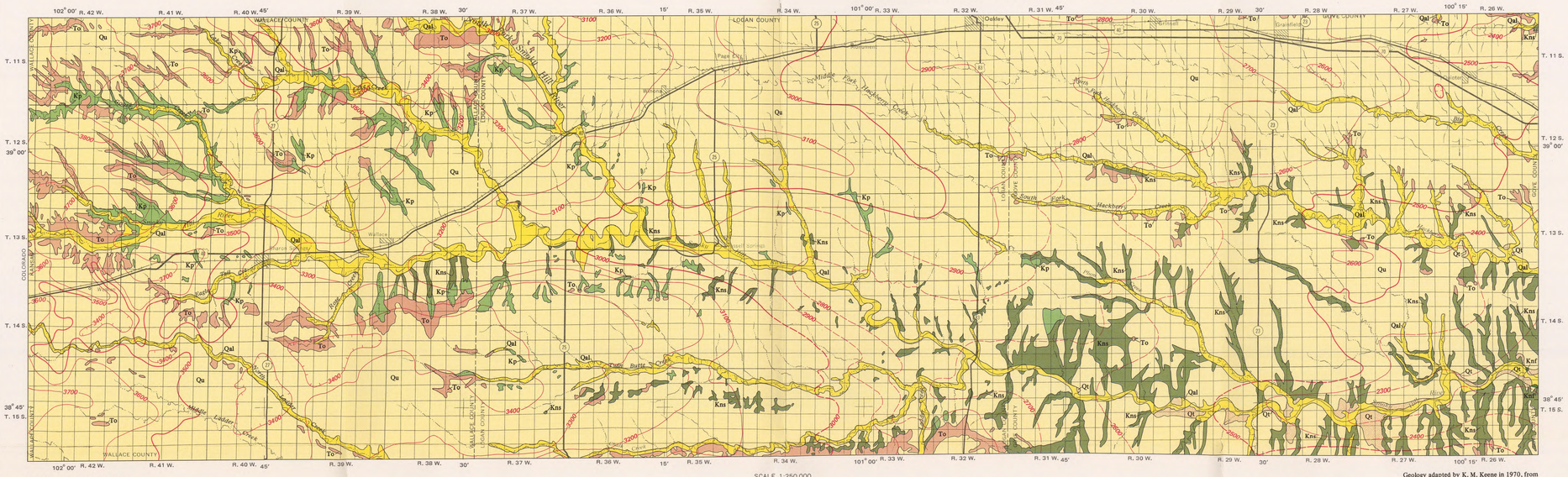
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
STATE GEOLOGICAL SURVEY OF KANSAS
KANSAS STATE DEPARTMENT OF HEALTH
KANSAS STATE BOARD OF AGRICULTURE

HYDROLOGIC INVESTIGATIONS
ATLAS HA-521 (SHEET 1 OF 2)

GEOLOGY AND GENERAL HYDROLOGY



Base from U.S. Geological Survey
Goodland, 1954, and Scott City, 1955-68
Roads modified 1971

SCALE 1:250 000
5 0 5 10 15 MILES
5 0 5 10 15 KILOMETRES

Geology adapted by K. M. Keene in 1970, from Johnson, 1958; Hodson, and Wahl, 1960; and Hodson, 1963

MAP SHOWING SURFACE GEOLOGY AND GENERALIZED CONFIGURATION OF BEDROCK SURFACE

EXPLANATION

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING CHARACTERISTICS

SURFICIAL GEOLOGIC UNITS

Unconsolidated Deposits

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

Qal

Alluvium

Alluvium of Holocene and Pleistocene age ranging from clayey silt to coarse sand and gravel is found along the major stream courses and is known to be as thick as 105 feet. Alluvium of Holocene age underlies valley flood plains, whereas alluvium of Pleistocene age underlies alluvium of Holocene age. Wells in alluvium are reported to yield as much as 2,100 gpm (gallons per minute) in the Smoky Hill River valley, and from 300 to 800 gpm in other valleys

Qu

Undifferentiated deposits

Undifferentiated deposits of Pleistocene age consisting of silt and fine sand, mostly eolian, mantle most of the uplands and much of the valley walls. These deposits are as thick as 40 feet and generally lie above the water table; where saturated, they yield 1 to 10 gpm of water to wells

Qt

Terrace deposits

Terrace deposits of Pleistocene age consist of stream-deposited silt, sand, and gravel with some small, isolated volcanic ash deposits. Terrace deposits in Logan County attain a maximum thickness of about 90 feet. In some parts of Gove and Logan Counties these deposits are the main source of ground water. Well yields commonly range from 100 to 400 gpm

QUATERNARY

To

Ogallala Formation

The Ogallala Formation of Pliocene age consists of discontinuous interbedded lenses of gravel, sand, silt, clay, and caliche. Locally, these lenses are moderately to well cemented by calcium carbonate and silica. The maximum thickness of the Ogallala is about 400 feet. Well yields of as much as 2,950 gpm have been measured prior to this investigation in southern Wallace County. Wells commonly yield 500 to 1,500 gpm in the northern part of Gove, Logan, and Wallace Counties and in southern Wallace County; yields elsewhere generally are less than 500 gpm

TERTIARY

Consolidated Deposits

Consolidated deposits of Cretaceous age are referred to as bedrock. The Pierre Shale, Niobrara Formation, Carlile Shale, Greenhorn Limestone, Graneros Shale, and Dakota Formation are bedrock units of hydrologic interest. Most of the bedrock units are too fine grained and impermeable to yield large quantities of water to wells; however, the Codell Sandstone Member of the Carlile Shale and the Dakota Formation do transmit water. The principal hydrologic function of the bedrock immediately below the unconsolidated deposits is to impede the downward movement of water by forming an impermeable base for the overlying unconsolidated aquifers. Because the bedrock surface is irregular, the greatest saturated thickness of the aquifer generally coincides with depressions or valleys in the bedrock surface

Kp

Pierre Shale

The Pierre Shale of Late Cretaceous age is a dark-gray fissile 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 study area and is exposed in stream valleys mainly in the western half. The Pierre is as much as 700 feet thick and yields little or no water to wells

Niobrara Formation

The Niobrara Formation of Late Cretaceous age comprises the Smoky Hill Chalk and Fort Hays Limestone Members

Kns

Smoky Hill Chalk Member

The Smoky Hill Chalk Member is a gray to light-gray chalk and a thin-bedded platy chalky shale. Locally the upper few feet weathers orange. This unit directly underlies most of the unconsolidated deposits of southeastern Logan County and most of Gove County, and is exposed along the stream valleys of the eastern two-thirds of the area. The Smoky Hill ranges from 0 to 650 feet in thickness and yields little or no water to wells

Knf

Fort Hays Limestone Member

The Fort Hays Limestone Member is a gray to light-gray chalk and massive fossiliferous chalky limestone; thin light- to dark-gray chalky shale beds separate the massive limestone beds. This member is exposed only along the Smoky Hill River valley at the eastern edge of the study area. The Fort Hays ranges from 40 to 85 feet in thickness and is not known to yield water to wells

CRETACEOUS

SUBSURFACE GEOLOGIC UNITS

The Carlile, Greenhorn, Graneros, and Dakota Formations underlie the three counties, but are not exposed at the surface and, therefore, do not appear on the geologic map

The Carlile Shale of Late Cretaceous age comprises the Codell Sandstone, Blue Hill Shale, and Fairport Chalky Shale Members. The Codell Sandstone Member is a brown to gray fine-grained silty sandstone that locally contains shaly stringers. The Codell ranges from 10 to 45 feet in thickness and generally yields less than 5 gpm to domestic and stock wells in the southern part of Gove County. The Blue Hill Shale Member is a dark-gray blocky to fissile clayey shale that contains fossils and concretions. The Blue Hill ranges from 85 to 115 feet in thickness and is not known to yield water to wells. The Fairport Chalky Shale Member is a bluish-gray to gray chalky shale that contains thin beds of chalk. The Fairport ranges from 60 to 85 feet in thickness and is not known to yield water to wells

The Greenhorn Limestone of Late Cretaceous age is an alternating light- to dark-gray thin-bedded chalky limestone and calcareous shale that weather yellowish gray or yellowish tan. The formation ranges from 50 to 100 feet in thickness and is not known to yield water to wells

The Graneros Shale of Late Cretaceous age is a medium- to dark-gray fissile shale that weathers gray or yellowish brown. The formation ranges from 35 to 100 feet in thickness and is not known to yield water to wells

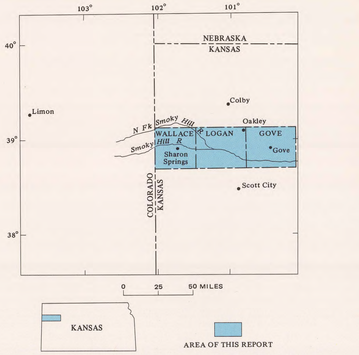
The Dakota Formation of Early Cretaceous age is a fine- to medium-grained sandstone with interbedded shale and siltstone. The unit ranges in thickness from 200 to 330 feet, and has been reported to yield as much as 20 gpm to domestic and stock wells in southern Gove and Logan Counties. Larger quantities may be possible to properly constructed wells. The chemical quality of the water may be unsatisfactory for some agricultural and domestic uses

Contact

3000 Bedrock contour

Shows altitude of bedrock surface. Dashed where approximately located. Contour interval 100 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.



INDEX MAP SHOWING LOCATION OF REPORT AREA

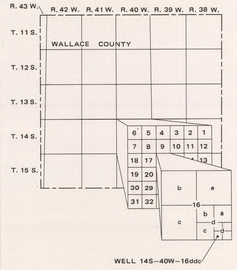
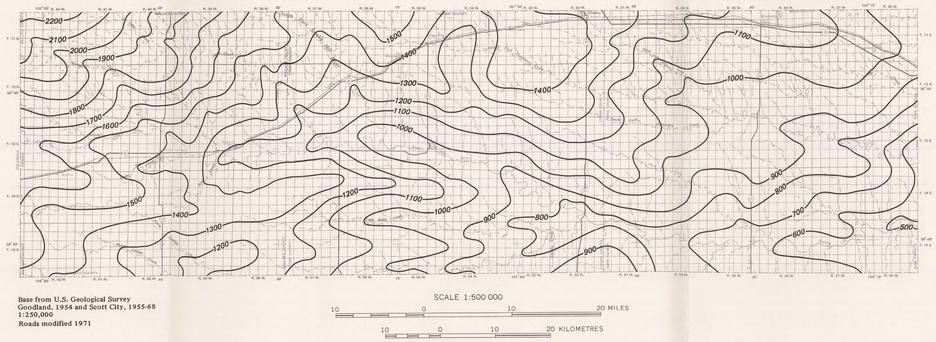


DIAGRAM SHOWING WELL-NUMBERING SYSTEM



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1:250,000
Roads modified 1971

SCALE 1:500 000
10 0 10 20 MILES
10 0 10 20 KILOMETRES

MAP SHOWING GENERALIZED DEPTH TO TOP OF DAKOTA FORMATION

EXPLANATION

1200 Line of equal depth to top of Dakota Formation

Interpolated from logs of oil and gas test wells. Interval 100 feet. Datum is land surface

INTRODUCTION

This atlas presents information on the geology and water resources of a three-county area in west-central Kansas (index map). The report is 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 central and southeastern parts of the area by shallow to deep valleys. The Smoky Hill River and its tributaries have eroded the cap of unconsolidated sand, gravel, and silt of the Ogallala Formation, thereby exposing older rocks of Cretaceous age in these valleys. Numerous undrained depressions ranging from a fraction of an acre to several tens of acres are scattered through the area. The upland plains are mantled by a fertile loess soil that is ideally suited for irrigation. The surface of the upland plains in the study area slopes gently east-southeastward at about 15 feet per mile. Land-surface altitudes range from 4,039 feet in western Wallace County to about 2,300 feet in eastern Gove County.

The surficial geologic units and the configuration of the bedrock that underlies the unconsolidated deposits are shown on the geologic map. The bedrock surface slopes eastward at about 14 feet per mile. A description of lithology and water-bearing characteristics of the individual geologic units is given in the explanation of the geologic map.

The principal water-bearing unit is the Ogallala Formation, but irrigation supplies also are obtained from the alluvium and the terrace deposits. Some ground water is available from the Dakota Formation at depths ranging from about 500 to 2,200 feet below land surface (map showing depth to Dakota Formation). In a few localities the Codell Sandstone Member of the Carlile Shale has yielded small quantities of water to wells.

Wells in this atlas are numbered according to the Federal system of land subdivision as follows: township, range, section, and position within the section. For example, well 14S-40W-16ddc is in the SW¼SE¼SE¼ sec. 16, T. 14 S., R. 40 W. (well-numbering system diagram).

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

GEOLOGIC HISTORY

West-central Kansas was covered by seas throughout most of geologic time during which limestone, shale, and sandstone were deposited. The last sea to cover west-central Kansas was in Cretaceous time when numerous formations were deposited. Two of these, the Niobrara Formation and the Pierre Shale, form the bedrock surface that underlies younger unconsolidated deposits in the study area. As the Cretaceous seas withdrew, the land was uplifted and eroded. The bedrock surface resulting from this erosion cycle shows the east-southeast-trending drainage pattern that developed across west-central Kansas. The closed basins on the map showing configuration of the bedrock surface in southern Wallace County indicate the probability of differential movement and local areas of subsidence on the bedrock surface.

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 west-central Kansas during the Pleistocene Epoch, the climate that accompanied each glacial stage affected the topography. Increased precipitation during each glacial stage developed new streams and deepened the channels of pre-existing streams. Later, because of downcutting and erosion, the Ogallala Formation was removed along the eastern edge of the mountains, thus severing any hydraulic connection. The westernmost edge of the Ogallala that is contiguous with the Ogallala in west-central Kansas is near Limon, Colo., about 65 miles east of the mountains and 90 miles west of the Colorado-Kansas border. East of the report area, 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 glacial stages. The deposits of Pleistocene and Holocene age are characterized by loess mantling the uplands and valley walls and by alluvium and terrace deposits along streams and rivers.

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Interior–Geological Survey, Reston, Va.–1975

WATER RESOURCES OF GOVE, LOGAN, AND WALLACE COUNTIES, WEST-CENTRAL KANSAS

By

Thomas J. McClain, Edward D. Jenkins, Katherine M. Keene, and Marilyn E. Pabst

1975

For sale by U.S. Geological Survey, Denver, Colo. 80225; and Reston, Va. 22092, price $1.50 per set