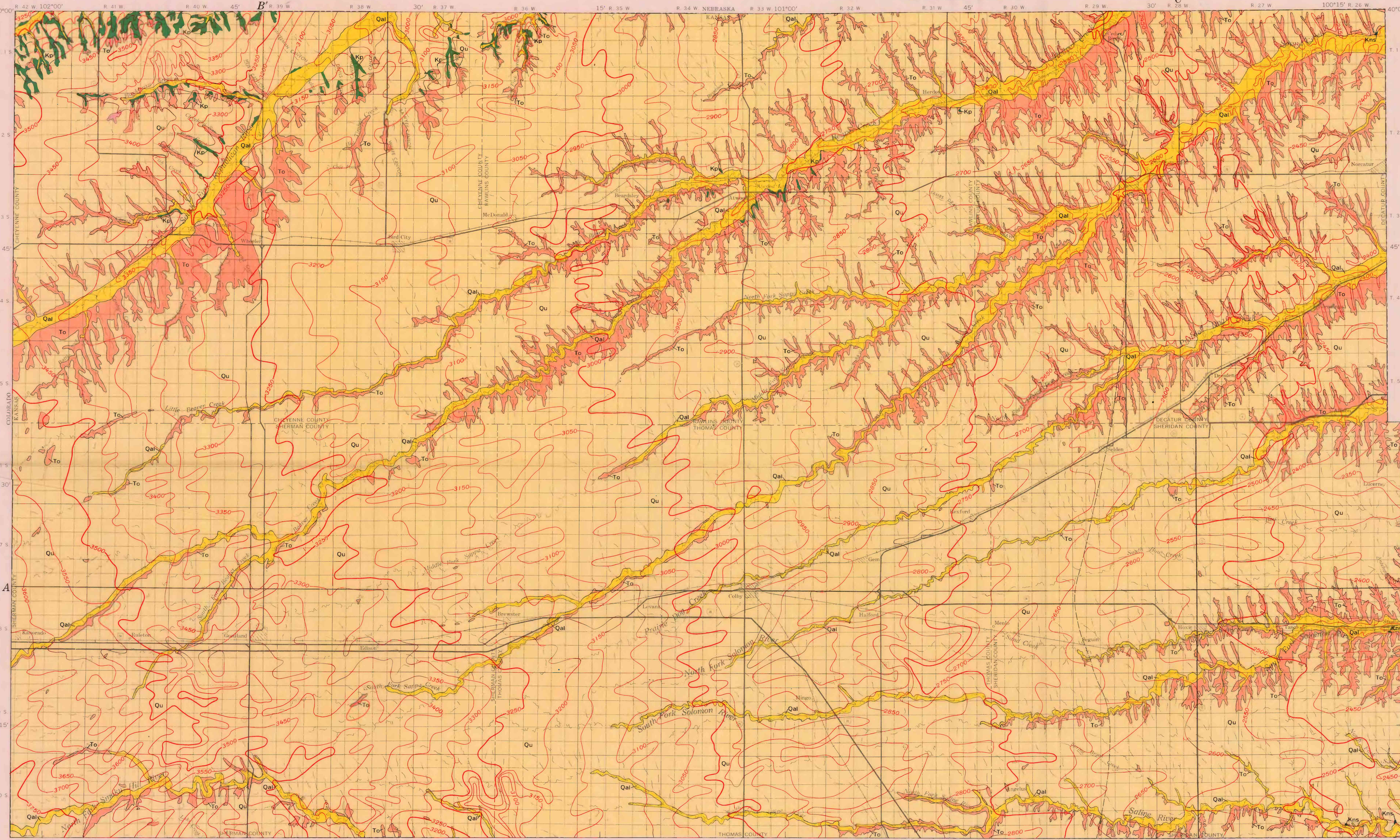
PREPARED IN COOPERATION WITH THE
STATE GEOLOGICAL SURVEY OF KANSAS
KANSAS STATE DEPARTMENT OF HEALTH
KANSAS STATE BOARD OF AGRICULTURE

GEOLOGY

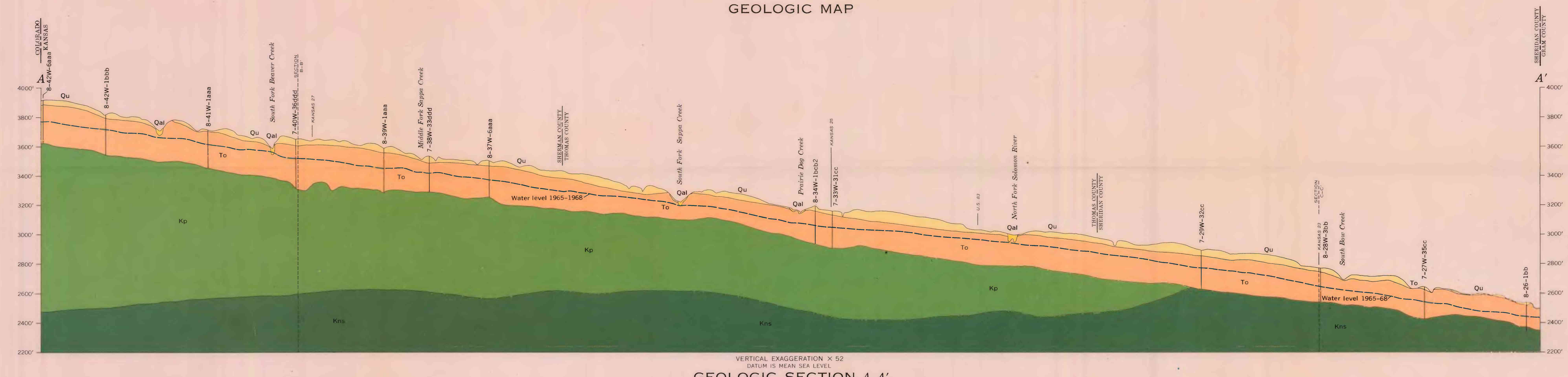


Base from U.S. Geological Survey
Goodland, 1954 and Limon, 1954–64
Roads modified 1969

SCALE 1:250 000

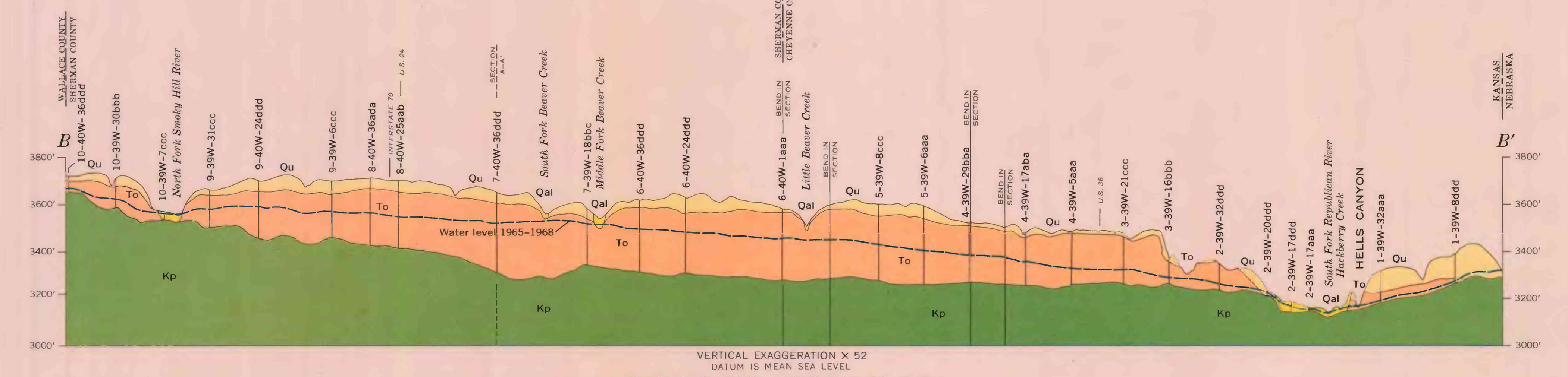
Geology adapted by R. H. Pearl in 1968 from Fry, 1945; Prescott, 1952–53; Bayne, 1956; Walters, 1956; and Hodson, 1968

GEOLOGIC MAP



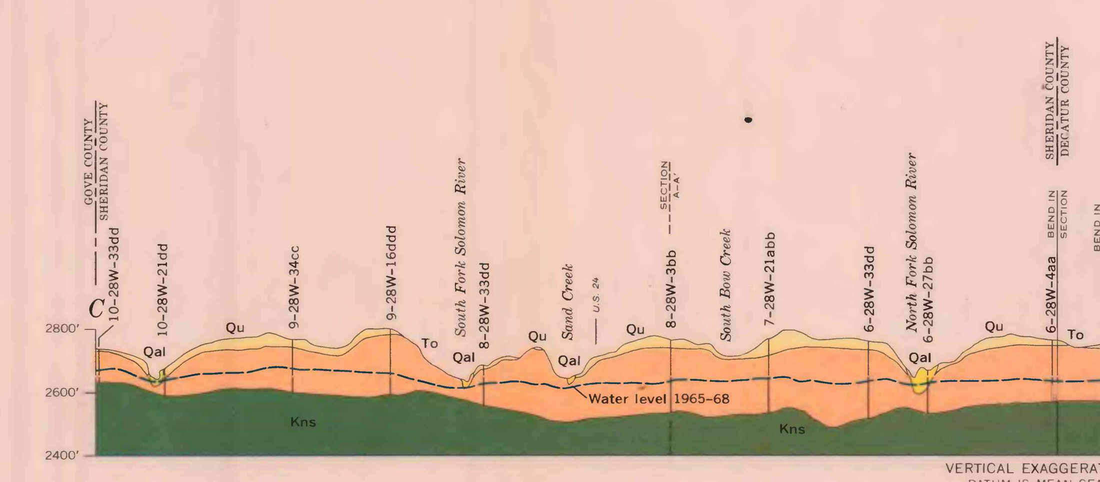
VERTICAL EXAGGERATION × 52
DATUM IS MEAN SEA LEVEL

GEOLOGIC SECTION A–A′



VERTICAL EXAGGERATION × 52
DATUM IS MEAN SEA LEVEL

GEOLOGIC SECTION B–B′



VERTICAL EXAGGERATION × 52
DATUM IS MEAN SEA LEVEL

GEOLOGIC SECTION C–C′

EXPLANATION

UNCONSOLIDATED DEPOSITS

Alluvium of Holocene and Pleistocene age, undifferentiated Pleistocene deposits, and the Ogallala Formation of Pliocene age are water bearing and are hydraulically connected where saturated

QUATERNARY

Qal

Alluvium

Alluvium of Holocene and Pleistocene age consisting of gravel, sand, silt, and clay is found along the major stream courses and is as thick as 85 feet. Alluvium of Holocene age underlies the valley flood plain, whereas alluvium of Pleistocene age underlies alluvium of Holocene age and terraces along the streams. Alluvial deposits commonly yield 100 to 1,500 gpm (gallons per minute) to wells in the principal valleys and 1 to 10 gpm to wells in the tributary valleys

Qu

Undifferentiated deposits

Undifferentiated deposits of Pleistocene age consisting of eolian silt, sand, minor amounts of volcanic ash, and some alluvial gravel mantle most of the uplands and a large part of the valleys. These deposits, as thick as 135 feet, generally lie above the water table, but locally yield 1 to 10 gpm to wells where the deposits are saturated

TERTIARY

To

Ogallala Formation

The Ogallala Formation of Pliocene age consists of discontinuous interbedded lenses of gravel, sand, silt, and clay. Locally these lenses are moderately to well cemented by calcium carbonate and silica. The Ogallala is as much as 320 feet thick. Where the saturated thickness is greatest, as much as 2,000 gpm is obtained from irrigation, municipal, and industrial wells. Wells commonly yield 500 to 1,500 gpm from the west-central to the east-central part of the area and less than 500 gpm along the northern and southern borders

CONSOLIDATED DEPOSITS

Consolidated deposits of Cretaceous age that underlie the alluvium, undifferentiated deposits, and Ogallala Formation are referred to as bedrock. These deposits, the Pierre Shale and the Smoky Hill Chalk Member of the Niobrara Formation, are too fine grained and impermeable to yield large quantities of water to wells. Their principal hydrologic function is to impede the downward movement of water by forming an impermeable base for the overlying aquifers. The irregular bedrock surface forms the base of the saturated zone, and greater saturated thicknesses generally coincide with those places where the overlying deposits fill ancient valleys in the bedrock

CRETACEOUS

Kp

Pierre Shale

The Pierre Shale of Late Cretaceous age is a fissile dark-gray marine shale with a local thin weathered zone of orange clay known as "ochre" at the top. This formation underlies approximately the western two-thirds of the area and is as thick as 1,600 feet in northwestern Kansas. It is exposed in stream valleys along the northern border of the six-county area, mainly in Cheyenne County. Very small quantities, 1 to 3 gpm, of poor-quality water are obtained from weathered and fractured zones of the Pierre in northern Cheyenne County

Kns

Smoky Hill Chalk Member of the Niobrara Formation

The Smoky Hill Chalk Member of Late Cretaceous age is the upper member of the Niobrara Formation. It is a gray and light-gray chalk and chalky shale that ranges from 300 to about 700 feet in thickness. Locally the upper few feet weathers to an orange clay. This unit underlies the unconsolidated deposits in the eastern two-thirds of Sheridan County and the eastern half of Decatur County, and yields no water to wells in northwestern Kansas

Contact

Approximate subcrop contact of Pierre shale and Smoky Hill Chalk Member of Niobrara Formation

2500
2450

Bedrock contour

Shows altitude of bedrock surface. Contour interval 50 feet. Datum is mean sea level

The classification and nomenclature of the stratigraphic units in this report are those of the U.S. Geological Survey and differ somewhat from those of the State Geological Survey of Kansas

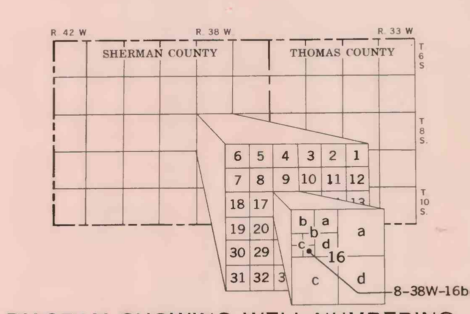
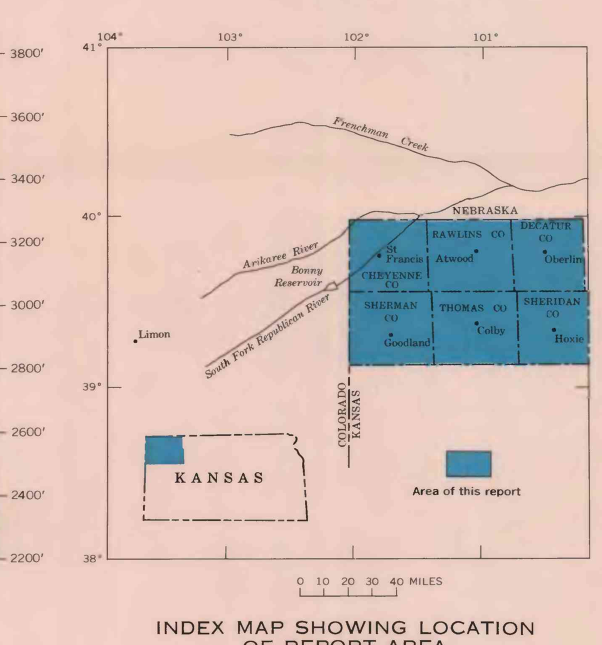


DIAGRAM SHOWING WELL-NUMBERING SYSTEM



INDEX MAP SHOWING LOCATION OF REPORT AREA

INTRODUCTION

This atlas presents information on geology and water resources of a six-county area in northwestern Kansas (see index map). The data are intended primarily as a guide to the availability of ground water, which is the main source of supply for domestic, stock, industrial, irrigation, and municipal uses.

Topography in the area is characterized by gently rolling upland plains that are dissected in the northern and eastern parts of the area by shallow to deep valleys. The plains are dotted with undrained depressions ranging from a fraction of an acre to as much as 100 acres. Much of the area is mantled by a fertile loess soil that is ideally suited for irrigation. The slope of the land surface is to the east-northeast at about 14 feet per mile. Altitudes of the land surface range from about 2,400 feet in east-central Sheridan County to about 4,000 feet in southwestern Sherman County.

The principal water-bearing formations are the Ogallala Formation and the alluvium. Some ground water also may be available from the Dakota Sandstone of Early Cretaceous age at depths ranging from 1,000 to 2,600 feet below land surface. However, the sandstone probably would yield only small quantities of highly mineralized water because of the depth, low hydraulic conductivity, and great distance from areas of fresh-water recharge.

The general relation of geologic units and the configuration of the bedrock surface are illustrated on the geologic map and the geologic sections. A description of lithology and water-bearing characteristics of the individual geologic units is given in the explanation of the geologic map. The general relation of the water table and the saturated zone also is shown on the geologic sections. The bedrock slopes northeastward at about 13 feet per mile, and the water table slopes northeastward at about 15 feet per mile.

The data used in compiling the maps for this atlas were obtained from many sources: county and city officials; oil and power companies; water-well drillers; well owners and operators; and Federal, State, and County agencies related to agriculture.

GEOLOGIC HISTORY

Northwestern Kansas was covered by seas throughout most of geologic time during which limestone, shale, and sandstone were deposited. The last sea to cover northwestern Kansas was in Cretaceous time when numerous formations were deposited. Two of these, the Smoky Hill Chalk Member of the Niobrara Formation and the Pierre Shale, form the bedrock that underlies younger unconsolidated deposits. After Cretaceous seas withdrew, the land was uplifted and eroded. The bedrock surface resulting from this erosion cycle shows the northeastward-trending drainage pattern that developed across northwestern Kansas.

During Pliocene time the Rocky Mountains were uplifted and subjected to erosion, and streams carried alluvial sediments of the Ogallala Formation into western Kansas. By late Pliocene time, valleys in the bedrock had been filled and overtopped by unconsolidated alluvial deposits. The surface of these deposits formed a featureless plain that sloped gently eastward from the mountains.

Although glaciers did not extend into northwestern Kansas during the Pleistocene Epoch, the climate that accompanied each glacial stage had an affect on the topography. Increased precipitation during each glacial stage developed new streams and deepened the channels of preexisting streams. Later, because of downcutting and erosion, the Ogallala Formation was removed along the eastern edge of the mountains. The westernmost edge of the Ogallala, which is contiguous with the Ogallala in northwestern Kansas, is now in the vicinity of Limon, Colo., about 65 miles east of the mountains and 90 miles west of the Colorado-Kansas border. East of Sheridan County, Kans., much of the Ogallala Formation has been removed by erosion and occurs only as discontinuous patches. Eolian (windblown) deposition also was important during the late phase of the last two glacial cycles. The deposits of Pleistocene and Holocene age are characterized by alluvium along streams and rivers, and loess mantling the uplands and valley walls.

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WATER RESOURCES OF NORTHWESTERN KANSAS

By
Richard Howard Pearl, Robert S. Roberts, Katherine M. Keene
and Thomas J. McClain

1972

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