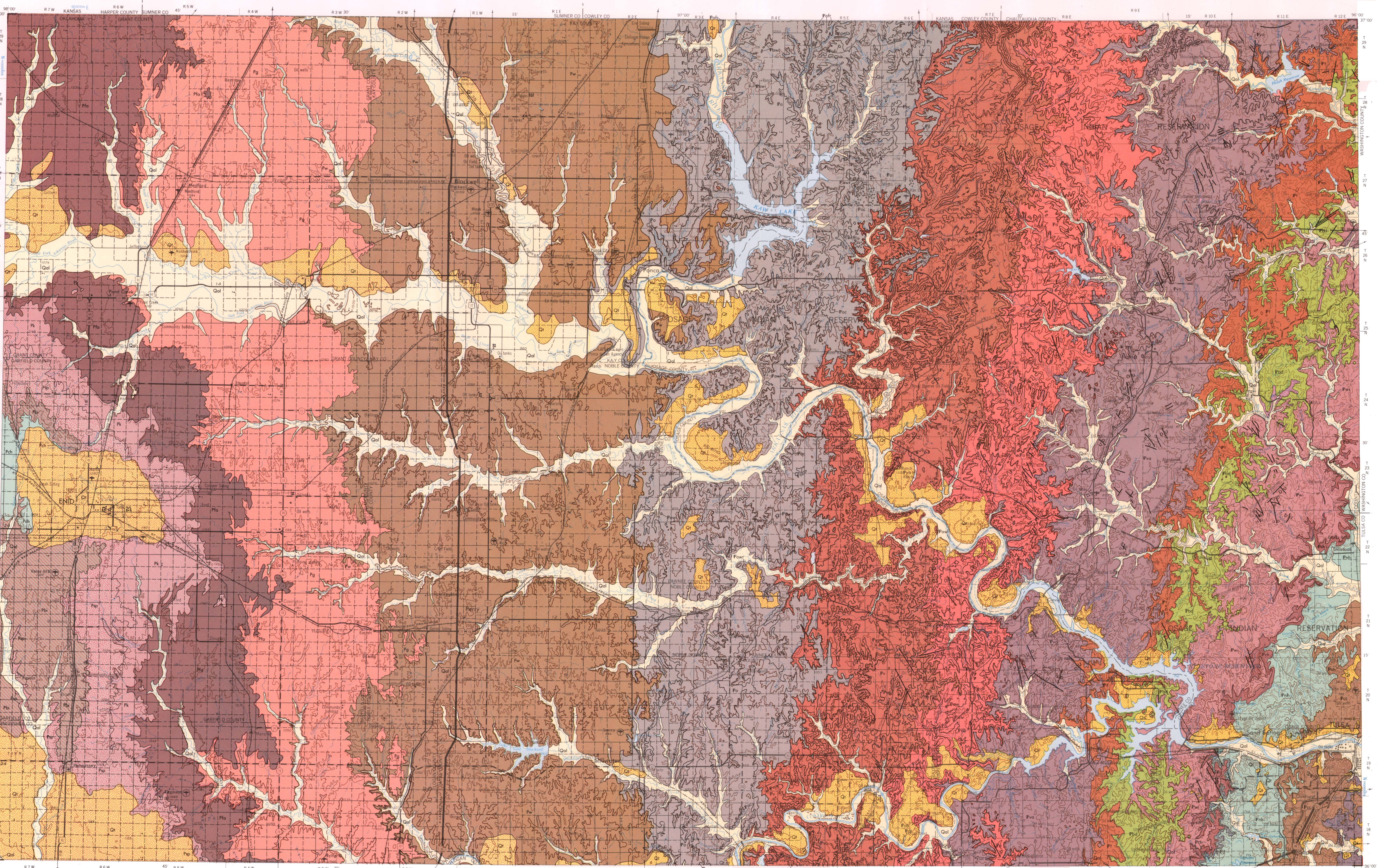

Base modified from U.S. Geological Survey 1:250,000 series: Enid quadrangle, 1966

Compiled by Robert O. Fay, Oklahoma Geological Survey, and Roy H. Bingham, U.S. Geological Survey, 1973

Scale 1:250,000

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS
DATUM: MEAN SEA LEVEL

Figure 2. Geologic map.

EXPLANATION

QUATERNARY

Qal

ALLUVIUM

Sand, silt, clay, and locally gravel. Maximum thickness ranges from 30 to 80 feet (9 to 24 m) along major streams and from 0 to 60 feet (0 to 18 m) along minor streams.

UNCONFORMITY

Qt

TERRACE DEPOSITS

Sand, silt, clay, and gravel. Maximum thickness, about 75 feet (23 m) along major streams.

UNCONFORMITY

PERMIAN

El Reno Group

Pch

CEDAR HILLS SANDSTONE

Mainly orange-brown, fine-grained quartzose sandstone. Thickness, about 180 feet (55 m).

Hennessey Group

Pbi

BISON FORMATION

Mainly red-brown shale and greenish-gray and orange-brown calcitic siltstone with minor sandstone in Garfield County. Thickness, about 120 feet (35 m).

Psp

SALT PLAINS FORMATION

Mainly red-brown shale with several thin beds of orange-brown, fine-grained sandstone. Thickness, about 160 feet (50 m).

Pk

KINGMAN SILTSTONE

Mainly red-brown with several thin layers of greenish-gray and orange-brown calcitic siltstone. Thickness, about 70 feet (20 m).

Pfa

FAIRMONT SHALE

Mainly red-brown shale with many thin layers of calcitic siltstone in upper 60 feet (18 m). Thickness, about 150 feet (45 m).

Sumner Group

Pg

GARBER SANDSTONE

Mostly orange-brown, fine- to medium-grained quartzose sandstone and conglomerate, grading northward into shale and calcitic siltstone. Thickness, about 600 feet (180 m).

Pw

WELLINGTON FORMATION

Mostly red-brown shale to north, grading into fine-grained sandstone and mudstone conglomerate southward into Logan County. Thickness, about 850 feet (260 m).

PENNSYLVANIAN

Virgilian

Gearyan

IPowi, IPofr, IPowr, IPo, IPoc

OSCAR GROUP

Mainly shale with many layers of limestones that pinch out southward, where fine-grained arkosic sandstones are thicker and more numerous. Near Kansas border, sequence is (descending): *Herington Limestone* (20 feet thick) at top, *Enterprise Shale* (45 feet thick), *Winfield Limestone,* IPowi (8 feet thick), *Gage Shale* (80 feet thick), *Towanda Limestone* (3 feet thick), *Holmesville Shale* (25 feet thick), *Fort Riley Limestone,* IPofr (30 feet thick) and underlying *Florence Flint,* IPofr (8 feet thick), *Blue Springs Shale* (60 feet thick), *Kinney Limestone* (5 feet thick), *Wymore Shale* (22 feet thick), *Wreford Limestone,* IPowr (25 feet thick), *Speiser Shale* (38 feet thick), *Funston Limestone* (4 feet thick), *Blue Rapids Shale* (15 feet thick), *Crouse Limestone* (6 feet thick), *Easly Creek Shale* (12 feet thick), *Bader Limestone* (5 feet thick), *Stearns Shale* (10 feet thick), *Morrill Limestone* (2 feet thick), *Florena Shale* (6 feet thick), *Cottonwood Limestone,* IPoc (3 feet thick), *Eskridge Shale* (65 feet thick), and *Neva Limestone* (25 feet thick) at base. Total thickness, about 400 feet (120 m).

IPv, IPvre, IPvlc, IPvam, IPvb, IPvg, IPv, IPve

VANOSS GROUP

Alternating layers of limestone and shale to north, grading southward into limestone, shale, and fine-grained arkosic sandstone. Locally group contains thin coal seams. Near Kansas border, group includes (descending): *Salem Point Shale* (12 feet thick) at top, underlain by *Burr Limestone* (8 feet thick), *Legion Shale* (4 feet thick), *Sallyards Limestone* (3 feet thick), *Roca Shale* (15 feet thick), *Red Eagle Limestone,* IPvre (20 feet thick), *Johnson Shale* (35 feet thick), *Long Creek Limestone,* IPvlc (10 feet thick), unnamed shale (3 feet thick), *Hughes Creek Limestone* (15 feet thick), unnamed shale (5 feet thick), *Americus Limestone,* IPvam (12 feet thick), *Oaks Shale* (3 feet thick), *Houchen Creek Limestone* (8 feet thick), *Stine Shale* (20 feet thick), *Five Point Limestone* (3 feet thick), unnamed shale (12 feet thick), *Brownville Limestone,* IPvb (8 feet thick), *Pony Creek Shale* (40 feet thick), *Grayhorse Limestone,* IPvg (5 feet thick), unnamed shale (12 feet thick), *Nebraska City Limestone* (5 feet thick), *French Creek Shale* (12 feet thick), *Jim Creek Limestone* (3 feet thick), *Friedrich Shale* (30 feet thick), *Grandhaven Limestone* (2 feet thick), *Dry Shale* (25 feet thick), *Dover Limestone* (30 feet thick), *Willard-Langdon Shale* (110 feet thick), *Elmont Limestone,* IPve (10 feet thick), *Stonebreaker Shale* (20 feet thick), and *Reading Limestone* (20 feet thick) at base. Total thickness, about 500 feet (150 m).

IPaw, IPa, IPab, IPat

ADA GROUP

Mainly shale with many limestone layers that are thinner and pinch out southward, where fine-grained sandstones are thicker and more numerous. Near Kansas border, group includes (descending): *Auburn Shale* (50 feet thick) at top, underlain by *Wakarusa Limestone,* IPaw (2 feet thick), unnamed shale (40 feet thick), *Rulo Limestone* (3 feet thick), unnamed shale (18 feet thick), *Happy Hollow Limestone* (2 feet thick), unnamed shale and sandstone (60 feet thick), *Bird Creek Limestone,* IPab (2 feet thick; = *Church Limestone* of Kansas), *Severy-Aarde Shale* (70 feet thick), *Turkey Run Limestone,* IPat (2 feet thick; = *Coal Creek Limestone* of Kansas), unnamed shale (30 feet thick), *Pearsonia Limestone* (3 feet thick), unnamed shale (15 feet thick), *Little Hominy Limestone* (22 feet thick), unnamed shale (15 feet thick), *Deer Creek Limestone* (15 feet thick), unnamed shale (10 feet thick), *Plummer Limestone* (2 feet thick), unnamed shale (35 feet thick), and *Beil Limestone Member* (10 feet thick) of *Lecompton Limestone* at base. Total thickness, about 400 feet (120 m).

IPvap, IPvale, IPval, IPvab, IPva

VAMOOSA GROUP

Alternating layers of shale and fine to coarse-grained sandstone, with some thin limestones. Sandstone layers are thicker, coarser grained, and more numerous southward. Group near Kansas border includes (descending): unnamed shale and sandstone (160 feet thick) at top, *Plattsmouth Limestone,* IPvap (14 to 23 feet thick), unnamed shale and sandstone (15 to 90 feet thick), *Leavenworth Limestone,* IPvale (4 feet thick), unnamed shale and sandstone (170 feet thick), *Labadie Limestone,* IPval (6 to 23 feet thick; = ?*Haskell Limestone),* unnamed shale and sandstone (60 to 100 feet thick), *Bowring Limestone,* IPvab (2 feet thick; = ?*Westphalia Limestone),* unnamed shale (5 to 10 feet thick), and basal *Cheshewalla Sandstone* (7 to 20 feet thick; = *Tonganoxie Sandstone).* Total thickness, about 630 feet (190 m).

PENNSYLVANIAN

Missourian

IPt

TALLANT FORMATION

Alternating layers of shale and fine- to medium-grained sandstone. Thickness ranges from 75 to 250 feet (23 to 75 m).

IPbd

BARNSDALL FORMATION

Formation is mainly fine- to medium-grained sandstone, overlain by shale. At top is a thick shale, with *Okesa Sandstone Member* in middle and *Birch Creek Limestone (= South Bend Limestone)* at base. Birch Creek extends southward from Kansas border to T. 23 N., where limestone grades into overlying Okesa Sandstone. South of T. 23 N., Okesa grades downward into underlying *Torpedo Sandstone* and underlying Wann Formation. Total thickness ranges from 45 feet to 200 feet (14 to 60 m).

IPwi

WANN FORMATION AND IOLA LIMESTONE

Wann Formation consists of shale and fine- to medium-grained sandstone with many thin layers of fossiliferous limestone. Thickness ranges from 50 to 400 feet (15 to 122 m). *Iola Limestone* is mainly limestone, calcareous sandstone, and shale and underlies Wann. Thickness ranges from 4 to 100 feet (1 to 30 m).

IPch

CHANUTE FORMATION

Mainly fine-grained micaceous sandstone and coarse-grained, crossbedded sandstone separated by shale. Locally Chanute contains thin coal seams. Thickness ranges from about 10 to 150 feet (3 to 45 m).

IPd

DEWEY LIMESTONE

Mainly medium-crystalline limestone and shale. Thickness ranges from 0 to 60 feet (0 to 18 m).

IPnh

NELLIE BLY FORMATION AND HOGSHOOTER LIMESTONE

Nellie Bly Formation consists mainly of shale with a few layers of fine- to medium-grained sandstone. Thickness ranges from 80 to 550 feet (25 to 170 m). Underlying *Hogshooter Limestone* is massive crinoidal limestone 1 to 50 feet (0.3 to 14 m) thick.

IPcc

COFFEYVILLE FORMATION AND CHECKERBOARD LIMESTONE

Coffeyville Formation is mainly shale interbedded with fine- to medium-grained sandstone. Locally formation contains thin coal seams. Thickness ranges from 175 to 470 feet (50 to 140 m). Underlying *Checkerboard Limestone* is crystalline limestone 2 to 15 feet (1 to 5 m) thick.

Desmoinesian

IPh

UPPER HOLDENVILLE FORMATION

Mainly shale with interbeded fine-grained sandstone locally containing beds of limestone. Only a few feet is exposed in quadrangle.

Contact

U / D

Fault: U, upthrown side; D, downthrown side

INTRODUCTION

Urbanization, economic growth, and improved standards of living in rural areas have increased water requirements in Oklahoma. Basic information on the availability and usability of water in many parts of the State is needed by planners and individual water users for development of this vital resource. To provide this information on a regional basis, the U.S. Geological Survey, in cooperation with the Oklahoma Geological Survey, is making reconnaissance appraisals of water resources, with special emphasis on ground water, throughout the State. The Enid quadrangle, which includes about 7,800 square miles (20,200 km^2) in north-central Oklahoma (fig. 1), is the seventh region included in the appraisal studies. Material in this atlas includes information on the geology of the area, the distribution and potential yield of the aquifers, the availability of surface water, the chemical quality of surface and ground water, and data on the physical quality of surface water.

Information used to appraise the water resources of the Enid quadrangle was obtained through field investigations, taken from U.S. Geological Survey reports and files, or obtained from published and unpublished records of State and federal agencies. For providing useful information on the water resources of the quadrangle, special acknowledgment is due the U.S. Army Corps of Engineers, U.S. Bureau of Indian Affairs, U.S. Public Health Service, the Farmers' Home Administration, the U.S. Soil Conservation Service, the Oklahoma Water Resources Board, and various city officials throughout the region. The assistance of many individuals is also acknowledged.

GEOLOGIC SETTING

Most of the Enid quadrangle is underlain by sandstone, shale, and limestone of Pennsylvanian age and by shale, sandstone, siltstone, and mudstone of Permian age (fig. 2). Generally, the shale and limestone layers are thicker northward; the sandstone layers are thicker southward. The regional dip, which averages about 40 feet/mile (7.6 m/km), is toward the northwest at the eastern edge of the area and toward the southwest at the western edge. The rocks dip toward the west near the center of the area, where Pennsylvanian rocks pass beneath rocks of Permian age. Erosion has formed a gently rolling surface that is interrupted by east-facing escarpments capped by resistant sandstone or limestone and intervening valleys formed in shale.

In the eastern one-fourth of the quadrangle, the rocks are broken by parallel faults that have an average displacement of about 25 feet (7.6 m). The faults probably were formed during Late Pennsylvanian time as a result of uplift of the Nemaha ridge, which extends northward from the Arbuckle Mountains through western Logan, eastern Garfield, southeastern Grant, and northwestern Kay Counties.

CONVERSION FACTORS

The analyses and compilations in this atlas were made with English units of measurements. Equivalent SI (International System) units of measurement are not given with the English units in the tables and in some illustrations because of space limitations. To convert English units to SI units, the following conversion factors should be used:

English units	*Multiply by*	*Obtained SI units*
inches (in)	25.4	millimeters (mm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
square miles (mi^2)	2.590	square kilometers (km^2)
acres	0.4047	square hectometers (hm^2)
acre-feet (acre-ft)	1.233×10^{-6}	cubic kilometers (km^3)
	1.233×10^{-3}	cubic hectometers (hm^3)
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
cubic feet per second per square mile $(ft^3/s)/mi^2$	0.0109	cubic meters per second per square kilometer $(m^3/s)/km^2$
gallons per minute (gal/min)	0.06308	liters per second (l/s)
million gallons per day (mgd)	0.04381	cubic meters per second (m^3/s)
feet per mile (ft/mi)	0.189	meters per kilometer (m/km)

SOURCES OF GEOLOGIC INFORMATION

The sources of geologic information used to compile the geologic map of the Enid quadrangle are listed below; the area reported on by each source is shown in figure 3.

1. BRYANT, D. G., 1957, Geology of the Gray Horse area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 118 p.
2. CARL, J. B., 1957, Geology of the Black Dog area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 105 p.
3. CARTER, J. A., JR., 1954, Geology of the Pearsonia area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 114 p.
4. FAY, R. O., 1971, Geology, *in* Appraisal of the water and related land resources of Oklahoma—Region Nine: Oklahoma Water Resources Board Publication 36, p. 17-32.
5. ———1972, Geology, *in* Appraisal of the water and related land resources of Oklahoma—Region Ten, Oklahoma Water Resources Board Publication 40, p. 19-29.
6. FENOGLIO, A. F., 1957, Geology of northeastern Payne County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 84 p.
7. FISHER, H. C. JR., 1956, Surface geology of the Belford area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 96 p.
8. GARDNER, W. E., 1957, Geology of the Barnsdall area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 102 p.
9. GREIG, P. B., JR., 1959, Geology of Pawnee County, Oklahoma: Oklahoma Geological Survey Bulletin 83, 188 p.
10. HRUBY, A. J., 1955, Surface geology of northeastern Kay County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 72 p.
11. MISER, H. D., and others, 1954, Geologic map of Oklahoma: U.S. Geological Survey and Oklahoma Geological Survey, scale 1:500,000.
12. NAKAYAMA, E., 1955, Geology of southeastern Payne County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 68 p.
13. NOLL, C. R., JR., 1955, Geology of southeastern Kay County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 88 p.
14. OAKES, M. C., 1959, Geology and mineral resources of Creek County, Oklahoma: Oklahoma Geological Survey Bulletin 81, 60 p.
15. OAKES, M.C., DILLE, G. S., AND WARREN, J. H., 1952, Geology and mineral resources of Tulsa County, Oklahoma: Oklahoma Geological Survey Bulletin 69, 234 p.
16. ROSS, J. S., 1972, Geology of central Payne County, Oklahoma: Oklahoma State University unpublished M.S. thesis, 87 p.
17. RUSSELL, O. R., 1955, Geology of the Hominy area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 84 p.
18. SHANNON, P. J., 1954, The geology of the Pawhuska area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 98 p.
19. SHELTON, J. W., Bingham, R. H., and Jenkins, W. A., 1979 [1980], Geology and mineral resources of Noble County, Oklahoma: Oklahoma Geological Survey Bulletin 128, 66 p.
20. TANNER, W. F., 1956, Geology of northeastern Osage County, Oklahoma: Oklahoma Geological Survey Circular 40, 76 p.
21. TAYLOR, R. C., 1953, The geology of the Foraker area, Osage County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 108 p.
22. VOSBURG, D. L., 1954, Geology of the Burbank-Shidler area, Osage County, Oklahoma: University of Oklahoma: unpublished M.S. thesis, 110 p.

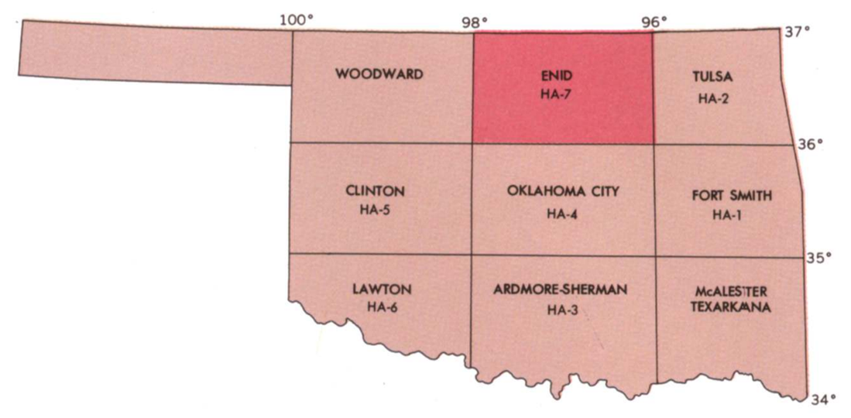

Figure 1. Location of Enid quadrangle.

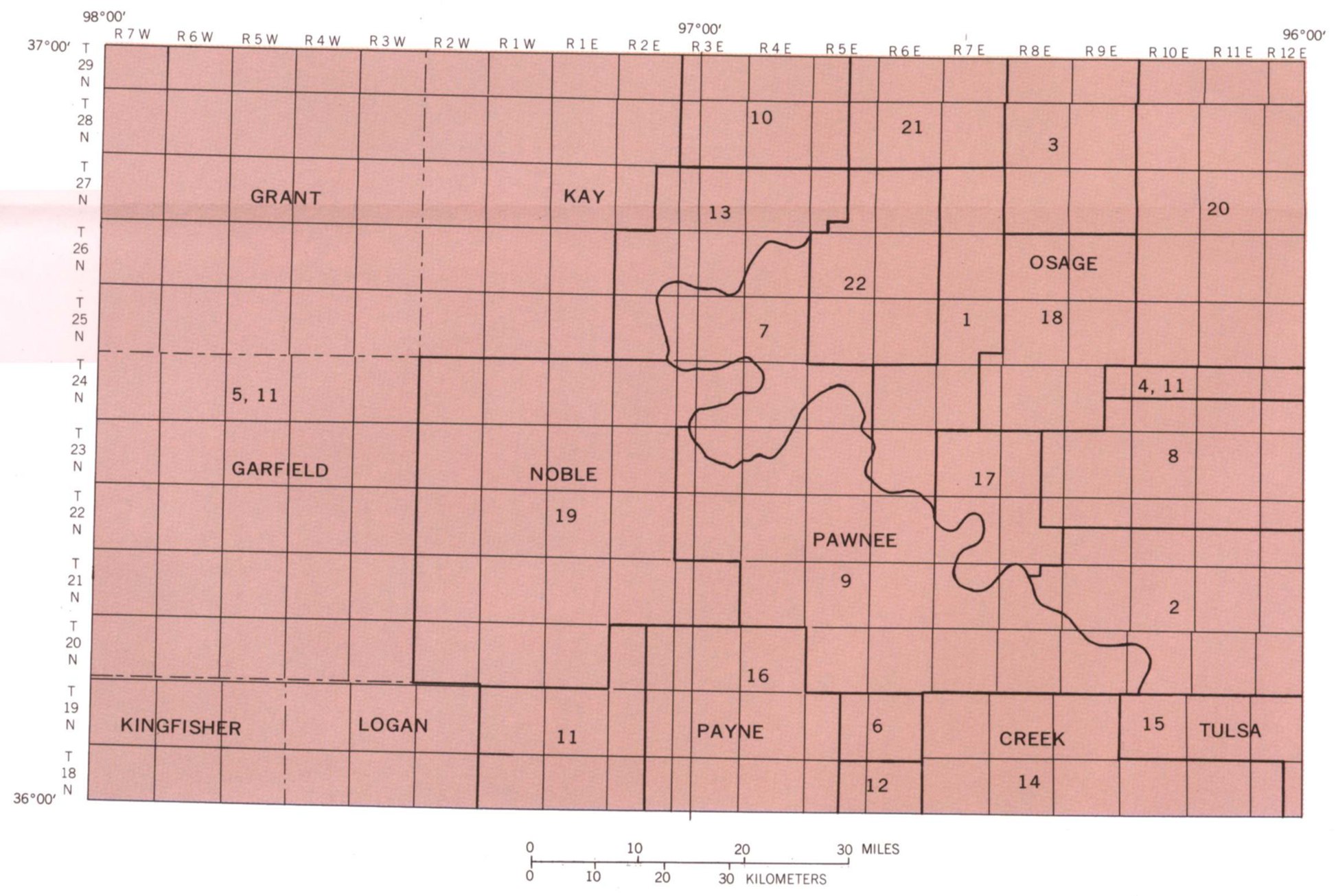

Figure 3. Index to geologic mapping.

RECONNAISSANCE OF THE WATER RESOURCES OF THE ENID QUADRANGLE, NORTH-CENTRAL OKLAHOMA

By

Roy H. Bingham and DeRoy L. Bergman

U.S. Geological Survey

1980