INDEX TO SELECTED MACHINE-READABLE GEOHYDROLOGIC DATA FOR PRECAMBRIAN THROUGH CRETACEOUS ROCKS IN KANSAS

By J. M. Spinazola, C. V. Hansen, E. J. Underwood, J. F. Kenny, and R. J. Wolf

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CONVERSION FACTORS

For those readers who prefer to use metric (International System, SI) units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound units	By	To obtain SI units
acre	4,047	square meter
foot	0.3048	meter
foot per day	0.3048	meter per day
foot squared per day	0.09290	meter squared per day
pound per square inch	0.07030	kilogram per square centimeter
million gallons per day	0.04381	cubic meter per second
degree Fahrenheit per 100 feet	18.2268[1/]	degree Celsius per 100 kilometers

[1] To convert degree Fahrenheit (°F) to degree Celsius (°C) use: °C = 5/9 x (F-32).

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ABSTRACT

Machine-readable geohydrologic data for Precambrian through Cretaceous rocks in Kansas were compiled as part of the U.S. Geological Survey's Central Midwest Regional Aquifer System Analysis. The geohydrologic data include log, water-quality, water-level, hydraulics, and water-use information. The log data consist of depths to the top of selected geologic formations determined from about 275 sites with geophysical logs and formation lithologies from about 190 sites with lithologic logs. The water-quality data consist of about 10,800 analyses, of which about 1,200 are proprietary. The water-level data consist of about 4,480 measured water levels and about 4,175 equivalent freshwater hydraulic heads, of which about 3,745 are proprietary. The hydraulics data consist of results from about 30 specific-capacity tests and about 20 aquifer tests, and interpretations of about 285 drill-stem tests (of which about 60 are proprietary) and about 75 core-sample analyses. The water-use data consist of estimates of freshwater withdrawals from Precambrian through Cretaceous geohydrologic units for each of the 105 counties in Kansas. Average yearly withdrawals were estimated for each decade from 1940 to 1980.

All the log and water-use data and the nonproprietary parts of the water-quality, water-level, and hydraulics data are available on magnetic tape from the U.S. Geological Survey office in Lawrence, Kans.

INTRODUCTION

Geohydrologic data have been compiled in machine-readable format for rocks from Precambrian through Cretaceous age in Kansas. The data were compiled as part of the Kansas contribution to the U.S. Geological Survey's Central Midwest Regional Aquifer System Analysis (CMRASA) (Jorgensen and Signor, 1981). Data were collated statewide and include depths to the top of selected geologic formations and lithologies coded from geophysical and lithologic logs; chemical analyses of water from wells; water levels in wells; specific-capacity and aquifer-test results; drill-stem-test and core-sample-analysis interpretations; and historical water-use data. To be consistent with the regional scope of the investigation, only limited, representative data were selected for all types of available data except for the chemical analyses.

Purpose and Scope

This report: (1) Presents the types of machine-readable data compiled for the Central Midwest Regional Aquifer System Analysis (CMRASA) in Kansas, and (2) describes how to retrieve these data from storage.

Data were compiled from records obtained from: (1) State and Federal agencies, (2) published reports, and (3) the oil and gas industry. The data are available from the U.S. Geological Survey in Lawrence, Kans. In addition, most of the data are available in large multistate computer data-base systems, such as the U.S. Geological Survey's water-quality file and GWSI (Ground Water Site Inventory) in WATSTORE (Water Data Storage and Retrieval System) and the CMRASA's partially proprietary QWFILE (water-quality file) and RPDB (reservoir parameter data base).

Well-Numbering System

Wells in this report are numbered according to a modification of the U.S. Bureau of Land Management's system of land subdivision. In this system, the first set of digits of a well number indicates the township south (S) of the Kansas-Nebraska State line; the second set, the range east (E) or west (W) of the sixth principal meridian; the third set, the section in which the well is situated. The first letter following the third set of digits denotes the quarter section or 160-acre tract within the section; the second, the quarter-quarter section or 40-acre tract; and the third, the quarter-quarter-quarter section or 10-acre tract. The sections are designated A, B, C, and D in a counterclockwise direction beginning in the northeast quadrant. The last two digits of the well number are the sequential order, beginning with "01," in which the wells in the same 10-acre tract were inventoried. For example, in figure 1, well number 28S 21W 15DDB 01 in Ford County is in the NW1/4 SE1/4 SE1/4 sec. 15, T. 28 S., R. 21 W. For convenience, when there is only one well inventoried in the same 10-acre tract, the trailing two-digit designation may be dropped.

Acknowledgments

Appreciation is expressed to the Kansas Geological Survey (Lawrence), especially to Shirley Paul and others in the well-log library for their valuable assistance and to P. Allen McFarlane for the contribution of data from southeastern Kansas. Other State agencies offering assistance and access to their records included the Kansas State Board of Agriculture, Division of Water Resources; the Kansas Department of Health and Environment; and the Kansas Corporation Commission (Topeka).

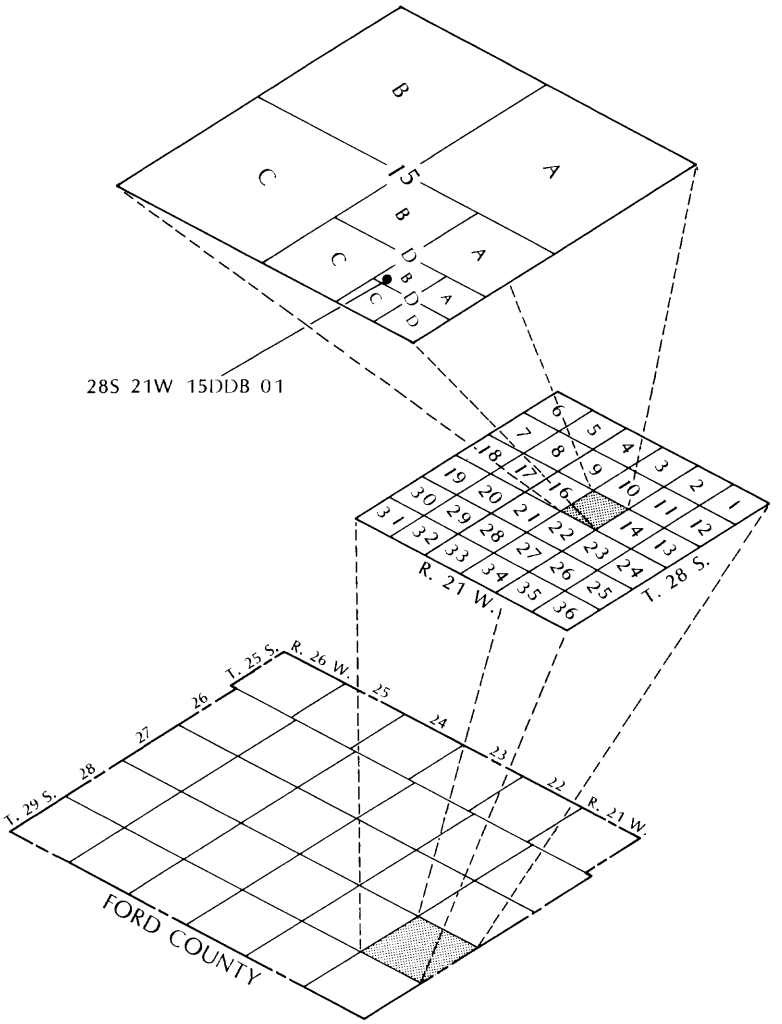

Figure 1.--Well-numbering system.

TYPES OF DATA FILES

Log Data

The purpose of the log file is to store a set of geophysical and lithologic logs that describe the interval from the land surface to the Precambrian surface at one site for each county in Kansas. A set of logs included, when available, lithologic, spontaneous potential, resistivity, gamma-ray, neutron, density, and acoustic-velocity logs. Many times there was no single set of logs that described the entire stratigraphic interval at one site. For this reason, in many counties, logs from several sites were selected to comprise a set. Geophysical logs from about 275 sites and lithologic logs from about 190 sites were selected from files of the Kansas Geological Survey in Lawrence. All sites selected were included in the investigation's data-base file. The percentages of the types of log data are shown in figure 2.

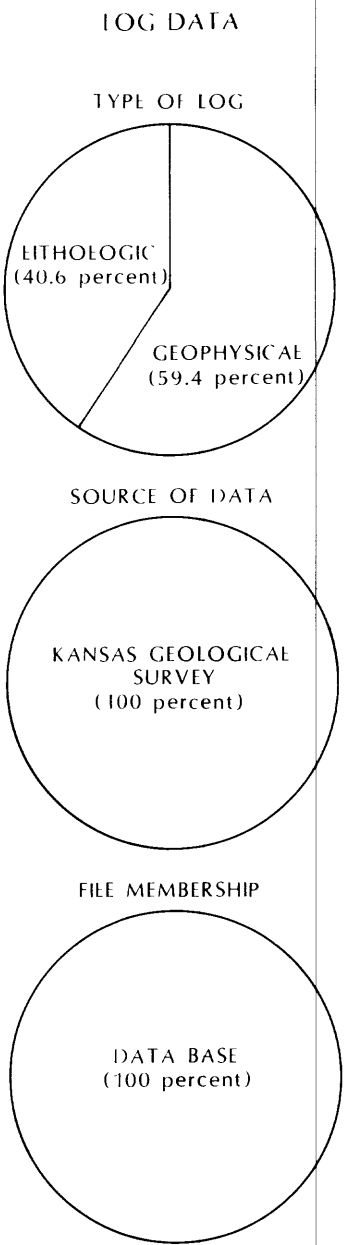

Figure 2.--Type, source, and file membership of log data.

Lithologies were described for the lithologic logs. Depths to the top of selected geologic formations were determined from the geophysical and lithologic logs for the units described in table 1. When necessary, depths to formation tops were determined on logs by correlating from nearby published logs on which the tops of the formations are indicated. In the western two-thirds of the State, "type logs" and geophysical-log cross sections describing depths to the top of various formations were available from the Kansas Geological Society in Wichita (see "Selected References"). Published reports also contain logs showing depths to various formation tops. Tops on logs from these two "established" sources provided control for correlation.

Table 1.--Correlation of geologic units to geohydrologic units identified by the Central Midwest Regional Aquifer System Analysis in Kansas

Code number	Geohydrologic unit	Geologic units[1/] Geologic name, U.S. Geological Survey's geologic unit code and lithologic description		Aquifers and confining units (*denotes major units; **denotes subunits)
1-44	Undesignated			
45-49		Cenozoic (110CNCZ) unconsolidated alluvial and glacial deposits; includes:		
	ØQ	Quaternary System (110QRNR)		*Alluvial and glacial aquifer and confining units
	ØT	Ogallala Formation (1210GLL)		*High Plains aquifer system
50-99		Upper Cretaceous (211CRCSU) shale, chalk, and limestone; includes:		*Great Plains confining system
	A1	Pierre Shale (211PIRR)		
	A2	Colorado Group (211CLRD); includes:		
		Niobrara Chalk (211NBBR), Fort Hays Limestone Member (211FRHS), Carlile Shale (211CRLL), Greenhorn Limestone (211GRNR), and Graneros Shale (211GRRS)		
100-249		Lower Cretaceous sandstone and shale; includes:		*Great Plains aquifer system
100-149	BØ	Lower Cretaceous sandstone and shale; includes: Dakota Formation (210DKOT or 2170MDI)	If cannot differentiate, use undifferentiated Lower Cretaceous (217CRCSL) and code numbers 1-44	**Upper aquifer unit of Great Plains aquifer system
150-199	CØ	Lower Cretaceous shale and sandstone; includes: Kiowa Shale (217KIOW)		**Confining unit of Great Plains aquifer system
200-249	DØ	Lower Cretaceous sandstone and shale; includes: Cheyenne Sandstone (217CYNN)		**Lower aquifer unit of Great Plains aquifer system
250-299	Undesignated			
300-549		Jurassic through Upper Mississippian shale, limestone, evaporite rocks, sandstone, and dolomite; includes:		*Western Interior Plains confining system
300-349	EØ	Jurassic (220JCTC) shale and sandstone; includes: Morrison Formation (221MRSN)		**Upper unit of Western Interior Plains confining system
350-549		Permian through Upper Mississippian shale, limestone, evaporite rocks, sandstone, and dolomite; includes:		**Lower unit of Western Interior Plains confining system

Table 1.--Correlation of geologic units to geohydrologic units identified by the Central Midwest Regional Aquifer System Analysis in Kansas--Continued

Code number	Geohydrologic unit	Geologic units[1/] Geologic name, U.S. Geological Survey's geologic unit code and lithologic description	Aquifers and confining units (*denotes major units; **denotes subunits)
350-399		Permian shale, evaporite rocks, sandstone, and dolomite; includes:	
	F1	Upper Permian (311PRMNU) redbeds; includes:	
		Big Basin Formation (311BGBS), Day Creek Dolomite (311DCRK), and Whitehorse Formation (310WTRS)	
	F2	Cimarronian Stage (317CMRN); includes:	
		Nippewalla Group (317NPPL); includes:	
		Dog Creek Shale (313DGCK), Blaine Gypsum (318BLIN), Flowerpot Shale (313FLRP), Cedar Hill Sandstone (318CDHL), Salt Plains Formation (318SLPL), and Harper Sandstone (317HRPR)	
		Sumner Group; includes:	
		Stone Corral Formation (317SCRL), Ninnescah Shale (310NNSC), Wellington Formation (310WLNG), and Hutchinson Salt Member (317HCNS)	
400-449		Lower Permian and Upper Pennsylvanian limestone and shale; includes:	
	G1	Wolfcampian Series (319WFMP); includes:	
		Chase Group (319CHSE), Council Grove Group (319CCGV), and Admire Group (319ADMR)	
	G2	Virgilian Series (322VRGL); includes:	
		Wabaunsee Group (322WBNS), Shawnee Group (322SHWN), and Douglas Group (322DGLS)	
	G3	Missourian Series (321MSRN); includes:	
		Lansing Group (323LNSG), Kansas City Group (323KSSC), and Pleasanton Group (323PLSN)	
450-499	Undesignated		
500-549		Middle and Lower Pennsylvanian and Upper Mississippian shale, limestone, and sandstone; includes:	
	H1	Desmoinesian Series (324DSMS); includes:	
		Marmaton Group (325MRMN) and Cherokee Group (325CHRK)	
	H2	Atokan Series (324AKBD),	
	H3	Morrowan Series (327MRRN) and Chesterian Series (332CRSN)	

Table 1.--Correlation of geologic units to geohydrologic units identified by the Central Midwest Regional Aquifer System Analysis in Kansas--Continued

Code number	Geohydrologic unit	Geologic units[1/] Geologic name, U.S. Geological Survey's geologic unit code and lithologic description	Aquifers and confining units (*denotes major units; **denotes subunits)
550-949		Upper Mississippian to Upper Cambrian limestone, dolomite, shale, and sandstone	*Western Interior Plain aquifer system
550-599	IØ	Mississippian (330MSSP) limestone and dolomite between Chesterian Series and Northview Shale; includes: Sedalia Dolomite (337SLDI)	**Upper aquifer unit of Western Interior Plains aquifer system
600-649	Undesignated		
650-699	JØ	Lower Mississippian and Devonian (337MPDV) shale and shaly limestone; includes: Northview Shale (339NRTV), Compton Limestone (337CMPN), Chouteau Limestone (337CHUT), Boice Shale (337BOIC), and Chattanooga Shale (330CTNG)	**Confining unit of Western Interior Plains aquifer system
700-949		Devonian to Upper Cambrian dolomite, limestone, shale, and sandstone; includes:	**Lower aquifer unit of Western Interior Plains aquifer system
700-749		Devonian, Silurian, and Upper Ordovician dolomite and shale; includes:	
	K1 K2	Hunton Group (340HNTN) and Maquoketa Shale (361MQKT)	
750-799	Undesignated		
800-849		Middle and Lower Ordovician and Upper Cambrian dolomite, limestone, and sandstone; includes:	
	L1 L2 L3	Viola Limestone (361VKMK), Simpson Group (364SMPS), and Arbuckle Group (367ABCK)--may include other Upper Cambrian rocks	
850-899	MØ	Upper Cambrian dolomite; includes: Bonneterre Dolomite (371BNTR)	
900-949	NØ	Upper Cambrian sandstone; includes: Lamotte and Reagan Sandstone (371LMRG) and Granite wash (320GRWS) if basal Pennsylvanian, otherwise the age of immediately overlying strata	
950-999	OØ	Precambrian (400PCMB) metamorphic and igneous rocks	*Basement confining unit

[1] The stratigraphic nomenclature used in this report was determined from several sources and may not follow usage of the U.S. Geological Survey.

The log file is available from two sources--the U.S. Geological Survey's GWSI computer file and magnetic tape. GWSI is the repository of all of the information that is available from the logs interpreted for the Kansas CMRASA study. Selected items from the log file are available on magnetic tape at the U.S. Geological Survey in Lawrence, Kans. A description of the kind and format of log data stored on magnetic tape is presented in table 2.

Water-Quality Data

The purpose of the water-quality file is to store all ground-water analyses from wells completed in geohydrologic units studied by the CMRASA (rocks older than Late Cretaceous age) in Kansas. The file includes about 10,800 analyses. Data include all historical records available through January 1, 1983, from the WATSTORE water-quality file, the Kansas Water-Quality File (U.S. Geological Survey, Lawrence, Kans.), the Kansas Brine File (Kansas Geological Survey, Lawrence), records of the National Uranium Resource Evaluation (U.S. Department of Energy, Grand Junction, Colo.), records of the Petroleum Data System (University of Oklahoma, Norman), and the Kansas Geological Survey (fig. 3).

All the analyses are in the investigation's working file. The analyses are densely spaced in some parts of Kansas and can be extremely variable over short distances. To facilitate mapping, representative analyses were chosen from the working file and were designated as belonging to a project file or a data-base file. The project file contains analyses selected from the working file; the data-base file contains data selected from the project file. The purpose of the project file is to store one representative analysis per 10- by 20-minute quadrangle for each aquifer. The purpose of the data-base file is to store one representative analysis per county for each aquifer. The goals of the project and data-base files were not always achieved due to lack of chemical-quality data for the aquifers in some parts of the State. There are about 1,900 analyses in the project file and about 185 analyses in the data-base file (fig. 3).

Water-quality data are stored in the CMRASA's QWFILE, the U.S. Geological Survey's WATSTORE water-quality file, and on magnetic tape. The CMRASA's QWFILE is the repository of all the water-quality analyses compiled for this study. The WATSTORE water-quality file is the National repository for water-quality data collected and analyzed by the U.S. Geological Survey. All nonproprietary analyses for Kansas also are available on magnetic tape from the U.S. Geological Survey in Lawrence, Kans. Analyses from the Petroleum Data System (about 1,200) are not available in machine-readable form due to their proprietary nature. A description of the kind and format of the water-quality data stored on magnetic tape is presented in table 3.

Water-Level Data

The purpose of the water-level file is to store recorded water levels from measured wells and equivalent freshwater hydraulic heads (as derived

Table 2.--Description and format of log data stored on magnetic tape

Record position	Description
1-3	Blank
4-9	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
10-16	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
17	Blank
18-31	Landline location (township, range, section, and quarter sections, as described in figure 1).
32-33	Sequence number (01 for the first well at any location; subsequent wells at same location are assigned larger numbers).
34	Blank
35-42	Altitude of land surface, in feet.
43	Blank
44-46	Code number (see table 1).
47	Blank
48-55	U.S. Geological Survey geologic unit code (see table 1 or Hutchinson, 1975, appendix F).
56	Blank
57-64	Depth to top of formation or lithology, in feet (blank if log begins below top of formation or lithology).
65	Blank
66-73	Depth to bottom of formation or lithology, in feet (blank if log ends before bottom of formation or lithology).
74	Blank
75-78	U.S. Geological Survey lithologic code (see Baker and Foulk, 1975, p. B62-B66).

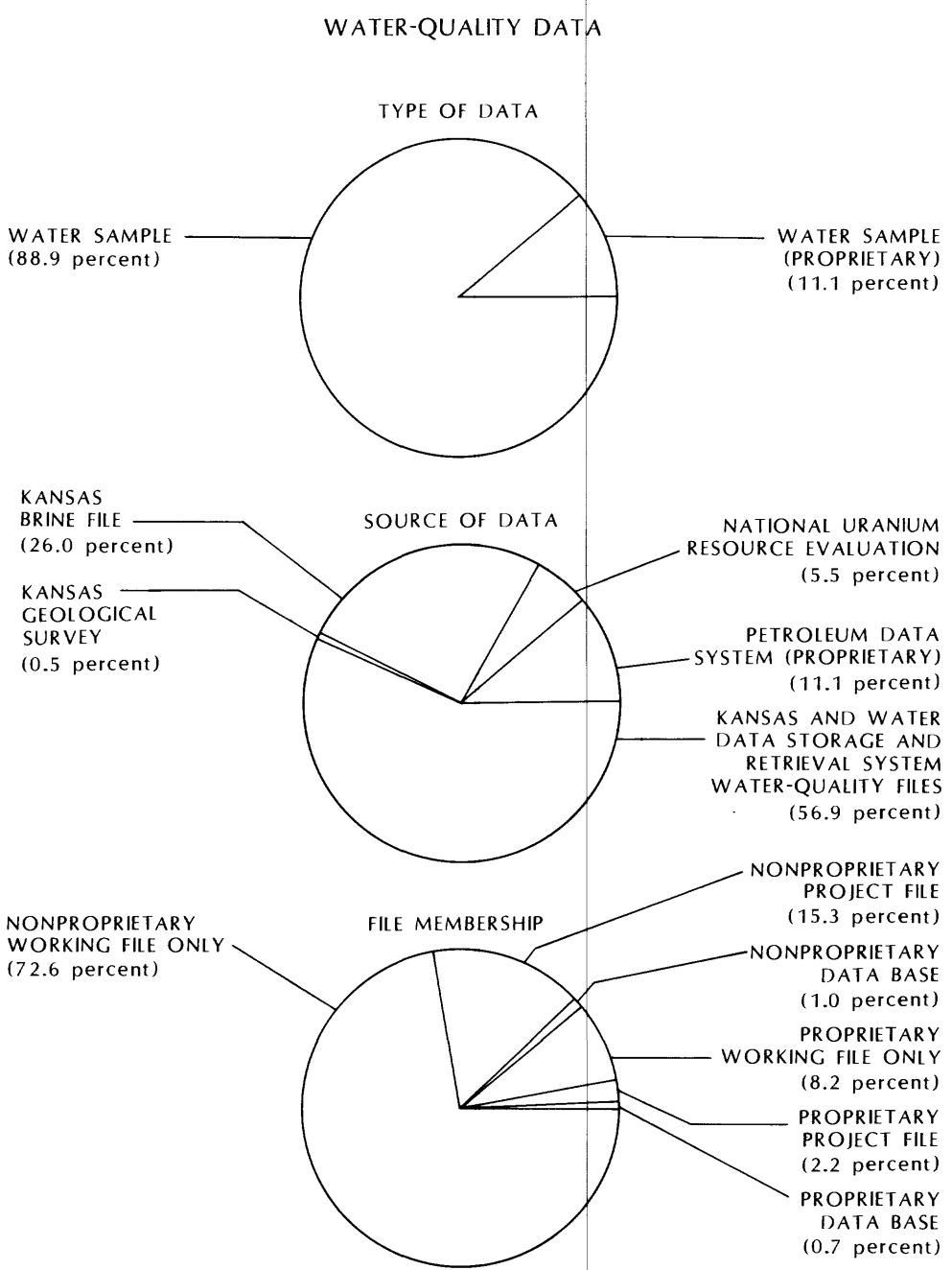

Figure 3.--Type, source, and file membership of water-quality data.

from drill-stem-test analysis) for the geohydrologic units studied by the CMRASA in Kansas. The file includes about 4,480 measured water levels and about 4,175 equivalent freshwater heads. Most of the water-level-measurement data came from the U.S. Geological Survey's GWSI file, the Kansas Geological Survey, and published reports; other incidental sources were the Kansas Department of Health and Environment (Topeka); the Kansas

Table 3.--Description and format of water-quality data stored on magnetic tape

Record position	Description
	H, N, and type-2 cards.
1	Card type: H = header card (identifies site uniquely), N = name card (name of well and formation tested), 2 = sample-analysis information.
2-16	Site identification; unique number for each site, which usually corresponds to latitude and longitude. Appears on each H, N, and 2 card.
	H cards only.
17-22	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
23-29	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
30-31	Sequence number (01 for the first well at any location; subsequent wells at the same location are assigned larger numbers).
32-35	State and district code (see U.S. Department of Commerce, 1979).
36-38	County code (see U.S. Department of Commerce, 1979).
39-40	Site type; GW = ground water.
41-80	Blank
	N cards only.
17-30	Landline location (township, range, section, and quarter sections, as described in figure 1).
31-44	Blank

Table 3.--Description and format of water-quality data stored on magnetic tape--Continued

Record position	Description
	N cards only--Continued
45-50	Sample number; uniquely identifies each sample. First digit of sample number (record position 45) identifies source of data: 0 or 1 = WATSTORE Water-quality file; 3 = Natural Uranium Resource Evaluation; 4 = Kansas Brine File; 5 = Kansas Geological Survey.
51	File membership: Blank or 0 = working file only; 2 = project file and working file; 3 = data base, project file, and working file.
52-53	Geohydrologic unit sampled (see table 1).
65-72	U.S. Geological Survey geologic unit code (see table 1 or Hutchinson, 1975, appendix F).
73-80	Blank
	Type-2 cards only.
17-22	Date of sample in order of year, month, and day (YYMMDD).
23-26	Time of sample in 24-hour-time notation.
27-32	Blank
33-37	Parameter code of analyzed constituent (see Hutchinson, 1975, appendix D).
38-43	Value of analyzed constituent; reported as a decimal fraction (record positions 38-41) multiplied by a power of 10 (exponent in record positions 42-43).
44	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).

Table 3.--Description and format of water-quality data stored on magnetic tape--Continued

Record position	Description
	Type 2 cards only--Continued
45-49	Parameter code of analyzed constituent (see Hutchinson, 1975, appendix D).
50-55	Value of analyzed constituent; reported as a decimal fraction (record positions 50-53) multiplied by a power of 10 (exponent in record positions 54-55).
56	Remarks code (see U.S. Geological Survey 1983, p. A14-A15).
57-61	Parameter code of analyzed constituent (see Hutchinson, 1975, appendix D).
62-67	Value of analyzed constituent; reported as a decimal fraction (record positions 62-65) multiplied by a power of 10 (exponent in record positions 66-67).
68	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).
69-73	Parameter code of analyzed constituent (see Hutchinson, 1975, appendix D).
74-79	Value of analyzed constituent; reported as a decimal fraction (record positions 74-77) multiplied by a power of 10 (exponent in record positions 78-79).
80	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).

State Board of Agriculture, Division of Water Resources (Topeka); and the Missouri Division of Geology and Land Survey (Rolla) (fig. 4). The equivalent freshwater heads are based on data from several sources: U.S. Geological Survey files (Lawrence, Kans.); the Kansas Geological Survey; Roger Hoeger, consultant (Denver, Colo.); the Kansas Corporation Commission, (Topeka); the Kansas Geological Society; Petroleum Information, Inc. (Denver, Colo.); and individual drilling or testing companies (fig. 4).

All the data are in the investigation's water-level working file. The data are dense in some parts of Kansas and can be variable over short distances. To facilitate mapping, representative data were chosen

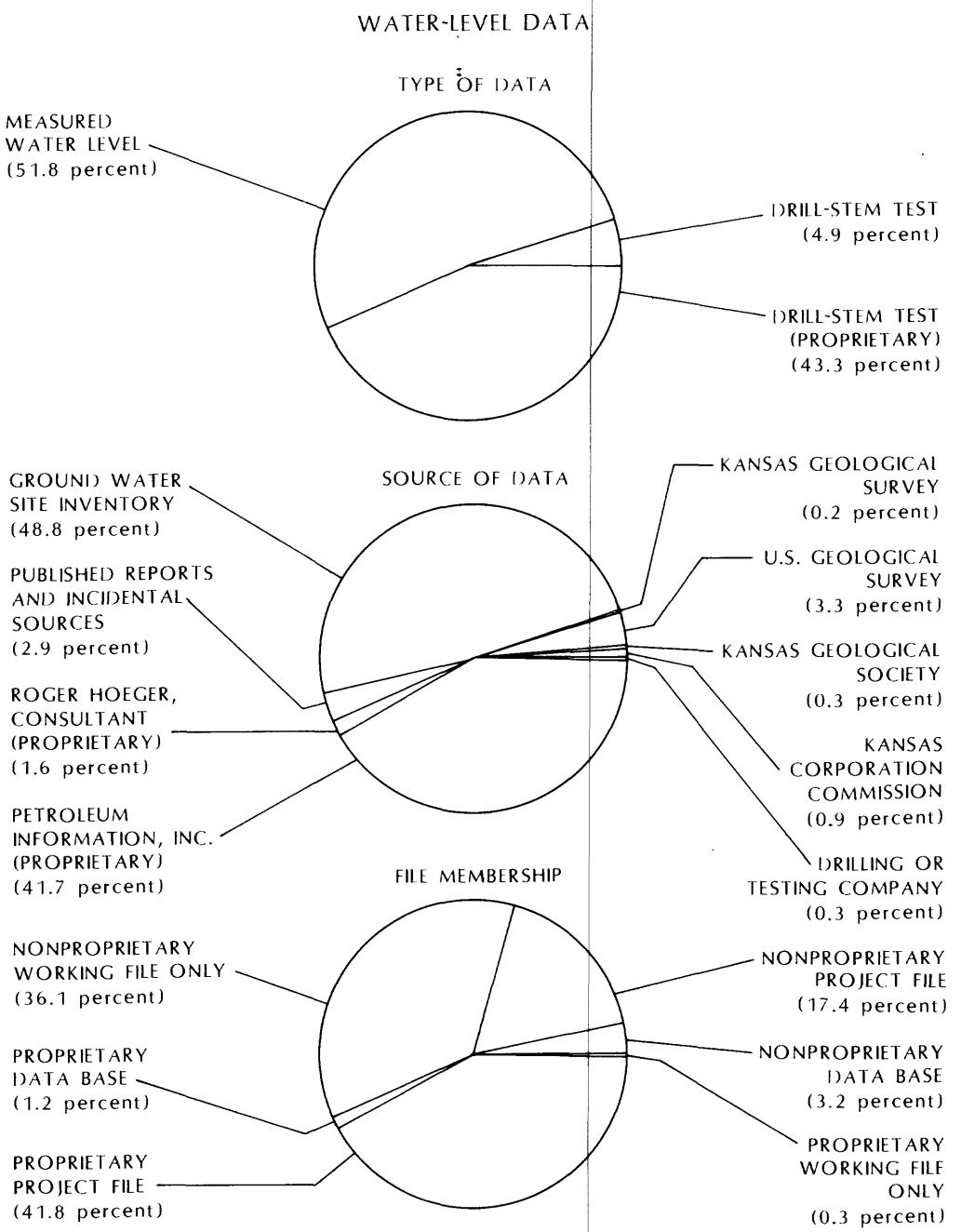

Figure 4.--Type, source, and file membership of water-level data.

from the working file and were designated as belonging to a project file or a data-base file. The project file contains data selected from the working file; the data-base file contains data selected from the project file. The purpose of the project file is to store one water-level measurement or equivalent freshwater head for each decade for each geohydrologic unit in each township in the State. Where there were more than one measurement or equivalent freshwater head in the township for a particular geohydrologic unit, the median value was selected. The purpose of the data-base file is to store one site for each county for each geohydrologic unit.

Sites with more than one measurement or equivalent freshwater head were preferred. The goals of the project and data-base files were not always achieved due to lack of data for the geohydrologic units in some parts of the State. There are about 1,225 water-level measurements and 3,890 equivalent freshwater heads in the project file and about 160 water-level-measurement sites and 220 equivalent freshwater heads in the data-base file (fig. 4).

Water-level data are stored in the U.S. Geological Survey's GWSI file, the CMRASA's RPDB file, and on magnetic tape. All the water-level measurements, except some of those from the literature, are available from GWSI. The CMRASA's RPDB file is the repository of most of the equivalent freshwater-head information. All the measured water levels and nonproprietary equivalent freshwater heads are available on magnetic tape from the U.S. Geological Survey in Lawrence, Kans. Those equivalent freshwater heads derived from information obtained from Roger Hoeger, consultant (Denver, Colo.), and Petroleum Information, Inc. (Denver) are not available in machine-readable form due to their proprietary nature (about 3,745). A description of the kind and format of data stored on magnetic tape is presented in table 4 for the measured water-level data and in table 5 for the equivalent freshwater-head data.

Hydraulics Data

The purpose of the hydraulics file is to store data related to transmission and storage properties of the geohydrologic units studied by the CMRASA in Kansas. The file includes results from about 30 specific-capacity tests and 20 aquifer tests, and interpretations from about 285 drill-stem tests and about 75 core-sample analyses (fig. 5). Hydraulics data were derived from information from U.S. Geological Survey files (Lawrence, Kans.) and publications, Kansas Geological Survey files and publications, Kansas Corporation Commission files, Kansas Department of Health and Environment files, Roger Hoeger, consultant, and individual drilling or testing companies (fig. 5).

All the data belong to the investigation's hydraulics working file. The data are dense in some parts of Kansas. To facilitate mapping, representative data were chosen from working files and designated as belonging to a project file. The purpose of the project file is to store one result from a specific-capacity or aquifer test or an interpretation from a drill-stem test for each geohydrologic unit in each township in the State. The goal of the project file was not always achieved due to lack of data for the geohydrologic units in some parts of the State. There are about 20 specific-capacity and 10 aquifer-test results and about 215 drill-stem-test interpretations in the project file (fig. 5).

Hydraulics data are stored in the U.S. Geological Survey's GWSI, the CMRASA's RPDB file, and on magnetic tape. GWSI is the repository for all specific-capacity and aquifer-test results. Hydraulics data from drill-stem tests and core-sample analyses are stored in the CMRASA's RPDB file. All specific-capacity and aquifer tests, core-sample analyses, and nonproprietary drill-stem-test data are available on magnetic tape from the U.S.

Table 4.--Description and format of measured water-level data stored on magnetic tape

Record position	Description
1	File membership: blank = working file only; 2 = project file and working file; 3 = data base, project file, and working file.
2	* = water level on same line was selected for project mapping (important where there are several water levels for one well).
3-8	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
9-15	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
16-17	Sequence number (01 for the first well at any location; subsequent wells at same location are assigned larger numbers).
18	Blank
19-32	Landline location (township, range, section, and quarter sections, as described in figure 1).
33-34	Sequence number (see record positions 16-17 above).
35	Blank
36-38	County code (see U.S. Department of Commerce, 1979).
39	Blank
40-43	Geohydrologic unit supplying water to the well (see table 1).
44	Blank
45-52	U.S. Geological Survey geologic unit code (see table 1 or Hutchinson, 1975, appendix F).
53	Importance of formation as a source of water to the well: P = primary; S = secondary; N = noncontributing; U = unknown.

Table 4.--Description and format of measured water-level data stored on magnetic tape--Continued

Record position	Description
54	Blank
55-61	Depth to top of formation, in feet.
62	Blank
63-69	Altitude of land surface, in feet.
70	Blank
71-77	Depth to bottom of well, in feet.
78	Blank
79-85	Depth to top of screened interval, in feet.
86	Blank
87-93	Depth to bottom of screened interval, in feet.
94	Blank
95-101	Depth to bottom of casing, in feet.
102	Blank
103-109	Depth to water, in feet.
110	Blank
111-117	Altitude of water level, in feet.
118	Blank
119-128	Date of water-level measurement in order of month, day, and year (MM/DD/YYYY).
129-132	Source of data: A = Static water level from aquifer test; P = Static water level from production test; G, L, or R = post-1929 measured water level; O = pre-1930 measured water level (location of well generally uncertain).

Table 5.--Description and format of equivalent freshwater-head data stored on magnetic tape

Record position	Description
1	File membership: blank = working file only; 2 = project file and working file; 3 = data base, project file, and working file.
2	Quality of data: 1 or 3 = good-quality pressure data; blank or 9 = medium- to poor-quality pressure data.
3	Blank
4-9	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
10-16	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
17-18	Sequence number (01 for first well at any location; subsequent wells at same location are assigned larger numbers).
19	Blank
20-21	State code (see U.S. Department of Commerce, 1979).
22	Blank
23-25	County code (see U.S. Department of Commerce, 1979).
26	Blank
27-37	Landline location (township, range, section, and quarter sections, as described in figure 1).
38	Blank

Table 5.--Description and format of equivalent freshwater-head data stored on magnetic tape--Continued

Record position	Description
39-40	Source of data: 10 = U.S. Geological Survey file or publication; 11 = Kansas Geological Survey file or publication; 22 = Kansas Corporation Commission; 23 = Kansas Geological Society; 24 = drilling or testing company.
41	Blank
42-46	Date of drill-stem test in order of month and year (MM/YY).
47	Blank
48-51	Geohydrologic units open to tested interval (see table 1).
52-59	U.S. Geological Survey geologic unit code open to tested interval (see table 1 or Hutchinson, 1975, appendix F).
60	Blank
61-64	Altitude of land surface, in feet.
65	Blank
66-70	Depth of top to tested interval, in feet.
71	Blank
72-76	Depth of bottom to tested interval, in feet.
77	Blank
78-81	Pressure, in pounds per square inch (graphically extrapolated according to conventional drill-stem-test analysis methods or the larger of the initial and final shut-in pressures).
82	Blank

Table 5.--Description and format of equivalent freshwater-head data stored on magnetic tape--Continued

Record position	Description
83-87	Altitude of pressure-recording gage, in feet, or the top of tested interval if gage location unknown.
88	Blank
89-93	Altitude of equivalent freshwater head, in feet, uncorrected for temperature and density of formation water and to the top of the aquifer.
94	Data-file source: E = CMRASA reservoir parameter data base file; blank = uncorrected equivalent freshwater head (not used for project mapping).
95-99	Altitude of top of aquifer, in feet, used as datum for corrected equivalent freshwater head.
100-102	Mean annual temperature at land surface, in degrees Fahrenheit.
103-106	Geothermal gradient, in degrees Fahrenheit per 100 feet.
107-110	Temperature of water in formation tested, in degrees Fahrenheit.
111-117	Estimated dissolved-solids concentration of water in formation tested, in milligrams per liter.
118-123	Altitude of equivalent freshwater head, in feet, corrected for temperature and density of formation water and to the top of the aquifer.
124	Data-file source (E = CMRASA reservoir parameter data base file).

Geological Survey in Lawrence, Kans. Those drill-stem-test interpretations (about 60) derived from data from Roger Hoeger, consultant, are not available in machine-readable form due to their proprietary nature. A description of the kind and format of the specific-capacity and aquifer-test data on magnetic tape is presented in table 6. A description of the kind and format of core-sample analyses and drill-stem-test data on magnetic tape is presented in table 7.

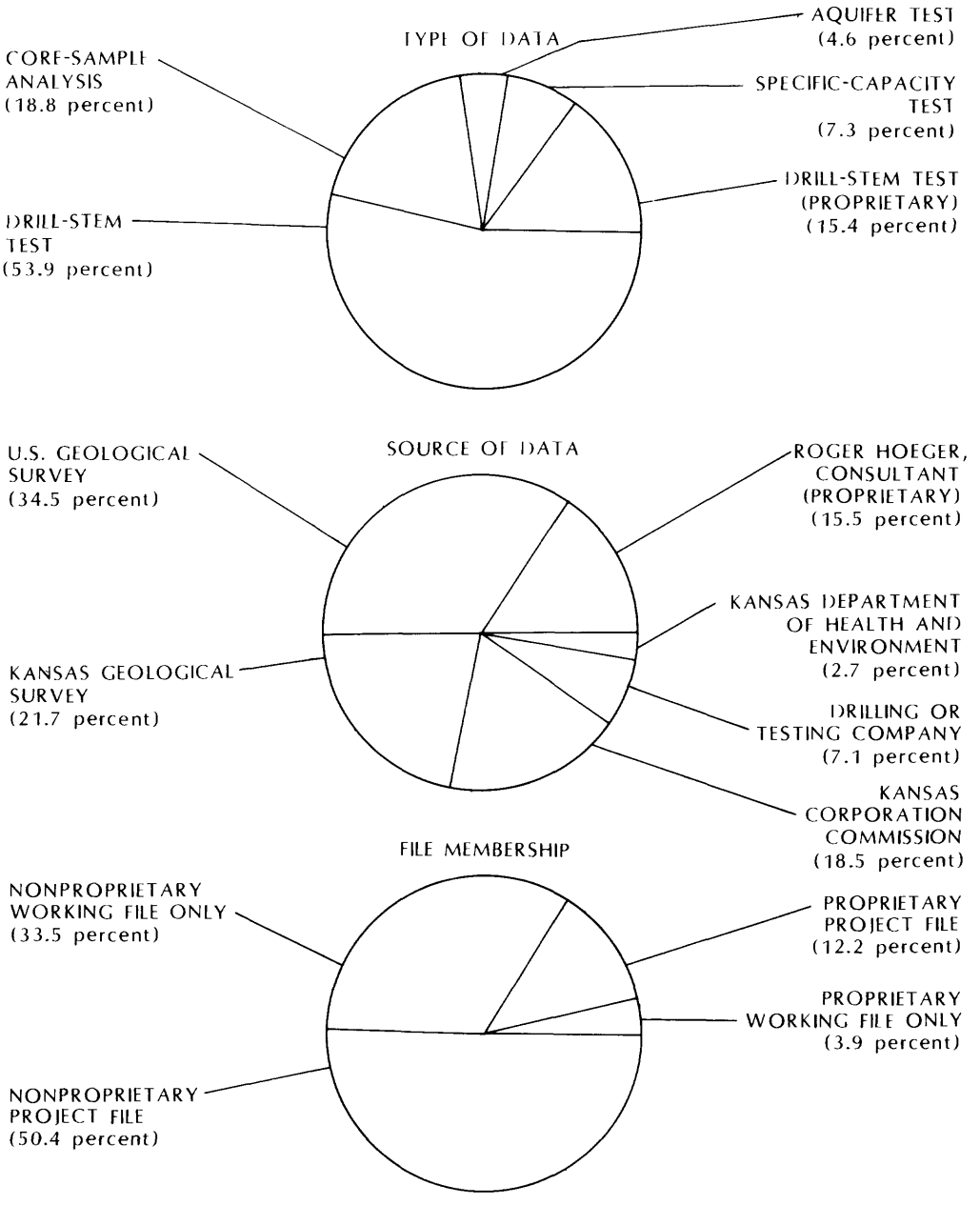

Figure 5.--Type, source, and file membership of hydraulics data.

Water-Use Data

Water-use data include estimates of freshwater withdrawals from each aquifer for several major uses for each county in Kansas, tabulated by decade. Unlike the other types of data, the water-use data are not time or site specific but rather are temporal and areal aggregates. Estimates of freshwater withdrawn in each county and of the percentages represented by each major use are based on appropriated and reported withdrawals from the Division of Water Resources of the Kansas State Board of Agriculture

and population information from the U.S. Census Bureau. Estimates of percentage withdrawals from each aquifer are based on information provided by Division of Water Resources representatives and U.S. Geological Survey personnel. Average yearly withdrawals were estimated at the midpoint of each decade from 1940 to 1980 and assumed to be representative of the decade.

Water-use data for the CMRASA in Kansas are available only on magnetic tape from the U.S. Geological Survey in Lawrence, Kans. A description of the format and kind of water-use data stored on magnetic tape is presented in table 8.

Table 6.--Description and format of specific-capacity and aquifer-test data stored on magnetic tape

Record position	Description
1	File membership: blank = working file only; 2 = project file and working file; 3 = data base, project file, and working file.
2	Type of test data: S = specific capacity; A = aquifer.
4-9	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
10-16	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
17-18	Sequence number (01 for first well at any location; subsequent wells at the same location are assigned larger numbers).
20-22	County code (see U.S. Department of Commerce, 1979).
23	Blank
24-35	Landline location (township, range, section, and quarter sections, as described in figure 1).
36	Blank

Table 6.--Description and format of specific-capacity and aquifer-test data stored on magnetic tape--Continued

Record position	Description
37-38	Source of data: 10 = U.S. Geological Survey file or publication; 11 = Kansas Geological Survey file or publication; 13 = Kansas Department of Health and Environment file; 24 = drilling or testing company.
39	Blank
41-42	Geohydrologic unit tested (see table 1).
45-52	U.S. Geological Survey geologic unit code (see table 1 or Hutchinson, 1975, appendix F).
53-62	Depth to top of interval tested, in feet.
63-72	Depth to bottom of interval tested, in feet.
73-82	Transmissivity, in feet squared per day.
83-92	Storage coefficient, dimensionless.
93-102	Hydraulic conductivity (horizontal), in feet per day.
103-112	Permeability factor = ratio of intrinsic permeability to viscosity, in millidarcies per centipoise.

DATA REPOSITORIES

Most of the data compiled for Kansas as part of the CMRASA are available from several sources--the original source, a large multistate computer file, and magnetic tape. The original agency or company file usually is the least-accessible source. Large multistate computer files usually are more accessible but may require extensive knowledge of the system to retrieve data. The magnetic tape available from the U.S. Geological Survey's office in Lawrence, Kans., is the most accessible, concise, and complete source of the data compiled for the Kansas part of this investigation.

Table 7.--Description and format of core-sample analysis and drill-stem-test data stored on magnetic tape

Record position	Description
1	File membership: blank = working file only; 2 = project file and working file; 3 = data base, project file, and working file.
2	Quality of data: 2 or 3 = good-quality permeability data; blank, 1, or 9 = medium- to poor-quality permeability data.
3	Blank
4-9	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
10-16	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
17-18	Sequence number (01 for first well at any location; subsequent wells at the same location are assigned larger numbers).
19	Blank
20-21	State code (see U.S. Department of Commerce, 1979).
22	Blank
23-25	County code (see U.S. Department of Commerce, 1979).
26	Blank
27-37	Landline location (township, range, section, and quarter sections, as described in figure 1).
38	Blank
39-40	Source of data: 10 = U.S. Geological Survey file or publication; 11 = Kansas Geological Survey file or publication;

Table 7.--Description and format of core-sample analysis and drill-stem-test data stored on magnetic tape--Continued

Record position	Description
39-40	Source of data--Continued: 22 = Kansas Corporation Commission; 24 = drilling or testing company.
41	Blank
42-46	Date of test in order of month and year (MM/YY).
47	Blank
48-49	Geohydrologic unit tested (see table 1).
51	Blank
52-59	U.S. Geological Survey geologic unit code (see table 1 or Hutchinson, 1975, appendix F).
60	Blank
61-64	Altitude of land surface, in feet.
65-66	Blank
67-70	Depth to top of interval tested, in feet.
71-72	Blank
73-76	Depth to bottom of interval tested, in feet.
77	Blank
78-85	Permeability factor = ratio of intrinsic permeability to viscosity, in millidarcies per centipoise.
86	Blank
87-93	Viscosity of fluid, in centipoise.
94	Blank
95-97	Reservoir temperature, in degrees Celsius.

Table 7.--Description and format of core-sample analysis and drill-stem-test data stored on magnetic tape--Continued

Record position	Description
98-99	Blank
100-106	Intrinsic permeability, in millidarcies.
107	Blank
108-114	Hydraulic conductivity (horizontal), in feet per day.
115	Blank
116-120	Median porosity (from core-sample analyses), in percent.
121	Blank
122-127	Ratio of horizontal to vertical permeability (from core-sample analyses).

Water Data Storage and Retrieval System (WATSTORE)

The U.S. Geological Survey acquires many types of data during its investigations of the occurrence, quantity, quality, distribution, and movement of the surface- and underground-water resources of the Nation. WATSTORE is a large-scale computerized system used to store and retrieve this data. WATSTORE consists of several files, one for each type of data; the water-quality and station-header files and GWSI are three of these files. All the data in the different WATSTORE files can be related by the location information in the station-header file (Hutchinson, 1975).

Ground Water Site Inventory (GWSI)

The U.S. Geological Survey's GWSI contains all the log data and parts of the water-level and hydraulics data that were compiled for the Kansas CMRASA study. Water-quality data-base file members also are identified in GWSI. Members of data-base files are flagged in GWSI by the use of the "other identifiers" and "other assigners" components (C190 and C191, respectively) under "other site-identification numbers" (R = 189). These components can be used to limit data retrieved from GWSI to only the members of the data-base file desired. How these components were used to identify a specific data base is presented in table 9.

All log interpretations, water-level measurements, and hydraulics data identified in GWSI as part of the CMRASA study are associated with a standard U.S. Geological Survey eight-character geologic unit code

(see table 1 or Hutchinson, 1975, appendix F). This code is stored in the "unit identifier" component (C93 for the log interpretations and water-level-measurement data or C100 for the hydraulics data). In addition, all log interpretations and hydraulics data are identified with a three-digit code number (table 1) in the "entry number" component (C256 for log interpretations or C99 for hydraulics data). Thus, all log-interpretation, water-level, and hydraulics data are identified with a geologic unit through at least one component.

Instructions for retrieving data from GWSI are detailed in Baker and Foulk (1975).

Water-Quality File

The WATSTORE water-quality file contains the results of chemical analyses of water samples collected by the U.S. Geological Survey. Instructions for using and retrieving data in the WATSTORE water-quality file are given in Hutchinson (1975) and U.S. Geological Survey (1983), respectively.

Central Midwest Regional Aquifer System Analysis Water-Quality File (CMRASA QWFILE)

The CMRASA's QWFILE file contains all the water-quality data compiled for Kansas, Nebraska, and the parts of the eight adjacent States included in the CMRASA study (see cover). The conventions used in QWFILE are similar to those of the WATSTORE water-quality file. Access to QWFILE is through a program called QWJOB. QWJOB is a series of programs developed to retrieve, process, and display records from QWFILE. Descriptions of QWFILE and QWJOB are not available at the time of this publication.

Central Midwest Regional Aquifer System Analysis Reservoir Parameter Data Base (CMRASA RPDB)

The CMRASA's RPDB file stores most of the drill-stem-test and core-sample-analyses data compiled for the Kansas, Nebraska, and parts of the eight adjacent States included in the CMRASA study. A description of RPDB is not available at the time of this publication.

Magnetic Tape

All nonproprietary data compiled for the Kansas part of the CMRASA study are stored on magnetic tape and are available on request from the U.S. Geological Survey in Lawrence, Kans. The characteristics of each file stored on magnetic tape are described in table 10. These files can be copied onto magnetic tape in various densities and formats depending on the needs of the requestor. At this time (1987) the densities available are 800, 1,600, and 6,250 bytes per inch on nine-track tape. The formats available are MAGSAV, ASCII, EBCDIC, BCD, or eight-bit BINARY. The maximum physical block size must be less than or equal to 10,000 characters. To obtain a copy of any of the files on magnetic tape, contact the U.S. Geological Survey office at 1950 Constant Avenue - Campus West, Lawrence, KS 66046 [telephone: (913) 864-4321] and request the particular files to be

copied onto a magnetic tape. The requestor will be charged the cost of the tape and the labor involved in making the tape (about $25.00 in 1987).

Table 8.--Description and format of water-use data stored on magnetic tape

Record position	Description
1-3	County code (see U.S. Department of Commerce, 1979).
4-5	Blank
6-9	Middle year of decade; values estimated for this year assumed to be representative of the entire decade.
10	Blank
11-19	Estimated total ground water used by county for the year, in millions of gallons per day.
20-21	Blank
22-24	Percentage of ground water derived from Upper Cretaceous through Cenozoic rocks (geohydrologic unit A1-A2; see table 1).
25-26	Blank
27-29	Percentage of ground water derived from Dakota Sandstone (geohydrologic unit BØ; see table 1).
30-31	Blank
32-34	Percentage of ground water derived from Cheyenne Sandstone (geohydrologic unit CØ; see table 1).
35-36	Blank
37-39	Percentage of ground water derived from Permian through Upper Mississippian rocks (geohydrologic units F1-H3; see table 1).
40-41	Blank
42-44	Percentage of ground water derived from Mississippian rocks (geohydrologic unit IØ; see table 1).
45-46	Blank
47-49	Percentage of ground water derived from Devonian to Upper Cambrian rocks (geohydrologic units K1-L3; see table 1).
50-51	Blank

Table 8.--Description and format of water-use data stored on magnetic tape --Continued

Record position	Description
52-54	Percentage of ground water derived from Upper Cambrian rocks (geohydrologic unit NØ; see table 1).
55-56	Blank
57-59	Percentage of ground water used by livestock and rural households.
60-61	Blank
62-64	Percentage of ground water used for industrial purposes.
65-66	Blank
67-69	Percentage of ground water used for irrigation.
70-71	Blank
72-74	Percentage of ground water used by municipalities.

SUMMARY

Machine-readable log, water-quality, water-level, hydraulics, and water-use data for Kansas were compiled as part of the U.S. Geological Survey's Central Midwest Regional Aquifer System Analysis (CMRASA). The log data consist of depths to the top of selected geologic formations determined from about 275 sites with geophysical logs and formation lithologies from about 190 sites with lithologic logs. The water-quality data consist of about 10,800 analyses, of which about 1,200 are proprietary. The water-level data consist of about 4,480 measured water levels and about 4,175 equivalent freshwater heads, of which about 3,745 are proprietary. The hydraulics data consist of results from about 30 specific-capacity tests and about 20 aquifer tests and interpretations of about 285 drill-stem tests (of which about 60 are proprietary) and about 75 core-sample analyses. The water-use data consist of estimates of freshwater withdrawals from geohydrologic units for several major uses for each of the 105 counties in Kansas. Average yearly withdrawals were estimated for each decade from 1940 to 1980.

Some of these data are stored in large multistate computer data bases, such as the U.S. Geological Survey's WATSTORE water-quality file and GWSI and the CMRASA's QWFILE and RPDB files. All the log and water-use data and the nonproprietary parts of the water-quality, water-level, and hydraulics data are available on magnetic tape from the U.S. Geological Survey office in Lawrence, Kans.

Table 9.--Components of Ground Water Site Inventory (GWSI) that identify data-base files of Central Midwest Regional Aquifer System Analysis (CMRASA)

Type of data	Other site-identification numbers (components in R=189)	
	Other identifier (C190)	Other assigner (C191)
Lithologic	LITH-DB	KSCMRASA
Geophysical	GEOPHYS-DB	KSCMRASA
Water quality	[Sample number and geohydrologic unit][1]	KSCMRASA-QWDB
Water level	WL-DB [geohydrologic unit][1]	KSCMRASA

[1] Components shown in brackets indicate additional information that was coded for water-level and water-quality data. This information varies for each site entered in GWSI.

Table 10.--Characteristics of files stored on magnetic tape

File name	Type of file	Record length	Lines of data	Lines of introduction	Lines in file	Bytes in file
LOG.GEOPHYS	Geophysical-log data	73	2,936	48	2,984	217,832
LOG.LITH	Lithologic-log data	78	3,191	53	3,244	253,032
WATER.QUAL	Water-quality data	80	67,726	117	67,843	5,427,440
WL.MEAS	Measured water-level data	132	5,342	107	5,449	719,268
HEAD.EQFW	Equivalent freshwater-head data	124	427	128	555	68,820
HYD.SCAQ	Specific-capacity test and aquifer-test data	112	49	72	121	13,552
HYD.DSTCORE	Drill-stem-test and core-sample-analyses data	127	297	116	413	52,451
WATER.USE	Water-use data	74	420	73	493	36,482

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