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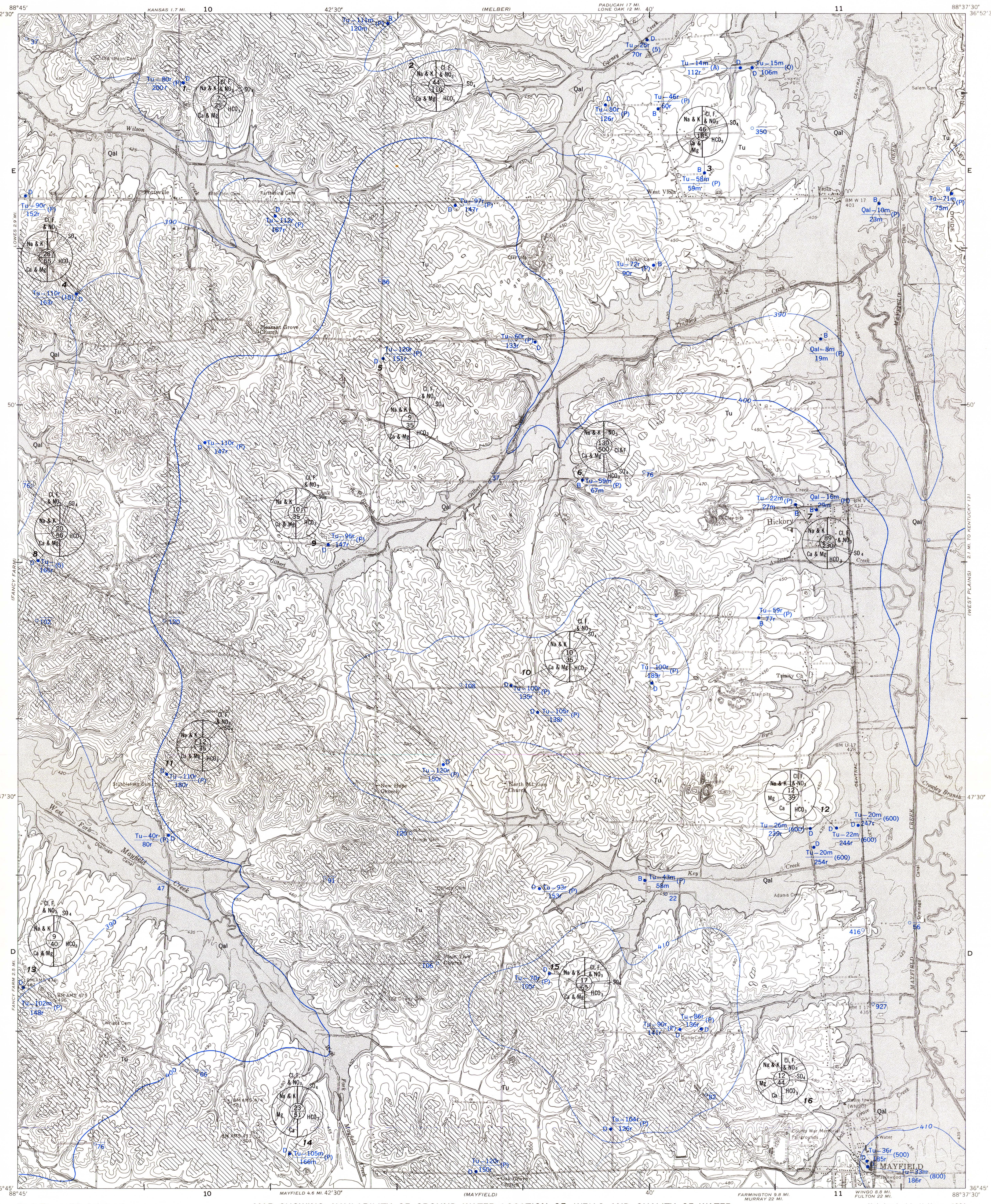
GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

System	Series	Group	Formation	Section	Thickness in feet	Lithology	Topography and geologic setting	Hydrology
QUATERNARY	Pleistocene and Recent		Alluvium		0–25′	Brown to tan micaceous silt, sand, and gravel. Upper part is commonly sandy silt, locally very clayey and, in places, contains a few pebbles of chert and quartz. Lower part is brown or grayish-brown sandy, generally very silty, iron-stained chert gravel.	Flood-plain deposits in the valley floors of the regional drainage system. The alluvium beneath the flood plain of Mayfield Creek is as thick as 25 feet but thins to less than 15 feet in many of the tributary valleys.	Water bearing in the lower few feet in the valley of Mayfield Creek where the alluvium intersects the main zone of saturation and in the larger tributaries where ground water is perched in the alluvium by clayey materials in the underlying sediments. Large-diameter wells in the valley of Mayfield Creek yield adequate domestic supplies, but in the tributaries they may obtain only small supplies. The small bodies of perched water may be inadequate during periods of low rainfall when they are not replenished. The alluvium may be dry in some places where it is underlain by porous sediments which permit the ground water to percolate downward and recharge the underlying main zone of saturation. The water is probably soft and contains only minor amounts of dissolved minerals
	Pleistocene		Loess		0–15′	Tan to brown to buff unstratified clayey silt containing very small pellets of iron oxide; generally sandy in lower few feet.	Windborne deposits which mantle the upland and drape down hillsides. As thick as 15 feet in upland; eroded thin on hillsides; absent in valley floors.	Not an aquifer. Probably transmits some water from rainfall into underlying aquifers.
TERTIARY	Pliocene(?)		Gravel and sand[1]		0–100′	Reddish-brown to tan gravel and sand containing some clay. The upper part is commonly composed of well-rounded to angular iron-stained chert pebbles and cobbles with a few quartz pebbles in a micaceous sandy matrix. The middle part is generally fine- to medium-grained clean sand containing some clay and, in places, very coarse-grained sand. Mostly iron-stained chert gravel and clayey sand in lower part. Iron-cemented zones generally present at base of lower gravel and in the middle sandy part.	Continental deposits which blanket the flat uplands and cap the narrow ridges in the deeply dissected areas; absent beneath the flood plain of the larger streams. The average thickness of the deposit is about 75 feet, but as much as 100 feet underlies the higher upland and less than 50 feet is beneath the gentle slopes to the flood plain. The basal gravel rests unconformably on the underlying sediments of Eocene age.	Not significant as an aquifer although it may be water bearing in a few places. The gravel underlying the gentle slopes to Mayfield Creek along U.S. Highway 45 is probably saturated in the lower few feet during the spring of the year when the water table commonly rises 3 or 4 feet due to the seasonal rainfall. Small bodies of perched water may be present at shallow depths above beds of clay or cemented zones; the basal part of the gravel could be saturated where it rests on clayey materials in the underlying sediments. Although no wells obtain water from the gravel, a small spring flowing from a perched water body in the gravel near Farthering Cemetery was developed for a domestic supply; however, it was abandoned when the spring became dry during the fall season. The water was reported to be soft and of a satisfactory chemical quality for a domestic supply.
	Eocene undifferentiated		Sand and clay	Upper	0–150′	Brown, gray, and white sand and dark- to light-gray, tan, and pink clay. The upper part is generally very clayey and silty, including fine- to medium-grained lenses of crossbedded, somewhat micaceous sand, locally containing clay balls and thin- to thick-bedded silty and lignitic clay. Lower part is predominantly medium - to coarse-grained sand with laminae of clay common in some places.	Coastal-plain deposits underlying either the Pliocene(?) gravel or the Quaternary alluvium in the entire quadrangle. The deposits range in thickness from about 150 feet in the northeastern part of the quadrangle to as much as 500 feet in the southwestern part where it attains the greatest thickness. Beneath the alluvium of Mayfield Creek near Viola, the uppermost part of the Eocene formations is missing, and the alluvium lies directly on the apparently continuous clayey section in the middle part. The sediments of Eocene age rest unconformably on the underlying Porters Creek Clay.	Water bearing in the entire quadrangle. The main zone of saturation ranges in thickness from about 150 feet to more than 400 feet and furnishes an abundant supply of ground water to both large-diameter bored wells and small-diameter drilled wells. Yields greater than 1,000 gallons per minute can be obtained from the coarse-grained sands. The large-capacity industrial wells in the eastern part of the area tap these sands in the middle part of the aquifer and show evidence of artesian conditions. Most farm wells are completed in sand in the upper part of the formation where the water is apparently under water-table conditions. The water is commonly soft and contains only minor concentrations of dissolved minerals. Objectionable amounts of iron may be present in the water in a few places; more than 0.30 part per million of iron imparts a disagreeable taste and may stain the laundry and plumbing fixtures. The rare occurrence of harmful amounts of nitrate in the water could be due to pollution in local areas. Nitrate in amounts greater than 45 parts per million in the water fed to infants may be the cause of methemoglobinemia ("blue-baby" disease) which is sometimes fatal.
				Middle	40–200′	Brown, gray, and white sand containing dark-gray to olive-gray to white clay at the top. The thin upper part is commonly composed of beds of sandy clay which are apparently continuous throughout the deposit. Grades down into thick beds of fine- to coarse-grained sand containing laminae of clay in the fine-grained sandy sections.		
				Lower	150′±	Brown to gray sand and clay. Sand is fine- to coarse-grained, thin- to thick-bedded, micaceous and lignitic. Clay is silty and sandy, interbedded with sand in upper part. Coarse grained sand common in basal part of the formation.		
	Paleocene	Midway	Porters Creek Clay		250′±	Dark-gray to black, micaceous, commonly massive clay containing thin beds of fine-grained glauconitic sand in upper part. Slightly glauconitic in several zones. Gray to greenish-gray, very glauconitic clayey sand or sandy clay at base.	Marine deposits concealed beneath the sediments of Eocene age at depths ranging from about 175 feet near Viola to 550 feet or more in the southwestern part of the quadrangle. The Porters Creek Clay is underlain by sand and clay of the McNairy Formation of Cretaceous age. The underlying Cretaceous sediments, which probably are as thick as 300 feet, rest on an eroded Paleozoic rock floor.	Not significant as an aquifer. The Porters Creek Clay holds water in the overlying sand of Eocene age and confines water in the deeper aquifers. Because the underlying Cretaceous aquifers have not been tapped for water supplies in this quadrangle, little is known of the occurrence of the deeper confined water. However, the water should rise in wells to altitudes of about 350 feet or more above sea level. The water probably is hard or very hard and possibly contains objectionable concentrations of iron and dissolved minerals.

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

EXPLANATION



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

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

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
4½°
APPROXIMATE MEAN DECLINATION, 1965

KENTUCKY
QUADRANGLE LOCATION

Hydrology by John H. Morgan, 1964

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 a domestic supply. 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 depths and water-bearing properties are described in the generalized columnar section

Qal

AREA 1
Water in Quaternary alluvium

Adequate domestic supplies of ground water are available in the lower few feet of the alluvium at depths commonly less than 25 feet in the valley of Mayfield Creek. The zone of saturation extends downward into the underlying Eocene sediments in this vicinity, and the alluvium is water bearing throughout the year. In the larger tributary valleys, however, the ground water is perched in the alluvium above clay or other fine-grained material and may not be adequate during part of the year, especially during periods of low rainfall. Where the alluvium is dry or furnishes only small supplies, wells can be deepened to obtain water from the underlying Eocene sands

Wells in alluvium are generally the shallow large-diameter bored or dug wells which provide large storage capacities in the casing capable of sustaining withdrawals by the use of power-pump installations. The small-diameter wells in alluvial areas are drilled to greater depths and obtain water from the deeper Eocene sands

Tu

AREA 2
Water in Eocene sands

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

Abundant quantities of ground water are available in the Eocene sands at depths ranging from only a few feet below the land surface in many stream valleys to depths slightly greater than 100 feet in the area shown by diagonal ruling. The zone of saturation, which is as thick as 400 feet and contains several thick beds of sand suitable for large-capacity wells, extends downward to the underlying Porters Creek Clay. The water in the deeper sand, apparently confined by beds of clay in the middle part of the aquifer, is under artesian conditions and will rise in wells to the altitude of the local water table. In a few places, small bodies of ground water probably are perched by beds of clay above the water table; however, the perched water is generally inadequate for modern demands, and wells should reach into the main zone of saturation. The depth to the main zone can be determined either by the water-level contours or from the well data for wells in this area

Small-diameter drilled or jetted wells, some as deep as 200 feet or more, penetrate deeply into the main zone of saturation and withdraw water directly from the aquifer through well screens placed in coarse sand. Large-capacity wells probably can obtain yields greater than 1,000 gallons per minute in most of the quadrangle. The large-diameter wells, which are designed for small pumping capacities and generally penetrate only a few feet below the water table, yield adequate domestic supplies; however, they could be deepened to obtain larger yields

Area boundary

○ 76

Test hole
Figure below line is depth of test hole

● B

Water well
D, *Drilled or jetted well, generally having well screen on lower end*
B, *Bored or dug well, generally 24-inch concrete casing open at the bottom*

Tu – 105m / 166m (18)
- 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; m, if measured, r, if reported

AQUIFER SYMBOLS

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

YIELD OR ADEQUACY

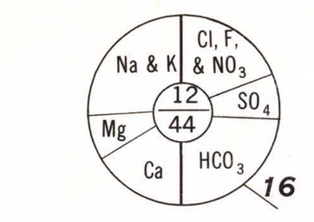
(18) .... Gallons per minute where known
(P) .... Well reported adequate for power pump for domestic and (or) stock supply
(H) .... Well reported adequate for hand pump or bailer
(O) .... Observation well
(A) .... Abandoned

——400——

Water-level contour

Shows altitude of water level in main zone of saturation. Contour interval 10 feet; datum is mean sea level. Depth to water is difference in feet between altitude of water-level contour and land surface. The water is confined where clay occurs at, or below, the altitude of the contour. Water-level measurements taken in February-March 1964

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 circular diagram is carbonate hardness (calcium magnesium hardness, as $CaCO_3$) in parts per million (ppm); 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 is shown separately if present in amounts greater than 45 ppm

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

An abundance of ground water for domestic, municipal, and industrial supplies is available in the water-bearing formations in the Hickory quadrangle. The valuable ground-water resource is only partially developed and will furnish sufficient water for industrial growth and future public demands. This atlas provides the necessary information and interpretation for development and use of the ground-water resource.

The most important aquifer (water-bearing formation) is the sand of Eocene age which contains an enormous volume of water filling the pore spaces between the grains in the main zone of saturation, that part of the sand formation completely saturated with water. Less important aquifers include small bodies of water above beds of clay, called "perched water", and confined water in the deeper McNairy Formation of Cretaceous age.

The depth to the main zone of saturation in the Eocene sands ranges from only a few feet below the land surface in many stream valleys to as much as 120 feet beneath the higher uplands. The saturated zone extends downward to the underlying Porters Creek Clay, as deep as 550 feet in the southwestern part of the quadrangle, and includes several thick beds of coarse-grained sand, suitable for the development of the water by means of screened wells. The water table, the upper surface of the main saturated zone, slopes gently toward the stream valleys where the ground water discharges into the alluvium and eventually into surface streams.

Large quantities of water can be obtained from the Eocene sands. A pumping test, made by the U.S. Geological Survey in 1960, of four closely spaced industrial wells in the southeastern part of the quadrangle indicates the aquifer has a coefficient of transmissibility of about 300,000 gallons per day. This means that in 1 day 300,000 gallons of water can move through each vertical strip of the aquifer 1 foot wide extending the full thickness of the aquifer. The wells are finished in the middle part of the formation, and the static water levels are about 175 feet above the top of the well screens. The theoretical yield of the pumped industrial well is approximately 8,750 gallons per minute. The theoretical yield of a well is the feet of water above the screen times the specific capacity, computed to be about 50 gallons per minute per foot of drawdown for the pumped well. Actually this amount cannot be obtained due to pipe friction and other well losses, but the figure indicates the magnitude of the yield that can be expected The coefficient of storage, computed to be in the range of 0.0002 for the wells in the pump test, indicates artesian conditions. Thin beds of clay or fine-grained sand in the middle part of the aquifer could be confining the water at greater depths in the formation. Similar conditions can be expected in other parts of the quadrangle.

Discontinuous beds of clay above the water table commonly retard the descending water that seeps into the ground. Where the beds of clay or other fine-grained materials are continuous over areas large enough to retain the water, small bodies of perched water may occur in the overlying Eocene sands, in the Pliocene(?) gravel, or in the Quaternary alluvium. Although these small bodies may furnish water for many household needs, they probably will not meet the demands of the modern home.

Because an abundance of good-quality ground water is available at shallow depths, the deeper McNairy Formation of Cretaceous age has not been developed as a source of water in the Hickory quadrangle and little is known of the occurrence of the water confined in this formation. However, in McCracken and Marshall Counties, where the aquifer is nearer the land surface and adequate amounts of water are not available at shallower depths, the McNairy Formation furnishes large supplies to farms, rural homes, and small communities.

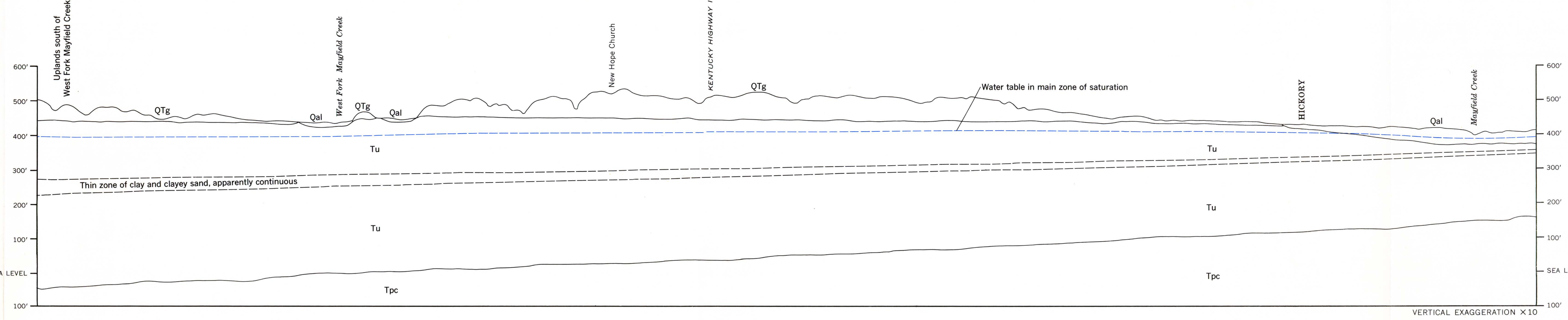
The shallowest water-bearing formation that will yield a dependable supply of ground water is shown on the water-availability map. The color pattern for area 2, for example, is shown in the area near New Hope Church in the south-central part of the quadrangle. The explanation states that the shallowest source is in the Eocene sands; the water table is greater than 100 feet below the land surface in this area, and water is obtained by both large-diameter bored wells and small-diameter drilled wells. The latter wells penetrate deeply into the saturated zone, indicating the depth to coarse-grained sand. The depth to the water table is the difference in feet between the altitude of the water level and the land surface. At New Hope Church the difference is about 120 feet.

The chemical quality of the water in the main zone of saturation in the Eocene sand is considered to be excellent. The concentration of dissolved solids rarely exceeds 50 or 60 parts per million and the water is commonly very soft. Where greater concentrations of dissolved solids are in the water, generally in bored wells, the increase usually is caused by excess nitrate, possibly the result of pollution. Bored and dug wells are susceptible to pollution unless properly sealed and located to prevent surface and sewage contamination. The water from the Eocene sands is slightly acidic and is considered somewhat corrosive. Objectionable amounts of iron probably are caused by the slightly acidic water reacting with steel casing and pump equipment. Large concentrations of iron are rarely present in water from wells that have concrete or plastic casing. The temperature of the water, ranging from about 58° to 62°F, makes it useful as a coolant. The confined water in the deeper McNairy Formation is probably less acidic than the shallower water, but may be very hard and contain iron in excessive concentrations.

The following table shows the iron content in parts per million and the hydrogen-ion concentration, expressed as pH, of the water shown by circular diagrams on figure 1. 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 with decreasing pH.

Analysis number	1	2	3	4	5	6	7	8	9	10
Iron content	2.3	0.06	0.03	0.47	2.6	0.15	0.29	1.7	1.2	11.0
pH	6.0	6.2	6.4	6.1	6.0	6.5	—	6.3	6.0	5.8

Analysis number	11	12	13	14	15	16
Iron content	0.63	0.48	1.9	0.16	0.24	0.24
pH	6.0	5.7	6.0	6.0	5.9	4.8



GENERALIZED GEOLOGIC SECTION ALONG A NORTHEAST-TRENDING LINE FROM THE UPLANDS SOUTH OF THE WEST FORK MAYFIELD CREEK, THROUGH HICKORY, TO MAYFIELD CREEK

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

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

By

J.H. Morgan

1965

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