INTRODUCTION

The purpose of this Hydrologic Investigations Atlas is to provide a description of the principal geohydrologic systems in Upper Cambrian through Lower Cretaceous rocks in Kansas. This investigation was made as part of the Central Midwest Regional Aquifer-System Analysis (CMRASA). The CMRASA is one of several major investigations by the U.S. Geological Survey of regional aquifer systems in the United States. These regional investigations are designed to increase knowledge of the flow regime and hydrologic properties of major aquifer systems and to provide quantitative information for the assessment, development, and management water supplies. The CMRASA study area includes all or parts of 10 Central Midwestern States (Jorgensen and Signor, 1981), as shown on the envelope cover.

This Hydrologic Investigations Atlas, which consists of a series of nine chapters, presents a description of the physical framework and the geohydrology of principal aquifers and confining systems in Kansas. Chapter D presents maps that show the areal extent, altitude and configuration of the top, and thickness of Mississippian rocks that compose the upper aquifer unit of the Western Interior Plains aquifer system in Kansas. The chapter is limited to the presentation of the physical framework of the upper aquifer unit. The interpretation of the physical framework of the upper aquifer unit is based on selected geophysical and lithologic logs and published maps of stratigraphically equivalent units. Maps indicating the thickness and the altitude and configuration of the top of the upper aquifer unit in the Western Interior Plains aquifer system have been prepared as part of a series of interrelated maps that describe the stratigraphic interval from the Precambrian basement through Lower Cretaceous rocks. A concerted effort was made to ensure that maps of each geohydrologic unit are consistent with the maps of underlying and overlying units. Chapter A of this atlas series (Wolf and others, 1990) describes the relation of principal geohydrologic systems in Kansas and presents a more detailed discussion of the methods and data used to prepare and ensure consistency among the sets of maps.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
gallon per minute	0.06309	liter per second

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

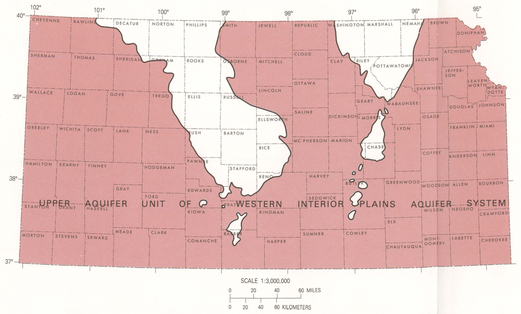
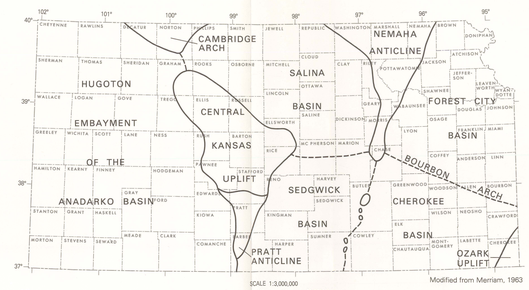


FIGURE 1.—Geohydrologic map showing areal extent of upper aquifer unit in Western Interior Plains aquifer system.



Modified from Merriam, 1963

FIGURE 2.—Geohydrologic map showing major pre-Desmoesian, post-Mississippian structural features and provinces in subsurface.

DEFINITION AND AREAL EXTENT

The upper aquifer unit in the Western Interior Plains aquifer system comprises permeable limestone, cherty limestone, and dolomite rocks of Mississippian age. In Kansas, these rocks underlie about 68,500 square miles (fig. 1) and occur throughout the State except in large areas over the Nemaha Anticline, the Central Kansas Uplift, the Cambridge Arch, and the Pratt Anticline (compare figs. 1 and 2). Except for a small outcrop area in the southeast corner of the State, these rocks occur only in the subsurface. The relation of the upper aquifer unit in the Western Interior Plains aquifer system to other geohydrologic systems in Kansas is shown in figure 3.

For the CMRASA study in Kansas, Mississippian rocks (Upper Kinderhookian, Osagean, and Meramecian Stages; table 1) have been divided into two separate, laterally adjacent flow systems on the basis of opposing directions of ground-water flow and distinctly different water quality. These two flow systems are:

(1) The Western Interior Plains aquifer system—A somewhat ill-defined salt-water system in which flow generally is slowly eastward. This system extends from the base of the Rocky Mountains in Colorado to the Ozark Plateaus of Missouri and occurs throughout Kansas with the exception of the southeast corner of the State.

(2) The Ozark Plateaus aquifer system—A well-defined freshwater system in which flow generally is rapidly westward. This system originates in the Ozark Plateaus of southern Missouri and extends into southeast Kansas.

The permeable limestone that forms the upper aquifer unit in the two flow systems is continuous across the western boundary of the Ozark Plateaus aquifer system into the Western Interior Plains aquifer system. The boundary between the two flow systems is not well defined because of a lack of data in the transition zone. The geohydrologic units in the Ozark Plateaus aquifer system designated by Imes (1990) apply only to parts of a few counties in the southeast corner of Kansas. Therefore, in this report, for ease of mapping and convenience of discussion, the Mississippian rocks that compose the laterally adjacent aquifer systems are referred to collectively as the "upper aquifer unit in the Western Interior Plains aquifer system," even though the maps also include a small area of the Ozark Plateaus aquifer system in southeast Kansas.

In central and eastern Kansas, the upper aquifer unit lies above the less permeable shale of the confining unit in the Western Interior Plains aquifer system (fig. 3). In western Kansas, where the confining unit is missing, the upper aquifer unit lies directly above the lower aquifer unit in the Western Interior Plains aquifer system (fig. 3), and the two units function as one aquifer. A thick, dominant shale sequence in the Western Interior Plains confining system overlies the upper aquifer unit throughout most of Kansas, except in a small area near the southeast corner.

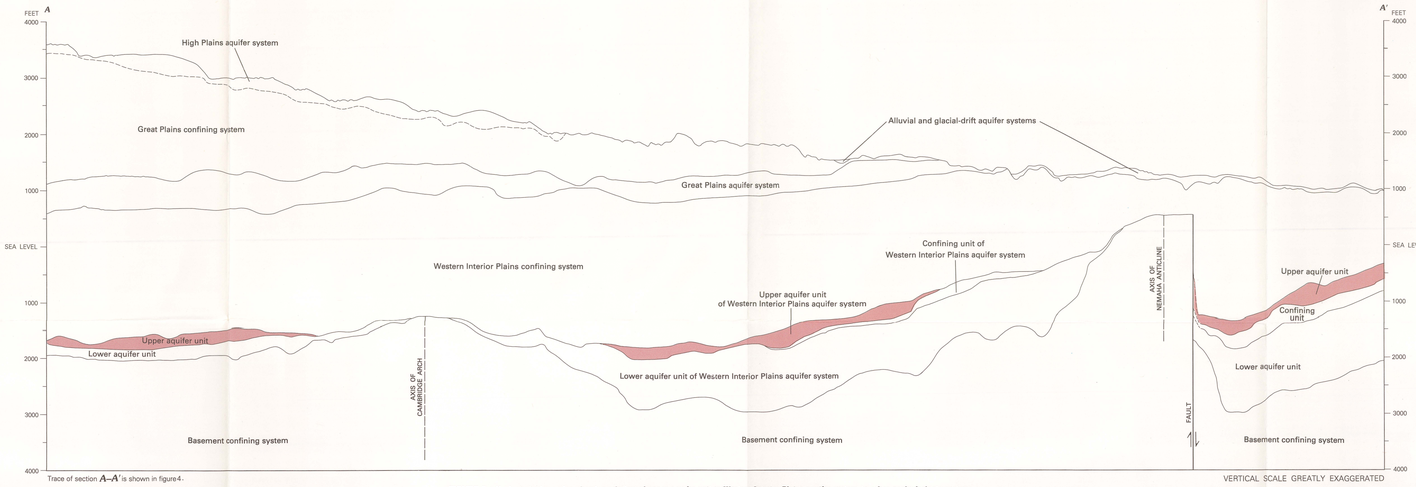
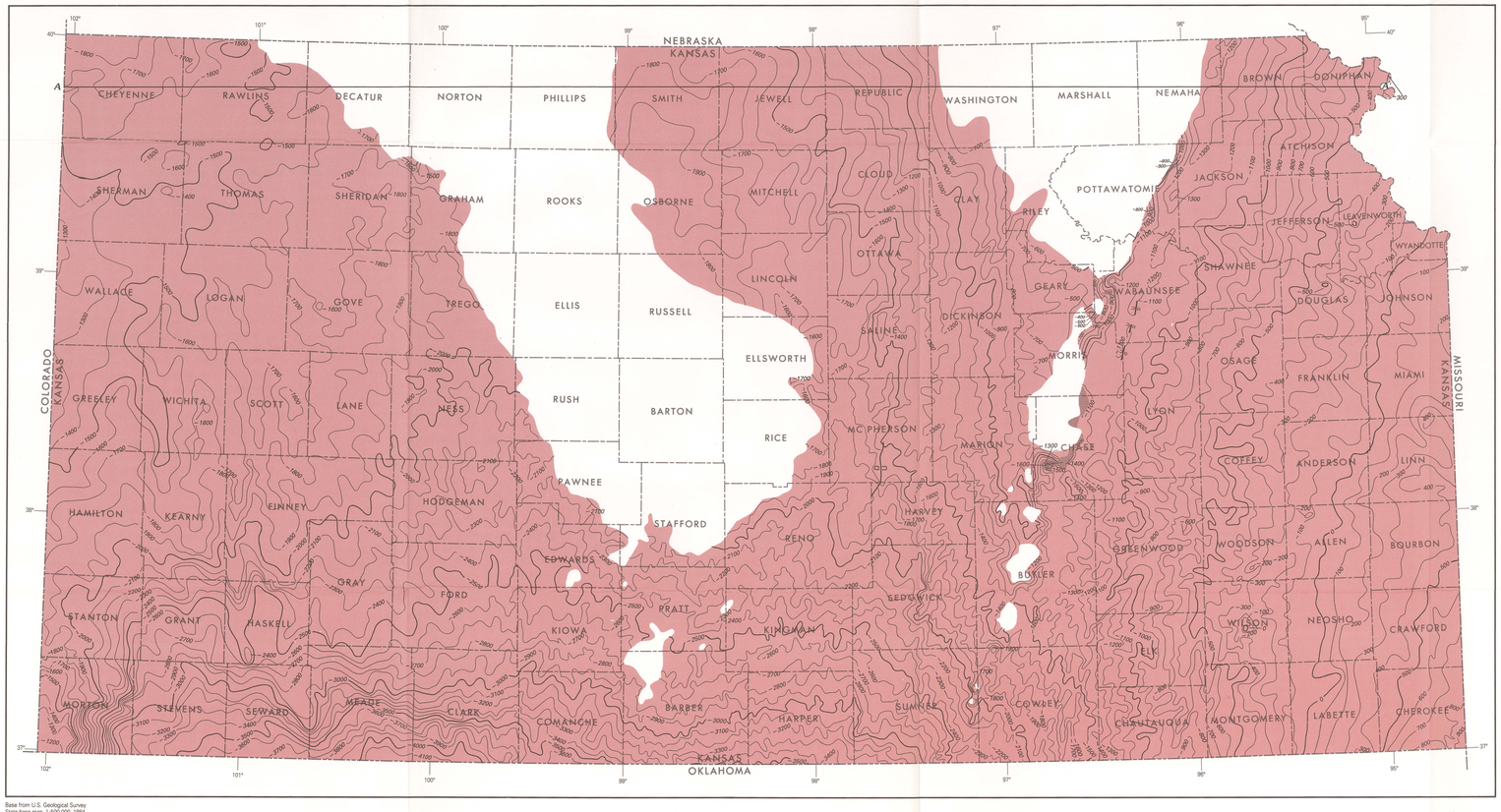


FIGURE 3.—Geohydrologic section showing relation of upper aquifer unit in Western Interior Plains aquifer system to other geohydrologic systems.



Base from U.S. Geological Survey
State base map, 1:500,000, 1984

SCALE 1:1,000,000
0 10 20 30 40 MILES
0 20 40 KILOMETERS

FIGURE 4.—Geohydrologic map showing altitude and configuration of top of upper aquifer unit.

Altitude and Configuration of Top

The altitude of the top of the upper aquifer unit in the Western Interior Plains aquifer system ranges from a high of about 900 feet above sea level where it crops out in the extreme southeast corner of the State to a low of about 4,100 feet below sea level in Clark and Meade Counties in southwestern Kansas (fig. 4). From the area of greatest altitude on the western flank of the Ozark Uplift in southeast Kansas, the surface dips gently at first and then more steeply to the northwest and west into the Forest City and the Cherokee Basins. The surface of the upper aquifer unit attains its greatest depth in both basins near the east edge of the Nemaha Anticline (compare figs. 2 and 4). The surface then rises steeply and irregularly from the bottoms of the basins toward the crest of the Nemaha Anticline. An area of abruptly changing altitude is indicated along the east edge of the Nemaha Anticline, where it was not possible to maintain a 100-foot contour interval at the scale of the map. The upper aquifer unit in the Western Interior Plains aquifer system has been eroded from a large area over the northeast-trending Nemaha Anticline, especially in the north where the anticline is highest.

Westward from the Nemaha Anticline, the surface dips gently into the Salina Basin and more steeply into the Sedgwick Basin. Its deepest point in the Salina Basin is located adjacent to the Central Kansas Uplift, which bounds the basin on the west. The upper aquifer unit in the Western Interior Plains aquifer system was eroded from most of the Cambridge Arch and the Central Kansas Uplift and its southern extension, the Pratt Anticline. From the western flank of the Cambridge Arch and the northern part of the Central Kansas Uplift, the surface slopes gently upward to the west; however, from the flanks of the southern part of the Central Kansas Uplift and the Pratt Anticline, it slopes steeply to the southeast into the Sedgwick Basin and plunges abruptly to the southwest into the Hugoton Embayment of the Anadarko Basin.

EXPLANATION

- AREA OF UPPER AQUIFER UNIT
- AREA WHERE AQUIFER UNIT IS ABSENT
- AREA OF ABRUPTLY CHANGING ALTITUDE
- —100— TOP-OF-UPPER AQUIFER UNIT CONTOUR—Shows altitude of top of upper aquifer unit. Contour Interval 100 feet. Datum is sea level
- U/D FAULT—U, upthrown side; D, downthrown side
- A—A' TRACE OF SECTION

TABLE 1. Generalized stratigraphic units and related geohydrologic systems

SYSTEM	Series	Provincial series	Geologic unit	Geohydrologic systems: Subdivisions	Geohydrologic systems: Major systems
QUATERNARY	Holocene		Undifferentiated Quaternary deposits		Alluvial and glacial-drift aquifer system
	Pleistocene				
TERTIARY	Miocene		Ogallala Formation		High Plains aquifer system
CRETACEOUS	Upper		Undifferentiated Upper Cretaceous rocks		Great Plains confining system
	Lower		Dakota Formation	Upper aquifer unit	Great Plains aquifer system
			Kiowa Shale	Confining unit	
			Cheyenne Sandstone	Lower aquifer unit	
JURASSIC	Upper		Morrison Formation	Upper unit	Western Interior Plains confining system
			Undifferentiated Upper Jurassic rocks		
PERMIAN	Upper		Big Basin Formation	Lower unit	
	Lower		Day Creek Dolomite Whitehorse Formation Nippewalla Group Dog Creek Formation Blaine Formation Flowerpot Shale Cedar Hills Sandstone Salt Plains Formation Harper Sandstone Sumner Group Stone Corral Formation Nirwanah Shale Wellington Formation Chase Group Council Grove Group Admire Group		
PENNSYLVANIAN	Upper	Virgilian	Wabaunsee Group Shawnee Group Douglas Group		
		Missourian	Undifferentiated Missourian rocks		
	Middle	Desmoinesian	Undifferentiated Desmoinesian rocks		
		Atokan	Undifferentiated Atokan rocks		
	Lower	Morrowan	Undifferentiated Morrowan rocks		
MISSISSIPPIAN	Upper	Chesterian	Undifferentiated Chesterian rocks		Western Interior Plains aquifer system
	Lower	Meramecian	Undifferentiated Upper and Lower Mississippian rocks	Upper aquifer unit	
		Osagean			
		Kinderhookian	Undifferentiated Lower Mississippian and Upper Devonian rocks	Confining unit	
DEVONIAN			Hunton Formation	Upper part of lower aquifer unit	
SILURIAN					
ORDOVICIAN	Upper		Maquoketa Shale		
	Middle		Viola Limestone Simpson Group		
	Lower		Arbuckle Group	Lower part of lower aquifer unit	
CAMBRIAN	Upper				
PRECAMBRIAN			Igneous, metamorphic, and metasedimentary rocks		Basement confining system

GEOHYDROLOGIC SYSTEMS IN KANSAS—PHYSICAL FRAMEWORK OF THE UPPER AQUIFER UNIT IN THE WESTERN INTERIOR PLAINS AQUIFER SYSTEM

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