DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WILLIAM T. PECORA, DIRECTOR

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND STATE GEOLOGIST

HYDROLOGIC INVESTIGATIONS
ATLAS HA-171

# 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


## EXPLANATION

Each water-availability area on this map shows the occurence and availability of ground water in the shallowest aquifer that may yield sufficient water for domestic use. This report considers that an adequate domestic supply will deliver about 500 gallons per day from a well equipped with a power pump and pressure-distribution system. The shallowest aquifer is underlain by other aquifers whose water-bearing properties are described in the generalized columnar section

OTg

Water in gravel of Pliocene(?) and Pleistocene age
Dotted pattern indicates areas where saturated gravel is less than 10 feet thick

*In the area below the 330-foot water-level contour, yields from bored wells will be adequate for domestic and stock use. Except where the saturated gravel is less than 10 feet thick, properly constructed wells will yield sufficient water for many industrial needs. Where the gravel is thin, industrial wells must be drilled deeper to penetrate the Paleozoic rocks. The saturated thickness of the gravel ranges from 3 to 61 feet*

*Above the 330-foot water-level contour, yields from bored wells may be adequate for domestic use; however, they will be inadequate where the saturated gravel is thin or absent. The saturated thickness of the gravel generally is less than 10 feet. The shallowest alternative aquifer is the McNairy Formation, at depths ranging between 100 and 175 feet. The underlying Paleozoic limestone may yield adequate water for industrial needs*

### AQUIFER SYMBOLS

QTs..... Sand and silt of Pliocene(?) and Pleistocene age
QTg..... Sand and gravel of Pliocene(?) and Pleistocene age
Tpc..... Porters Creek Clay of Paleocene age
Km..... McNairy Formation of Cretaceous age

### YIELD OR ADEQUACY

(8)..... Gallons per minute, where known
(P)..... Reported adequate for power pump for domestic and/or stock supply
(H)..... Reported adequate for bailer or hand pump
(A)..... Abandoned or destroyed

Test hole

300 — Water-level contour

*Shows altitude of water level in the saturated gravel. The depth to water is the difference between the land-surface altitude and the water-level contour. Water levels measured in March and April 1964. Contour interval 10 feet; datum is mean sea level*

31—85Km / 97 — Saturated thickness of gravel, in feet ( * means not less than); Depth to base of gravel, in feet below land surface; Formation underlying gravel (see formation symbols below); Depth of test hole, in feet below land surface

D● — Water well
D, *Drilled or jetted well, generally 4-inch steel casing with well screen*
B, *Bored or dug well, generally 8-inch vitrified clay pipe or 24-inch concrete tile, open at the bottom*
WP, *System of well points for dewatering construction site below the water table*

QTs—53 (H) / 59 — 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

### QUALITY

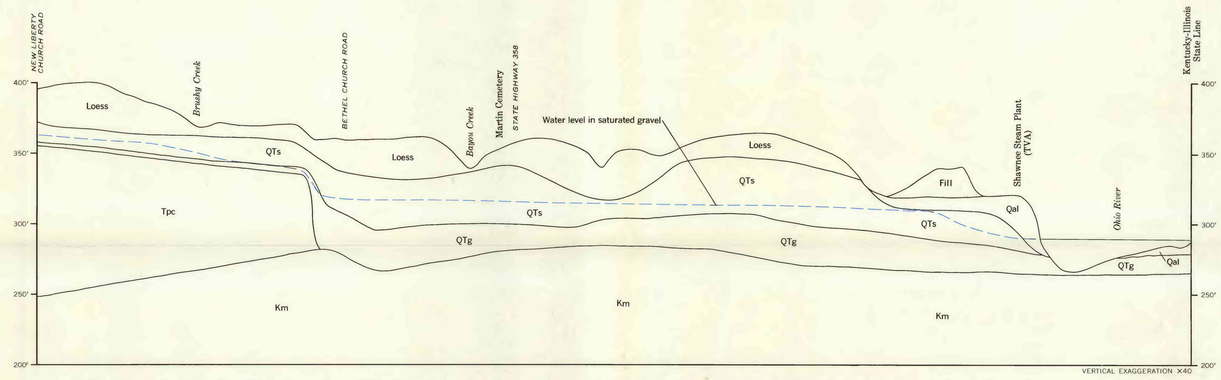
Chemical composition of dissolved solids

*Figure between circular diagram and well symbol is 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 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; in partial analyses, dissolved solids are computed from specific conductances and are only approximate. The area of each segment in the circle is proportional to the mineral component dissolved in the water. Percentages are computed from equivalents per million of the anions and cations. Calcium and magnesium are shown together as a single segment in partial analyses. Nitrate is shown separately if present in amounts greater than 45 ppm*

## 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 | | 0–40′ | Brown or gray sandy and silty clay or clayey silt with streaks of sand. Some brown sand with streaks of clay and silt. | Recent flood-plain deposits in the valleys of the Ohio River and its larger tributaries. | No wells tap the alluvium in this area. In the tributary valleys, the alluvium is above the zone of saturation. Near the Ohio River, bored wells penetrating streaks of sand may yield enough water for domestic use. |
| | Pleistocene | | Loess | | 0–43′ | Brown or yellowish-brown unstratified silty clay. | Wind-laid deposits covering all upland areas. | Above the zone of saturation. When saturated by precipitation, transmits water to underlying aquifers. |
| | | | Gravel sand and clay[1] | | 0–60′ | Orange to yellowish-brown clayey silt, some very fine sand, trace of fine to medium sand; occasional layers of light gray clay. Often micaceous. | Continental deposits underlying loess throughout the area. Occasionally present beneath the alluvium. | Yields from bored wells generally are reported adequate for domestic use. However, present yields probably are inadequate for modern suburban homes; larger yields can be had from the underlying Pliocene(?) gravel. Most of the wells in this aquifer penetrate about 7 to 18 feet into the zone of saturation; generally, the bottom of these wells is within 5 feet of the underlying gravel. The water generally is moderately hard and has about 240 ppm (parts per million) of dissolved solids. It contains about 0.4 ppm of iron; an iron content greater than 0.3 ppm imparts a disagreeable taste to water and may cause staining of clothing and utensils. It contains about 20 ppm of nitrate; in 3 of 10 samples, it contains more than 45 ppm. Water containing more than 45 ppm of nitrate may cause methemoglobinemia ("blue baby" disease), sometimes fatal, in infants and should not be used in their formulas. |
| TERTIARY | Pliocene(?) | | | | 3–121′ | Reddish-brown silty and sandy gravel, trace of clay; occasional lenses of clay. | Continental deposits lying on an irregular surface consisting of channels and terraces cut by an intricate drainage system into sediments of Paleocene and Cretaceous ages. Coastal-plain sediments of Eocene age may underlie the gravel near the intersection of Bethel Church Road and the south edge of the quadrangle. | Below the 330-foot water-level contour, yields from bored wells are more than adequate for domestic and stock use. Drilled wells will supply as much as 1000 gallons per minute to meet many industrial needs, except in the small part of the area where the saturated gravel is less than 10 feet thick. Above the 330-foot water-level contour, yields from bored wells generally are reported adequate for domestic use. Occasionally, additional storage (wells penetrating the Porters Creek Clay or more than one well) may be necessary to meet daily peaks of domestic consumption. Where the saturated gravel is thin, or absent, yields will be inadequate. If coastal-plain sediments of Eocene age are present above the Porters Creek Clay, the overlying Pliocene(?) and Pleistocene gravel probably will be above the zone of saturation and the shallowest aquifer may be the Eocene deposits. The shallowest alternative aquifer is the sand in the McNairy Formation, which underlies the Porters Creek Clay at depths increasing from about 100 feet at the northern curve of the 330-foot contour to about 175 feet along the southern edge of the map. The shallowest alternative aquifer adequate for industrial needs may be the Mississippian limestone, at a depth of about 500 feet. |
| | Paleocene | Midway | Porters Creek Clay | | 0–88′ | Dark gray montmorillonitic clay, often silty or sandy; occasionally micaceous. Glauconitic at the base and in the upper part. | Marine deposit underlying the Pliocene(?) and Pleistocene gravel south of the 330-foot water-level contour. Pinched out near the contour; it thickens southward. | Not an aquifer. Retards ground-water movement between the Pliocene(?) and Pleistocene gravel and the sand in the McNairy Formation. |
| CRETACEOUS | Upper Cretaceous | | McNairy Formation[1] | | 200–300′ | Grayish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine- to medium-grained sand. The upper part is mostly clay; the lower part is predominantly micaceous fine sand. | Deltaic deposits underlying the Porters Creek Clay south of the 330-foot water-level contour and the Pliocene(?) and Pleistocene gravel north of it. | Drilled wells may yield enough water for domestic use; however, the water contains sufficient iron that it may need iron-removal treatment to be satisfactory for most uses. |
| | | | Tuscaloosa Formation | | 0–? | White, well-rounded or broken chert gravel with tripolitic clay matrix. | Discontinuous stream-laid deposits on post-Paleozoic erosion surface. Present in parts of adjacent quadrangles; may be present in this area. | Not an aquifer because of fine-grained matrix and poor sorting. |
| MISSISSIPPIAN | | | Carbonate rocks undifferentiated | | 300–500′ | The Paleozoic consolidated rocks underlying the Cretaceous sediments are the "bedrock" of well drillers.<br>Dark gray limestone interbedded with chert. | Underlies the entire area. | No wells penetrate the bedrock in this area. In the Illinois part of the Joppa quadrangle, the yield of an industrial well penetrating Mississippian limestone exceeds 1000 gallons per minute. Probably, the water is hard. |

[1] Age undetermined. Estimates of age range from Pliocene(?) to Pleistocene
[1] Upper part may include layers of Clayton age

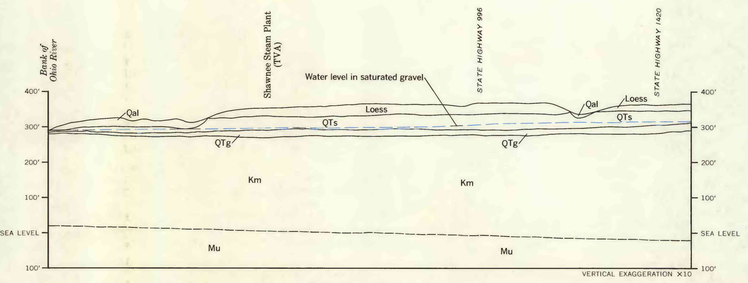

GENERALIZED GEOLOGIC SECTION OF THE SATURATED PLIOCENE(?) AND PLEISTOCENE GRAVEL THROUGH SHAWNEE STEAM PLANT (TVA) AND MARTIN CEMETERY

EXPLANATION

Gravel, Sand, Silt, Clay, Loess, Mica, Glauconite, Limestone, Chert

EXPLANATION

Qal..... Alluvium of Quaternary age
QTs..... Sand and silt of Pliocene(?) and Pleistocene age
QTg..... Sand and gravel of Pliocene(?) and Pleistocene age
Tpc..... Porters Creek Clay of Paleocene age
Km..... McNairy Formation of Cretaceous age
Mu..... Mississippian rocks, undifferentiated




GENERALIZED GEOLOGIC SECTION TRENDING NORTHWEST-SOUTHEAST THROUGH SHAWNEE STEAM PLANT (TVA)

## AVAILABILITY OF GROUND WATER IN THE KENTUCKY PARTS OF THE JOPPA AND METROPOLIS QUADRANGLES, JACKSON PURCHASE REGION, KENTUCKY

Ground water for domestic and industrial use is abundant in the Kentucky parts of the Joppa and Metropolis quadrangles. This atlas, one of a series for the entire Jackson Purchase region in western Kentucky, presents nontechnical data concerning ground water in northwestern McCracken County.

The availability map shows the occurrence and quality of ground water in the shallowest aquifer that may yield enough water for an adequate domestic supply. Ground-water availability at any site is shown by the map pattern and the data for nearby wells and test holes. Chemical quality is shown by circular diagrams.

The principal aquifer is gravel of Pliocene(?) and Pleistocene age. Below the 330-foot water-level contour, the saturated thickness ranges from 3 to 61 feet. Except where the saturated gravel is less than 10 feet thick, the yields from properly constructed wells should be adequate for many industrial needs. These yields may be as much as 1,000 gallons per minute.

Above the 330-foot water-level contour in the southwestern corner of the quadrangle, bored wells in the gravel may yield enough water for domestic use; however, yields will be small where the saturated gravel is thin. Where yields are inadequate, additional storage can help to meet the peak demands of household activity. This storage can be obtained by using large pressure tanks or by deepening bored wells into the Porters Creek Clay. The water supply may be increased by pumping alternately from two or more widely spaced bored wells or by drilling a well through the Porters Creek Clay into the sand in the McNairy Formation.

The water level in the saturated gravel slopes northward from about 380 feet above sea level near the intersection of New Liberty Church Road and the south edge of the quadrangle to about 290 feet at the Ohio River in the northwest corner of the area. The annual range of water-level fluctuation is about 9 feet near the Ohio River; it decreases inland.

The Porters Creek Clay is not an aquifer; instead, it retards ground-water movement between the Pliocene(?) and Pleistocene gravel and the McNairy Formation of Cretaceous age. The clay pinches out and is absent north of the 330-foot water-level contour; it thickens to about 100 feet south of the 370-foot water-level contour.

The McNairy Formation ranges from about 200 to 300 feet in thickness. The depth to the McNairy increases southward from about 100 feet near the 330-foot water-level contour to about 175 feet along the south edge of the map. Drilled wells tapping the McNairy may yield enough water for domestic use; however, the water from the upper part of the formation contains large amounts of iron.

The Tuscaloosa Formation of Cretaceous age, a discontinuous deposit, underlies the McNairy Formation in parts of adjacent quadrangles and may be present in the Joppa-Metropolis area. It is not an aquifer because of its fine-grained matrix and poor sorting.

Paleozoic bedrock, consisting of interbedded limestone and chert of Mississippian age, underlies the Cretaceous sediments. In the area above the 330-foot water-level contour, it is the shallowest aquifer that may supply an industrial well; it is about 500 feet deep. The water from the bedrock probably is hard.

The quality of water in the deposits of Pliocene(?) and Pleistocene age is satisfactory for most uses. Generally, the water is moderately hard and contains about 120 to 300 ppm (parts per million) of dissolved solids. It is slightly acidic, with a pH generally between 6.1 and 6.6, and may be slightly corrosive. The nitrate content generally is less than 25 ppm; however, in 3 of 10 samples, it exceeds 45 ppm. In 5 of 10 samples, the iron content exceeds 0.3 ppm.

One sample, from a well in the upper part of the McNairy Formation, is moderately hard, has about 160 ppm of dissolved solids, a pH of 6.5, and almost no nitrate; however, the water contains so much iron that iron-removal treatment is needed to make it satisfactory for most uses. Based on analyses of water from wells in adjacent areas, the water in the lower part of the McNairy contains much less iron than that in the upper part.

The following table lists the iron content, in parts per million, and the hydrogen-ion concentration, as pH, of the water analyses on the availability map. A pH of 7.0 indicates neutrality. Values higher than 7.0 denote alkalinity; lower values indicate acidity. Below 7.0, corrosiveness generally increases as pH decreases.

| Analysis number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Iron content | 0.69 | 0.50 | 0.49 | 0.12 | 0.22 | 23.0 | 0.52 | 0.12 | 0.34 | 0.10 | 0.07 |
| pH | 6.4 | 6.2 | 6.1 | 6.6 | 6.1 | 6.5 | 6.3 | 6.0 | 6.9 | 6.5 | — |

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# AVAILABILITY OF GROUND WATER IN THE KENTUCKY PARTS OF THE JOPPA AND METROPOLIS QUADRANGLES, JACKSON PURCHASE REGION, KENTUCKY

By
Arnold J. Hansen, Jr.

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