PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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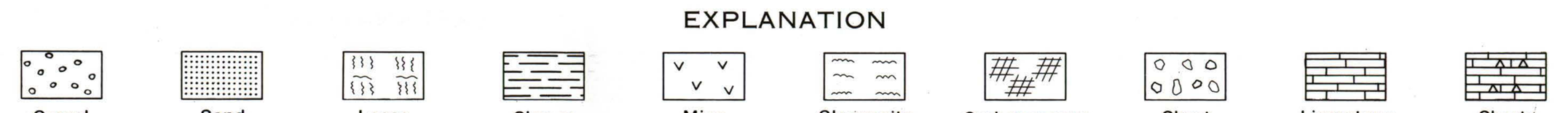
GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

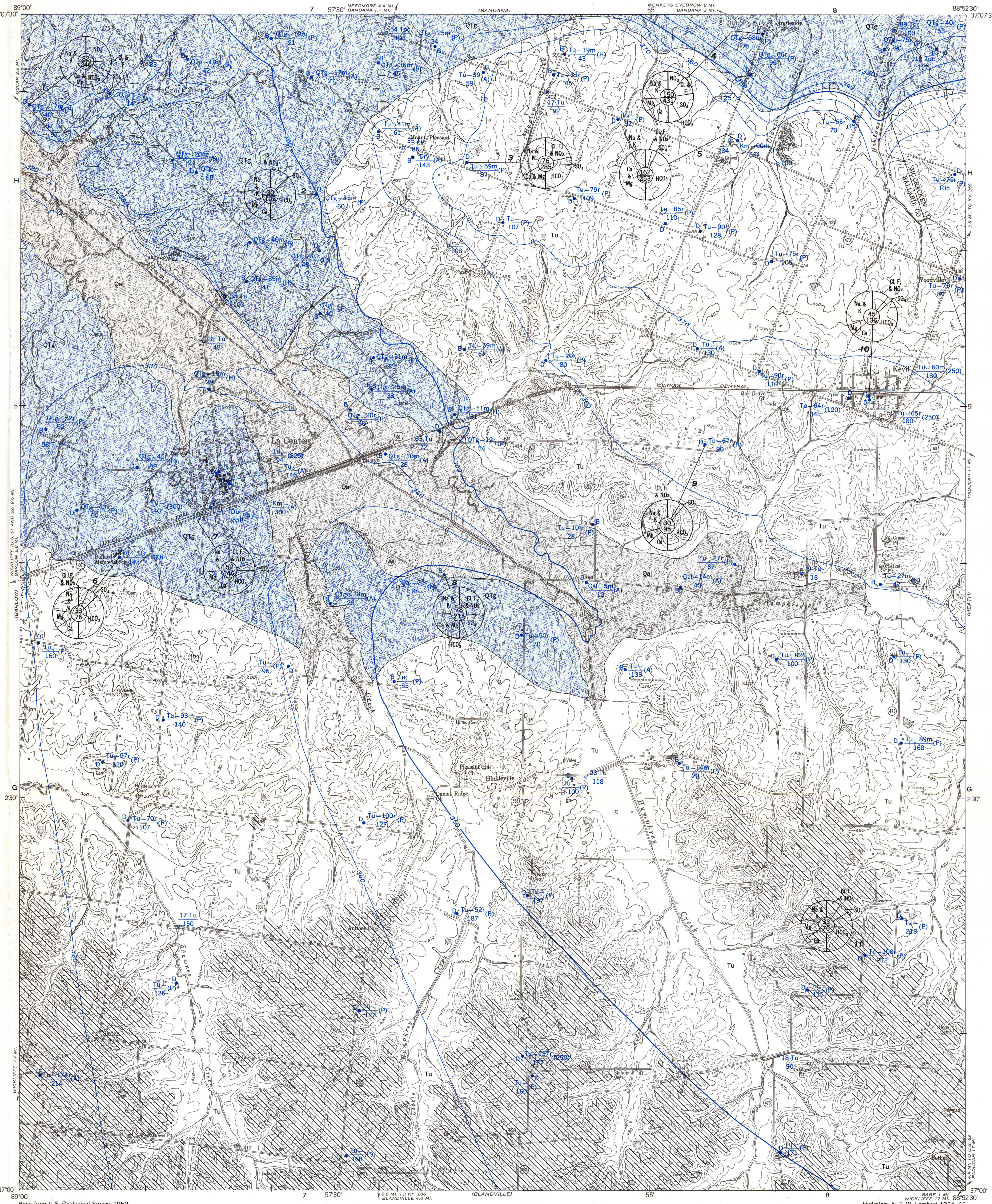
SYSTEM	SERIES	GROUP	FORMATION	SECTION	THICKNESS IN FEET	LITHOLOGY	TOPOGRAPHY AND GEOLOGIC SETTING	HYDROLOGY
QUATERNARY	Pleistocene and Recent		Alluvium		0–20′+	Clay or silt near the surface grading downward into clayey gravel and (or) sand.	Occurs in upper reaches of streams. Rests on rocks of Eocene and later age.	Water bearing in Humphrey Creek valley upstream from U. S. Highway 60. Saturated thickness is only a few feet, and most wells probably will be completed in underlying aquifers. One test hole indicates the alluvium may be too clayey to supply a well downstream from U. S. Highway 60.
QUATERNARY	Pleistocene		Loess		0–15′	Tan to gray silt or clay.	Covers all upland and sloping sides of stream valleys.	Not an aquifer. When saturated by rainfall, transmits water to lower aquifers.
QUATERNARY / TERTIARY	Pleistocene / Pliocene(?)		Gravel, sand, and silt[1]		0–96′+	Brown to brownish-red sandy chert gravel and beds of gray sandy gravel, silt, and clay.	Continental terrace deposits lying on an irregular surface cut at different levels into sediments of Eocene and Paleocene ages. The pre-Pliocene surface consists of channels and terraces cut by an intricate drainage system at an altitude of about 400 feet above mean sea level. In the Pliocene(?) and Pleistocene water-availability area, the gravel rests on an eroded surface that is below 320 feet in altitude.	Wells tapping the Pliocene(?) and Pleistocene gravel west and north of La Center may yield sufficient water for domestic use. Wells drilled between Lucy Creek and State Highway 358 and west of La Center should provide larger yields. Saturated thickness ranges from a few feet to a possible 40 feet. Locally in areas of thick saturated gravel, yields may meet industrial needs. Along the 400-foot contour south of Ingleside in the northern part of the quadrangle, the gravel is commonly too thin to supply adequate amounts of water for domestic use. The quality of water is soft to hard. One sample contains an objectionable amount of iron. More than 0.3 ppm (part per million) of iron may cause staining of textiles and porcelain. Two samples contain more than 45 ppm of nitrate. Water containing more than 45 ppm may cause a type of methemoglobinemia in infants ("blue baby" disease), sometimes fatal, and should not be used in infants' formulas.
TERTIARY	Eocene		Sand and clay		0–300′+ (0–200′+)	Red, brown, or white fine- to coarse-grained sand. Beds of white to dark-gray clay are distributed at random.	Underlies the Pliocene(?) and Pleistocene gravel and Quaternary deposits. Exposed in creek beds and cuts in the quadrangle.	An excellent aquifer in most of the quadrangle. Most wells obtain water from the Eocene sand at depths as great as 220 feet. Wells south of U. S. Highway 60 should be capable of meeting domestic and most public and industrial needs. Yields of 500 to 1000 gpm may be obtained. About 70 feet of saturated sand has been found in auger holes. Problem areas of obtaining a sufficient yield occur in the area north of a line between Kevil and Mount Pleasant Church. The water is slightly acidic, soft, and generally contains less than 0.3 ppm of iron. An iron content of more than 0.3 ppm imparts a disagreeable taste to water and may cause staining of porcelain and textiles. The analyses of water and owners' reports of water quality often show an objectionable amount of iron, believed to be due to the reaction between the acidic ground water and the steel well casing and pump apparatus.
					(0–100′+)	White to gray sandy clay, clay conglomerate and boulders, scattered clay lenses, and lenses of coarse red sand. Black to dark-gray lignitic clay, silt, or fine-grained sand. A bed of coarse-grained sand is apparently discontinuous at the base of the Eocene sequence.		
TERTIARY	Paleocene		Porters Creek Clay		110–150′	Dark-gray, slightly to very micaceous clay. Fine-grained clayey sand, commonly glauconitic, in the upper part. Glauconitic sand and clay at the base.	Underlies the entire quadrangle beneath the Eocene deposits, except for a small area along the northern edge of the quadrangle where the Eocene deposits are missing and it underlies the Pliocene(?) gravel.	Not an aquifer. Retards the movement of water between the overlying aquifers and the Cretaceous sands.
CRETACEOUS	Upper Cretaceous		McNairy Formation[2]		130′	Dark-gray to black clay interlaminated with fine-grained sand. Mica and lignitic material are common. Clay is the most common lithology in upper part; sand and clay alternate throughout the middle and lower parts; sand generally present at base. May contain lenses of sandy gravel near base.	Underlies Porters Creek Clay throughout the quadrangle. Between Paducah West quadrangle and La Center, the McNairy thins to less than half its normal thickness.	Capable of supplying adequate water for domestic use and for public supplies. Properly constructed wells may yield more than 100 gpm. Formerly one public supply well at La Center obtained water from the McNairy Formation. The water was slightly basic, hard, and commonly contained more than 0.3 ppm of iron. The only well tapping the McNairy sand is south of Ingleside. The water contains 1.1 ppm of iron and has a hardness of 162 ppm.
CRETACEOUS	Upper Cretaceous		Tuscaloosa Formation		?	White rounded pebbles and cobbles in tripolitic matrix and lenses of tripolitic clay.	May occur in pockets in the eroded surface of the Paleozoic rocks. An oil-test hole in the Bandana quadrangle has 18 feet of gravel above the Fort Payne Formation of Mississippian age.	Water-bearing character is not known. Generally this unit is a poor aquifer owing to its clayey nature.
DEVONIAN AND MISSISSIPPIAN			Limestone, chert, and shale		500′±	All rocks below the Cretaceous beds are of Paleozoic age and are the "bedrock" of drillers. The upper surface of the bedrock is deeply weathered, forming a chert rubble of angular or subangular chert blocks in a matrix of tripolitic clay, or forming a clay where the weathered rock was shale. Argillaceous, siliceous, and cherty limestones interbedded with light- to dark-gray chert beds separated by black fissile shales.	Present at great depth throughout the quadrangle. Consolidated marine sedimentary rocks underlying the Cretaceous deposits. The pre-Cretaceous erosion surface slopes south on truncated subcrop of northward-dipping Paleozoic rocks. Glenn (1906) reported bedrock in a railroad well at La Center at a depth of 387 feet (−17 feet altitude); bedrock nearby in an abandoned city well is at 404-feet (−34 feet altitude).	Probably will yield large quantities of ground water for domestic and public supplies from gravellike chert rubble and a lesser amount from solutional openings in limestone. One railroad well at La Center tapped Devonian chert rubble, but it has not been used for many decades. The water is likely to be hard and to contain objectionable amounts of iron. Mississippian rocks underlie the Cretaceous in the northern part of the quadrangle; however, no wells have penetrated the unit. The extent of the area underlain by Mississippian rocks is not known, but probably is north of the generalized geologic section.

[1] Age undetermined. Estimates of age range from Pliocene or older to Pleistocene.

[2] May contain beds of Clayton (Paleocene) age at the top.

EXPLANATION





Base from U.S. Geological Survey, 1952

The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

MAP SHOWING AVAILABILITY OF GROUND WATER, LOCATION OF WELLS AND TEST HOLES, AND QUALITY OF WATER

Hydrology by T. W. Lambert 1964–65

SCALE 1:24 000

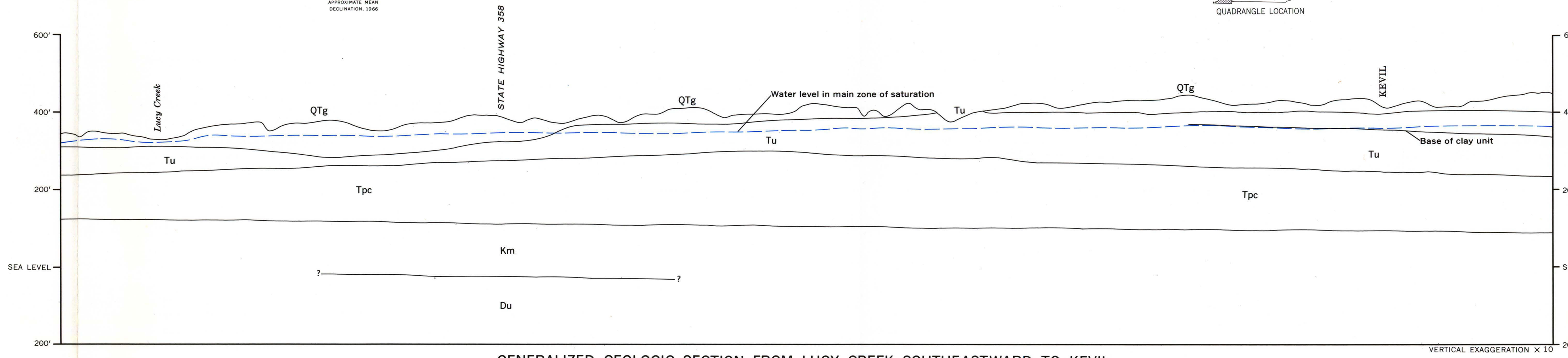
1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

TRUE NORTH — MAGNETIC NORTH 4°
APPROXIMATE MEAN DECLINATION, 1966

KENTUCKY
QUADRANGLE LOCATION



GENERALIZED GEOLOGIC SECTION FROM LUCY CREEK SOUTHEASTWARD TO KEVIL

EXPLANATION

QTg........Gravel of Pleistocene and Pliocene(?) age
Tu........Sand and clay of Eocene age
Tpc........Porters Creek Clay of Paleocene age
Km........McNairy Formation of Cretaceous age
Du........Devonian rocks, undifferentiated

EXPLANATION

The water-availability areas on this map show the occurrence and availability of ground water in the shallowest aquifer that may yield adequate amounts of water for domestic supply in each area. As considered in this report an adequate domestic supply will deliver approximately 500 gallons per day from a well equipped with a power pump and pressure-distribution system. The shallowest aquifer is underlain by deeper aquifers whose geologic and water-bearing properties are described in the generalized columnar section

Qal

AREA 1
Water in Quaternary alluvium

Small-diameter bored wells obtain water from the alluvial deposits in the valley bottom of Humphrey Creek and Humphrey Branch. Most wells tapping the alluvium are less than 20 feet deep and will yield only small supplies of water. Wells can be deepened into the underlying Pliocene (?) gravel or the Eocene sand to obtain larger yields

QTg

AREA 2
Water in Pleistocene and Pliocene(?) gravel

The gravel, where it underlies the area below an altitude of 390 feet, will yield sufficient water for domestic and stock uses and for some industrial and commercial uses. Properly constructed wells should yield more than 100 gpm (gallons per minute). Some problem areas exist south of Ingleside where the gravel is thin, but wells may be completed in the deeper Cretaceous sand. The aquifer is developed by small diameter bored wells, but these are being replaced chiefly by drilled wells

Tu

AREA 3
Water in Eocene sand
Diagonal ruling shows areas where the water level in wells is more than 100 feet below land surface

Abundant quantities of ground water are obtainable from the Eocene sand at depths ranging from a few feet along Humphrey Creek to 200 feet or more in the southern part of the quadrangle, where the water level is more than 100 feet below the land surface. A basal sand above the Porters Creek Clay and an upper sand separated from the basal sand by a clay and sand unit are the principal aquifers. The zone of saturation, which extends down to the Porters Creek Clay, is at least 100 feet thick in the southern part of the quadrangle. Yields of 500 to 1000 gpm may be obtained in the southern part of the quadrangle, but north of La Center, yields may be inadequate or wells cannot be completed in the basal Eocene sediments, owing to the high content of fine sand and clay. Sufficient water may be obtained from the McNairy Formation in these problem areas.

A perched water body in Eocene sand east of Hinkleville is reported to yield sufficient water for domestic use

Area boundary

o 84
Test hole

112 Tpc / 117
- Depth to base of gravel, in feet below land surface
- Geologic unit underlying gravel (see aquifer symbols below)
- Depth of test hole, in feet below land surface

•D
Water well

D, *Drilled or jetted well, generally steel casing with well screen on lower end*

B, *Bored or dug well, generally 24-inch concrete tile casing or 8-inch vitrified clay pipe, open at the bottom*

Tu–51r (100) / 143
- Aquifer (see below)
- Water level in well, in feet below land surface; m, if measured, r, if reported
- Yield, in gallons per minute, or adequacy (see below)
- Depth of well, in feet below land surface

AQUIFER SYMBOLS

Qal........Alluvium of Quaternary age
QTg........Gravel and sand of Pleistocene and Pliocene (?) age
Tu........Sand of Eocene age
Tpc........Porters Creek Clay of Paleocene age
Km........McNairy Formation of Cretaceous age
Du........Rocks of Devonian ages, undifferentiated

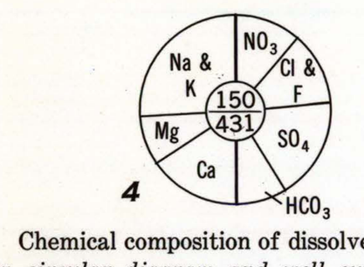
YIELD OR ADEQUACY

(100)........Gallons per minute
(P)........Well reported for power pump for domestic and (or) stock supply
(H)........Well reported adequate for hand pump or bailer
(A)........Well abandoned or destroyed

——350——
Water-level contour, January 1965

Shows altitude of water level in main zone of saturation. Contour interval 10 feet; datum is mean sea level. Where impermeable sediments occur at the altitude of the contour, the water is confined and will rise to the altitude of the contour in wells that penetrate the underlying saturated zone. The depth to water is the difference, in feet, between the altitude of the land surface and the water-level contour

QUALITY



Chemical composition of dissolved solids

Figure between circular diagram and well symbol refers to analysis number in table at end of text. Figure above line at center of circle is carbonate hardness (calcium magnesium hardness, as $CaCO_3$) in parts per million; figure below line is dissolved solids in parts per million. Hardness of water is classified by the U.S. Geological Survey as follows: 0-60 ppm, soft; 61-120 ppm, moderately hard; 121-180 ppm, hard; and 181 ppm or more, very hard. Dissolved solids in partial analyses are computed from specific conductances and are only approximate values. Areas of the segments of each circle are proportional to the mineral component in the dissolved solids in the water. Percentages are computed from equivalents per million of the anions and cations. Calcium and magnesium are shown as one segment in partial analyses. Nitrate shown separately if present in amounts greater than 45 ppm

AVAILABILITY OF GROUND WATER IN THE LA CENTER QUADRANGLE, JACKSON PURCHASE REGION, KENTUCKY

Large undeveloped supplies of ground water are available for domestic and industrial use in the La Center quadrangle. This atlas, one of a series that includes the entire Jackson Purchase region in western Kentucky, presents nontechnical data about ground water in an area surrounding the town of La Center.

The water-availability map is a graphic representation of the occurrence and quality of water in the shallowest aquifer that will yield water in adequate amounts for domestic use. The availability of ground water at a particular site may be determined from the area pattern on the map and a study of data on wells near the site. The approximate depth to water can be calculated by subtracting the altitude of the water level (as shown by water-level contours) from the altitude of the land surface. The chemical quality of water from wells is shown by circular diagrams.

Aquifers underlying the La Center quadrangle will provide adequate ground water for domestic and industrial uses. Wells tapping the Eocene sand may yield more than 500 gallons per minute. This aquifer consists of 70 feet of saturated sand at an auger hole west of Antioch Church, and similar thicknesses of sand should occur south of U.S. Highway 60. On the divide northwest of Kevil, however, the Eocene sequence is clayey, thins toward Ingleside, and will probably not supply large amounts of water; wells may need to be deepened into the Cretaceous sand to obtain an adequate supply.

The Pliocene(?) and Pleistocene gravel will meet the demands for most domestic uses; it will supply several hundred gallons per minute to properly constructed wells. Pliocene(?) gravel overlies a thin Eocene unit lying on the Porters Creek Clay northward from Mount Pleasant Church. The water level in the Pliocene(?) and Pleistocene gravel at Ingleside is approximately the same as that in the McNairy Formation (320-330 feet above mean sea level). Under conditions of heavy pumping, recharge would be from the Eocene sand at higher altitudes to the south and from the McNairy Formation below the Pliocene(?) gravel.

Several wells tap the McNairy Formation and the Devonian rocks in the northern part of the quadrangle, but little is known about the yields of these aquifers. No wells tap the Mississippian rocks. One well tapping the NcNairy sand formerly was used for public supply by the town of La Center. In the early 1900's, the Illinois Central Railroad at La Center used a well that tapped Devonian rocks. Presently, only one well in use is known to tap a pre-Tertiary aquifer. The well is south of Ingleside and obtains water from the Cretaceous sand at a depth of 244 feet.

The quality of the water from the Cretaceous and Tertiary rocks is excellent for most uses. The temperature is approximately the mean annual air temperature of 60°F.

The water from the Pliocene(?) and Pleistocene gravel is moderately hard and normally has an iron content of less than 0.3 ppm (part per million). Iron in excess of 0.3 ppm may cause staining of porcelain and textiles. Water from two of the three wells has a nitrate content of more than 45 ppm; such water may cause a type of methemoglobinemia in infants ("Blue baby" disease), sometimes fatal, and should not be used in infants' formulas.

The water from the Eocene aquifers is soft, low in dissolved solids, and slightly acidic. Most of the water pumped from 2- to 3-inch jetted wells equipped with steel casings and "sucker rod" pumps contains large amounts of iron. Many jetted wells have been abandoned because of the iron content, and the owners have had to buy water for their cisterns. Formerly, people pumped water into their cisterns to remove part of the iron content. It is believed that the high iron content is not typical of the water from the Eocene aquifer in the La Center quadrangle. Water samples from this aquifer collected from plastic-cased 4-inch wells elsewhere in the Jackson Purchase region are noted to have a much lower iron content than those from steel-cased wells. It is believed that the iron results from corrosion of the steel by the slightly acid water. There are no wells in this quadrangle known to be cased with plastic pipe.

The water in one sample collected from a well in the McNairy Formation has an iron content of 1.1 ppm and a hardness of 162 ppm.

The following table shows the iron content, in parts per million, and the hydrogen-ion concentration, expressed as pH, of the water samples analyzed, shown by circular diagrams on the availability map. A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote alkalinity; values lower than 7.0 indicate acidity. Corrosiveness of water generally increases as pH decreases.

Analysis number	1	2	3	4	5	6	7	8	9	10	11
Iron content	0.08	1.4	1.3	0.44	1.1	2.4	0.39	0.13	0.35	0.23	1.8
pH	6.2	6.9	7.9	6.6	7.6	6.1	6.4	5.8	7.0	6.8	6.5

REFERENCE

Glenn, L. C., 1906, Underground waters of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois: U.S. Geol. Survey Water-Supply Paper 164, 173p, 7 pls.

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AVAILABILITY OF GROUND WATER IN THE LA CENTER QUADRANGLE, JACKSON PURCHASE REGION, KENTUCKY

By
T. W. Lambert

1966

For sale by U.S. Geological Survey, price 75 cents