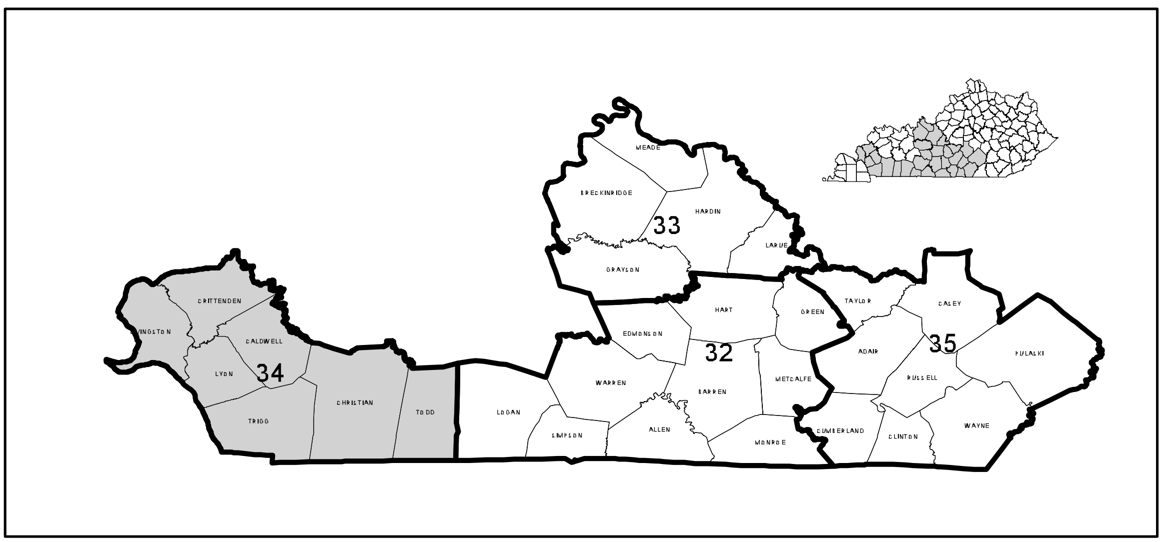
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY
AND THE KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY

AVAILABILITY OF GROUND WATER IN CALDWELL, CHRISTIAN, CRITTENDEN, LIVINGSTON, LYON, TODD, AND TRIGG COUNTIES, KENTUCKY

By
T.W. Lambert and R.F. Brown

HYDROLOGIC INVESTIGATIONS
ATLAS HA-34



INDEX MAP OF THE MISSISSIPPIAN PLATEAU REGION, KENTUCKY, SHOWING COUNTY GROUPS AND AREA OF THIS ATLAS

This is 1 of 4 atlases (HA-32 to HA-35) showing geology and availability of ground water in the Mississippian Plateau region, Kentucky U.S. Geological Survey Water-Supply Paper 1603 contains a text description and illustrations providing further information on the occurrence and quality of ground water in the Mississippian Plateau region.

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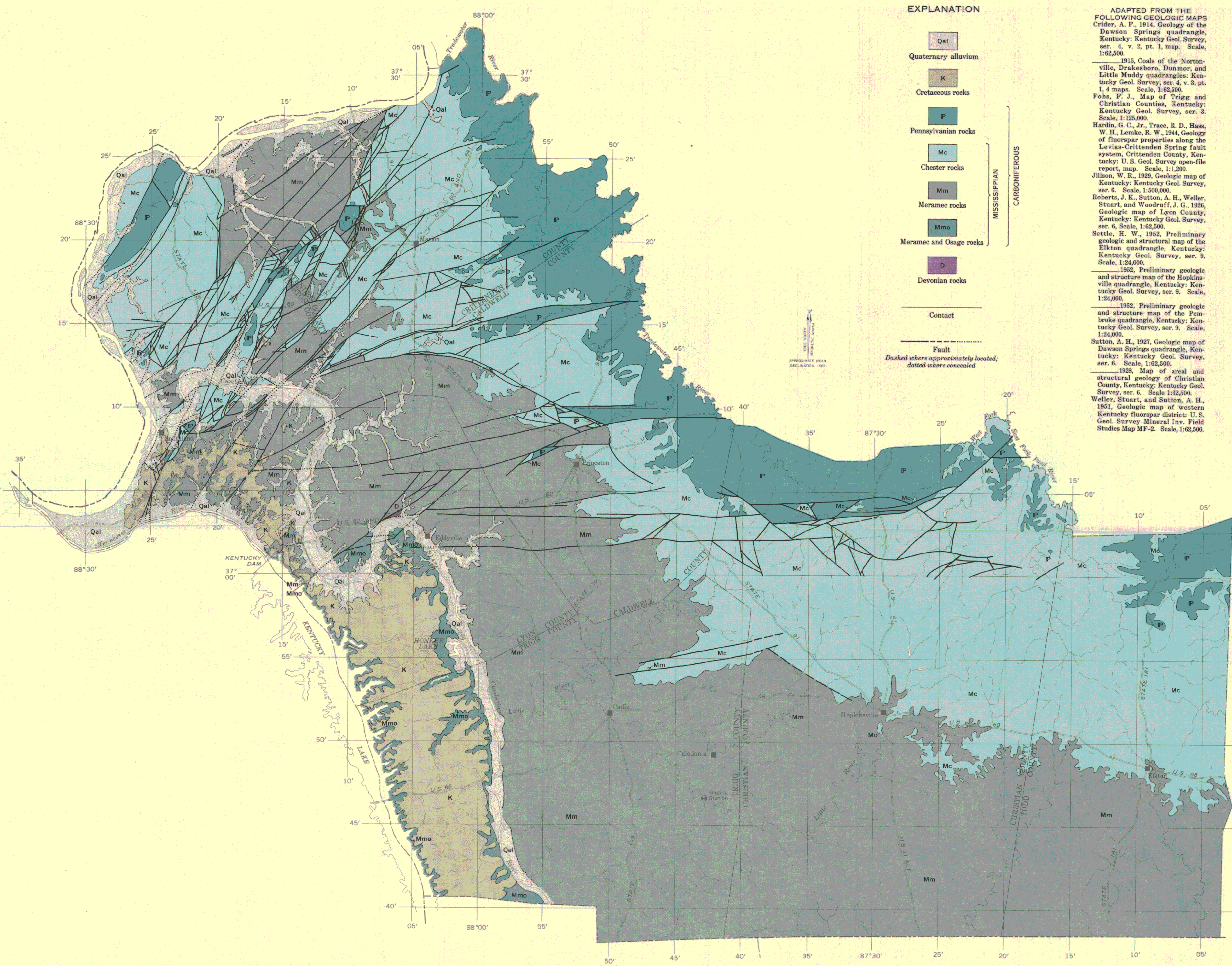

ADAPTED FROM THE FOLLOWING GEOLOGIC MAPS

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Base maps are county highway maps and adjacent county groups may not match

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—10416

GEOLOGIC MAP OF CALDWELL, CHRISTIAN, CRITTENDEN, LIVINGSTON, LYON, TODD, AND TRIGG COUNTIES, KENTUCKY

By
T. W. Lambert and R. F. Brown

SCALE 1:250 000

4 0 4 8 12 MILES
4 0 4 8 12 KILOMETERS

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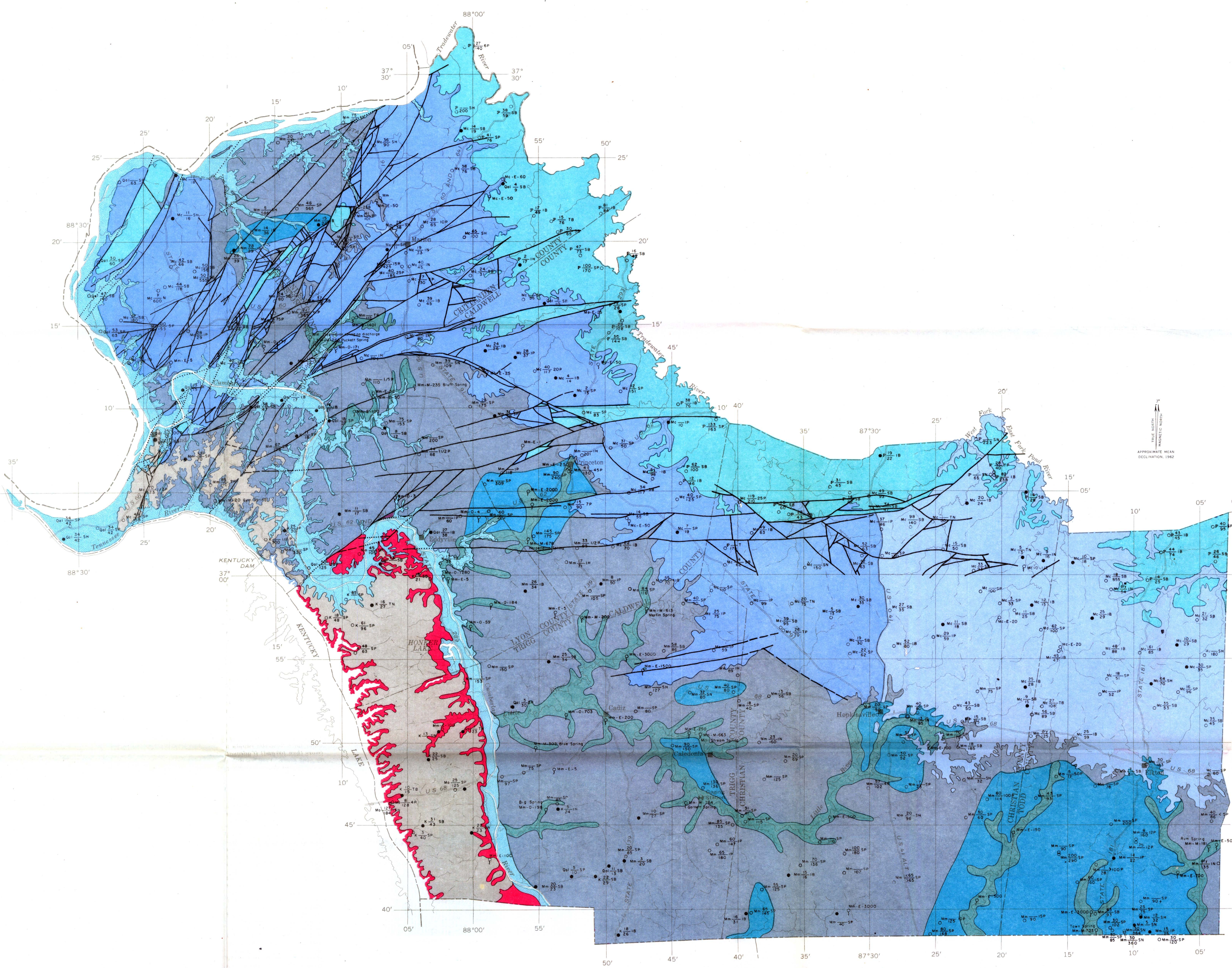

EXPLANATION

WATER-BEARING FORMATION

Qal — Quaternary alluvium

K — Cretaceous rocks

IP — Pennsylvanian rocks

Mc — Chester rocks

Mm — Meramec rocks

Mmo — Meramec and Osage rocks

D — Devonian rocks

(Pennsylvanian through Meramec and Osage: CARBONIFEROUS; Chester through Meramec and Osage: MISSISSIPPIAN)

Contact

Fault
Dashed where approximately located; dotted where concealed

Water in Recent and Pleistocene alluvium
Drilled wells in alluvium in the Ohio River valley yield several hundred gallons per minute. Compound horizontal wells yield as much as 5,000 gpm (gallons per minute). Nearly all wells yield more than 500 gpd (gallons per day), enough for domestic use with a power pump. The alluvium in Crittenden County contains less clay and silt than that in the counties to the west and south and generally yields more water to wells. Alluvium in stream valleys tributary to the Ohio River is fine grained and thin. Most drilled wells are inadequate; dug wells generally yield enough for a bailer.

Water in rocks of Cretaceous age
Most drilled wells in gravel of the Tuscaloosa formation of Upper Cretaceous series do not yield enough water for a domestic supply with power pump (less than 500 gpd) but are adequate for bucket or bailer (more than 100 gpd). Some wells adjacent to Kentucky Lake yield more than 5 gpm. The overlying Ripley formation crops out mostly on hilltops and is too thin to supply water to drilled wells.
Dug wells generally yield enough water for a domestic supply with bailer or bucket (more than 100 gpd) when adjacent to drainage. Most wells in upland areas are inadequate.

Water in rocks of Pennsylvanian age
Most drilled wells in the upland are inadequate for power pumps (less than 500 gpd). About half the wells yield enough water for a domestic supply where a bailer or bucket is used (less than 100 gpd). Drilled wells in lowland areas bordering streams generally yield enough water for a domestic supply with power pump (more than 500 gpd).
Dug wells in lowlands bordering streams yield enough water for a domestic supply with bailer or bucket (more than 100 gpd) if adequate storage is provided for peak needs. Very few dug wells are adequate for power pumps (more than 500 gpd).

Water in Mississippian rocks of Chester age
Most drilled wells that obtain water from fault zones are adequate for a domestic supply with power pump (more than 500 gpd). Yields are as much as 100 gpm. Many wells that penetrate fault zones flow as much as 20 gpm. More than half the wells drilled into the Bethel[1] and Cypress sandstone formations yield enough water for a domestic supply with power pump (more than 500 gpd). Wells that obtain water from one of the many perched water bodies generally are inadequate for a domestic supply with a power pump (less than 500 gpd) but are adequate for a bailer or bucket (more than 100 gpd).
Most dug wells obtain water from perched bodies. Yields are generally low, and most wells yield only enough water for a domestic supply with bailer or bucket (more than 100 gpd).
Two spring horizons are present. The most important is in the Kinkaid limestone of late Chester age with springs that discharge as much as 60 gpm near the tops of hills and ridges. The second is at the shale-limestone contact of the Hardinsburg sandstone and the Glen Dean limestone. Flows are as much as 40 gpm. Seepage springs occur at other horizons, but most are seasonal.

Water in Mississippian rocks of Chester age
Most drilled wells are inadequate for a domestic supply with power pump (less than 500 gpd). Maximum yields probably do not exceed 20-30 gpm. Some wells in sandstone formations yield enough water for a domestic supply with power pump (more than 500 gpd). These formations increase in thickness to the east, and yields increase proportionately. The major aquifer from Todd County eastward is the Big Clifty sandstone[1]. Where it crops out, the water body in it is perched.
Most dug wells obtain water from perched bodies. Yields are generally low, but some wells in the Big Clifty sandstone[1] are adequate for a domestic supply with a power pump (more than 500 gpd).
A spring horizon is present at the shale-limestone contact of the Hardinsburg sandstone and the Glen Dean limestone. Flows are as much as 40 gpm. Seepage springs occur at other horizons, but most are seasonal.

Water in Mississippian rocks of Meramec age
Springs with low flows ranging from less than 10 gpm to 1,500 gpm occur at or near stream level. Maximum flows range from less than 100 gpm to more than 100,000 gpm. Minimum flows generally occur in early fall, maximum flows in late winter. A few drilled wells in this area that intercept major solution openings may yield as much as the flow of the springs that discharge from these openings, but most wells are inadequate for domestic use (less than 100 gpd).
Dug wells are inadequate for a domestic supply with bailer or bucket (less than 100 gpd) except where water levels are not high above perennial streams.

Water in Mississippian rocks of Meramec age
More than three-fourths of the drilled wells in this area yield enough water for a domestic supply with a power pump (more than 500 gpd). Very few wells are inadequate for domestic use with bailer or bucket (less than 100 gpd). Wells that encounter large solution channels yield more than 5 gpm, and some yield more than 50 gpm.
Dug wells are inadequate for a domestic supply (less than 100 gpd) except where water levels are not high above perennial streams.

Water in Mississippian rocks of Meramec age
Most drilled wells in this area yield 5 gpm. Wells that encounter large solution channels yield more than 50 gpm. Very few wells are inadequate for domestic use with power pump (less than 500 gpd).
Most dug wells are inadequate for domestic use with power pump (less than 500 gpd.)
Yields from fault zones generally are greater than shown by the availability pattern; however, some wells yield much less than is shown by the pattern.

Water in Mississippian rocks of Meramec and Osage ages
More than three-fourths of the drilled wells in this area yield enough water for a domestic supply with a power pump (more than 500 gpd). Very few wells are inadequate for domestic use with bailer or bucket (less than 100 gpd). Wells that encounter large solution channels yield more than 5 gpm, and some yield more than 50 gpm. Adjacent to Kentucky Lake, the chert rubble of the Fort Payne chert of Osage age (included with the Meramec of Lyon and Trigg Counties) generally yields more than 5 gpm to drilled wells, and some yields are more than 50 gpm.
Dug wells are inadequate for a domestic supply (less than 100 gpd) except where water levels are not high above perennial streams.

Water in Devonian rocks
Wells generally yield little or no water.

○ Drilled well — ◎ Drilled observation well

● Dug well — ⊙ Dug observation well

Mm 25/59 60 P
- 25 — Depth to water below land surface, in feet
- P — Type of lift
- 60 — Yield of well
- 59 — Depth of well below land surface, in feet
- Mm — Water-bearing formation

TYPE OF LIFT
- B Bailer or bucket
- H Hand force pump
- P Power pump
- N No pump, bucket, or bailer

YIELD
- 60 Gallons per minute, where known
- S Satisfactory supply for domestic use
- I Inadequate supply for domestic use
- T Yield not determined
- SB, SH Minimum yield of well reported 100 gallons per day
- SP Minimum yield of well reported 500 gallons per day
- IB, IH, IP Will not yield a minimum supply with type of lift installed

Spring

Mm–E–3000
- Mm — Formation
- 3000 — Yield
- E — Method used to determine yield figure

METHOD USED TO DETERMINE YIELD
- E Estimated on basis of one observation
- M Measured with pygmy meter or flume more than one time. Minimum measured flow shown
- O Measured with pygmy meter or flume one time. Observed measured flow shown

YIELD
5000 Gallons of flow per minute

[1] As used by McFarlan, Swann, Walker, and Nosow (1955).

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SYSTEM	SERIES	FORMATION	THICKNESS (IN FEET)	SECTION	LITHOLOGY	TOPOGRAPHY	WATER-BEARING CHARACTER
QUATERNARY	Recent and Pleistocene	Alluvium	0–120		Silt, clay, and some sand and gravel in tributary valleys. Sand, gravel, and clay in major stream valleys.	Terraces and flood plains of Cumberland, Tennessee, and Ohio Rivers and tributaries.	Yields several hundred gallons a minute to drilled wells in the alluvium of the Ohio River valley and its two main tributaries, Cumberland and Tennessee River valleys. Nearly all wells produce more than 500 gpm (gallons per minute), enough water for domestic use with a power pump. Locally, north of Smithland, Livingston County, wells must penetrate the underlying bedrock to obtain an adequate supply. Alluvium in stream valleys tributary to the three major rivers is fine-grained and thin; most wells in these areas furnish less than 100 gpd (gallons per day), not enough for a bailer or bucket.
TERTIARY		Sand and gravel	0–40		Gravel, iron-stained, mainly chert, and small amounts of quartzite. Pebbles subangular to rounded, average diameter ½ to 1 in. Medium to coarse, orange or brick-red sand. Mostly chert and quartzite but contains some feldspar, hornblende, kyanite, and zircon. Sand and pebbles in places cemented by iron oxide into a hard conglomeratic sandstone.	Underlies dissected uplands between Cumberland and Tennessee Rivers above altitude of approximately 380 feet.	Yields enough water for a domestic supply (more than 100 gpd) to dug wells of large storage capacity. Only locally is there a sufficient thickness to obtain a domestic supply.
CRETACEOUS	Upper Cretaceous	Ripley	0–50		Sand and interbedded clay; thin, indurated beds at sand-clay contacts. Sand may be white, buff, yellow, or red. Clay ranges from white to dark gray. Formation mostly silt and clay in some areas.	Underlies dissected uplands and ridges between Cumberland and Tennessee Rivers; truncated and covered by the alluvium of the Ohio and Tennessee Valleys.	Yields almost no water to wells owing to its small thickness and its topographic situation, except south of Smithland, Livingston County, where it underlies the alluvium.
		Tuscaloosa	0–200		Rounded chert gravel in matrix of angular chert sand and tripolitic clay. Average diameter of gravel about 1½ in.	Underlies dissected ridges between Cumberland and Tennessee Rivers.	Most drilled wells in the gravel of the Tuscaloosa formation are adequate for a bailer (more than 100 gpd.) Yields adjacent to Kentucky Lake may exceed 5 gpm. Tripolitic clay is present locally and wells penetrating it are inadequate (less than 100 gpd).
CARBONIFEROUS: PENNSYLVANIAN		Caseyville sandstone	30–400		Sandstone containing interbedded sandy shale and coal. Quartzose conglomerate present in base in some places.	Underlies dissected uplands adjacent to Tradewater and Pond Rivers. Forms major escarpment. Occurs in faulted zone of the fluorspar area.	Yields enough water for a domestic supply with a power pump (more than 500 gpd) to drilled wells in lowland areas bordering streams and locally in broad upland areas. Wells in small areas upland generally are inadequate (less than 100 gpd).
CARBONIFEROUS: MISSISSIPPIAN	Chester	Kinkaid limestone	0–200		Limestone, light- to medium-gray, dense, thin-bedded, alternating with light-gray chert, and gray to black shale; unit red and olive green in places. Sandstone in lower part of formation.	Underlie gently rolling upland having some sinkholes. Form moderate to steep slopes.	Most drilled wells that obtain water from fault zones are adequate for a domestic supply with a power pump (more than 500 gpd). Yields are as much as 100 gpm. Flows of as much as 20 gpm are obtained from fractures along fault zones and adjacent beds. Most flowing wells are in sandstone. Water is usually obtained from the hanging walls or gouge zones of faults. Sandstone formations yield enough water for a domestic supply with a bailer or bucket (more than 100 gpd) where there is an adequate saturated thickness in perched water zones. Most shallow wells in broad uplands are dug and usually yield more than 100 gpd, but yields are not dependable in dry years. Drilled wells produce enough water for a bailer (more than 100 gpd) and most of these wells produce enough water for a power pump (more than 500 gpd). Minor spring horizons occur near the base of the sandstone on discontinuous shale beds. Very few of the springs are adequate for a domestic supply, and many go dry in late fall or winter. Limestone formations yield small to adequate supplies from solution openings. In lowland areas bordering streams, some wells furnish enough for a domestic supply with a power pump (more than 500 gpd). Most wells in upland areas are inadequate for a domestic supply with bailer or bucket (less than 100 gpd). On uplands deep wells that penetrate solution openings in limestone may produce more than 5 gpm, but most deep wells on uplands are inadequate for a domestic supply with bailer or bucket (less than 100 gpd). Close to outcrop areas, particularly near major escarpments, yields from perched water bodies generally are inadequate during dry periods. Springs occur at the base of many limestone formations where they crop out on escarpments and hillsides. Adjacent to large upland areas, springs yield as much as 100 gpm and low flows are more than 5 gpm from some springs.
		Degonia sandstone	10–30		Sandstone, yellow to brown, thin-bedded, flaggy, crossbedded, ripple-marked; calcareous in places.		
		Clore limestone	30–60		Limestone, gray, shaly, thin-bedded; interbedded with argillaceous and calcareous shale.		
		Palestine sandstone	40–80		Sandstone, light-gray, medium-grained, thin-bedded to massive.	Forms minor bench on hillsides. Underlies gently rolling upland.	
		Menard limestone	80–140		Limestone, dark-gray, dark olive-tan, and black, fine-grained to sublithographic, commonly argillaceous; interbedded with dark-gray fissile shale.	Underlie flat uplands. Form gentle slopes on hillsides.	
		Waltersburg sandstone	20–60		Sandstone, medium-gray, fine-grained, shaly; massive in places. In lower part consists chiefly of very dark gray shale.		
		Vienna limestone	20–40		Shale, dark-gray, fissile; also dark-gray, clayey, calcareous in upper part, alternated with medium- to dark-gray fine-grained to crystalline limestone and dark bluish-gray chert.		
		Tar Springs sandstone	100–200		Sandstone, light- to medium-gray, fine-grained; shaly limestone containing interbedded dark-gray shale and thin sandstone lenses and thin coal beds.	Underlies gently rolling upland. Forms minor bench on hillsides.	
		Glen Dean limestone	40–90		Limestone, light- to medium-gray, fine-grained to coarsely crystalline, crinoidal; contains medium-gray shale beds. Limestone coarsely oolitic in places. Sandy shale and sandstone near middle of formation.	Underlies gently rolling upland. Forms a gradual slope above Hardinsburg bench.	
		Hardinsburg sandstone	20–140		Sandstone, light-gray, fine- to medium-grained, massive; dark shale horizon in middle. Thin, basal conglomerate present in places.	Forms minor escarpment, modified in many places by faults. Underlies broad rolling uplands.	
		Golconda: Haney limestone[1]	30–170		Limestone, light-gray, coarsely crystalline, argillaceous in places. Chert and gray shale interbedded with limestone.	Underlie gently rolling upland. Form steep slope below minor Hardinsburg sandstone escarpment. Frailey shale grades into Big Clifty sandstone[1] eastward from Christian County to form a major escarpment.	
		Golconda: Frailey shale[1]			Shale, light- to dark-gray, slightly calcareous. Gray limestone interbedded with shale. Grades into Big Clifty sandstone[1] eastward from Todd County.		
		Golconda: Beech Creek limestone[1]			Limestone, dark-gray, very hard, slightly argillaceous.		
		Cypress sandstone	25–125		Sandstone, light- to greenish-gray, fine- to medium-grained. Thin, basal conglomerate, and thin coal present in places. Dark shale in middle or lower part.	Forms a major escarpment, but broken by faults in fluorspar area. Eastward from Christian County the escarpment wedges out against the overlying Big Clifty[1] Underlies broad flat uplands.	
		Ridenhower shale[1]	1–100		Shale, dark-gray, slightly sandy, and sandstone. Nodular impure limestone predominant to east.	Forms moderate to rolling slope below Cypress sandstone escarpment; modified by faults in fluorspar area.	
		Bethel sandstone[1]	25–125		Sandstone, light-gray, medium-grained, massive. In places a conglomerate is present at the base.	Forms lowest major escarpment from fluorspar area to Todd County; escarpment broken by faults in fluorspar area. Underlies broad rolling upland.	
		Paoli limestone[1]	20–100		Limestone, medium- to dark-gray, medium- to coarse-grained, crystalline, oölitic in places, and interbedded dark greenish-gray shale, commonly calcareous in places.	Forms a moderate slope under Bethel sandstone[1] escarpment except where modified by faults or a higher sandstone escarpment.	Yields little or no water to wells. Small springs with low flows of about 5 gpm occur near the top of the formation.
	Meramec	Ste. Genevieve limestone	180–270		Limestone, white to medium-gray, fine-grained to oölitic, crossbedded; contains chert nodules. Calcareous or shaly, slabby or massive lenticular sandstone may be present in the upper one-third of the formation.	Underlies rolling karst uplands[1] Forms moderate slope under Bethel sandstone escarpment except where modified by faults. Exposed as large fault blocks in much of the fluorspar area.	Yields more than 50 gpm to wells from large solution openings in karst areas. Most wells penetrate solution openings, but in areas high above perennial streams, solution openings are dry in late summer and fall and many wells are inadequate. Springs having low flows ranging from less than 10 to about 1,500 gpm occur at or near stream level. Smaller springs discharge from perched water bodies in upland areas, but many go dry during late summer and fall.
		St. Louis limestone	350–400		Limestone, medium-gray to black, fine-grained to lithographic; contains abundant bluish-gray chert nodules.	Underlies dissected uplands and ridges. Underlies rolling karst uplands in faulted parts of the fluorspar area and uplands of Christian, Trigg, and Todd Counties. Forms steep valley walls along Cumberland River.	Low flows of numerous springs that discharge from near the top of the formation and near stream level range from less than 10 gpm to about 1,500 gpm. Maximum flows range from less than 100 gpm to more than 100,000 gpm. Most large springs are situated near minor rivers. In karst areas, drilled wells generally produce enough water for domestic use with a power pump (more than 500 gpd). Some produce more than 50 gpm from large solution openings. Most wells high above perennial streams are adequate. In nonkarst areas, yields generally are lower than in karst. The number of solution openings is fewer and their size smaller. Many wells are insufficient for bailer or bucket (less than 100 gpd). Most springs are small and many go dry during late summer and fall. Most wells high above perennial streams are inadequate (less than 100 gpd).
		Spergen limestone[2]	50		Limestone, light- to medium-gray, fine-grained to oölitic.	Underlies dissected uplands and ridges adjacent to Ohio River in Livingston and Crittenden Counties and adjacent to Cumberland River in Trigg County.	Wells that encounter large solution openings near stream level or near sinkholes yield sufficient water for a power pump (more than 500 gpd). In most other areas, the rock is fine-grained and yields generally are insufficient for a bailer or bucket (less than 100 gpd).
		Warsaw limestone	50±		Limestone, medium- to dark-gray, coarsely granular, crinoidal, fossiliferous. The basal part of the formation consists of medium- to dark-gray fine-grained shaly limestone containing nodules and stringers of gray chert.	Underlies dissected uplands and ridges adjacent to Cumberland and Tennessee Rivers and tributaries in Trigg, Lyon, and Livingston Counties. Exposed in faulted zone at Kuttawa.	
	Osage	Fort Payne chert	515		Limestone, dark bluish-gray, and interlayered chert. Chert is dark-gray to black and has fine laminations paralleling the bedding or is concentric in nodules. Along Kentucky Lake leached section consists of residual bleached chert and interbedded tripolitic clay.	Underlies dissected ridges between Tennessee and Cumberland Rivers. Exposed in fault scarp at Kuttawa.	Yields almost no water to wells where unweathered. Where the limestone has been leached away and chert rubble is left, yields may exceed 50 gpm. Yields of most wells of moderate depths range from 2 to 10 gpm. Tripolitic clay may be present in some areas and here the formation yields little or no water to wells.
		New Providence shale	30		Shale, green, clayey.	Exposed in faulted scarp at Kuttawa.	Yields little or no water to wells.
DEVONIAN		Chattanooga shale	200±		Shale, black, massive.	Exposed in faulted scarp at Kuttawa.	Yields little or no water to wells.

See list of references in Water-Supply Paper 1603.

[1] As used by McFarlan, Swann, Walker, and Nosow (1955).

[2] As used by Stockdale (1939) =Salem limestone of Cumings (1901)= Somerset shale member of Warsaw limestone.

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