw=**
FIME SAND.		65.	76	
/				
32-26-13D.	2330.	2290.	2137	
TOP SOIL.		0.	10	RCOD=0.18
CLAY.		10.	75	Kw=36.3
SDY CLAY.		75.	165	
SDGL.		165.	193	
/				
32-26-18ABB.	2480.	2359.	2312	
TOP SOIL.		0.	3	RCOD=0.65
CLAY.		3.	37	Kw=87.9
SDY CLAY.		37.	71	
CLAY.		71.	110	
SDY CLAY.		110.	125	
SDGL.		125.	150	
CLAY.		150.	168	
/				
32-26-21DDC.	2320.	2305.	2262	
TOP SOIL.		0.	4	RCOD=0.50

CLAY.	4.	12		Kw=80.0
MED SAND.	12.	58		
/				
32-26-22DDD.	2295.	2280.	2240	
TOP SOIL.	0.	1		RCOD=0.49
SDY CLAY.	1.	7		Kw=89.9
FIME SAND.	7.	28		
CLAY.	28.	32		
SDGL.	32.	48		
SDGL CLAY.	48.	55		
/				
32-27-1AD.	2491.	2395.	2315	
TOP SOIL.	0.	3		RCOD=0.21
CLAY.	3.	85		Kw=34.4
FIMC SAND.	85.	92		
CLAY.	92.	142		
FIMC SAND.	142.	146		
CLAY.	146.	152		
SS.	152.	160		
SDGL.	160.	173		
CLAY.	173.	176		
/				
32-27-2ADD.	2500.	2401.	2315	
TOP SOIL.	0.	3		RCOD=0.20
CLAY.	3.	17		Kw=54.8
FINE SAND.	17.	19		
SDY CLAY.	19.	55		
FINE SAND.	55.	60		
SDGL.	60.	85		
CEMT SILT.	85.	86		
SDGL.	86.	93		
CLAY.	93.	130		
SDY CLAY.	130.	140		
CLAY.	140.	144		
FINE SAND.	144.	151		
SDY CLAY.	151.	160		
SDGL.	160.	185		
/				
32-27-9DC.	2540.	2405.	2305	
TOP SOIL.	0.	2		RCOD=0.35
CLAY.	2.	98		Kw=60.5
SDY CLAY.	98.	104		
CORS SAND.	104.	165		
CLAY.	165.	195		
MED SAND.	195.	235		
/				

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32-27-10ABA. 2515. 2405. 2315
         TOP SOIL.    0.   10          RCOD=0.18
             CLAY.   10.   60          Kw=35.6
         SDY CLAY.   60.  160
             CLAY.  160.  180
         CLY SDGL.  180.  190
             SDGL.  190.  200
/
32-27-15ABB. 2530. 2390. 2315
         SDY CLAY.    0.   25          RCOD=0.28
             CLAY.   25.   75          Kw=61.5
         MED SAND.   75.   80
             CLAY.   80.  110
             SDGL.  110.  130
        CEMT SAND.  130.  138
             CLAY.  138.  145
         SDY CLAY.  145.  178
             SDGL.  178.  190
             CLAY.  190.  198
         CLY SDGL.  198.  205
             SDGL.  205.  215
/
32-27-17DAA. 2530. 2403. 2290
         TOP SOIL.    0.    8          RCOD=0.32
             CLAY.    8.   68          Kw=41.1
         CLY SDGL.   68.  132
         SDY CLAY.  132.  206
         CLY SDGL.  206.  240
/
32-27-19BB.  2528. 2405. 2278
         TOP SOIL.    0.    2          RCOD=0.55
             CLAY.    2.   63          Kw=62.3
         SDY CLAY.   63.  115
        FIMC SAND.  115.  160
        FINE SAND.  160.  200
        FIMC SAND.  200.  235
         SDY CLAY.  235.  250
/
32-27-22CDD. 2487. 2365. 2294
         TOP SOIL.    0.    8          RCOD=0.34
             CLAY.    8.   43          Kw=47.1
        FIME SAND.   43.   62
             CLAY.   62.  105
         MED SAND.  105.  110
             CLAY.  110.  147
        FIME SAND.  147.  193
```

```
/
32-27-25ABD. 2490. 2339. 2292
         TOP SOIL.    0.    5          RCOD=0.42
             CLAY.    5.  103          Kw=137.4
         SDY CLAY.  103.  120
        CEMT SAND.  120.  150
             CLAY.  150.  157
             SDGL.  157.  198
/
32-27-27DCC. 2397. 2353. 2224
         TOP SOIL.    0.    5          RCOD=0.57
             CLAY.    5.   20          Kw=99.4
        FINE SAND.   20.   26
             CLAY.   26.   40
             SDGL.   40.   60
         CLY SDGL.   60.  140
         MED SAND.  140.  165
             CLAY.  165.  170
         MED SAND.  170.  173
/
32-27-30BBA. 2523. 2397. 2298
         TOP SOIL.    0.    5          RCOD=0.46
         SDY CLAY.    5.   97          Kw=22.5
         CLY SAND.   97.  118
         SDY CLAY.  118.  167
         CLY SAND.  167.  198
         SDY CLAY.  198.  225
/
32-27-31DC.  2500. 2375. 2253
         TOP SOIL.    0.    2          RCOD=0.33
             CLSS.    2.    6          Kw=72.7
             LIME.    6.   21
             CLAY.   21.   39
             SDGL.   39.   60
             CLAY.   60.   65
        FIMC SAND.   65.   90
             CLAY.   90.   95
         SDY CLAY.   95.  106
        FIME SAND.  106.  127
             CLAY.  127.  139
        FIME SAND.  139.  160
             CLAY.  160.  165
         SDY CLAY.  165.  184
             SDGL.  184.  190
             CLAY.  190.  210
             SDGL.  210.  247
```

```
/
32-27-33BAB. 2480. 2365. 2310
        TOP SOIL.    0.   10          RCOD=0.38
        SDY CLAY.   10.   35          Kw=120.0
            SDGL.   35.   42
        CLY SAND.   42.  120
              SS.  120.  137
            SDGL.  137.  170
/
32-27-34BDB. 2440. 2352. 2290
        TOP SOIL.    0.    4          RCOD=0.49
       FINE SAND.    4.   32          Kw=77.7
        SDY CLAY.   32.   90
        MED SAND.   90.  150
/
32-28-1CBB.  2440. 2430. 2126
        TOP SOIL.    0.    3          RCOD=0.45
       FINE SAND.    3.    9          Kw=28.0
        SDY CLAY.    9.   45
            CLAY.   45.   97
       FINE SAND.   97.  105
            SDGL.  105.  116
            CLAY.  116.  133
        CLY SDGL.  133.  147
        SDY CLAY.  147.  174
            SDGL.  174.  177
        SDY CLAY.  177.  201
            SDGL.  201.  207
            CLAY.  207.  253
       FINE SAND.  253.  262
            CLAY.  262.  294
        CLY SAND.  294.  300
            SDGL.  300.  307
            CLAY.  307.  308
        SDY CLAY.  308.  314
/
32-28-2A.    2455. 2448. 2084
        TOP SOIL.    0.    2          RCOD=0.27
            CLSS.    2.   16          Kw=27.1
            CLAY.   16.  159
        SDY CLAY.  159.  170
            CLAY.  170.  200
        SDY CLAY.  200.  231
       FIME SAND.  231.  235
        SDY CLAY.  235.  244
       FIMC SAND.  244.  280
```

	SDY CLAY.	280.	290	
	FIMC SAND.	290.	299	
	SDY CLAY.	299.	304	
	SDGL.	304.	314	
	SDY CLAY.	314.	321	
	SDGL.	321.	331	
	SDY CLAY.	331.	336	
	LISD.	336.	371	
/				
32-28-4DD.	2540.	2482.	2176	
	CLAY.	0.	5	RCOD=0.42
	SDY CLAY.	5.	11	Kw=33.3
	CLAY.	11.	72	
	SS.	72.	83	
	CLAY.	83.	90	
	CLSS.	90.	115	
	SDY CLAY.	115.	128	
	FIME SAND.	128.	135	
	CLAY.	135.	145	
	FIME SAND.	145.	158	
	CLAY.	158.	160	
	FIME SAND.	160.	173	
	CLAY.	173.	184	
	CLY SAND.	184.	189	
	CLAY.	189.	192	
	FIME SAND.	192.	201	
	CLAY.	201.	212	
	FIME SAND.	212.	217	
	CLAY.	217.	219	
	FIME SAND.	219.	225	
	SDY CLAY.	225.	238	
	FIMC SAND.	238.	240	
	SDY CLAY.	240.	257	
	SDGL.	257.	268	
	CLAY.	268.	270	
	FIME SAND.	270.	285	
	SDY CLAY.	285.	300	
	CLAY.	300.	312	
	FINE SAND.	312.	346	
	LIME.	346.	357	
	FINE SAND.	357.	364	
/				
32-28-10BAA.	2500.	2460.	2090	
	TOP SOIL.	0.	2	RCOD=0.37
	SDY CLAY.	2.	7	Kw=34.4
	CLSS.	7.	65	

CLAY.		65.	120	
CLSS.		120.	155	
FIME SAND.		155.	160	
SDY CLAY.		160.	170	
FIME SAND.		170.	175	
SDY CLAY.		175.	180	
FIME SAND.		180.	188	
CLAY.		188.	192	
FIMC SAND.		192.	210	
CLAY.		210.	252	
SDGL.		252.	259	
SDY CLAY.		259.	272	
SDGL.		272.	280	
SDY CLAY.		280.	300	
SDGL.		300.	316	
SDY CLAY.		316.	322	
SDGL.		322.	327	
SDY CLAY.		327.	340	
FINE SAND.		340.	347	
SDY CLAY.		347.	370	
LIME.		370.	400	
SDGL.		400.	410	
/				
32-28-14DDD.	2510.	2420.	2233	
TOP SOIL.		0.	1	RCOD=0.55
CEMT SILT.		1.	40	Kw=35.8
FINE SAND.		40.	70	
CLAY.		70.	90	
CLY SAND.		90.	180	
SDY CLAY.		180.	200	
CLAY.		200.	220	
CLY SAND.		220.	255	
FIME SAND.		255.	277	
/				
32-28-22ADD.	2425.	2420.	1983	
TOP SOIL.		0.	3	RCOD=0.30
CLAY.		3.	35	Kw=63.9
FINE SAND.		35.	45	
CLAY.		45.	175	
SDGL.		175.	190	
CLAY.		190.	205	
CLY SAND.		205.	250	
SDGL.		250.	278	
FINE SAND.		278.	282	
CLY SDGL.		282.	318	
FINE SAND.		318.	321	

CLY SDGL.	321.	411		
SDGL.	411.	434		
CLY SDGL.	434.	442		
/				
32-28-23CCA.	2415.	2409.	2114	
TOP SOIL.	0.	3		RCOD=0.41
CLAY.	3.	54		Kw=66.4
FINE SAND.	54.	64		
SDGL.	64.	73		
CLAY.	73.	79		
SDGL.	79.	93		
CLAY.	93.	121		
SDGL.	121.	128		
CLAY.	128.	143		
SDGL.	143.	179		
SDY CLAY.	179.	186		
CLY SAND.	186.	206		
SDY CLAY.	206.	221		
FINE SAND.	221.	240		
SDY CLAY.	240.	266		
SDGL.	266.	301		
/				
32-28-24CC.	2537.	2385.	2255	
TOP SOIL.	0.	3		RCOD=0.52
CLSS.	3.	75		Kw=70.3
FIMC SAND.	75.	103		
CLAY.	103.	142		
SDGL.	142.	178		
CLAY.	178.	195		
SDY CLAY.	195.	200		
CLAY.	200.	213		
FIMC SAND.	213.	225		
CLAY.	225.	256		
SDGL.	256.	275		
CORS SAND.	275.	282		
/				
32-28-33CDA.	2405.	2420.	2071	
TOP SOIL.	0.	1		RCOD=0.40
SDY CLAY.	1.	23		Kw=10.9
CLAY.	23.	160		
CEMT SAND.	160.	210		
CLAY.	210.	235		
MED SAND.	235.	240		
CLAY.	240.	295		
FINE SAND.	295.	300		
CLSS.	300.	312		

```
           MED SAND.  312.  318
               CLAY.  318.  334
/
32-28-33DDB. 2393. 2410. 2252
           TOP SOIL.    0.    1          RCOD=0.35
               CLAY.    1.    8          Kw=26.0
          FINE SAND.    8.   10
           SDY CLAY.   10.   60
          FINE SAND.   60.   75
           SDY CLAY.   75.  105
           MED SAND.  105.  125
           SDY CLAY.  125.  138
           MED SAND.  138.  141
/
32-28-34BDB. 2410. 2372. 2287
           TOP SOIL.    0.    1          RCOD=0.46
               CLAY.    1.   15          Kw=47.5
          FINE SAND.   15.   65
               CLAY.   65.   85
          CORS SAND.   85.  108
               CLAY.  108.  115
          CORS SAND.  115.  120
           SDY CLAY.  120.  123
/
32-28-34CBB. 2410. 2371. 2255
           TOP SOIL.    0.    1          RCOD=0.43
               CLAY.    1.   44          Kw=60.4
           MED SAND.   44.   60
               CLAY.   60.   84
           MED SAND.   84.  120
          CORS SAND.  120.  140
               CLAY.  140.  144
           MED SAND.  144.  155
/
32-28-35BDD. 2535. 2377. 2355
           TOP SOIL.    0.    2          RCOD=0.39
               CLAY.    2.    6          Kw=30.0
          FINE SAND.    6.   25
           SDY CLAY.   25.   35
           MED SAND.   35.   90
           SDY CLAY.   90.  132
           MED SAND.  132.  160
           SDY CLAY.  160.  178
               SDGL.  178.  180
/
32-28-35CCD. 2540. 2377. 2302
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```
          TOP SOIL.     0.    8        RCOD=0.43
         CEMT SILT.     8.   40        Kw=27.5
          SDY CLAY.    40.  100
         FINE SAND.   100.  120
          SDY CLAY.   120.  200
          MED SAND.   200.  220
              CLAY.   220.  238
/
32-29-9B.     2700.  2570. 2212
          TOP SOIL.     0.   10        RCOD=0.56
          SDY CLAY.    10.   43        Kw=88.1
              SDGL.    43.   76
              CLAY.    76.  164
              SDGL.   164.  172
              CLAY.   172.  178
         FIME SAND.   178.  185
              SDGL.   185.  198
          SDY CLAY.   198.  216
              SDGL.   216.  380
          SDY CLAY.   380.  488
/
32-29-14DB.   2570.  2542. 2195
          TOP SOIL.     0.   20        RCOD=0.34
              CLAY.    20.   40        Kw=30.3
          SDY CLAY.    40.   60
         FINE SAND.    60.   70
         CEMT SAND.    70.   74
              FCLAY.   74.  140
          SDY CLAY.   140.  200
          CLY SAND.   200.  375
/
32-29-20AAA.  2710.  2566. 2210
          TOP SOIL.     0.    3        RCOD=0.64
          SDY CLAY.     3.    7        Kw=45.7
              CLSS.     7.   41
              SDGL.    41.   57
              CLAY.    57.   85
              SDGL.    85.  109
              CLAY.   109.  119
         FIME SAND.   119.  185
              CLAY.   185.  190
         FIME SAND.   190.  201
              CLAY.   201.  205
          CLY SAND.   205.  210
              CLAY.   210.  212
         FIMC SAND.   212.  225
```

	CLAY.	225.	227	
CEMT	SAND.	227.	233	
FIMC	SAND.	233.	301	
	CLAY.	301.	311	
CLY	SAND.	311.	317	
	CLAY.	317.	323	
FIMC	SAND.	323.	370	
	CLAY.	370.	374	
FIMC	SAND.	374.	376	
	CLAY.	376.	420	
FIMC	SAND.	420.	430	
	CLAY.	430.	500	
/				
32-29-31ACA.	2705.	2562.	2195	
TOP	SOIL.	0.	3	RCOD=0.55
SDY	CLAY.	3.	112	Kw=119.9
FIME	SAND.	112.	120	
SDY	CLAY.	120.	128	
	SDGL.	128.	207	
CLY	SDGL.	207.	213	
SDY	CLAY.	213.	228	
CLY	SDGL.	228.	260	
	SDGL.	260.	287	
CLY	SDGL.	287.	307	
	SDGL.	307.	381	
CLY	SDGL.	381.	410	
	SDGL.	410.	440	
CLY	SDGL.	440.	460	
	CLAY.	460.	472	
CLY	SAND.	472.	510	
/				
32-29-31CB.	2707.	2564.	2247	
TOP	SOIL.	0.	2	RCOD=0.60
	CLAY.	2.	41	Kw=59.2
	SDGL.	41.	56	
	CLAY.	56.	70	
FIMC	SAND.	70.	128	
	CLAY.	128.	140	
FIMC	SAND.	140.	259	
	CLAY.	259.	280	
FIMC	SAND.	280.	392	
	CLAY.	392.	405	
SDY	CLAY.	405.	420	
	CLAY.	420.	460	
/				
32-29-32DDD.	2700.	2552.	2212	

TOP SOIL.	0.	3		RCOD=0.63
FINE SAND.	3.	18		Kw=73.0
CLAY.	18.	92		
CLY SAND.	92.	158		
SDGL.	158.	220		
FIMC SAND.	220.	322		
CLAY.	322.	368		
CLY SAND.	368.	488		
/				
32-30-2CBA.	2755.	2603.	2273	
TOP SOIL.	0.	2		RCOD=0.59
CLAY.	2.	59		Kw=47.7
SDGL.	59.	64		
CLAY.	64.	86		
CLY SDGL.	86.	142		
FIMC SAND.	142.	167		
CLAY.	167.	170		
FIME SAND.	170.	180		
CLAY.	180.	187		
FIME SAND.	187.	202		
FIMC SAND.	202.	229		
CEMT SAND.	229.	232		
FIME SAND.	232.	262		
CLAY.	262.	270		
FIME SAND.	270.	275		
CLAY.	275.	290		
FIME SAND.	290.	298		
CLAY.	298.	303		
FIME SAND.	303.	331		
CLAY.	331.	335		
FIMC SAND.	335.	365		
CLAY.	365.	370		
CLY SDGL.	370.	379		
SDY CLAY.	379.	385		
FIMC SAND.	385.	394		
SDY CLAY.	394.	397		
CLY SDGL.	397.	402		
SDY CLAY.	402.	410		
FIMC SAND.	410.	415		
SDY CLAY.	415.	417		
LIME.	417.	425		
SDY CLAY.	425.	442		
CLAY.	442.	462		
SDY CLAY.	462.	482		
/				
32-30-7B.	2780.	2613.	2300	

TOP SOIL.	0.	3		RCOD=0.48
SDY CLAY.	3.	51		Kw=60.9
FIMC SAND.	51.	77		
CEMT SILT.	77.	125		
SDGL.	125.	162		
CLAY.	162.	170		
FIMC SAND.	170.	181		
CLAY.	181.	239		
FIMC SAND.	239.	330		
CLY SDGL.	330.	360		
SDGL.	360.	386		
CLY SDGL.	386.	401		
SDGL.	401.	411		
CLAY.	411.	480		
/				
32-30-6DA.	2769.	2625.	2258	
TOP SOIL.	0.	3		RCOD=0.60
SDY CLAY.	3.	30		Kw=74.0
CLSS.	30.	47		
SDGL.	47.	60		
CLSS.	60.	85		
SDGL.	85.	97		
CEMT SAND.	97.	100		
SDGL.	100.	129		
CLSS.	129.	133		
SDY CLAY.	133.	145		
SDGL.	145.	160		
CLAY.	160.	174		
SDGL.	174.	194		
CLAY.	194.	206		
SDGL.	206.	215		
SDY CLAY.	215.	220		
CLAY.	220.	238		
SDGL.	238.	257		
SDY CLAY.	257.	262		
SDGL.	262.	275		
CLAY.	275.	283		
SDGL.	283.	320		
CLAY.	320.	340		
SDGL.	340.	355		
CLAY.	355.	380		
SDGL.	380.	400		
CLAY.	400.	450		
FINE SAND.	450.	475		
CLAY.	475.	496		
FIMC SAND.	496.	511		

/

32-30-12BBB.	2742.	2594.	2226	
	TOP SOIL.	0.	3	RCOD=0.49
	CLSS.	3.	48	Kw=59.0
	SDGL.	48.	56	
	CLSS.	56.	80	
	SDGL.	80.	97	
	CLAY.	97.	120	
	SDGL.	120.	186	
	SDY CLAY.	186.	196	
	SDGL.	196.	306	
	CLAY.	306.	310	
	SDGL.	310.	380	
	SDY CLAY.	380.	389	
	FIMC SAND.	389.	396	
	SDY CLAY.	396.	436	
	CLAY.	436.	458	
	FINE SAND.	458.	475	
	SDY CLAY.	475.	500	
	FINE SAND.	500.	512	
	LIME.	512.	516	

/

32-30-16ABB.	2760.	2605.	2182	
	TOP SOIL.	0.	3	RCOD=0.67
	SDY CLAY.	3.	30	Kw=93.5
	CLAY.	30.	46	
	SDGL.	46.	58	
	CLSS.	58.	97	
	SDGL.	97.	113	
	CLAY.	113.	121	
	SDGL.	121.	162	
	CLAY.	162.	170	
	SDGL.	170.	206	
	CLAY.	206.	211	
	SDGL.	211.	340	
	SDY CLAY.	340.	346	
	SDGL.	346.	410	
	SDY CLAY.	410.	485	
	LIME.	485.	487	
	SDY CLAY.	487.	578	

/

32-30-17A.	2763.	2607.	2252	
	TOP SOIL.	0.	3	RCOD=0.61
	CLAY.	3.	92	Kw=60.7
	FIMC SAND.	92.	97	
	CLAY.	97.	120	

	SDGL.	120.	178	
	CLAY.	178.	187	
FIME	SAND.	187.	260	
	CLAY.	260.	275	
FINE	SAND.	275.	290	
FIMC	SAND.	290.	380	
	SDGL.	380.	407	
	CLAY.	407.	511	
/				
32-30-17BC.	2768.	2610.	2254	
TOP	SOIL.	0.	3	RCOD=0.59
	CLSS.	3.	50	Kw=114.8
	SDGL.	50.	55	
	CLSS.	55.	97	
	SDGL.	97.	123	
	CLSS.	123.	138	
	SDGL.	138.	223	
	CLAY.	223.	225	
	SDGL.	225.	230	
	CLSS.	230.	235	
	SDGL.	235.	241	
	CLAY.	241.	250	
	SDGL.	250.	276	
SDY	CLAY.	276.	280	
	CLAY.	280.	285	
	SDGL.	285.	398	
	CLAY.	398.	403	
	SDGL.	403.	440	
	CLAY.	440.	514	
/				
32-30-17CC.	2772.	2605.	2256	
TOP	SOIL.	0.	3	RCOD=0.60
SDY	CLAY.	3.	16	Kw=110.6
	CLSS.	16.	50	
	SDGL.	50.	96	
	CLSS.	96.	104	
	SDGL.	104.	126	
	CLSS.	126.	140	
	SDGL.	140.	177	
	CLAY.	177.	185	
	SDGL.	185.	210	
	CLAY.	210.	213	
	SDGL.	213.	320	
FIMC	SAND.	320.	326	
	CLAY.	326.	340	
SDY	CLAY.	340.	350	

```
                SDGL.  350.  416
                CLAY.  416.  422
                SDGL.  422.  445
                CLAY.  445.  458
                  SS.  458.  516
/
32-30-20ACC.  2767. 2598. 2307
        TOP SOIL.    0.     2          RCOD=0.54
            CLAY.    2.    49          Kw=101.0
        SDY CLAY.   49.    58
            SDGL.   58.    80
            CLAY.   80.    87
            SDGL.   87.   180
        CLY SDGL.  180.   240
            SDGL.  240.   280
        SDY CLAY.  280.   328
            SDGL.  328.   392
        CLY SDGL.  392.   432
            CLAY.  432.   455
       FIMC SAND.  455.   460
/
32-30-22BA.   2747. 2597. 2267
        TOP SOIL.    0.     4          RCOD=0.51
            CLAY.    4.    80          Kw=54.3
       FIMC SAND.   80.   182
            CLAY.  182.   192
        CLY SAND.  192.   386
        CLY SDGL.  386.   438
        SDY CLAY.  438.   480
/
32-30-21BCC.  2760. 2596. 2245
            CLAY.    0.    20          RCOD=0.55
            CLSS.   20.    35          Kw=52.2
        CLY SAND.   35.    65
            CLSS.   65.    80
       CORS SAND.   80.    95
            SDGL.   95.   110
        CLY SDGL.  110.   125
            CLAY.  125.   140
        CLY SAND.  140.   170
            CLSS.  170.   185
        CLY SAND.  185.   215
        MED SAND.  215.   238
            CLSS.  238.   240
        CLY SAND.  240.   245
        MED SAND.  245.   252
```

CLAY.	252.	255		
CLY SAND.	255.	265		
SDGL.	265.	275		
CORS SAND.	275.	290		
CLY SAND.	290.	365		
CLY SDGL.	365.	405		
CLAY.	405.	415		
CLY SAND.	415.	420		
CLSS.	420.	425		
CLAY.	425.	455		
CLSS.	455.	475		
CLY SAND.	475.	485		
CLSS.	485.	490		
CLY SAND.	490.	515		
/				
32-30-25A.	2721.	2574.	2226	
TOP SOIL.	0.	2		RCOD=0.55
CLAY.	2.	67		Kw=91.5
CLY SDGL.	67.	146		
CLAY.	146.	160		
FIMC SAND.	160.	260		
SDGL.	260.	400		
FIMC SAND.	400.	413		
CLAY.	413.	495		
/				
32-30-27C.	2743.	2584.	2249	
TOP SOIL.	0.	4		RCOD=0.52
CLY SAND.	4.	56		Kw=100.3
SDGL.	56.	70		
CLSS.	70.	89		
SDGL.	89.	180		
SDY CLAY.	180.	184		
FIMC SAND.	184.	203		
SS.	203.	204		
FIMC SAND.	204.	260		
SDY CLAY.	260.	266		
SDGL.	266.	280		
FIMC SAND.	280.	289		
SDY CLAY.	289.	310		
SDGL.	310.	410		
CLY SAND.	410.	420		
SDGL.	420.	446		
SDY CLAY.	446.	480		
LIME.	480.	494		
/				
32-30-29CAA.	2763.	2593.	2278	

TOP SOIL.	0.	1		RCOD=0.55
CLAY.	1.	61		Kw=67.8
SDGL.	61.	98		
CLAY.	98.	110		
SDY CLAY.	110.	121		
CLY SDGL.	121.	191		
CLAY.	191.	200		
CLY SDGL.	200.	221		
CLAY.	221.	260		
CLY SDGL.	260.	280		
SDGL.	280.	293		
CLAY.	293.	296		
CLY SDGL.	296.	421		
CLAY.	421.	485		
/				
32-30-31ABB.	2762.	2590.	2235	
TOP SOIL.	0.	2		RCOD=0.51
CLAY.	2.	42		Kw=76.6
FIME SAND.	42.	58		
CLAY.	58.	94		
SDGL.	94.	133		
CLAY.	133.	154		
SDGL.	154.	172		
CLAY.	172.	180		
SDGL.	180.	189		
CLAY.	189.	217		
SDGL.	217.	258		
CLAY.	258.	302		
CLY SDGL.	302.	486		
SDY CLAY.	486.	527		
/				

33-26-3BBC.	2348.	2265.	2269	
TOP SOIL.		0.	2	RCOD=**
SS.		2.	15	Kw=**
FIMC SAND.		15.	26	
SS.		26.	38	
CLAY,		38.	63	
SDGL.		63.	79	
/				
33-26-6CBD.	2285.	2300.	2248	
TOP SOIL.		0.	2	RCOD=0.47
FIMC SAND.		2,	37	Kw=75.9
/				
33-26-17BBD,	2220.	2210.	2194	
TOP SOIL,		0,	10	RCOD=0.32
SDGL.		10.	26	Kw=100.4
/				
33-26-33ABC.	2350.	2240.	2275	
TOP SOIL,		0.	3	RCOD=**
SDY CLAY.		3.	23	Kw=**
FINE SAND,		23.	40	
SDY CLAY.		40.	62	
SDGL,		62,	75	
/				
33-26-34CAC.	2300.	2229.	2230	
TOP SOIL.		0,	5	RCOD=**
CEMT SAND.		5,	40	Kw=**
CLAY,		40.	69	
SDGL.		69.	70	
/				
33-27-5CDB.	2410,	2364,	2211	
TOP SOIL,		0.	1	RCOD=0.32
CLAY.		1.	85	Kw=42.7
FINE SAND,		85,	90	
CLAY.		90,	101	
FIME SAND,		101.	111	
FINE SAND.		111,	116	
FIMC SAND,		116.	120	
CLAY,		120,	122	
FIME SAND,		122.	126	
SDY CLAY,		126.	140	
FIME SAND,		140,	160	
SDY CLAY.		160.	162	
FIMC SAND,		162.	199	
/				
33-27-6DAA.	2465.	2372.	2232	
TOP SOIL,		0.	6	RCOD=0.46

SDY CLAY,	6,	32	Kw=59.2
FINE SAND,	32,	37	
LIME,	37,	40	
CLY SAND,	40,	160	
FIMC SAND,	160,	180	
CLY SAND,	180,	210	
FIMC SAND,	210,	233	
/			
33-27-15BBB, 2456,	2331,	2270	
TOP SOIL,	0,	4	RCOD=0.50
CLAY,	4,	11	Kw=63.1
CLY SAND,	11,	34	
CLSS,	34,	51	
FINE SAND,	51,	147	
SDGL,	147,	155	
CEMT SAND,	155,	169	
FIME SAND,	169,	186	
/			
33-27-17B, 2470,	2351,	2260	
TOP SOIL,	0,	3	RCOD=0.40
CLAY,	3,	14	Kw=129.0
SDY CLAY,	14,	76	
CLAY,	76,	118	
SDY CLAY,	118,	137	
SDGL,	137,	210	
/			
33-27-26DDB, 2440,	2295,	2250	
TOP SOIL,	0,	2	RCOD=0.43
CEMT SILT,	2,	161	Kw=36.8
MED SAND,	161,	175	
CLAY,	175,	186	
MED SAND,	186,	190	
/			
33-27-28AB, 2468,	2325,	2258	
TOP SOIL,	0,	2	RCOD=0.44
CLAY,	2,	45	Kw=70.6
CEMT SILT,	45,	62	
CLAY,	62,	135	
SDY CLAY,	135,	152	
FIMC SAND,	152,	210	
/			
33-27-30DC, 2430,	2340,	2290	
TOP SOIL,	0,	2	RCOD=0.44
SDY CLAY,	2,	18	Kw=70.0
FIMC SAND,	18,	40	
SDY CLAY,	40,	90	

```
           CLY SDGL,  135,  140
/
33-27-35AAC, 2452, 2298, 2262
           TOP SOIL,    0,    2          RCOD=0.42
          CEMT SILT,    2,  161          Kw=66.4
           MED SAND,  161,  190
/
33-28-2BAC,  2530, 2378, 2302
           TOP SOIL,    0,    2          RCOD=0.44
          CEMT SILT,    2,   40          Kw=65.0
               CLAY,   40,   75
           MED SAND,   75,  110
           SDY CLAY,  110,  150
          FINE SAND,  150,  190
           MED SAND,  190,  228
/
33-28-2DBD,  2515, 2380, 2240
           TOP SOIL,    0,    2          RCOD=0.54
          CEMT SILT,    2,   60          Kw=36.6
               CLAY,   60,  160
          FINE SAND,  160,  175
           MED SAND,  175,  220
               CLAY,  220,  270
           MED SAND,  270,  275
/
33-28-3ABD,  2505, 2374, 2312
           TOP SOIL,    0,    1          RCOD=0.41
               CLSS,    1,   30          Kw=56.5
          FINE SAND,   30,   40
               CLAY,   40,   65
           MED SAND,   65,   85
           SDY CLAY,   85,  140
          FINE SAND,  140,  155
          FIME SAND,  155,  193
/
33-28-3CAA,  2500, 2373, 2345
           TOP SOIL,    0,    1          RCOD=0.50
          FINE SAND,    1,   20          Kw=70.0
               CLAY,   20,   40
           MED SAND,   40,   60
           SDY CLAY,   60,  100
          FIME SAND,  100,  155
/
33-28-4DAC,  2440, 2367, 2339
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```
               TOP SOIL,     0,     3          RCOD=0.55
               SDY CLAY,     3,    45          Kw=72.0
              FINE SAND,    45,    60
              CEMT SILT,    60,    62
              FIMC SAND,    62,    98
                   CLAY,    98,   101
/
33-28-8D,          2400,  2390,  2295
               SDY CLAY,     0,    10          RCOD=0.28
              FIME SAND,    10,    20          Kw=68.9
                   CLAY,    20,    30
               CLY SAND,    30,    70
                   SDGL,    70,   105
/
33-28-9ABA,        2412,  2367,  2362
               TOP SOIL,     0,     1          RCOD=0.50
                   CLAY,     1,     2          Kw=80.0
              FINE SAND,     2,    15
                   CLAY,    15,    20
               MED SAND,    20,    50
/
33-28-9ADB,        2440,  2366,  2304
               TOP SOIL,     0,     3          RCOD=0.29
               MED SAND,     3,    15          Kw=31.6
                   CLAY,    15,    62
              FINE SAND,    62,    70
                   CLAY,    70,    95
              FINE SAND,    95,   105
                   CLAY,   105,   120
               MED SAND,   120,   136
/
33-28-10BBA,       2490,  2370,  2365
               TOP SOIL,     0,     4          RCOD=0.50
              FINE SAND,     4,     8          Kw=80.0
                   CLAY,     8,    85
               MED SAND,    85,   125
/
33-28-11AA,        2500,  2379,  2264
               TOP SOIL,     0,     2          RCOD=0.32
              CEMT SILT,     2,    55          Kw=48.3
                   CLAY,    55,    65
              FINE SAND,    65,    85
              FIMC SAND,    85,   108
              CEMT SILT,   108,   168
              FINE SAND,   168,   180
              FIMC SAND,   180,   236
```

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/
33-28-11BCC, 2512, 2375, 2319
         TOP SOIL,     0,    4          RCOD=0.47
             CLAY,     4,  140          Kw=76.0
         MED SAND,   140,  193
/
33-28-15ADD, 2511, 2372, 2321
         TOP SOIL,     0,    7          RCOD=0.50
             CLAY,     7,   32          Kw=80.0
         CLY SAND,    32,   75
             CLAY,    75,   85
         CLY SAND,    85,  140
        FIMC SAND,   140,  190
/
33-28-18DD,  2440, 2390, 2161
         TOP SOIL,     0,    6          RCOD=0.40
        FIME SAND,     6,   12          Kw=84.0
             CLAY,    12,   66
         CLY SAND,    66,   71
             SDGL,    71,   95
             CLAY,    95,  120
             SDGL,   120,  128
             CLAY,   128,  162
         CLY SDGL,   162,  249
             SDGL,   249,  279
/
33-28-19DDD, 2375, 2362, 2112
         CLY SAND,     0,   20          RCOD=0.38
         CLY SDGL,    20,   38          Kw=71.6
             CLAY,    38,   53
         SDY CLAY,    53,   98
         MED SAND,    98,  113
             SDGL,   113,  128
         MED SAND,   128,  143
             CLAY,   143,  158
         CLY SAND,   158,  188
         SDY CLAY,   188,  203
         CLY SDGL,   203,  218
             SDGL,   218,  263
/
33-28-20AA,  2440, 2359, 2423          RCOD=**
             SDGL,     0,   17          Kw=**
/
33-28-20BA,  2360, 2365, 2154
         CLY SDGL,     0,   19          RCOD=0.43
        FIME SAND,    19,   53          Kw=55.6
```

```
                CLAY,    53,    73
                CLSS,    73,   156
            CLY SAND,   156,   165
                SDGL,   165,   201
                CLAY,   201,   206
/
33-28-21ACC, 2503, 2361, 2314
            TOP SOIL,     0,     2            RCOD=0.50
           CEMT SILT,     2,     8            Kw=80.0
                CLAY,     8,    23
            SDY CLAY,    23,    87
           FINE SAND,    87,   123
           FIMC SAND,   123,   189
/
33-28-22BBC, 2520, 2365, 2310
            TOP SOIL,     0,     2            RCOD=0.50
                CLAY,     2,    15            Kw=80.0
            SDY CLAY,    15,    26
           CEMT SILT,    26,    38
            SDY CLAY,    38,    82
            MED SAND,    82,    96
           CEMT SILT,    96,   104
            SDY CLAY,   104,   132
            MED SAND,   132,   210
/
33-28-23AAA, 2500, 2370, 2305
            TOP SOIL,     0,     8            RCOD=0.65
                CLAY,     8,    43            Kw=70.8
            MED SAND,    43,    55
                CLAY,    55,    94
           FINE SAND,    94,   110
                CLAY,   110,   125
            MED SAND,   125,   152
                CLAY,   152,   160
            MED SAND,   160,   195
/
33-28-24BAA, 2495, 2368, 2332
            TOP SOIL,     0,     2            RCOD=0.45
                CLAY,     2,    33            Kw=27.4
           FIMC SAND,    33,    55
                SDGL,    55,    71
                CLSS,    71,   107
           FIME SAND,   107,   120
            CLY SAND,   120,   129
                CLAY,   129,   144
           FIME SAND,   144,   155
```

```
                CLAY,  155,  163
/
33-28-25ABC, 2465, 2360, 2287
            TOP SOIL,    0,    4         RCOD=0.50
                CLAY,    4,   22         Kw=50.0
           FIMC SAND,   22,   40
            CLY SAND,   40,  178
/
33-28-27BC,  2490, 2359, 2288
            TOP SOIL,    0,    2         RCOD=0.27
                CLAY,    2,   42         Kw=35.6
                CLSS,   42,   68
                CLAY,   68,   79
                CLSS,   79,  118
            SDY CLAY,  118,  176
           FIMC SAND,  176,  202
/
33-29-12DDA, 2470, 2435, 2110
                CLAY,    0,   20         RCOD=0.30
            SDY CLAY,   20,   60         Kw=18.9
                CLAY,   60,  200
            SDY CLAY,  200,  220
           FIME SAND,  220,  240
                CLAY,  240,  280
           FIME SAND,  280,  320
            SDY CLAY,  320,  340
/
33-29-14CB,  2500, 2491, 2149
           FIME SAND,    0,   11         RCOD=0.41
            CLY SAND,   11,   30         Kw=120.0
                SDGL,   30,   56
                CLSS,   56,  100
           FIME SAND,  100,  150
                CLAY,  150,  152
                SDGL,  152,  351
/
33-29-18A,   2700, 2542, 2337
                CLAY,    0,   59         RCOD=0.50
           FIME SAND,   59,   74         Kw=45.3
                CLAY,   74,  101
           FIME SAND,  101,  164
            CLY SAND,  164,  243
                CLAY,  243,  276
           FIME SAND,  276,  296
            CLY SAND,  296,  363
/
```

```
33-29-20BAA, 2680, 2535, 2203
         SDY CLAY,    0,    4              RCOD=0.59
             CLAY,    4,   29              Kw=81.0
        FINE SAND,   29,   48
             CLAY,   48,   74
        FIMC SAND,   74,  165
             CLAY,  165,  170
             SDGL,  170,  258
         SDY CLAY,  258,  297
        FIME SAND,  297,  310
         CLY SAND,  310,  360
        FIME SAND,  360,  461
        CEMT SAND,  461,  477
/
33-29-23AD,  2455, 2435, 2191
         TOP SOIL,    0,    2              RCOD=0.34
         CLY SAND,    2,   19              Kw=47.9
             CLAY,   19,   21
         CLY SDGL,   21,   42
             CLAY,   42,  180
             SDGL,  180,  210
             CLAY,  210,  239
             SDGL,  239,  264
/
33-29-23BB,  2460, 2470, 2170
         CLY SAND,    0,    7              RCOD=0.46
             CLAY,    7,   52              Kw=31.4
         CLY SAND,   52,   71
        FIMC SAND,   71,  108
         SDY CLAY,  108,  140
             CLAY,  140,  240
             SDGL,  240,  260
             CLAY,  260,  280
         CLY SAND,  280,  290
/
33-29-24BBA, 2450, 2440, 2210
         TOP SOIL,    0,    5              RCOD=0.22
        FINE SAND,    5,   50              Kw=17.8
             CLAY,   50,  135
         SDY CLAY,  135,  195
             CLAY,  195,  200
             SDGL,  200,  205
             CLAY,  205,  215
         MED SAND,  215,  240
/
33-29-25BC,  2445, 2400, 2239
```

```
          TOP SOIL,     0,    2          RCOD=0.39
              CLAY,     2,   62          Kw=33.9
         CEMT SILT,    62,   83
         FINE SAND,    83,  111
              CLAY,   111,  126
         FINE SAND,   126,  135
              CLAY,   135,  142
         FINE SAND,   142,  206
/
33-29-27BDB, 2530, 2472, 1954
          TOP SOIL,     0,    3          RCOD=0.42
          SDY CLAY,     3,  294          Kw=45.3
              SDGL,   294,  370
          CLY SAND,   370,  390
          SDY CLAY,   390,  414
              SDGL,   414,  436
          CLY SAND,   436,  506
          SDY CLAY,   506,  576
/
33-29-30ABC, 2665, 2527, 2192
          TOP SOIL,     0,    3          RCOD=0.44
              CLSS,     3,   20          Kw=83.4
              CLAY,    20,   45
              SDGL,    45,   60
              CLAY,    60,   80
          CLY SDGL,    80,  220
              CLAY,   220,  240
          SDY CLAY,   240,  250
              CLAY,   250,  320
              SDGL,   320,  380
          CLY SDGL,   380,  420
         SDGL CLAY,   420,  440
              SDGL,   440,  473
/
33-29-32BCA, 2618, 2513, 2173
              CLAY,     0,   90          RCOD=0.39
          SDY CLAY,    90,  160          Kw=60.4
              CLAY,   160,  180
          MED SAND,   180,  270
         FIME SAND,   270,  330
          CLY SAND,   330,  390
         FINE SAND,   390,  420
              SDGL,   420,  445
/
33-30-1BAAA, 2715, 2564, 2210
          TOP SOIL,     0,    2          RCOD=0.58
```

CLSS,	2,	37		Kw=113.4
SDGL,	37,	57		
CLAY,	57,	100		
FIMC SAND,	100,	108		
CLAY,	108,	120		
SDGL,	120,	280		
CLY SDGL,	280,	299		
SDY CLAY,	299,	330		
SDGL,	330,	400		
CLAY,	400,	440		
SDGL,	440,	463		
CLAY,	463,	474		
FIME SAND,	474,	505		
/				
33-30-1CBBB,	2720,	2563,	2215	
TOP SOIL,	0,	2		RCOD=0.61
SDY CLAY,	2,	50		Kw=79.6
SDGL,	50,	60		
SDY CLAY,	60,	90		
FIMC SAND,	90,	102		
CLAY,	102,	110		
SDGL,	110,	214		
CLAY,	214,	217		
SDGL,	217,	240		
SDY CLAY,	240,	258		
CLY SDGL,	258,	280		
SDY CLAY,	280,	288		
FIMC SAND,	288,	300		
SDY CLAY,	300,	330		
FIMC SAND,	330,	360		
SDGL,	360,	380		
SDY CLAY,	380,	416		
CLY SDGL,	416,	444		
SDY CLAY,	444,	460		
FINE SAND,	460,	505		
/				
33-30-6BBC,	2755,	2586,	2223	
TOP SOIL,	0,	3		RCOD=0.47
SDY CLAY,	3,	40		Kw=116.6
MED SAND,	40,	45		
SDY CLAY,	45,	60		
FIME SAND,	60,	70		
CLSS,	70,	78		
SDGL,	78,	107		
CLAY,	107,	130		
SDGL,	130,	158		

SDY CLAY,	158,	163	
SDGL,	163,	243	
SDY CLAY,	243,	250	
CLAY,	250,	280	
SDY CLAY,	280,	311	
CLY SDGL,	311,	317	
CLY SAND,	317,	333	
SDGL,	333,	338	
SDY CLAY,	338,	347	
SDGL,	347,	500	
CLY SDGL,	500,	532	
/			
33-30-8B, 2740,	2564,	2232	
TOP SOIL,	0,	4	RCOD=0.61
CLAY,	4,	86	Kw=67.7
CLY SDGL,	86,	162	
CLAY,	162,	192	
SDGL,	192,	220	
CLAY,	220,	232	
SDGL,	232,	266	
CLAY,	266,	280	
CLY SDGL,	280,	330	
CLAY,	330,	336	
SDGL,	336,	348	
CLAY,	348,	380	
CLY SDGL,	380,	398	
SDY CLAY,	398,	432	
FIME SAND,	432,	450	
SDY CLAY,	450,	490	
FIMC SAND,	490,	508	
/			
33-30-12BA, 2700,	2557,	2230	
TOP SOIL,	0,	2	RCOD=0.54
CLSS,	2,	45	Kw=60.6
FIMC SAND,	45,	56	
CLSS,	56,	66	
FIMC SAND,	66,	87	
SDY CLAY,	87,	96	
FIMC SAND,	96,	233	
SDY CLAY,	233,	270	
FIME SAND,	270,	280	
FIMC SAND,	280,	340	
FIME SAND,	340,	360	
FIMC SAND,	360,	380	
FIME SAND,	380,	390	
SDY CLAY,	390,	397	

```
          FIMC SAND,  397,  405
          FINE SAND,  405,  420
          FIMC SAND,  420,  430
               LIME,  430,  450
           SDY CLAY,  450,  460
          FINE SAND,  460,  470
/
33-30-12CC,    2712, 2550, 2206
           TOP SOIL,    0,    2            RCOD=0.47
               CLSS,    2,   50            Kw=52.7
          FIMC SAND,   50,  270
           SDY CLAY,  270,  280
          FIMC SAND,  280,  292
           SDY CLAY,  292,  317
          FIMC SAND,  317,  407
           SDY CLAY,  407,  506
/
33-30-12DDA,   2708, 2548, 2369
           TOP SOIL,    0,    2            RCOD=0.55
           SDY CLAY,    2,   30            Kw=72.0
          CEMT SILT,   30,   50
           MED SAND,   50,   77
           SDY CLAY,   77,  115
           MED SAND,  115,  320
               CLAY,  320,  339
/
33-30-14BBA,   2718, 2551, 2171
           TOP SOIL,    0,    3            RCOD=0.57
               CLSS,    3,   40            Kw=58.7
          FIME SAND,   40,   51
               CLSS,   51,   66
          FIME SAND,   66,   98
               CLAY,   98,  107
          FIME SAND,  107,  280
           CLY SDGL,  280,  325
               CLAY,  325,  330
          FIME SAND,  330,  390
               CLAY,  390,  405
          FIMC SAND,  405,  425
           SDY CLAY,  425,  430
          FIME SAND,  430,  440
           SDY CLAY,  440,  460
               CLAY,  460,  500
          FIME SAND,  500,  526
               LISD,  526,  537
          FIME SAND,  537,  547
```

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/
33-30-22AAA, 2714, 2545, 2367
         TOP SOIL,    0,    5          RCOD=0.50
         SDY CLAY,    5,   63          Kw=80.0
         CLY SAND,   63,   97
         SDY CLAY,   97,  112
        FIMC SAND,  112,  347
/
33-30-24BB,  2705, 2540, 2227
         SDY CLAY,    0,    4          RCOD=0.54
             CLAY,    4,   30          Kw=112.7
        FIME SAND,   30,   55
             SDGL,   55,   77
             CLAY,   77,   98
             SDGL,   98,  216
             CLAY,  216,  223
             SDGL,  223,  244
             CLAY,  244,  261
             SDGL,  261,  300
        FIME SAND,  300,  320
             SDGL,  320,  357
             CLAY,  357,  399
             SDGL,  399,  460
             CLAY,  460,  478
/
33-30-25DAA, 2690, 2526, 2339
         SDY CLAY,    0,   10          RCOD=0.60
             CLSS,   10,   53          Kw=62.5
         CLY SAND,   53,   61
             SDGL,   61,  110
        CEMT SAND,  110,  115
         MED SAND,  115,  258
        FIME SAND,  258,  312
         SDY CLAY,  312,  351
/
33-30-28D,   2705, 2533, 2257
         SDY CLAY,    0,   36          RCOD=0.39
             CLAY,   36,   46          Kw=31.7
        FINE SAND,   46,   62
             CLAY,   62,   80
         CLY SAND,   80,  108
             CLAY,  108,  112
         CLY SAND,  112,  144
         SDY CLAY,  144,  162
         CLY SAND,  162,  176
         SDY CLAY,  176,  202
```

```
             CLAY,  202,  270
         CLY SAND,  270,  354
             CLAY,  354,  358
         CLY SAND,  358,  375
             CLAY,  375,  380
         CLY SAND,  380,  422
             CLAY,  422,  434
         CLY SAND,  434,  448
/
33-30-28ACC, 2710, 2536, 2328
         TOP SOIL,    0,    2          RCOD=0.47
        FINE SAND,    2,    4          Kw=64.5
             CLAY,    4,   29
        FIME SAND,   29,  109
             CLAY,  109,  147
         CLY SAND,  147,  174
             CLAY,  174,  209
         CLY SAND,  209,  225
             SDGL,  225,  251
         CLY SAND,  251,  261
        FIMC SAND,  261,  309
             CLAY,  309,  320
         CLY SAND,  320,  356
        FIMC SAND,  356,  382
/
33-30-29AB,  2700, 2539, 2158
         TOP SOIL,    0,    2          RCOD=0.64
             CLSS,    2,   60          Kw=70.2
             CLAY,   60,  102
             SDGL,  102,  179
         SDY CLAY,  179,  184
        FIME SAND,  184,  221
             CLAY,  221,  226
        FIME SAND,  226,  231
             CLAY,  231,  236
             SDGL,  236,  301
             CLAY,  301,  308
        FIMC SAND,  308,  341
             CLAY,  341,  349
        FIME SAND,  349,  366
             CLAY,  366,  382
             SDGL,  382,  404
             CLAY,  404,  420
         SDY CLAY,  420,  442
        FIMC SAND,  442,  448
         SDY CLAY,  448,  499
```

```
        FINE SAND,  499,  509
         SDY CLAY,  509,  522
        FINE SAND,  522,  542
/
33-30-30AAA, 2708, 2540, 2213
         TOP SOIL,    0,    3         RCOD=0.45
             CLAY,    3,   43         Kw=78.5
        CEMT SAND,   43,   49
        FINE SAND,   49,   93
             SDGL,   93,  147
             CLAY,  147,  155
         MED SAND,  155,  190
         SDY CLAY,  190,  209
        FIMC SAND,  209,  242
         CLY SAND,  242,  259
             CLAY,  259,  309
             SDGL,  309,  377
             CLAY,  377,  409
             SDGL,  409,  464
             CLAY,  464,  495
/
33-30-32ACC, 2700, 2526, 2198
         SDY CLAY,    0,    4         RCOD=0.59
             CLSS,    4,   55         Kw=68.7
        FIMC SAND,   55,  118
         CLY SAND,  118,  218
         CLY SDGL,  218,  264
             SDGL,  264,  308
         CLY SAND,  308,  382
         CLY SDGL,  382,  408
         SDY CLAY,  408,  466
         CLY SAND,  466,  502
/
33-30-35C,   2700, 2520, 2150
         CLY SAND,    0,   10         RCOD=0.53
             CLAY,   10,   38         Kw=47.3
         CLY SAND,   38,   55
             CLAY,   55,   86
        FIMC SAND,   86,  150
         CLY SAND,  150,  218
         SDY CLAY,  218,  256
        FIMC SAND,  256,  360
             CLAY,  360,  380
        FIME SAND,  380,  418
         SDY CLAY,  418,  446
             CLAY,  446,  476
```

```
          CLY SAND,   476,   550
/
33-30-35CBA, 2695, 2522, 2395
          TOP SOIL,     0,     4          RCOD=0.34
          SDY CLAY,     4,    80          Kw=46.1
          CLY SAND,    80,   162
          SDY CLAY,   162,   202
              CLAY,   202,   222
         FIME SAND,   222,   300
/
```

```
34-26-5BB.   2350. 2276. 2265
         TOP SOIL.    0.    2          RCOD=0.50
         SDY CLAY.    2.   55          Kw=80.0
        FIMC SAND.   55.   85
/
34-26-7BCA.  2442. 2292. 2297
         TOP SOIL.    0.    7          RCOD=**
         SDY CLAY.    7.  145          Kw=**
/
34-26-10ACC. 2195. 2205. 2118
         TOP SOIL.    0.    5          RCOD=0.47
        FINE SAND.    5.   30          Kw=35.4
             CLAY.   30.   50
         CLY SAND.   50.   77
/
34-26-12DDD. 2125. 2100. 1988
         TOP SOIL.    0.   10          RCOD=0.22
             CLAY.   10.   85          Kw=60.9
        FIME SAND.   85.  105
             SDGL.  105.  137
/
34-26-13AA.  2100. 2090. 2013
         TOP SOIL.    0.    2          RCOD=0.50
             CLAY.    2.   30          Kw=49.6
         CLY SDGL.   30.   65
         SDY CLAY.   65.   87
/
34-26-30A.   2297. 2278. 2167
         TOP SOIL.    0.    2          RCOD=0.27
             CLAY.    2.   65          Kw=39.5
         SDY CLAY.   65.   80
        FIMC SAND.   80.  130
/
34-27-2AAA.  2450. 2303. 2278
         TOP SOIL.    0.    3          RCOD=0.30
             CLSS.    3.  160          Kw=43.6
         MED SAND,  160.  172
/
34-27-5CAA.  2295. 2317. 2150
         TOP SOIL,    0.    5          RCOD=0.32
        FIMC SAND.    5.   18          Kw=62.9
         SDY CLAY.   18.   45
             CLAY.   45.   90
             SDGL.   90.  130
             CLAY.  130.  138
             SDGL,  138.  145
```

```
/
34-27-11BCC. 2420. 2302. 2270
          TOP SOIL.    0.    7          RCOD=0.50
              CLAY.    7.   30          Kw=20.0
          SDY CLAY.   30.   42
         CEMT SAND.   42.  150
/
34-27-13ABC. 2428. 2293. 2208
          TOP SOIL.    0.    2          RCOD=0.47
              CLAY.    2.   20          Kw=75.9
          SDY CLAY.   20.   40
         FIMC SAND.   40.   50
          SDY CLAY.   50.  140
         FIMC SAND.  140.  220
/
34-27-13ACA. 2420. 2294. 2233
          TOP SOIL.    0.    3          RCOD=0.45
              CLAY.    3.   10          Kw=89.2
         FINE SAND.   10.   20
          SDY CLAY.   20.  112
          MED SAND.  112.  180
              SDGL.  180.  187
/
34-27-16ABC. 2370. 2285. 2235
          TOP SOIL.    0.    5          RCOD=0.15
         FINE SAND.    5.   76          Kw=27.1
              CLAY.   76.  127
              SDGL.  127.  134
/
34-27-23BCA. 2420. 2270. 2360
          CLY SAND.    0.   40          RCOD=**
              CLAY.   40.   60          Kw=**
/
34-27-27BBB. 2230. 2210. 2215          RCOD=**
          SDY CLAY.    0.   15          Kw=**
/
34-28-11BAD. 2330. 2330. 2237
          TOP SOIL.    0.    5          RCOD=0.37
         FINE SAND.    5.   60          Kw=61.6
              CLAY.   60.   75
              SDGL.   75.   93
/
34-28-13DB.  2260. 2267. 2130
          TOP SOIL.    0.    2          RCOD=0.44
          CLY SAND.    2.   60          Kw=65.5
         FIMC SAND.   60.  130
```

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/
34-28-15C.     2290. 2300. 2280
         TOP SOIL.    0.    2          RCOD=0.41
        FINE SAND.    2.   10          Kw=41.0
/
34-28-18A.     2504. 2355. 2329
             CLSS.    0.   20          RCOD=0.50
             CLAY.   20.  120          Kw=80.0
         CLY SAND.  120.  140
        FIMC SAND.  140.  175
/
34-28-18BAA.   2515. 2360. 2285
         SDY CLAY.    0.   20          RCOD=0.33
             CLAY.   20.  158          Kw=86.7
        FIME SAND.  158.  160
         SDY CLAY.  160.  182
             SDGL.  182.  195
             CLAY.  195.  205
             SDGL.  205.  230
/
34-28-18CD.    2508. 2365. 2268
         SDY CLAY.    0.  160          RCOD=0.47
         MED SAND.  160.  200          Kw=55.4
         CLY SAND.  200.  240
/
34-28-24CCA.   2400. 2275. 2165
         TOP SOIL.    0.    3          RCOD=0.53
             CLAY.    3.   58          Kw=133.3
         SDY CLAY.   58.   79
             SDGL.   79.   95
         CLY SDGL.   95.  137
             SDGL.  137.  198
         CLY SDGL.  198.  235
/
34-28-29BB.    2490. 2363. 2293
         TOP SOIL.    0.    2          RCOD=0.33
             CLAY.    2.   66          Kw=31.4
         MED SAND.   66.   82
             CLAY.   82.  156
         CLY SAND.  156.  183
        FINE SAND.  183.  197
/
34-28-29CC.    2472. 2360. 2212
         SDY CLAY.    0.  185          RCOD=0.31
        FINE SAND.  185.  240          Kw=33.0
        FIME SAND.  240.  260
```

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/
34-28-32D.   2406, 2372, 2013
         TOP SOIL,    0,    5          RCOD=0.45
             CLAY,    5,   40          Kw=33.6
         CLY SAND,   40,   92
         SDY CLAY,   92,  140
             CLAY,  140,  180
         SDY CLAY,  180,  192
             CLAY,  192,  202
         CLY SDGL,  202,  210
             SDGL,  210,  220
         SDY CLAY,  220,  240
         CLY SDGL,  240,  250
         SDY CLAY,  250,  308
        FINE SAND,  308,  359
         SDY CLAY,  359,  380
             SDGL,  380,  390
         SDY CLAY,  390,  393
/
34-28-33AAA, 2446, 2336, 2212
        FIME SAND,    0,    6          RCOD=0.49
         TOP SOIL,    6,    9          Kw=53.0
        FIME SAND,    9,   15
             CLAY,   15,   17
         MED SAND,   17,   27
         SDY CLAY,   27,   81
             CLSS,   81,  100
             SDGL,  100,  118
             CLAY,  118,  151
        FIME SAND,  151,  200
         CLY SAND,  200,  234
/
34-29-3DBB,  2503, 2410, 2105
         TOP SOIL,    0,    2          RCOD=0.28
        CEMT SILT,    2,   12          Kw=32.6
             SDGL,   12,   31
             CLAY,   31,  203
         CLY SAND,  203,  218
             CLAY,  218,  285
             SDGL,  285,  307
             CLAY,  307,  324
         CLY SAND,  324,  342
             CLAY,  342,  352
         CLY SAND,  352,  360
         CLY SDGL,  360,  389
         CLY SAND,  389,  398
```

```
/
34-29-10BB.  2497. 2412. 2097
        TOP SOIL,     0,    2          RCOD=0.21
            CLAY,     2,   23          Kw=27.8
       CORS SAND,    23,   45
        SDY CLAY,    45,   84
            CLAY,    84,  273
        MED SAND,   273,  313
        CLY SAND,   313,  390
        MED SAND,   390,  400
/
34-29-23BA.  2440, 2370, 2205
            CLAY,     0,   90          RCOD=0.41
       FIMC SAND,    90,   94          Kw=13.2
            CLAY,    94,  125
       FIMC SAND,   125,  128
            CLAY,   128,  215
       FIMC SAND,   215,  226
            CLAY,   226,  235
/
34-29-24CC,  2500, 2360, 2255
        SDY CLAY,     0,  155          RCOD=0.44
       CORS SAND,   155,  160          Kw=70.5
        MED SAND,   160,  245
/
34-29-33AA,  2498, 2355, 2015
        TOP SOIL,     0,    2          RCOD=0.38
            CLAY,     2,  150          Kw=45.1
        CLY SAND,   150,  200
            CLAY,   200,  320
            SDGL,   320,  346
            CLAY,   346,  370
       FIME SAND,   370,  483
/
34-29-35AB,  2400, 2335, 2140
        TOP SOIL,     0,    2          RCOD=0.44
            CLAY,     2,   50          Kw=71.0
        SDY CLAY,    50,   90
       FIMC SAND,    90,  260
/
34-29-36AA.  2490, 2350, 2172
       FIME SAND,     0,    4          RCOD=0.47
        TOP SOIL,     4,   12          Kw=68.7
        CLY SAND,    12,   74
       FINE SAND,    74,   79
            LIME,    79,   90
```

	CLAY,	90,	161	
	SDGL,	161,	180	
	FINE SAND,	180,	230	
	MED SAND,	230,	237	
	CLY SAND,	237,	253	
	FIME SAND,	253,	308	
	CLAY,	308,	313	
	SDGL,	313,	318	
/				
34-30-12CAA,	2668,	2492,	2064	
	FINE SAND,	0,	4	RCOD=0.58
	FIME SAND,	4,	38	Kw=93.4
	CLAY,	38,	57	
	SDY CLAY,	57,	96	
	CLY SDGL,	96,	180	
	SDGL,	180,	320	
	CLY SAND,	320,	331	
	CLAY,	331,	400	
	CLY SAND,	400,	446	
	SDGL,	446,	460	
	CLAY,	460,	467	
	SDGL,	467,	498	
	CLAY,	498,	510	
	CLY SAND,	510,	564	
	CLY SDGL,	564,	604	
/				
34-30-13A,	2655,	2470,	2170	
	SDY CLAY,	0,	6	RCOD=0.55
	CLAY,	6,	23	Kw=90.2
	SDGL,	23,	30	
	CLAY,	30,	92	
	CLY SDGL,	92,	140	
	SDGL,	140,	213	
	CLY SDGL,	213,	227	
	SDGL,	227,	280	
	SDY CLAY,	280,	360	
	FIMC SAND,	360,	405	
	SDY CLAY,	405,	420	
	SDGL,	420,	470	
	SDY CLAY,	470,	485	
/				
34-30-26DD,	2600,	2440,	2254	
	SDY CLAY,	0,	1	RCOD=0.49
	CLSS,	1,	8	Kw=60.8
	CLAY,	8,	9	
	SDGL,	9,	36	

CLAY,	36,	53
FIME SAND,	53,	227
CLAY,	227,	232
LIME,	232,	240
SS,	240,	255
FIME SAND,	255,	346

```
35-26-5BBA.  2172. 2160. 2102          RCOD=0.49
        FIMC SAND.    0.   40          Kw=60.8
             SDGL.   40.   60
             CLAY.   60.   70
/
35-26-5CCC.  2155. 2140. 2090
         TOP SOIL.    0.    2          RCOD=0.21
         SDY CLAY.    2.   50          Kw=55.0
             SDGL.   50.   65
/
35-26-9CBA.  2139. 2105. 2089
         TOP SOIL.    0.    2          RCOD=0.50
             SDGL.    2.   50          Kw=160.0
/
35-26-11DBD. 2227. 2180. 2192
         TOP SOIL.    0.    1          RCOD=**
         MED SAND.    1.   20          Kw=**
             CLAY.   20.   35
/
35-27-7BCD.  2342. 2270. 2164
         TOP SOIL.    0.    5          RCOD=0.33
        FINE SAND.    5.   65          Kw=38.9
             CLAY.   65.   82
        FINE SAND.   82.   89
         SDY CLAY.   89.  130
         MED SAND.  130.  150
             CLAY.  150.  157
         MED SAND.  157.  178
/
35-26-15BCB. 2124. 2100. 1949
         TOP SOIL.    0.    2          RCOD=0.34
        FINE SAND.    2.   12          Kw=41.1
         SDY CLAY.   12.   30
             CLAY.   30.   70
        FINE SAND.   70.  140
        FIME SAND.  140.  175
/
35-27-11B.   2297. 2205. 2027
         TOP SOIL.    0.    2          RCOD=0.41
             CLAY.    2.   20          Kw=50.6
        FINE SAND.   20.  150
        CEMT SILT.  150.  160
         SDY CLAY.  160.  190
        FINE SAND.  190.  220
         CLY SAND.  220.  240
        FIMC SAND.  240.  260
```

```
              SDGL.  260.  270
/
35-27-18BCB. 2348. 2260. 2122
         TOP SOIL.    0.    5        RCOD=0.36
        FINE SAND.    5.   65        Kw=52.3
             CLAY.   65.   80
        FINE SAND.   80.   86
             CLAY.   86.  100
         MED SAND.  100.  106
             CLAY.  106.  135
         MED SAND.  135.  150
             CLAY.  150.  160
         MED SAND.  160.  226
/
35-27-12C.   2265. 2185. 2107
         TOP SOIL.    0.    2        RCOD=0.43
             CLAY.    2.   95        Kw=56.7
        FIMC SAND.   95.  125
        FINE SAND.  125.  148
         MED SAND.  148.  158
/
35-28-1DDD.  2340. 2290. 2125
             CLAY.    0.   20        RCOD=0.25
         SDY CLAY.   20.  190        Kw=22.7
        FINE SAND.  190.  205
             SDGL.  205.  215
/
35-28-18ACB. 2274. 2270. 2196
         TOP SOIL.    0.    2        RCOD=0.52
             SDGL.    2.   35        Kw=128.6
             CLAY.   35.   42
             SDGL.   42.   50
             CLAY.   50.   58
             SDGL.   58.   78
/
35-29-1ABB.  2492. 2320. 2212
         TOP SOIL.    0.    3        RCOD=0.39
             CLAY.    3.   78        Kw=25.1
        FINE SAND.   78.   86
             CLAY.   86.  202
             SDGL.  202.  205
             CLAY.  205.  245
             SDGL.  245.  256
             CLAY.  256.  280
/
35-29-10DCC. 2365. 2310. 2171
```

```
          TOP SOIL.    0.    2          RCOD=55.3
              SDGL.    2.   12          Kw=0.51
              CLAY.   12.   73
          CLY SDGL.   73.  104
          CLY SAND.  104.  163
         FINE SAND.  163.  194
/
35-29-13AD.   2285. 2278. 2220
          TOP SOIL.    0.    2          RCOD=58.0
         FIMC SAND.    2.   25          Kw=0.55
              CLAY.   25.   30
         FIMC SAND.   30.   44
              CLAY.   44.   56
         FIMC SAND.   56.   65
/
35-29-13B.    2290. 2280. 1935
          SDY CLAY.    0.   30          RCOD=0.46
              SDGL.   30.   53          Kw=51.1
              CLAY.   53.  110
          CLY SAND.  110.  113
          SDY CLAY.  113.  130
          CLY SAND.  130.  137
              CLAY.  137.  158
          CLY SAND.  158.  172
              CLAY.  172.  215
              SDGL.  215.  268
          SDY CLAY.  268.  282
              SDGL.  282.  300
              CLAY.  300.  355
/
35-29-13BCC.  2340. 2310. 2258
          SDY CLAY.    0.   25          RCOD=0.50
          MED SAND.   25.   82          Kw=80.0
/
35-30-3CD.    2475. 2398. 2258
          TOP SOIL.    0.    2          RCOD=0.38
              CLAY.    2.   73          Kw=42.6
          SDY CLAY.   73.   84
              CLAY.   84.  110
          CLY SAND.  110.  203
         FIMC SAND.  203.  217
/
35-30-13AAA.  2349. 2347. 2271
          TOP SOIL.    0.    2          RCOD=0.56
              SDGL.    2.   38          Kw=128.4
          CLY SDGL.   38.   78
/
```

APPENDIX B

CALIBRATED COMPUTER MODEL

INPUT AND OUTPUT

```
1                    U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL
0MEADE COUNTY, KANSAS: 2D SIMULATION BY BRIAN G. HANSEN, 7/88, FOR CSM ER-3591.  CALIBRATED INPUT/OUTPUT.
    1 LAYERS        22 ROWS        28 COLUMNS
   1 STRESS PERIOD(S) IN SIMULATION
 MODEL TIME UNIT IS DAYS
0I/O UNITS:
 ELEMENT OF IUNIT:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
         I/O UNIT: 11  0  0 14  0  0  0 18 19  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0BAS1 -- BASIC MODEL PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT  1
 ARRAYS RHS AND BUFF WILL SHARE MEMORY.
 START HEAD WILL BE SAVED
   5598 ELEMENTS IN X ARRAY ARE USED BY BAS
   5598 ELEMENTS OF X ARRAY USED OUT OF 100000
0BCF1 -- BLOCK-CENTERED FLOW PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 11
 STEADY-STATE SIMULATION
      LAYER  AQUIFER TYPE
      -------------------
        1         1
   1233 ELEMENTS IN X ARRAY ARE USED BY BCF
   6831 ELEMENTS OF X ARRAY USED OUT OF 100000
0RCH1 -- RECHARGE PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 18
 OPTION 1 -- RECHARGE TO TOP LAYER
    616 ELEMENTS OF X ARRAY USED FOR RECHARGE
   7447 ELEMENTS OF X ARRAY USED OUT OF 100000
0RIV1 -- RIVER PACKAGE, VERSION 1,  12/08/83 INPUT READ FROM UNIT 14
 MAXIMUM OF   52 RIVER NODES
    312 ELEMENTS IN X ARRAY ARE USED FOR RIVERS
   7759 ELEMENTS OF X ARRAY USED OUT OF 100000
0SIP1 -- STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 19
 MAXIMUM OF  50 ITERATIONS ALLOWED FOR CLOSURE
  5 ITERATION PARAMETERS
   2669 ELEMENTS IN X ARRAY ARE USED BY SIP
  10428 ELEMENTS OF X ARRAY USED OUT OF 100000
1MEADE COUNTY, KANSAS: 2D SIMULATION BY BRIAN G. HANSEN, 7/88, FOR CSM ER-3591.  CALIBRATED INPUT/OUTPUT.
0

                                        BOUNDARY ARRAY FOR LAYER  1 WILL BE READ ON UNIT  1 USING FORMAT: (40I2)
                         -------------------------------------------------------------------------------------------

       1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
 ..........................................................................................
0 1    0  0  0  0  0  0  0  0  0  0  0  0  0  0 -1  1 -1  0  0  0  0  0  0  0  0  0  0  0
0 2    0  0  0  0  0  0  0  0  0  0  0 -1  1  1  1  1  1 -1  0  0  0  0  0  0  0  0  0  0
0 3    0  0  0  0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0  0  0
0 4    0  0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0  0
0 5    0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0
0 6    0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0
0 7    0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0
```

```
0  8 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0
0  9 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0
0 10 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0
0 11  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0
0 12  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0
0 13  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0
0 14  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0
0 15  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0
0 16  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0
0 17  0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0
0 18  0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1 -1  0  0  0  0  0  0
0 19  0  0  0  0  0  0  0 -1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0  0
0 20  0  0  0  0  0  0  0  0 -1  1  1  1  1  1  1  1 -1  0  0  0  0  0  0  0  0  0  0  0
0 21  0  0  0  0  0  0  0  0  1  1  1  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0 22  0  0  0  0  0  0  0  0  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0AQUIFER HEAD WILL BE SET TO  9999.0     AT ALL NO-FLOW NODES (IBOUND=0).
0
```

INITIAL HEAD FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (7F11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28		
0 1	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	2507.	2503.	2505.	2506.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 2	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	2515.	2508.	2498.	2493.	2498.	2505.	2495.	2480.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 3	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2540.
	2532.	2521.	2506.	2494.	2488.	2494.	2502.	2497.	2473.	2440.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 4	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2570.	2559.	2548.
	2535.	2517.	2502.	2487.	2479.	2482.	2487.	2485.	2462.	2450.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 5	9999.	9999.	9999.	9999.	9999.	9999.	2592.	2580.	2567.	2549.
	2525.	2504.	2484.	2472.	2464.	2460.	2460.	2460.	2440.	2405.
	2372.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 6	9999.	9999.	9999.	9999.	2632.	2615.	2599.	2586.	2571.	2550.
	2514.	2485.	2470.	2461.	2452.	2441.	2433.	2426.	2414.	2377.
	2343.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 7	9999.	2670.	2655.	2645.	2631.	2616.	2599.	2585.	2569.	2542.
	2507.	2477.	2460.	2450.	2437.	2425.	2416.	2402.	2387.	2366.
	2336.	2306.	9999.	9999.	9999.	9999.	9999.	9999.		
0 8	2677.	2668.	2659.	2644.	2632.	2620.	2600.	2583.	2563.	2535.
	2497.	2472.	2447.	2433.	2425.	2416.	2406.	2393.	2366.	2344.

	2319.	2268.	2220.	9999.	9999.	9999.	9999.	9999.		
0 9	2674.	2670.	2658.	2641.	2632.	2623.	2603.	2584.	2559.	2538.
	2497.	2462.	2424.	2416.	2410.	2407.	2396.	2378.	2351.	2329.
	2305.	2265.	9999.	9999.	9999.	9999.	9999.	9999.		
0 10	2677.	2668.	2655.	2638.	2631.	2623.	2605.	2584.	2558.	2538.
	2506.	2460.	2422.	2412.	2405.	2400.	2392.	2365.	2350.	2329.
	2260.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 11	9999.	2662.	2650.	2637.	2630.	2620.	2606.	2580.	2558.	2535.
	2502.	2459.	2426.	2401.	2390.	2387.	2377.	2364.	2348.	2319.
	2265.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 12	9999.	9999.	9999.	2634.	2627.	2618.	2595.	2576.	2560.	2534.
	2496.	2461.	2424.	2394.	2390.	2387.	2377.	2360.	2339.	2319.
	2280.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 13	9999.	9999.	9999.	2630.	2625.	2611.	2593.	2574.	2559.	2539.
	2500.	2462.	2408.	2385.	2381.	2371.	2367.	2360.	2338.	2320.
	2311.	2290.	9999.	9999.	9999.	9999.	9999.	9999.		
0 14	9999.	9999.	9999.	9999.	2619.	2607.	2590.	2574.	2555.	2531.
	2514.	2464.	2407.	2391.	2375.	2357.	2358.	2341.	2315.	2300.
	2289.	2273.	2246.	2243.	2250.	9999.	9999.	9999.		
0 15	9999.	9999.	9999.	9999.	2609.	2595.	2581.	2568.	2550.	2532.
	2512.	2450.	2399.	2372.	2353.	2339.	2332.	2321.	2292.	2256.
	2232.	2204.	2183.	2163.	2150.	9999.	9999.	9999.		
0 16	9999.	9999.	9999.	9999.	9999.	2590.	2569.	2559.	2542.	2523.
	2500.	2458.	2411.	2383.	2369.	2353.	2334.	2316.	2296.	2278.
	2268.	2260.	2236.	2209.	2180.	9999.	9999.	9999.		
0 17	9999.	9999.	9999.	9999.	9999.	9999.	2552.	2545.	2530.	2504.
	2487.	2456.	2406.	2383.	2374.	2355.	2334.	2307.	2284.	2274.
	2265.	2260.	2256.	9999.	9999.	9999.	9999.	9999.		
0 18	9999.	9999.	9999.	9999.	9999.	9999.	2532.	2528.	2515.	2500.
	2476.	2440.	2397.	2378.	2359.	2341.	2333.	2301.	2279.	2272.
	2268.	2253.	9999.	9999.	9999.	9999.	9999.	9999.		
0 19	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2511.	2508.	2489.
	2461.	2426.	2388.	2362.	2338.	2312.	2301.	2280.	2268.	2255.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 20	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2490.	2470.
	2442.	2409.	2371.	2342.	2333.	2326.	2330.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 21	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2423.	2410.
	2392.	2376.	2371.	2360.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 22	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2414.
	2410.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		

0DEFAULT OUTPUT CONTROL — THE FOLLOWING OUTPUT COMES AT THE END OF EACH STRESS PERIOD:

TOTAL VOLUMETRIC BUDGET

HEAD

DRAWDOWN

0 COLUMN TO ROW ANISOTROPY = 1.000000

0

DELR WILL BE READ ON UNIT 11 USING FORMAT: (7G11.4)

10560.	10560.	10560.	10560.	10560.	10560.	10560.	10560.	10560.	7920.0
7920.0	7920.0	5280.0	5280.0	5280.0	5280.0	5280.0	7920.0	7920.0	7920.0
7920.0	7920.0	7920.0	7920.0	7920.0	7920.0	7920.0	7920.0		

0
DELC = 10560.00
0

HYD. COND. ALONG ROWS FOR LAYER 1 WILL BE READ ON UNIT 11 USING FORMAT: (7G11.4)

	1 11 21	2 12 22	3 13 23	4 14 24	5 15 25	6 16 26	7 17 27	8 18 28	9 19	10 20
0 1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	55.00	35.00	25.00	25.00	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 2	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	80.00	65.00	45.00	35.00	25.00	20.00	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 3	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	85.00
	85.00	85.00	80.00	80.00	70.00	65.00	35.00	30.00	20.00	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	115.0	105.0	85.00
	80.00	80.00	65.00	60.00	45.00	40.00	45.00	37.00	20.00	40.00
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 5	999.0	999.0	999.0	999.0	999.0	999.0	105.0	105.0	75.00	50.00
	45.00	67.00	50.00	45.00	40.00	35.00	40.00	30.00	22.00	35.00
	25.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 6	999.0	999.0	999.0	999.0	100.0	90.00	110.0	108.0	80.00	40.00
	38.00	40.00	45.00	40.00	45.00	35.00	30.00	25.00	35.00	55.00
	40.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 7	999.0	115.0	115.0	140.0	150.0	110.0	97.00	100.0	75.00	45.00
	45.00	35.00	10.00	18.00	40.00	30.00	25.00	50.00	60.00	60.00
	45.00	40.00	999.0	999.0	999.0	999.0	999.0	999.0		
0 8	120.0	120.0	115.0	120.0	125.0	100.0	82.00	100.0	80.00	60.00
	55.00	35.00	10.00	23.00	65.00	25.00	35.00	60.00	70.00	75.00
	75.00	70.00	55.00	999.0	999.0	999.0	999.0	999.0		
0 9	115.0	115.0	87.00	85.00	100.0	85.00	45.00	45.00	58.00	52.00
	48.00	10.00	15.00	40.00	45.00	45.00	50.00	28.00	80.00	90.00
	65.00	40.00	999.0	999.0	999.0	999.0	999.0	999.0		
0 10	90.00	85.00	67.00	62.00	85.00	85.00	75.00	80.00	68.00	48.00
	40.00	9.000	20.00	40.00	45.00	35.00	45.00	38.00	87.00	70.00
	55.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0		

0 11	999.0	70.00	87.00	75.00	70.00	80.00	87.00	90.00	80.00	48.00
	5.000	9.000	12.00	45.00	50.00	35.00	65.00	38.00	65.00	40.00
	55.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 12	999.0	999.0	999.0	62.00	55.00	80.00	72.00	80.00	68.00	40.00
	5.000	8.000	15.00	50.00	60.00	60.00	65.00	40.00	70.00	55.00
	40.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 13	999.0	999.0	999.0	55.00	60.00	50.00	60.00	40.00	45.00	35.00
	5.000	8.000	13.00	65.00	85.00	80.00	70.00	28.00	60.00	55.00
	30.00	40.00	999.0	999.0	999.0	999.0	999.0	999.0		
0 14	999.0	999.0	999.0	999.0	105.0	80.00	70.00	95.00	70.00	65.00
	38.00	18.00	33.00	80.00	80.00	65.00	45.00	50.00	60.00	60.00
	35.00	35.00	15.00	15.00	10.00	999.0	999.0	999.0		
0 15	999.0	999.0	999.0	999.0	999.0	75.00	68.00	75.00	75.00	70.00
	43.00	9.000	18.00	30.00	65.00	80.00	75.00	70.00	60.00	70.00
	40.00	15.00	15.00	20.00	30.00	999.0	999.0	999.0		
0 16	999.0	999.0	999.0	999.0	999.0	85.00	70.00	65.00	75.00	75.00
	65.00	10.00	18.00	20.00	50.00	85.00	80.00	70.00	70.00	80.00
	40.00	20.00	20.00	20.00	20.00	999.0	999.0	999.0		
0 17	999.0	999.0	999.0	999.0	999.0	90.00	80.00	70.00	65.00	50.00
	60.00	13.00	15.00	20.00	37.00	65.00	50.00	35.00	55.00	60.00
	35.00	35.00	35.00	999.0	999.0	999.0	999.0	999.0		
0 18	999.0	999.0	999.0	999.0	999.0	999.0	80.00	60.00	45.00	60.00
	75.00	17.00	18.00	30.00	40.00	65.00	55.00	30.00	45.00	45.00
	40.00	40.00	999.0	999.0	999.0	999.0	999.0	999.0		
0 19	999.0	999.0	999.0	999.0	999.0	999.0	999.0	65.00	65.00	55.00
	55.00	23.00	18.00	35.00	45.00	45.00	45.00	50.00	90.00	80.00
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 20	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	45.00	45.00
	40.00	23.00	25.00	60.00	67.00	70.00	80.00	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 21	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	80.00	65.00
	65.00	65.00	75.00	85.00	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0 22	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	75.00
	75.00	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0		
0										

BOTTOM FOR LAYER 1 WILL BE READ ON UNIT 11 USING FORMAT: (7G11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28		
0 1	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	2050.	2150.	2420.	2460.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		

0 2	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	2200.	2100.	2080.	2275.	2420.	2440.	2450.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 3	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2305.
	2250.	2180.	2070.	2080.	2240.	2380.	2405.	2415.	2410.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 4	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2345.	2320.	2235.
	2200.	2160.	2150.	2095.	2290.	2330.	2360.	2375.	2405.	2435.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 5	9999.	9999.	9999.	9999.	9999.	9999.	2330.	2330.	2290.	2180.
	2135.	2145.	2180.	2100.	2170.	2250.	2320.	2340.	2355.	2355.
	2350.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 6	9999.	9999.	9999.	9999.	2320.	2290.	2280.	2280.	2230.	2180.
	2140.	2125.	2125.	2105.	2100.	2230.	2290.	2320.	2330.	2305.
	2290.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 7	9999.	2325.	2325.	2335.	2310.	2230.	2240.	2245.	2175.	2125.
	2150.	2095.	2065.	2100.	2205.	2300.	2315.	2310.	2330.	2300.
	2265.	2200.	9999.	9999.	9999.	9999.	9999.	9999.		
0 8	2325.	2340.	2340.	2328.	2320.	2255.	2230.	2260.	2165.	2205.
	2240.	2140.	2090.	2175.	2280.	2305.	2320.	2320.	2320.	2300.
	2265.	2225.	2160.	9999.	9999.	9999.	9999.	9999.		
0 9	2325.	2365.	2390.	2330.	2315.	2295.	2190.	2140.	2160.	2225.
	2250.	2075.	2125.	2270.	2275.	2290.	2310.	2305.	2300.	2295.
	2275.	2225.	9999.	9999.	9999.	9999.	9999.	9999.		
0 10	2315.	2340.	2335.	2270.	2305.	2275.	2215.	2255.	2185.	2160.
	2190.	2080.	2175.	2305.	2280.	2295.	2315.	2305.	2290.	2285.
	2245.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 11	9999.	2350.	2275.	2270.	2280.	2285.	2265.	2235.	2220.	2170.
	2170.	2120.	2200.	2265.	2320.	2275.	2275.	2275.	2290.	2300.
	2250.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 12	9999.	9999.	9999.	2280.	2270.	2285.	2250.	2235.	2220.	2175.
	2150.	2125.	2050.	2225.	2335.	2245.	2260.	2270.	2275.	2285.
	2250.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 13	9999.	9999.	9999.	2275.	2260.	2225.	2235.	2225.	2215.	2180.
	2155.	2100.	2100.	2305.	2345.	2315.	2305.	2275.	2270.	2260.
	2270.	2245.	9999.	9999.	9999.	9999.	9999.	9999.		
0 14	9999.	9999.	9999.	9999.	2300.	2260.	2250.	2225.	2220.	2195.
	2170.	2160.	2095.	2200.	2335.	2290.	2280.	2270.	2220.	2160.
	2210.	2250.	2175.	2165.	2175.	9999.	9999.	9999.		
0 15	9999.	9999.	9999.	9999.	2320.	2295.	2245.	2235.	2285.	2270.
	2175.	2090.	2180.	2100.	2130.	2280.	2275.	2255.	2190.	2140.
	2145.	2175.	2170.	2140.	2140.	9999.	9999.	9999.		
0 16	9999.	9999.	9999.	9999.	9999.	2270.	2230.	2240.	2285.	2245.
	2150.	2070.	2135.	2090.	2150.	2270.	2270.	2260.	2250.	2220.
	2200.	2150.	2115.	2140.	2140.	9999.	9999.	9999.		
0 17	9999.	9999.	9999.	9999.	9999.	9999.	2220.	2275.	2310.	2200.
	2100.	2075.	2055.	2045.	2200.	2255.	2260.	2200.	2145.	2135.
	2125.	2075.	2040.	9999.	9999.	9999.	9999.	9999.		
0 18	9999.	9999.	9999.	9999.	9999.	9999.	2195.	2155.	2150.	2175.

```
          2115.     2075.     2045.     2035.     2100.     2160.     2150.     2150.     2050.     2035.
          2050.     2050.     9999.     9999.     9999.     9999.     9999.     9999.
0 19      9999.     9999.     9999.     9999.     9999.     9999.     9999.     2055.     2055.     2025.
          2155.     2175.     2100.     2055.     2100.     2140.     2140.     2160.     2075.     1980.
          9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.
0 20      9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     1985.     1990.
          2145.     2260.     2210.     2150.     2080.     2130.     2140.     9999.     9999.     9999.
          9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.
0 21      9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     1980.     2010.
          2150.     2255.     2255.     2250.     9999.     9999.     9999.     9999.     9999.     9999.
          9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.
0 22      9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     2025.
          2070.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.
          9999.     9999.     9999.     9999.     9999.     9999.     9999.     9999.
0
```

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

```
0          MAXIMUM ITERATIONS ALLOWED FOR CLOSURE =      50
                     ACCELERATION PARAMETER =     1.0000
             HEAD CHANGE CRITERION FOR CLOSURE =     .10000E-01
             SIP HEAD CHANGE PRINTOUT INTERVAL =       1
0            CALCULATE ITERATION PARAMETERS FROM MODEL CALCULATED WSEED
1           STRESS PERIOD NO.   1, LENGTH =   1.000000

            NUMBER OF TIME STEPS =     1

             MULTIPLIER FOR DELT =     1.000

          INITIAL TIME STEP SIZE =   1.000000
0
```

RECHARGE WILL BE READ ON UNIT 18 USING FORMAT: (7G11.4)

```
             1          2          3          4          5          6          7          8          9         10
            11         12         13         14         15         16         17         18         19         20
            21         22         23         24         25         26         27         28
.............................................................................................................
0  1      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000
          .0000      .0000      .0000      .0000      .0000 4.5700E-05 4.5700E-05      .0000      .0000      .0000
          .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000
0  2      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000
          .0000 4.5100E-05 4.5100E-05 4.5700E-05 4.5700E-05 4.5700E-05 4.5700E-05      .0000      .0000      .0000
          .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000
0  3      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000      .0000 4.4500E-05
```

	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	4.5700E-05	4.5700E-05	4.5700E-05	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	4.4500E-05	4.4500E-05	4.4500E-05
	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	4.5700E-05	4.5700E-05	4.5700E-05
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 5	.0000	.0000	.0000	.0000	.0000	.0000	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05
	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	4.5700E-05	4.5700E-05
	4.5700E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 6	.0000	.0000	.0000	.0000	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05
	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	4.5700E-05
	4.5700E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 7	.0000	.0000	.0000	4.3400E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05
	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	4.5700E-05
	4.5700E-05	4.5700E-05	.0000	.0000	.0000	.0000	.0000	.0000		
0 8	.0000	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05
	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05
	4.5700E-05	4.5700E-05	4.5700E-05	.0000	.0000	.0000	.0000	.0000		
0 9	.0000	4.2200E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05
	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05
	4.5700E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 10	.0000	4.2200E-05	4.2200E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05
	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 11	.0000	.0000	4.2200E-05	4.2200E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05
	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05	4.5100E-05	4.5100E-05
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 12	.0000	.0000	.0000	4.2200E-05	4.2200E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05
	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 13	.0000	.0000	.0000	4.2200E-05	4.2200E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05
	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05	4.5100E-05
	4.5100E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 14	.0000	.0000	.0000	.0000	4.2200E-05	4.2200E-05	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05
	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.5100E-05
	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	.0000	.0000	.0000	.0000		
0 15	.0000	.0000	.0000	.0000	4.2200E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05
	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05
	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	.0000	.0000	.0000	.0000		
0 16	.0000	.0000	.0000	.0000	.0000	4.2800E-05	4.2800E-05	4.2800E-05	4.2800E-05	4.3400E-05
	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05
	4.5100E-05	4.5100E-05	4.5100E-05	4.5700E-05	.0000	.0000	.0000	.0000		
0 17	.0000	.0000	.0000	.0000	.0000	.0000	4.2800E-05	4.2800E-05	4.3400E-05	4.3400E-05
	4.3400E-05	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05
	4.5100E-05	4.5100E-05	4.5100E-05	.0000	.0000	.0000	.0000	.0000		
0 18	.0000	.0000	.0000	.0000	.0000	.0000	4.2800E-05	4.3400E-05	4.3400E-05	4.3400E-05
	4.3400E-05	4.3400E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05
	4.4500E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 19	.0000	.0000	.0000	.0000	.0000	.0000	.0000	4.3400E-05	4.3400E-05	4.3400E-05
	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	4.4500E-05	4.4500E-05	.0000

	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 20	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	4.3400E-05	4.3900E-05
	4.3900E-05	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	4.4500E-05	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 21	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	4.3900E-05	4.3900E-05
	4.3900E-05	4.3900E-05	4.3900E-05	4.4500E-05	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
0 22	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	4.3900E-05
	4.3900E-05	4.3900E-05	4.3900E-05	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		

0

52 RIVER REACHES

0

LAYER	ROW	COL	STAGE	CONDUCTANCE	BOTTOM ELEVATION	RIVER REACH
1	2	13	2508.	3902.	2506.	1
1	2	14	2488.	4877.	2486.	2
1	3	14	2475.	4877.	2473.	3
1	4	15	2467.	4877.	2465.	4
1	5	15	2458.	5173.	2456.	5
1	6	15	2447.	5358.	2445.	6
1	6	16	2445.	3695.	2443.	7
1	7	14	2444.	2088.	2442.	8
1	7	13	2442.	5358.	2440.	9
1	8	13	2438.	5358.	2436.	10
1	9	13	2434.	5358.	2432.	11
1	10	13	2409.	5173.	2407.	12
1	11	14	2407.	5173.	2405.	13
1	12	14	2387.	4951.	2385.	14
1	13	14	2368.	3954.	2366.	15
1	14	14	2359.	3902.	2357.	16
1	15	15	2328.	6741.	2326.	17
1	15	16	2325.	8374.	2323.	18
1	15	17	2315.	5432.	2313.	19
1	15	18	2297.	4187.	2295.	20
1	16	18	2288.	5968.	2286.	21
1	16	19	2274.	8374.	2272.	22
1	15	19	2258.	7137.	2256.	23
1	15	20	2245.	.1174E+05	2243.	24
1	15	21	2227.	8406.	2225.	25
1	15	22	2206.	8406.	2204.	26
1	15	23	2188.	8406.	2186.	27
1	15	24	2172.	8723.	2170.	28
1	21	9	2420.	.1483E+06	2418.	29
1	21	10	2407.	.1372E+06	2405.	30
1	21	11	2389.	.1378E+06	2387.	31
1	21	12	2371.	.1400E+06	2369.	32
1	21	13	2360.	.1103E+06	2358.	33
1	21	14	2344.	.4705E+05	2342.	34

```
                  1      20      15    2328.        .1047E+06        2326.          35
                  1      19      16    2308.        .5733E+05        2306.          36
                  1      19      17    2296.        .6990E+05        2294.          37
                  1      19      18    2278.        .9316E+05        2276.          38
                  1      19      19    2266.        .1290E+06        2264.          39
                  1       5      11    2515.        .3345E+06        2400.          40
                  1       5      12    2494.        .4646E+06        2408.          41
                  1       5      13    2474.        .6970E+06        2439.          42
                  1       5      14    2462.        .1115E+07        2452.          43
                  1       6      10    2540.        .2788E+06        2400.          44
                  1       6      11    2504.        .4182E+06        2405.          45
                  1       6      12    2475.        .4182E+06        2374.          46
                  1       6      13    2460.        .2323E+06        2352.          47
                  1       6      14    2451.        .9293E+06        2435.          48
                  1       7      11    2497.        .4646E+06        2435.          49
                  1       7      12    2467.        .5227E+06        2382.          50
                  1       8      12    2462.        .6970E+06        2400.          51
                  1       9      12    2452.        .8364E+06        2420.          52
0AVERAGE SEED =  .00246009
 MINIMUM SEED =  .00082540
0
    5 ITERATION PARAMETERS CALCULATED FROM AVERAGE SEED:

          .0000000E+00   .7772911E+00   .9504007E+00   .9889538E+00   .9975399E+00
0
    11 ITERATIONS FOR TIME STEP   1 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ------------------------------------------------------------------------------------------------------------------------------------
    83.75      (  1, 15, 23)  -67.54      (  1, 15, 23)   6.899      (  1, 16, 22)   1.744      (  1, 14, 22)   1.357      (  1, 14, 23)
    .9460      (  1, 14, 23)   .4717      (  1, 14, 23)  -.9768E-01 (  1, 13, 10)  -.7042E-01 (  1, 13, 10)   .1313E-01 (  1, 12,  9)
    .4218E-02 (  1, 14, 14)
0
1                    HEAD IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  1
            --------------------------------------------------------------------

             1          2          3          4          5          6          7          8          9         10
            11         12         13         14         15         16         17         18         19         20
            21         22         23         24         25         26         27         28
 ..........................................................................................................................
0 1     9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.
        9999.      9999.      9999.      9999.      2503.      2504.      2506.      9999.      9999.      9999.
        9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.
0 2     9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.
        9999.      2515.      2512.      2508.      2505.      2503.      2500.      2495.      9999.      9999.
        9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.
0 3     9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.      2540.
        2524.      2513.      2506.      2502.      2499.      2495.      2490.      2482.      2473.      9999.
        9999.      9999.      9999.      9999.      9999.      9999.      9999.      9999.
```

0 4	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2570.	2553.	2536.
	2521.	2507.	2498.	2491.	2484.	2480.	2475.	2468.	2458.	2450.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 5	9999.	9999.	9999.	9999.	9999.	9999.	2592.	2574.	2555.	2536.
	2515.	2494.	2474.	2462.	2462.	2460.	2457.	2448.	2427.	2404.
	2372.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 6	9999.	9999.	9999.	9999.	2632.	2612.	2593.	2576.	2558.	2539.
	2504.	2476.	2461.	2451.	2450.	2447.	2441.	2425.	2399.	2374.
	2343.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 7	9999.	9999.	2655.	2640.	2627.	2612.	2594.	2576.	2556.	2532.
	2498.	2468.	2455.	2447.	2443.	2436.	2423.	2406.	2385.	2359.
	2330.	2306.	9999.	9999.	9999.	9999.	9999.	9999.		
0 8	2677.	2665.	2653.	2639.	2625.	2610.	2593.	2575.	2556.	2533.
	2504.	2463.	2449.	2440.	2435.	2426.	2411.	2395.	2372.	2346.
	2314.	2276.	2220.	9999.	9999.	9999.	9999.	9999.		
0 9	2674.	2665.	2652.	2637.	2623.	2609.	2593.	2574.	2557.	2537.
	2513.	2453.	2439.	2432.	2425.	2417.	2407.	2386.	2361.	2340.
	2307.	2265.	9999.	9999.	9999.	9999.	9999.	9999.		
0 10	2677.	2664.	2650.	2635.	2621.	2606.	2591.	2575.	2560.	2543.
	2522.	2477.	2438.	2427.	2418.	2408.	2396.	2377.	2356.	2335.
	2260.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 11	9999.	2662.	2649.	2635.	2620.	2604.	2589.	2575.	2562.	2552.
	2518.	2467.	2434.	2416.	2408.	2396.	2387.	2373.	2355.	2326.
	2265.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 12	9999.	9999.	9999.	2634.	2618.	2603.	2588.	2574.	2561.	2550.
	2513.	2456.	2422.	2408.	2398.	2387.	2380.	2365.	2345.	2320.
	2280.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 13	9999.	9999.	9999.	2630.	2617.	2601.	2585.	2569.	2554.	2541.
	2506.	2453.	2418.	2400.	2390.	2379.	2370.	2349.	2325.	2308.
	2292.	2290.	9999.	9999.	9999.	9999.	9999.	9999.		
0 14	9999.	9999.	9999.	9999.	2619.	2600.	2580.	2562.	2545.	2527.
	2504.	2459.	2417.	2399.	2384.	2367.	2351.	2325.	2299.	2284.
	2273.	2257.	2230.	2228.	2250.	9999.	9999.	9999.		
0 15	9999.	9999.	9999.	9999.	2609.	2596.	2575.	2556.	2537.	2518.
	2501.	2460.	2411.	2383.	2364.	2347.	2329.	2305.	2276.	2261.
	2246.	2214.	2193.	2178.	2150.	9999.	9999.	9999.		
0 16	9999.	9999.	9999.	9999.	9999.	2590.	2567.	2547.	2526.	2507.
	2493.	2457.	2413.	2386.	2368.	2354.	2337.	2305.	2280.	2268.
	2259.	2248.	2238.	2211.	2180.	9999.	9999.	9999.		
0 17	9999.	9999.	9999.	9999.	9999.	9999.	2552.	2535.	2514.	2495.
	2481.	2449.	2410.	2385.	2366.	2350.	2332.	2304.	2283.	2273.
	2266.	2258.	2256.	9999.	9999.	9999.	9999.	9999.		
0 18	9999.	9999.	9999.	9999.	9999.	9999.	2532.	2520.	2502.	2483.
	2469.	2438.	2398.	2372.	2353.	2337.	2323.	2298.	2277.	2268.
	2268.	2253.	9999.	9999.	9999.	9999.	9999.	9999.		
0 19	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2511.	2493.	2474.
	2458.	2425.	2383.	2356.	2338.	2315.	2300.	2279.	2266.	2255.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 20	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2490.	2456.

	2435.	2401.	2364.	2343.	2331.	2329.	2330.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 21	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2428.	2412.
	2394.	2373.	2360.	2348.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 22	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	2406.
	2403.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		

1 DRAWDOWN IN LAYER 1 AT END OF TIME STEP 1 IN STRESS PERIOD 1

	1 11 21	2 12 22	3 13 23	4 14 24	5 15 25	6 16 26	7 17 27	8 18 28	9 19	10 20
0 1	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	.0000	1.024	.0000	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 2	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	.0000	-3.830	-9.604	-12.20	-4.696	5.201	.0000	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 3	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	.0000
	7.544	7.878	-.2932	-7.755	-11.12	-1.350	12.04	14.96	.0000	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 4	9999.	9999.	9999.	9999.	9999.	9999.	9999.	.0000	5.810	11.56
	13.99	10.01	4.422	-4.125	-5.368	2.261	12.38	16.87	3.744	.0000
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 5	9999.	9999.	9999.	9999.	9999.	9999.	.0000	5.809	11.55	13.40
	10.25	10.06	9.533	9.504	1.993	-.4924	3.045	11.90	12.62	1.377
	.0000	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 6	9999.	9999.	9999.	9999.	.0000	2.979	5.667	10.04	13.14	11.23
	9.607	9.179	9.288	9.672	1.854	-6.396	-8.241	.8069	14.53	2.699
	.0000	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 7	9999.	9999.	.0000	5.296	4.073	4.468	4.979	9.327	12.94	10.42
	9.270	9.108	4.923	2.799	-5.793	-11.45	-7.369	-4.303	2.390	6.738
	5.836	.0000	9999.	9999.	9999.	9999.	9999.	9999.		
0 8	.0000	2.793	6.209	5.419	7.062	9.676	6.746	8.294	7.299	1.550
	-6.671	9.197	-1.510	-6.832	-9.605	-9.506	-5.204	-1.991	-6.065	-1.531
	5.465	-7.791	.0000	9999.	9999.	9999.	9999.	9999.		
0 9	.0000	5.297	6.319	4.229	8.990	13.84	10.40	9.612	2.412	.7278
	-15.77	9.412	-15.20	-16.11	-15.35	-9.786	-10.67	-7.958	-10.01	-11.48
	-1.616	.0000	9999.	9999.	9999.	9999.	9999.	9999.		
0 10	.0000	3.651	4.704	2.633	10.18	16.74	13.98	8.650	-1.620	-5.484
	-16.13	-16.55	-15.55	-14.85	-13.11	-8.321	-4.200	-12.05	-6.099	-5.724
	.0000	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 11	9999.	.0000	1.453	1.945	10.17	15.77	16.70	4.736	-4.270	-16.67
	-15.66	-7.842	-8.205	-15.37	-17.79	-9.157	-9.637	-8.810	-7.219	-6.743
	.0000	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 12	9999.	9999.	9999.	.0000	8.747	15.46	7.266	2.263	-.8030	-16.00

	-16.65	4.919	1.982	-13.63	-7.816	-1.5869E-02	-2.845	-4.616	-6.019	-1.393
	.0000	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 13	9999.	9999.	9999.	.0000	7.582	9.550	7.695	4.884	5.419	-1.733
	-5.856	9.044	-10.39	-14.70	-9.180	-8.374	-2.870	10.94	12.76	11.92
	18.52	.0000	9999.	9999.	9999.	9999.	9999.	9999.		
0 14	9999.	9999.	9999.	9999.	.0000	6.795	9.730	11.83	10.01	3.748
	9.602	5.218	-9.725	-8.454	-9.005	-10.45	6.518	15.67	15.73	15.64
	15.61	16.26	15.58	15.12	.0000	9999.	9999.	9999.		
0 15	9999.	9999.	9999.	9999.	.0000	-1.218	6.350	11.93	13.13	13.61
	11.09	-10.01	-11.74	-10.91	-10.80	-7.867	2.700	15.90	15.85	-5.052
	-13.85	-10.18	-9.857	-15.11	.0000	9999.	9999.	9999.		
0 16	9999.	9999.	9999.	9999.	9999.	.0000	2.473	11.97	15.65	15.77
	7.379	1.005	-1.931	-3.247	.8147	-.9722	-2.504	10.55	16.35	10.02
	9.474	11.60	-1.973	-2.421	.0000	9999.	9999.	9999.		
0 17	9999.	9999.	9999.	9999.	9999.	9999.	.0000	10.09	15.56	9.495
	6.449	6.720	-3.851	-2.332	7.521	4.964	2.373	2.518	1.498	1.321
	-.5032	2.313	.0000	9999.	9999.	9999.	9999.	9999.		
0 18	9999.	9999.	9999.	9999.	9999.	9999.	.0000	7.698	13.40	17.48
	6.654	1.786	-.6636	6.052	5.615	3.746	9.950	2.897	2.304	3.602
	.0000	.0000	9999.	9999.	9999.	9999.	9999.	9999.		
0 19	9999.	9999.	9999.	9999.	9999.	9999.	9999.	.0000	14.57	15.06
	3.153	1.161	5.086	5.989	6.4941E-02	-2.640	1.269	.6550	2.108	.0000
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 20	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	.0000	14.17
	6.663	7.531	6.923	-1.304	1.870	-3.377	.0000	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 21	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	-4.939	-2.271
	-2.243	3.293	11.20	12.26	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		
0 22	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	7.567
	7.035	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.
	9999.	9999.	9999.	9999.	9999.	9999.	9999.	9999.		

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 1

	CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
0	IN:		IN:	
	STORAGE =	.00000	STORAGE =	.00000
	CONSTANT HEAD =	.11374E+08	CONSTANT HEAD =	.11374E+08
	RECHARGE =	.10447E+07	RECHARGE =	.10447E+07
	RIVER LEAKAGE =	.49009E+06	RIVER LEAKAGE =	.49009E+06
0	TOTAL IN =	.12909E+08	TOTAL IN =	.12909E+08
0	OUT:		OUT:	

	STORAGE =	.00000	STORAGE =	.00000
	CONSTANT HEAD =	.26240E+07	CONSTANT HEAD =	.26240E+07
	RECHARGE =	.00000	RECHARGE =	.00000
	RIVER LEAKAGE =	.10285E+08	RIVER LEAKAGE =	.10285E+08
0	TOTAL OUT =	.12909E+08	TOTAL OUT =	.12909E+08
0	IN - OUT =	677.00	IN - OUT =	677.00
0	PERCENT DISCREPANCY =	.01	PERCENT DISCREPANCY =	.01

0

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	86400.0	1440.00	24.0000	1.00000	.273785E-02
STRESS PERIOD TIME	86400.0	1440.00	24.0000	1.00000	.273785E-02
TOTAL SIMULATION TIME	86400.0	1440.00	24.0000	1.00000	.273785E-02

1