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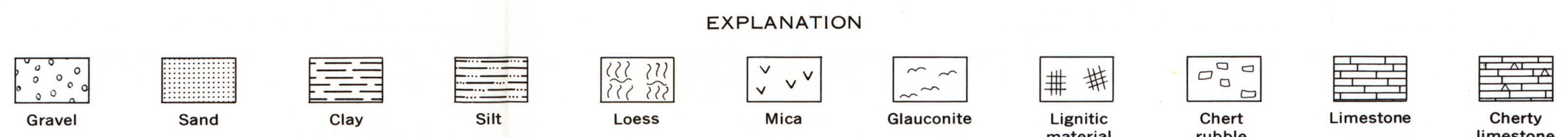
GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

SYSTEM	SERIES	GROUP	FORMATION	SECTION	THICKNESS (IN FEET)	LITHOLOGY	TOPOGRAPHY AND GEOLOGIC SETTING	HYDROLOGY
QUATERNARY	Pleistocene and Recent		Alluvium		0-50'	Tan to gray silt and clay near the surface; grades downward to silty and sandy gravel. Gravelly beds common near the base.	Fills the valleys of the larger streams and their tributaries.	Water bearing in most of the quadrangle. The water table is near land surface in the larger stream valleys, and ground-water discharge maintains perennial flows in Mayfield Creek and in West Fork Clarks River and its major tributaries. The valleys are sparsely populated, in part because of the often swampy conditions, and few wells are known that tap alluvial deposits. Springs or seeps are common in the valleys of Spring Creek, Trace Creek, and probably are present in Panther Creek. The quality of the ground water from wells tapping the alluvium has not been tested; however, water from spring 5 is of good quality and similar to water from the Eocene deposits.
	Pleistocene		Loess		0-9'	Tan to gray unstratified silt and clay.	Covers all upland areas; locally absent along steep valley walls of the larger streams.	Not an aquifer. When saturated by rainfall transmits water to lower aquifers.
TERTIARY	Pliocene(?)		Gravel, sand and clay[1]		0-90'	Tan, red, and brown chert gravel, commonly sandy, grading upward to gravelly sand, sand with chert pebbles, sand, or yellow to brown silt and clay beds. A buried channel trending northeast-southwest from well 3 is filled predominantly with fine-grained, micaceous sand and silt with a gravel bed at the base.	Overlies Eocene sediments in all of the quadrangle, except below some of the alluvium where it has been removed by erosion. Most exposures are gravel or gravelly sand; the finer grained sediments in the upland areas are generally concealed by loess.	The water table is below the base of the gravel deposits in the entire quadrangle; therefore, the gravel is not an aquifer. Cemented zones at the base of the gravel may perch water locally, but no wells are known that obtain water from a perched zone.
	Eocene, undifferentiated		Sand and clay		0-400' (0-300')	Red, tan, and white sand, fine- to coarse-grained and light-to dark-colored clays. Sand with varying amounts of intermixed clay and clay stringers common in well cuttings. The cleanest, coarsest sand appears to be at the base of the unit.	Underlies Pliocene(?) gravel or Quaternary alluvium throughout the quadrangle. Exposed in creek beds and road cuts except in the higher upland areas. Largest exposure in a clay pit near Hopewell Church.	An excellent aquifer in almost all of the quadrangle. Most wells obtain water from Eocene sand at depths as great as 288 feet. Wells in the Eocene sand in the western half of the quadrangle should be capable of supplying all domestic needs and most public-supply and industrial needs. Because the Eocene sands are thinner in the eastern half, wells probably will not yield large amounts of water for public and industrial uses. However, the supply of water will be more than sufficient for domestic or light industrial use. The water is slightly acidic, soft, and generally contains less iron than 0.3 ppm (part per million). An iron content of more than 0.3 ppm imparts a disagreeable taste to water and may cause staining of clothing and utensils. The analysis of water from some wells shows an objectionable amount of iron because of the reaction between the slightly acidic ground water and the steel well casing and pump apparatus.
					(0-100'±)	Black to gray clay, probably lignitic, with fine- to coarse-grained sand layers. A coarse-grained sand bed is present, apparently discontinuous, at the base of the unit.	Underlies the main body of Eocene sediments in most of the quadrangle. Exposed along Ray Branch and possibly in other areas near the valley floor of West Fork Clarks River.	Little is known about the hydrology of this unit. The deeper wells at Hicksville yield good-quality water from the sand at the base of the unit, but the sand is reported to be discontinuous. The water is slightly acidic, is soft, and contains less iron than 0.3 ppm.
	Paleocene	Midway	Porters Creek Clay		200'	Light- to dark-gray or black, slightly to very micaceous clay with fine- to medium-grained, commonly glauconitic sand beds in the upper part. Glauconitic sand or clay and black clay at the base.	Not exposed but underlies Eocene sediments in all the quadrangle. The formation has been penetrated by only a few test holes in Casey Bottoms in the Westplains quadrangle.	The water-bearing characteristics of the formations below the Eocene Series have not been tested in the quadrangle. The Porters Creek Clay generally is not an aquifer.
CRETACEOUS	Upper Cretaceous		McNairy Formation[2]		300'±	Dark-gray to black clay interlaminated with fine- to medium-grained sand; mica and lignitic material common. Clay is most common in the upper part; sand and clay alternate throughout the middle and lower parts; and sand, probably fine-grained, of varying thickness generally present at the base.	Not exposed. Underlies Porters Creek Clay in all of the quadrangle; has not been penetrated by wells or test holes in the quadrangle.	Sands in the lower part of the formation may be capable of supplying several hundred gallons per minute of water of fair to good quality; however, the extreme fineness of the sand may cause difficulty in completing wells. Water from the McNairy commonly contains more than 0.3 ppm of iron.
			Tuscaloosa Formation		?	Rounded chert gravel in a micaceous sand or clay matrix.	Not exposed. Present discontinuously farther east below the McNairy Formation and above the Paleozoic rocks. May be thin or absent in the Westplains quadrangle.	Water bearing, but generally not an aquifer because of the poor sorting and high clay content.
DEVONIAN	Lower and Middle(?) Devonian		Devonian rocks undifferentiated		100'+	All rocks below the Cretaceous are of Paleozoic age and are the bedrock of well drillers. Dolomitic limestone and chert. Probably weathered, with fractures and solutional openings at the top.	Not exposed. Underlies the McNairy or Tuscaloosa Formation throughout the quadrangle. The Devonian rocks have not been penetrated by wells or test holes in the Westplains quadrangle. The formation apparently dips toward the northeast and becomes thicker in that direction.	In other parts of western Kentucky the upper part of the Paleozoic limestone is water bearing; in the Westplains quadrangle the potential yield is unknown. Water in limestone probably is not saline, but may contain sufficient dissolved solids to limit the use of the untreated water.

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

[2] May contain beds of Clayton age in upper part

EXPLANATION



MAP SHOWING AVAILABILITY OF GROUND WATER, LOCATION OF WELLS AND A SPRING, AND QUALITY OF WATER

Base by Tennessee Valley Authority and U.S. Geological Survey, 1951

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

TRUE NORTH / MAGNETIC NORTH 4½°
APPROXIMATE MEAN DECLINATION, 1966

SCALE 1:24 000
1 ½ 0 1 MILE
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

Hydrology by L. M. MacCary, 1963 and R. W. Davis, 1964

EXPLANATION

The water-availability areas on this map show the occurrence and availability of ground water in the shallowest aquifer that will yield adequate amounts of water for domestic use 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 water-bearing properties are described in the generalized columnar section

Qal

AREA 1

Water in Quaternary alluvium

Large-diameter wells in the valleys of Mayfield Creek and of West Fork Clarks River and its major tributaries should yield sufficient water for an adequate domestic supply from the alluvium. If the alluvium is dry or yields only small amounts of water, wells may be deepened to obtain sufficient water at shallow depths from the underlying Eocene sands

Tu

AREA 2

Water in Eocene sands

Diagonal ruling shows areas where the water level in wells is more than 100 feet below land surface

Furnishes sufficient water for an adequate domestic supply in all the area. Wells in the western half of the quadrangle should be capable of supplying most public and industrial needs. Yields presently as great as 200 gpm (gallons per minute) are produced. The potential yields may be 500 gpm or more in this half of the area

Yields from wells in the eastern half of the area probably will be inadequate for public supply or large industrial uses, but may be as great as 50-100 gpm if sufficient sand is penetrated. If large yields are needed in the eastern half, test wells should be drilled to the Porters Creek Clay to determine the amount and character of the saturated sand above the Porters Creek. Larger yields may be produced from wells drilled through the Porters Creek Clay to the basal sand of the McNairy Formation

Drilled wells are most common where the depth to water is more than 100 feet. Both drilled and large-diameter bored wells are common where the depth to water is less than 100 feet. In many areas the loose, water-saturated Eocene sands "heave-up" into the bottom of large-diameter wells and the sand is drawn into the pump. Placing fine, washed gravel in the bottom of such wells, either when the well is drilled or after cleaning the sand from the well, often keeps the sand from entering the well and alleviates the problem

Area boundary

○ 47 — Test hole
Figure below line is depth of test hole

• D — Water well

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

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

Spring

Stream gaging site

Tu–102r / 192 (P)
- Tu — Aquifer (see below)
- 102r — Water level in well, in feet below land surface; r if reported
- (P) — Yield in gallons per minute, or adequacy (see below)
- 192 — Depth of well, in feet below land surface

AQUIFER SYMBOLS

Qal .... Alluvium of Quaternary age
Tu .... Sand of Eocene age

YIELD OR ADEQUACY

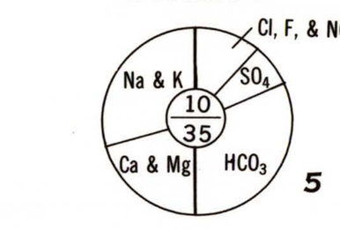
(60) .... Gallons per minute where known
(P) .... Well reported adequate for power pump for domestic and (or) stock supply
(H) .... Well reported adequate for hand pump or bailer
(A) .... Abandoned
(X) .... No yield data available

—400—

Water-level contour, August 1963

Shows altitude of water level in the saturated zone of the Quaternary alluvium and Eocene sand. Contour interval 10 feet; datum is mean sea level

QUALITY



Chemical composition of dissolved solids

Figure between circular diagram and well location refers to analysis number at end of text. Figure above line at center of circular diagram is carbonate hardness (calcium magnesium hardness as $CaCO_3$), in ppm (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. Figure below line is dissolved solids in parts per million; dissolved solids, in partial analyses are computed from specific conductances and are only approximate values. The segments of each circle are proportional to the mineral components dissolved in the water. Percentages are computed from equivalents per million of the anions and cations. Nitrate is shown separately if present in amounts greater than 45 ppm. Calcium and magnesium are shown as one segment in partial analyses. Water containing more than 45 ppm of nitrate may cause a type of methemoglobinemia in infants ("blue baby" disease), sometimes fatal, and should not be used in infants' formulas.

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

Sufficient supplies of ground water for domestic and many public and industrial needs are available in the Westplains quadrangle. This atlas, one of a series being prepared to describe in detail ground-water conditions in the Jackson Purchase region, presents nontechnical information about ground water in an area northeast of Mayfield, Ky., for use by well drillers, landowners, and other well users.

Most wells in the quadrangle are less than 200 feet deep and obtain ground water from sand of Eocene age. A few wells in the bottom-land areas obtain ground water from alluvial deposits.

The water-availability map presents information on the occurrence of the shallowest ground water that will be adequate for domestic use. Availability of ground water at a particular location may be determined by the area pattern on the map. The map explanation and columnar section briefly describe the water-yielding properties of the formation. Chemical analyses of water from wells are represented on the map by circular diagrams. The approximate depth to water can be calculated by subtracting the altitude of the water level (as shown by the water-level contours) from the altitude of the land surface.

The maximum yield of wells tapping Eocene sands is not uniform throughout the quadrangle. The Eocene sands thicken from east to west, and the maximum yields of wells generally are greater toward the west. Wells in the western half of the quadrangle, tapping sand in the lower part of the Eocene Series, have relatively large capacities, and yields there may be as great as 500 gpm (gallons per minute) or more. The largest known yield from the thicker sands is from the Hardeman Water District well near Hardeman School. It has been test pumped at 200 gpm with a reported specific capacity of 26 gpm per foot of drawdown. Wells in the thinner sands of the Eocene Series in the eastern half of the quadrangle should have lesser yields, with a maximum of about 50-100 gpm along the easternmost edge of the quadrangle. Greater yields may be available, however, from wells penetrating the deeper McNairy Formation in this eastern area.

Present withdrawals of ground water from the Eocene sands in the area are insignificant compared to the large amount of water in storage in the sands. As a result the Eocene sands should be capable of supplying all foreseeable public and domestic needs, and many industrial needs. Excess ground water drains from the Eocene aquifers continuously, maintaining perennial flows in Mayfield Creek and in West Fork Clarks River and its major tributaries. As an example, the flow of Trace Creek at Clear Springs was measured in order to determine the amount of ground water draining from the aquifer when the creek was nearly at base flow. The flow on June 8, 1964, was about 400 gpm, derived almost entirely from ground-water discharge in the Trace Creek drainage basin.

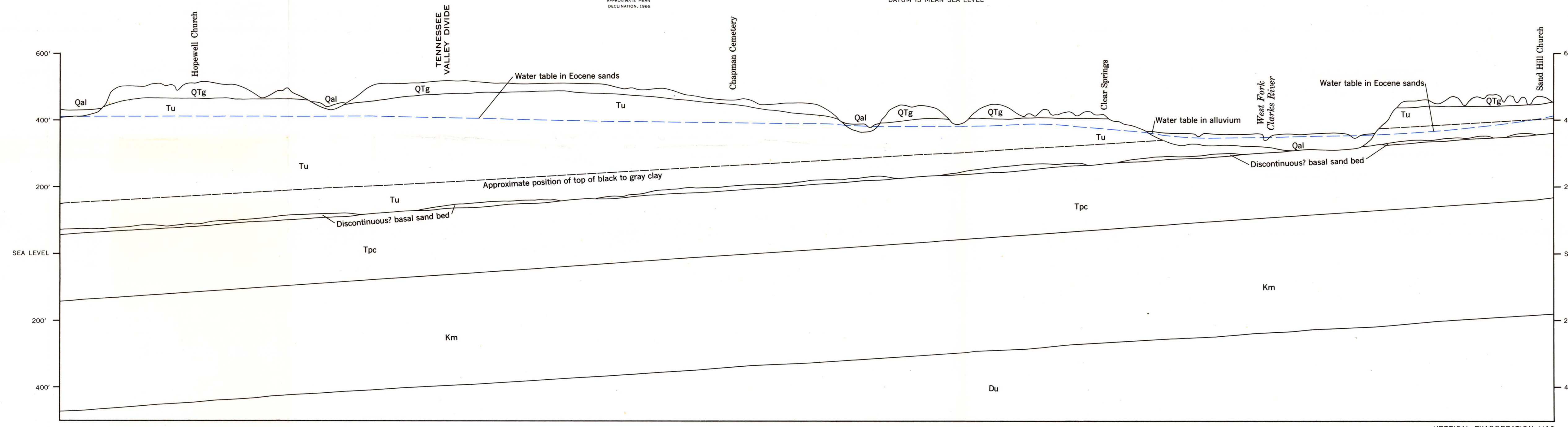
The temperature of ground water from the Eocene sand is about 59°F.

The following table shows the iron content, in parts per million, and the hydrogen-ion concentration, expressed as pH, of the water analyzed and shown by circular diagrams on the 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
Iron content	0.15	0.27	1.6	1.4	0.09	0.02	1.8	0.07	5.2	0.11
pH	8.4[1]	6.1	6.6	6.8	6.6	6.0	6.7	5.9	5.9	6.2

Analysis number	11	12	13	14	15	16	17	18	19
Iron content	0.12	0.06	3.6	0.34	0.08	0.09	0.19	0.07	0.14
pH	6.7	5.9	6.6	6.2	6.6	6.0	6.4	6.5	6.5

[1] Sample from new well with concrete tile casing, which contributed excess alkalinity to the water



EXPLANATION

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

GENERALIZED GEOLOGIC SECTION ALONG A SOUTHWEST-NORTHEAST-TRENDING LINE FROM HOPEWELL CHURCH TO SAND HILL CHURCH

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

By
L. M. MacCary and R. W. Davis
1966

For sale by U.S. Geological Survey, price 50 cents