DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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HYDROLOGIC INVESTIGATIONS
ATLAS HA-172

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

Sufficient supplies of ground water for domestic and many public and industrial needs are available in the Lovelaceville quadrangle. This atlas, one of a series being prepared to describe ground-water conditions in the Jackson Purchase region in detail, presents nontechnical information about ground water in an area near Lovelaceville 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 may obtain some water from alluvial deposits.

The water-availability map presents information on the occurrence of the shallowest ground water that will yield an adequate supply of water 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, and circular diagrams show the chemical composition of the water. 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. Because thick clay beds that do not yield water are present in much of the quadrangle, the calculated depth to water may be considered the minimum depth of a well. Many wells must be drilled through the clay beds to the deeper sand beds below, especially in the central and northern parts of the quadrangle. The water level in such wells will rise to the approximate altitude shown by the water-level contours.

Wells with large yields are known only in the southeast quarter of the quadrangle; however, wells tapping Eocene sand anywhere in the quadrangle should be capable of yielding 100 gpm (gallons per minute). In addition, wells tapping the lower part of the Eocene sands in the southern half of the quadrangle may yield as much as 500 gpm.

Present withdrawals of ground water from the Eocene sands in the area are insignificant compared to the large amount of water in storage there. 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 Wilson Creek downstream from near the Graves-Carlisle County boundary. The U. S. Geological Survey has maintained a stream-gaging station on Mayfield Creek 1 mile south of Lovelaceville since 1938. According to its record, the minimum daily discharge, derived almost entirely from excess ground-water discharge, was 5.7 cubic feet per second (2,600 gpm) on September 11 and 12, 1943.

The quality of water from the Eocene sands is good. The water is soft, generally containing less than 100 ppm (parts per million) dissolved solids, is slightly acidic, 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 clothing and utensils.

Excess iron is a common complaint of many well owners in this area. However, because many of the domestic wells have 2-inch steel or galvanized-iron well casings and cylinder pumps (locally called "sucker rod" pumps) that use the casing for the cylinder, probably most of the iron is derived from the corrosion of the casing and the pump mechanism by the slightly acidic ground water. Samples of water from wells having plastic casings show a low iron content.

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 analyses 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	0.02	0.04	5.2	0.52	0.07	0.11	0.09	1.5	0.36	1.0
pH	6.3	6.1	6.2	6.2	6.5	6.4	5.9	6.3	5.4	5.8

Analysis number	11	12	13
Iron content	0.12	0.03	2.7
pH	6.5	6.1	5.5

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		0–35±	Clay or silt near the surface, grading downward into clayey sand or silt with clayey gravel and (or) clean gravel (about 5 to 10 feet thick in Mayfield Creek valley) near the base. Near the McCracken-Graves County boundary, at the eastern edge of the map, the predominantly silty or clay part is as thick as 34 feet and may, in part, be colluvial material. At places along gentle slopes near the main drainages, the extent of the alluvial material is not easily distinguished.	Present in the larger stream valleys and their tributaries. As thick as 35 feet in the valley of Mayfield Creek; from about 5 to 30 feet thick in smaller stream valleys.	Water bearing in most of the quadrangle. Will furnish a sufficient supply for domestic use in the valleys of Mayfield and Wilson Creeks, and probably in the lower reaches of Brush and Lick Creeks. Presently appears to be unused, either because of poor chemical quality (possibly high iron content and hardness) or because of concern about possible contamination existing in such a shallow aquifer.
	Pleistocene		Loess		0–12	Tan to gray unstratified silt or clay.	Covers all upland areas and the gently sloping sides of stream valleys. Appears to merge with the clay and silt of the alluvium along the edges of gently sloping valleys appearing as loesslike alluvium.	Not an aquifer. When saturated by rainfall transmits water to lower aquifers.
	Pliocene(?)		Gravel[1]		0–40	Tan, red, or brown chert gravel, commonly sandy, grading upward to gravelly sand, sand with chert pebbles, or sand.	Overlies Eocene sediments in most of the quadrangle. Not present below the alluvium or in an upland area extending from the railroad at Lowes to about U. S. Highway 62, bounded by the valleys of Brush and Wilson Creeks. Most exposures are gravel; the finer grained sediments in the upland areas are concealed by loess.	The water table is below the base of the Pliocene(?) gravel 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 tap such a perched zone.
TERTIARY	Eocene, undifferentiated		Sand and clay		0–150± 50–100± 90–150 120 250–450±	Red, tan to white fine- to coarse-grained sand, with stringers of white to gray clay. White to gray clay; fine- to medium-grained sand; interlayered sand and clay. Brown to white coarse- to fine-grained sand. Coarse sand appears to be more common in this unit than in any other Eocene units. Gray to black clay, probably lignitic, and fine-grained sand, grading downward to coarse-grained sand near the base.	Exposed in the upland areas both north and south of Mayfield Creek; absent beneath the larger stream valleys. Exposed in the lower areas north of Mayfield Creek; underlies the entire quadrangle. Both Mayfield and Wilson Creek alluvium rest on this unit. Not exposed but underlies the entire quadrangle. Not exposed but appears to underlie the entire quadrangle.	Tapped by drilled and bored wells south of Wilson Creek and by bored wells between Mayfield and Wilson Creeks. Not known to be tapped by wells north of Mayfield Creek. This unit is an excellent aquifer for domestic wells, but probably will not sustain large yields for industrial uses. Sand beds in this unit are tapped by a few wells. Most wells in the quadrangle tap either the sands above or the sands below this unit. Tapped only by drilled wells north of Mayfield Creek and by the deeper drilled wells south of Mayfield Creek. This unit probably is the best aquifer in the area and should yield as much as 500 gallons per minute in the southern part of the quadrangle. No wells in this quadrangle tap this unit. The sand near the base of the unit may be capable of supplying water for domestic use, but because of its thinness probably will not produce large yields.
	Paleocene	Midway	Porters Creek Clay		150±	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 throughout the quadrangle.	Generally not an aquifer. The clay is the base of the zone of ground-water circulation in the overlying Eocene sediments and confines ground water in the underlying McNairy Formation. Penetrated in the Lovelaceville quadrangle by only the 520-foot test hole near Lovelaceville.
CRETACEOUS			McNairy Formation[2]		300	Dark-gray to black clay interlaminated with fine- to medium-grained sand; mica and lignitic material common. Clay is the most common material in the upper part of the formation. Sand and clay are interbedded in the lower part; sand beds of varying thicknesses are generally present at the base.	Not exposed but underlies Porters Creek Clay throughout the quadrangle.	The water-bearing character of the formations below the Porters Creek Clay has not been tested in the Lovelaceville quadrangle. The sand in the McNairy Formation could yield a large amount of water of fair to good quality, but because of the large amount of water available from the more shallow Eocene aquifer, the McNairy has not been tapped for a source of ground water.
			Tuscaloosa Formation		?	Rounded chert gravel in a clay matrix.	Not exposed. Present discontinuously farther north and east below the McNairy Formation and above Paleozoic rocks. May be thin or absent in Lovelaceville quadrangle.	Water bearing, but generally not an aquifer because of poor sorting and high clay content.
DEVONIAN			Devonian rocks, undifferentiated		300–550±	All rocks below the Cretaceous are of Paleozoic age and are the "bedrock" of well drillers. Coarsely crystalline dolomitic limestone and chert.	Not exposed. Underlies the entire quadrangle.	Not penetrated by wells in the Lovelaceville quadrangle. Probably water bearing, but of an unknown quality and quantity.

[1] Age undetermined. Estimates of age range from Pliocene(?) or older to Pleistocene.
[2] May contain beds of Clayton age at top.

EXPLANATION

Gravel · Sand · Clay or shale · Silt · Loess · Mica · Glauconite · Lignite · Chert rubble · Limestone · Crystalline limestone · Cherty limestone

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
The alluvium will yield sufficient supplies of water for domestic use in the valleys of Mayfield and Wilson Creeks, and probably in the lower reaches of Brush and Lick Creeks. In other parts of the quadrangle ground water may be perched in the alluvium above cemented beds or clay bodies. At present, wells in the Area 1 obtain water from the underlying Eocene sands, probably because of the better quality water in the Eocene and because of the possibility of contamination from the shallow alluvial sources

Tu

AREA 2
Water in Eocene sand
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 throughout the quadrangle. Properly constructed wells anywhere in the area should be capable of yielding 100 gallons per minute. In the southern part of the quadrangle, wells tapping the lower part of the Eocene sands may yield as much as 500 gallons per minute
Drilled wells are most common where the depth to water is more than 100 feet. Both drilled and bored wells are common where the depth to water is less than 100 feet

Area boundary

37 — Test hole
Figure below line is depth of test hole

D, B — 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 or 6-inch vitrified clay pipe, open at the bottom*

Stream-gaging station

Tu–110(P) / 135 — Aquifer (see below); Water level in well, in feet below land surface; r if reported; Yield in gallons per minute, or adequacy (see below); Depth of well, in feet below land surface

AQUIFER SYMBOL

Tu.....Sand of Eocene age

YIELD OR ADEQUACY

(75).....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
(X).....No yield data available

350 — Water-level contour
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. Water-level measurements taken in February 1965

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); 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 10 ppm
One well sampled contained more than 45 ppm of nitrate. 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

Base by Tennessee Valley Authority and 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

APPROXIMATE MEAN DECLINATION, 1965

SCALE 1:24 000
1 MILE · 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

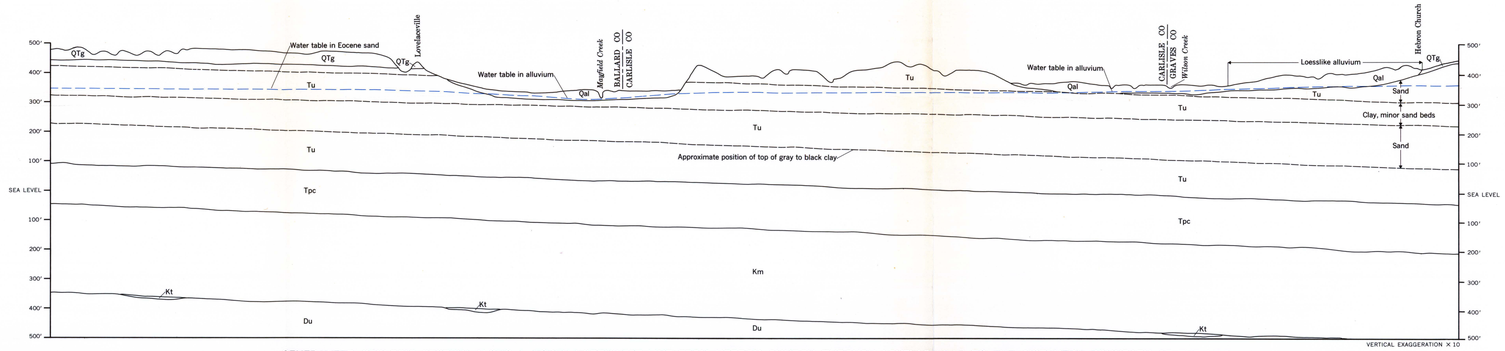
KENTUCKY
QUADRANGLE LOCATION

Hydrology by R. W. Davis, 1964–65

MAP SHOWING AVAILABILITY OF GROUND WATER, LOCATION OF WELLS, AND QUALITY OF 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
Kt.....Tuscaloosa Formation of Cretaceous age
Du.....Devonian rocks, undifferentiated



VERTICAL EXAGGERATION × 10

GENERALIZED GEOLOGIC SECTION ALONG A NORTH-NORTHWEST LINE FROM HEBRON CHURCH, THROUGH LOVELACEVILLE, TO THE NORTHERN BOUNDARY OF THE MAP

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