Figure 10 is a generalized geologic section showing the stratigraphic and structural relationship of the Dugger and Patoka aquifers. Well A penetrates the Patoka aquifer at a depth of 25 feet, whereas well B, which is only 1 mile from well A but southeast of the Patoka aquifer outcrop, must be drilled to a depth of 200 feet before penetrating the Dugger aquifer. Well C penetrates the same aquifer as well A. Because it is northwest of well A, well C must be drilled deeper in order to reach the aquifer.

How Good are the Aquifers?

Reported yields from wells in the fresh-water sandstone aquifers of Vanderburgh County are relatively low. They range from less than 1 gpm to as much as 20 gpm. It is rare, however, to find a reported yield greater than 10 gpm and most wells are reported to yield 5 gpm or less. Any attempt to develop high-yield municipal or industrial wells in these aquifers would be impractical. The importance of these aquifers is that they are practically the sole source of fresh water throughout most of the rural areas of the county.

The amount of water presently being withdrawn from the fresh-water sandstone aquifers is estimated to be 2 mgd (million gallons per day).

Lithologic details of sediments penetrated by the observation well Vanderburgh 6 (SW 1/4 NW 1/4 sec. 8, T. 5 S., R. 11 W.), which is in the Patoka aquifer, are diagrammatically shown on figure 11. This well is generally representative of wells drilled in the Pennsylvanian sandstone aquifers of Vanderburgh County. The hydrograph of the observation well Vanderburgh 6 for a 1-year period is shown on figure 12. The amount of water-level fluctuation, as well as the general configuration of the hydrograph, is considered to represent the natural fluctuation in the sandstone aquifer.

The hydrologic characteristics of the fresh-water sandstone aquifers are in all probability very similar. This is indicated by the uniformity of the lithologic, petrologic, and geometric features of the sandstone units that constitute the aquifers. Direct information about the hydrologic characteristics is limited to the data from a specific capacity test of the observation well Vanderburgh 6. This test was conducted under optimum conditions. The well completely penetrates the Patoka aquifer and is cased to the top of the aquifer (fig. 11). The well was pumped for 8 hours at a constant rate of 8 gpm. The specific capacity (definition, p. 35) of the well is 0.134 gpm per ft. The field coefficient of permeability (definition, p. 35) of the aquifer is estimated to be 10 gpd per sq ft. These are considered to be generally representative of all fresh-water sandstone aquifers in the county. The maximum coefficient of transmissibility (definition, p. 35) for the sandstone aquifers in Vanderburgh County is estimated to be 1,000 gpd per ft.

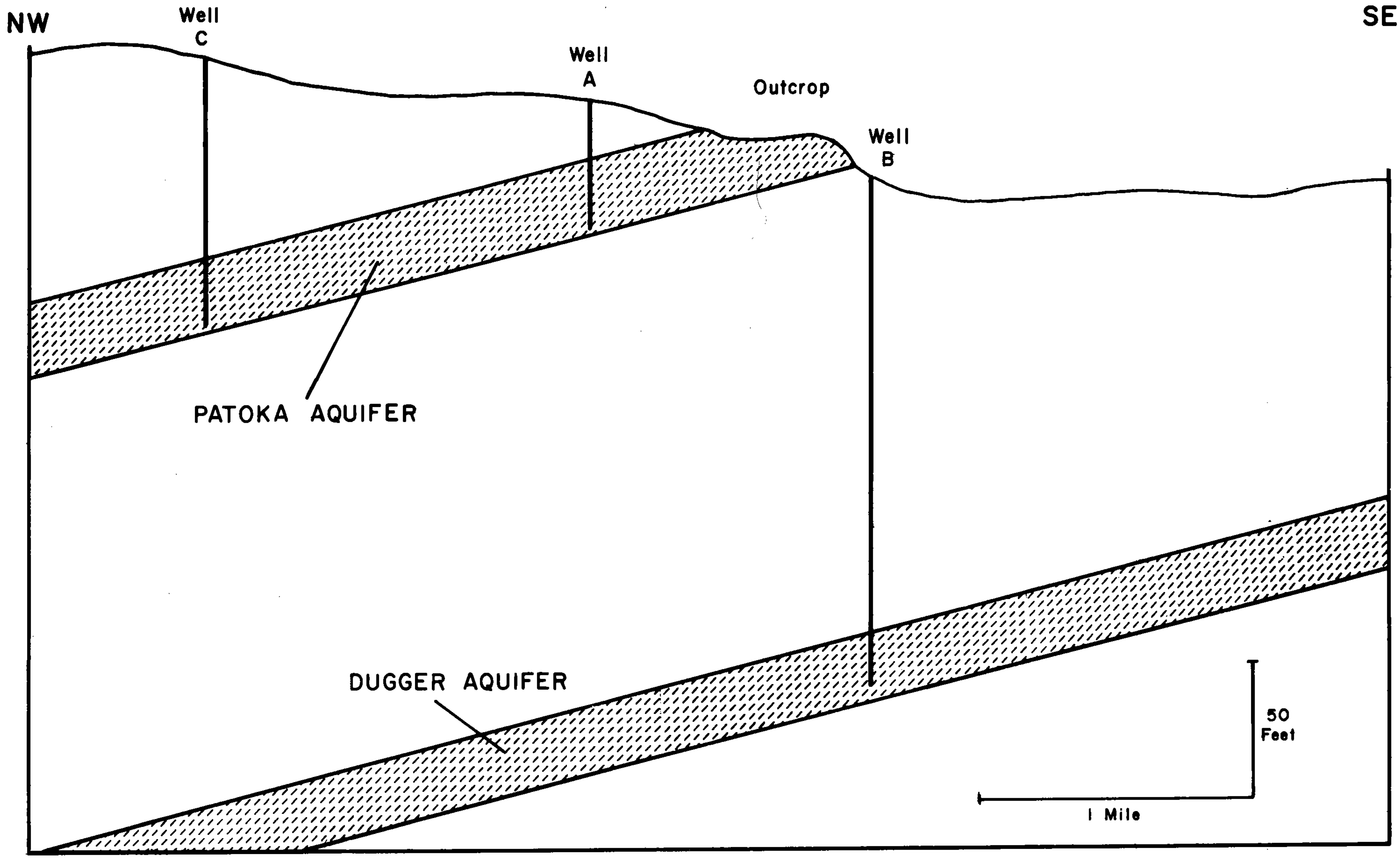


FIGURE 10.-- Generalized geologic section showing the stratigraphic and structural relationship of the Dugger and Patoka aquifers.

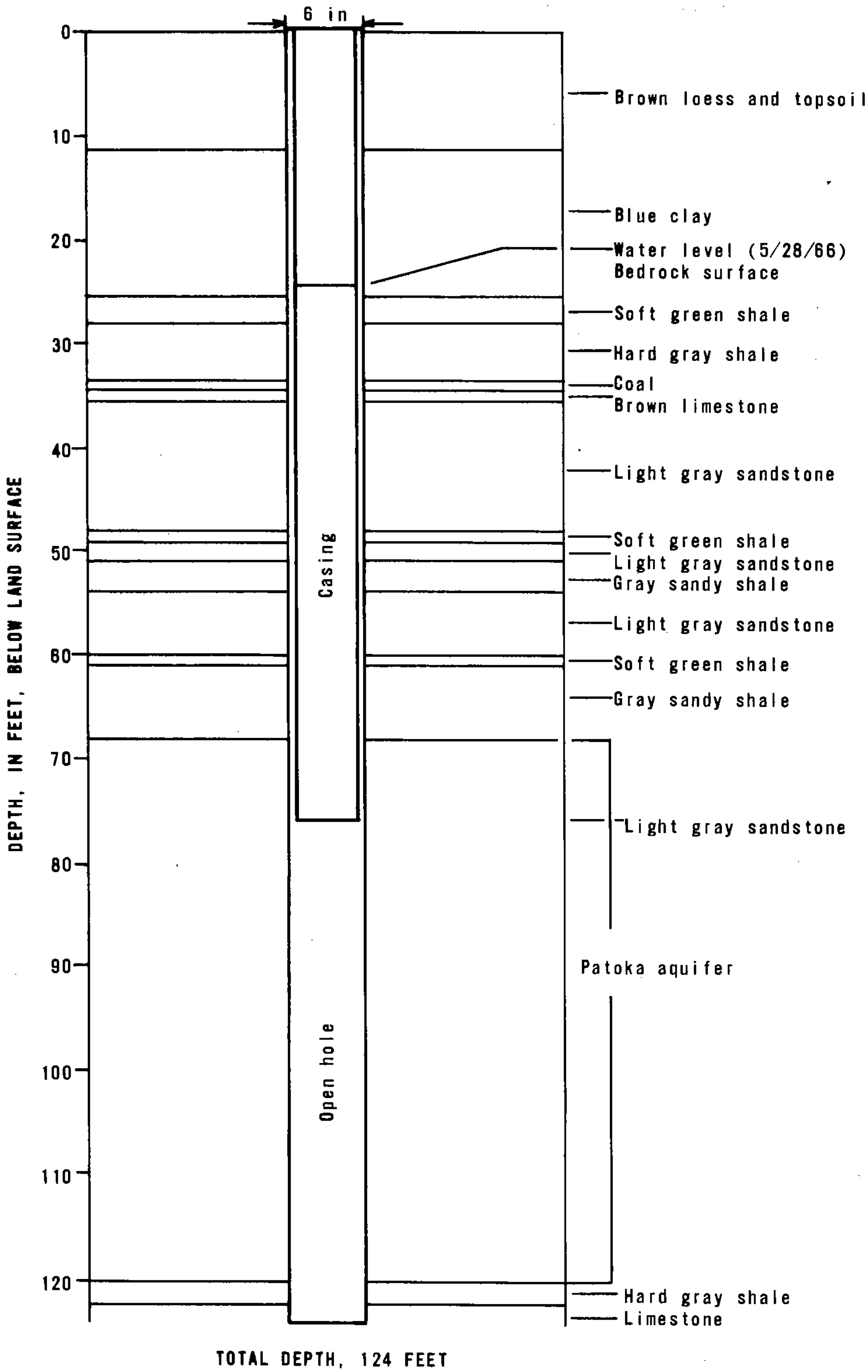


Figure 11.-- Total depth, depth of casing, diameter and lithology of the observation well Vanderburgh 6.

Water well drillers in Vanderburgh County frequently report that the lower part of the sandstone aquifers is the most productive. This is especially common where a well has penetrated a relatively thick section of aquifer. A grain-size analysis of samples of the Patoka aquifer taken during the drilling of the observation well Vanderburgh 6 shows that the grain-size distribution is not uniform throughout the aquifer. The depth of sampling and the median grain size of each sample are shown in figure 13. The material is generally coarser in the lower part of the aquifer than in the upper part. This feature has also been noted in other Pennsylvanian sandstones (Malott, 1948, p. 139; Hopkins, 1958, p. 33; and Andresen, 1961, p. 24). Where the sandstone aquifers are relatively thick, indications are that the coarsest material and, therefore, the highest permeability is in the lower part of the aquifer. For maximum yield, wells should completely penetrate the sandstone aquifers.

What is the Chemical Quality of the Water?

Water samples from wells in the Pennsylvanian sandstone aquifers of Vanderburgh County were collected and analyzed in order to ascertain the chemical quality of the water. The amount and type of dissolved mineral constituents present were defined, and characteristics of the water such as pH, hardness, specific conductance, and temperature were determined. Results of the laboratory analyses, which are more comprehensive than the field analyses, are given in table 2. The mineral constituents listed in the table are given in ionic form in parts per million.

The chemical quality of ground water in Vanderburgh County is controlled by several factors. Ground water generally becomes increasingly mineralized with depth. This can be seen by comparing the analyses given in table 2 of water samples from the Dugger and Patoka aquifers with that from the much lower Mansfield Sandstone. Although it is not possible to determine the exact depth at which the water ceases to be fresh, data indicate that there are two and possibly three sandstone aquifers which either partially or totally contain fresh water. The chemical quality of the water in these aquifers is not uniform and varies significantly throughout the county. The amount and kind of soluble minerals present in the rock as well as the length of time the water remains in the rock largely determine the chemical quality of the water. Variations in one or both of these features will result in corresponding variations in the chemical quality of the water. Locally the chemical quality of ground water may be affected by agents such as unplugged oil wells and improper waste disposal.

Analyses of water samples from the Dugger aquifer show the water to be mostly of the sodium bicarbonate type. Over most of eastern and southern Vanderburgh County where wells are supplied from this aquifer the water is fresh. Locally, however, areas occur in which the dissolved mineral content of the water is considerably in excess of 1,000 ppm owing to the presence of abnormally large amounts of sodium, bicarbonate, and chloride. This water is referred to by the local inhabitants as "soda water". Although this

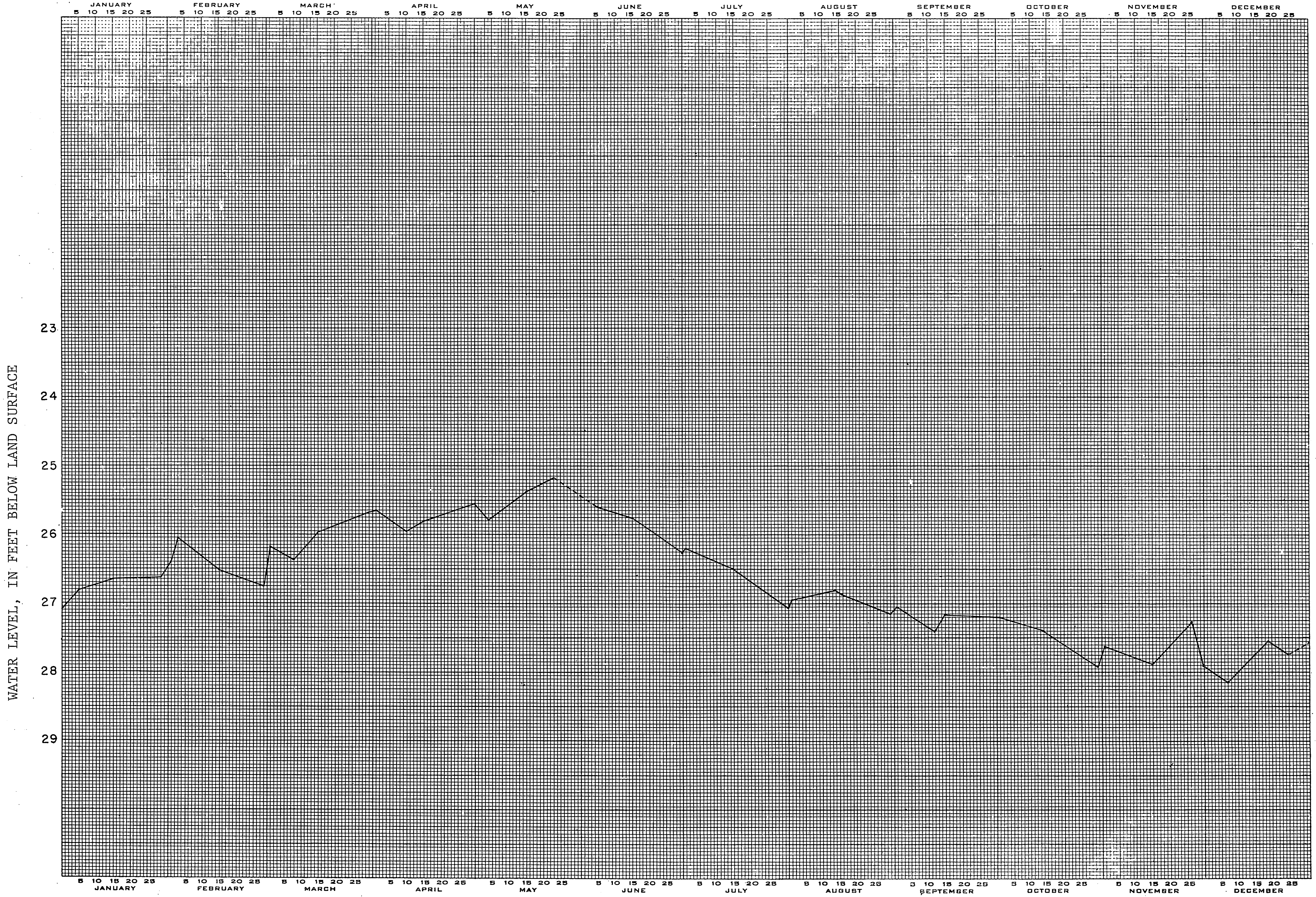


FIGURE 12.--Hydrograph of the observation well Vanderburgh 6 in 1966.

Table 2 .--Chemical analyses of ground water in Vanderburgh County, Indiana

(Results given in parts per million except as indicated)

Analysis Number	Source of Water	Well location	Land Surface Elevation (feet)	Well depth (feet)	Date of Collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids (Calculated)	Hardness as $CaCO_3$	Noncarbonate Hardness	Specific Conductance (Micromhos at 25° C)	pH
Pennsylvanian System																								
1	Mansfield Formation	SE 1/4 SW 1/4 Sec.15 T. 7 S., R. 11 W.	365	930	10-26-65	63	12.0	2.00	0.55	107.0	38.0	3,060	16.0	740	0	195.0	4,420.0	0.4	---	8,210	423	0	14,000	7.6
2	Dugger aquifer	SE 1/4 NE 1/4 Sec.11 T. 6 S., R. 10 W.	385	98	10-27-65	61	21.0	.04	.02	78.0	40.0	36	8.0	508	0	.8	.5	.4	9.0	436	359	0	747	7.5
3	Do	NE 1/4 NE 1/4 Sec.25 T. 4 S., R. 10 W.	420	125	10-26-65	63	14.0	.98	0	16.0	9.3	206	2.1	540	0	32.0	31.0	.7	2.0	580	78	0	956	7.7
4	Do	SW 1/4 SW 1/4 Sec.25 T. 5 S., R. 10 W.	391	175	10-26-65	61	9.0	.78	.01	5.4	1.1	718	3.0	965	0	23.0	530.0	2.0	2.2	1,770	18	0	2,980	8.1
5	Do	NE 1/4 NE 1/4 Sec.27 T. 7 S., R. 11 W.	371	197	10-27-65	59	18.0	.44	0	25.0	8.3	109	1.6	340	0	3.8	43.0	.4	.9	377	96	0	634	7.8
6	Do	SW 1/4 NW 1/4 Sec.1 T. 5 S., R. 10 W.	410	118	10-28-65	58	12.0	.06	0	9.5	6.6	388	2.6	850	0	16.0	127.0	2.8	1.5	984	50	0	1,640	7.9
7	Patoka aquifer	SE 1/4 NE 1/4 Sec.13 T. 5 S., R. 11 W.	472	47	2-24-66	58	30.0	1.40	.05	102.0	27.0	51	1.0	380	0	132.0	20.0	.2	.3	552	366	54	860	7.0
8	Do	NE 1/4 NW 1/4 Sec.30 T. 5 S., R. 11 W.	543	228	2-24-66	57	23.0	.25	.03	39.0	10.0	71	1.8	316	0	27.0	9.0	.3	.2	336	136	0	544	7.7
9	Do	NW 1/4 NW 1/4 Sec.16 T. 5 S., R. 11 W.	535	193	2-24-66	55	32.0	.28	0	53.0	15.0	35	1.3	304	0	15.0	8.0	.3	.2	309	194	0	495	7.5
10	Do	SW 1/4 NW 1/4 Sec.8 T. 5 S., R. 11 W.	448	124	5-26-66	58	35.0	.50	.03	64.0	24.0	39	1.5	372	0	28.0	9.0	.1	1.2	385	258	0	616	7.6
Quaternary System																								
11	Sand and gravel	NW 1/4 NE 1/4 Sec.34 T. 6 S., R. 10 W.	380	80	2-25-66	59	18.0	.19	.11	97.0	27.0	11	1.4	354	0	65.0	14.0	.3	.4	408	353	63	676	7.4
12	Do	NE 1/4 NE 1/4 Sec.22 T. 7 S., R. 11 W.	372	68	2-25-66	55	17.0	6.40	.10	73.0	15.0	20	.9	248	0	69.0	8.0	.2	.6	332	244	40	527	7.2
13	Do	NE 1/4 SE 1/4 Sec.20 T. 6 S., R. 10 W	385	71	7-10-56	66	20.0	4.10	1.40	169.0	54.0	27	3.5	499	0	268.0	22.0	.1	0	815	644	235	1,200	6.9
14	Do	SW 1/4 SW 1/4 Sec.19 T. 6 S., R. 10 W.	383	82	7-11-56	62	21.0	1.90	.93	193.0	52.0	41	7.1	525	0	314.0	36.0	.2	.6	926	695	265	1,340	6.9
15	Do	NE 1/4 NE 1/4 Sec.30 T. 6 S., R. 10 W.	382	80	7-23-53	61	18.0	1.90	.69	188.0	3.2	20	3.7	364	0	188.0	24.0	.2	1.3	621	484	---	931	7.6
16	Do*	NW 1/4 NW 1/4 Sec.31 T. 6 S., R. 9 W.	390	55	--------	--	----	----	----	115.0	40.0	30	2.0	500	-	45.0	30.0	0	---	518	450	---	-----	8.2
17	Do*	NE 1/4 NE 1/4 Sec.3 T. 7 S., R. 10 W.	379	104	--------	--	----	1.50	----	70.0	25.0	8	1.0	317	-	27.0	8.0	.2	0	315	290	---	-----	7.4

*Analysis from Indiana State Board of Health, Bull. S. E. 10, 1960.

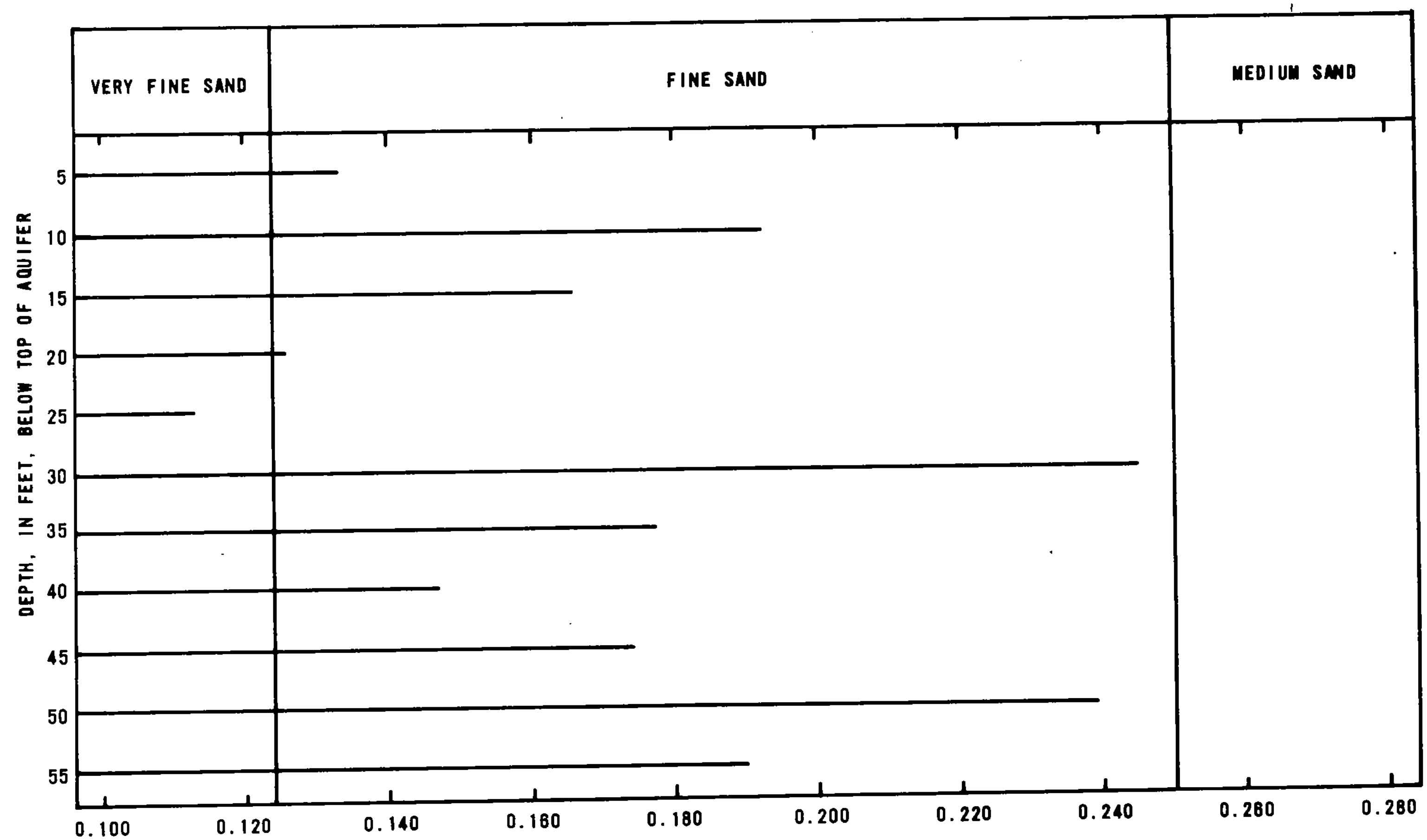


Figure 13.-- Grain-size distribution in the Patoka aquifer.

water is generally not fresh, it is excellent for such household and commercial purposes as laundering and cleaning owing to its softness and low iron content. Analysis 4 of table 2 is from a "soda water" area. The approximate boundaries of the two largest of these "soda water" areas is shown on figure 14.

Other significant characteristics of the water in the Dugger aquifer are the hardness and iron content. Except in the "soda water" areas where the water is predominantly soft, the water in the Dugger aquifer is moderately hard (table 3). Of the samples analyzed, hardness (as $CaCO_3$) ranged from 5 to 396 ppm with an average value of 108 ppm. The iron content was almost always less than 1.0 ppm.

Table 3.--U.S. Geological Survey Classification of Hardness (as $CaCO_3$) of Water (Durfur and Becker, 1964)

ppm	
0-60	Soft
61-120	Moderately hard
121-180	Hard
More than 180	Very hard

Analyses of water samples from the Patoka aquifer show the water to be of the hard to very hard (table 3) calcium bicarbonate type. The dissolved mineral content is relatively low, and the water is fresh throughout Vanderburgh County. However, analyses show the hardness and iron content to be generally greater than in the Dugger aquifer. Of the samples analyzed, the hardness (as $CaCO_3$) ranged from 136 to 552 ppm with an average value of 260 ppm, and the iron content ranged from 0.1 to 7.5 ppm with an average value of 2.4 ppm.

THE QUATERNARY SYSTEM

The Quaternary System of Vanderburgh County consists of unconsolidated rocks of Pleistocene and Recent ages. In this report these rocks are subdivided into five units. These units include the flood-plain deposits and terrace deposits of the Ohio River valley, the lacustrine deposits and stream alluvium of the tributary valleys, and the loess, which mantles the bedrock hills. Plate 2 shows the surface distribution of these rock units throughout the county. The thickest and most hydrologically important of these rock units are the terrace and flood-plain deposits of the Ohio River valley. These deposits range in thickness from less than 40 feet to approximately 140 feet (fig. 15) and consist mostly of glacial outwash sand and gravel.

The Ohio River Valley Aquifer

Sand and gravel deposits of the Ohio River valley terraces and flood plain constitute a single hydrologic unit that is referred to as the Ohio River valley aquifer. In Vanderburgh County this aquifer is bounded on the south by the Ohio River and on the north by the bedrock hills of the river

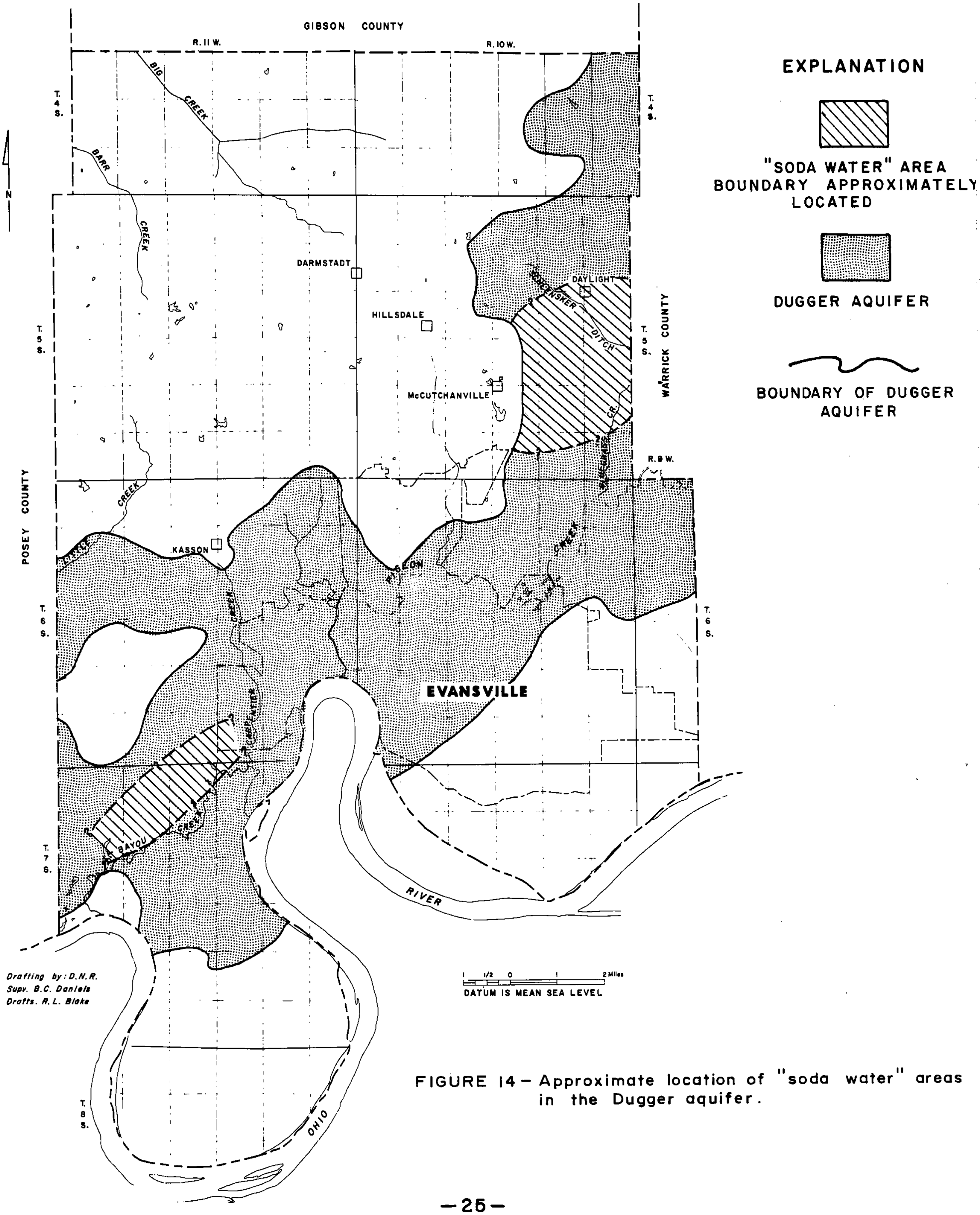


FIGURE 14 – Approximate location of "soda water" areas in the Dugger aquifer.

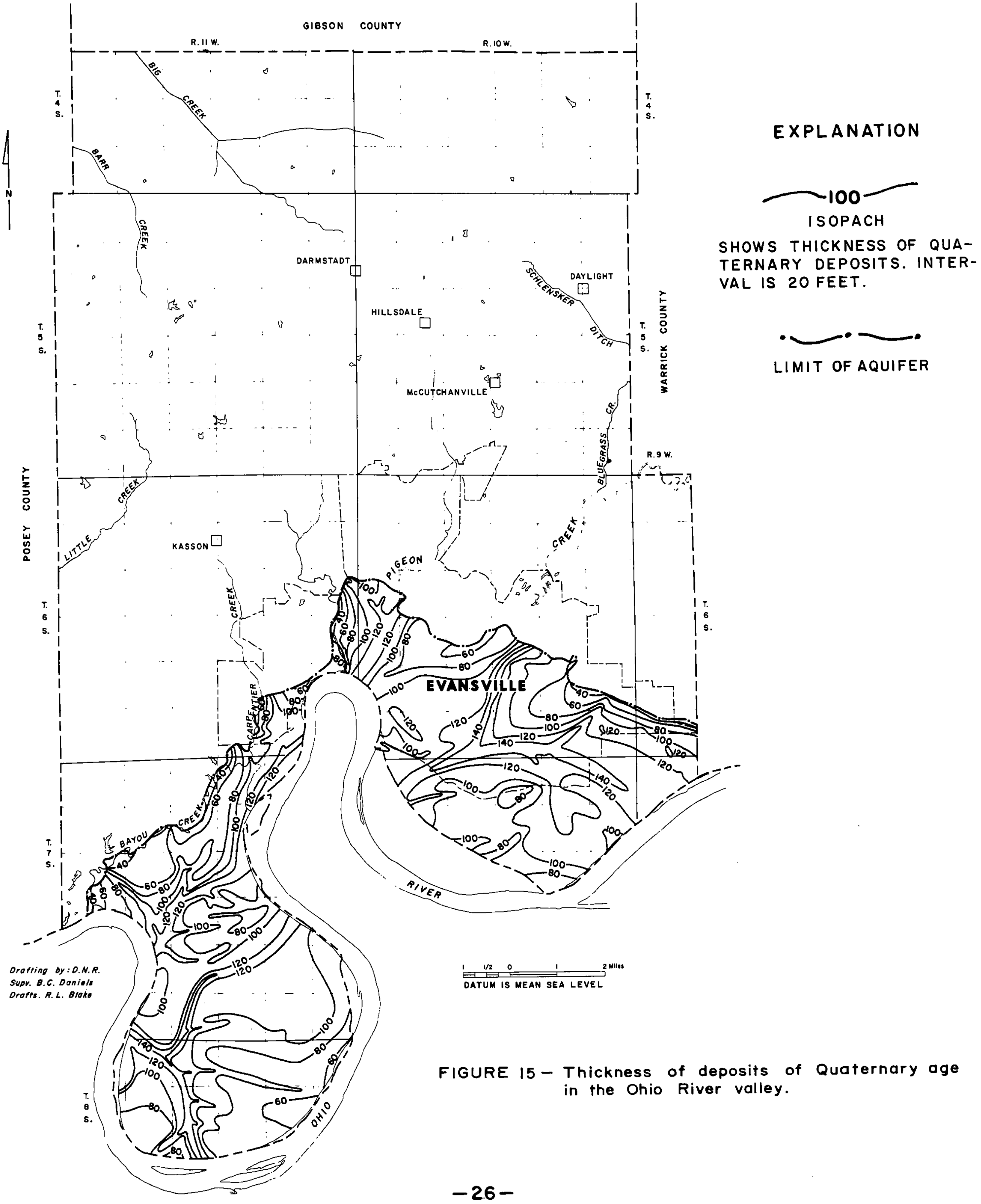


FIGURE 15 — Thickness of deposits of Quaternary age in the Ohio River valley.

bluffs and the lacustrine deposits of the tributary valleys. In places, however, the sand and gravel deposits may extend into the deeper tributary valleys. A layer of silt and clay covers the sand and gravel, and over much of the area it causes leaky artesian conditions.

The Ohio River valley aquifer varies greatly in thickness and composition. Variations in thickness are due to differences in: (a) the elevation of the buried bedrock surface; (b) topography; and (c) the thickness of the overlying silt and clay. The main factor controlling the thickness of the aquifer is the differences in altitude of the buried bedrock surface. This buried surface varies from higher elevations near the valley wall to the lowest elevation in the old buried channel. (See fig. 16.) Consequently, the thickest area of the aquifer tends to follow the old buried channel. Differences in topography can affect the thickness of the aquifer; however, the area of the aquifer is relatively flat with a total relief of about 60 feet. The terrace deposits shown on plate 2 are generally at a higher elevation than the alluvial flood-plain deposits. Higher altitudes of the land surface generally will result in slightly thicker sections of the aquifer except where the factor of the thickness of the overlying silt and clay decreases the thickness from a few feet to over 30 feet with a probable average thickness of 15 feet.

The composition of the Ohio River valley aquifer changes with depth from a fine to medium sand just beneath the surface silt and clay to coarse sand and gravel near the bedrock surface. The coarse sand and gravel tends to occur most consistently in the thicker parts of the aquifer. Near the valley walls, however, fine to medium sand may persist down to the bedrock surface. In the vicinity of the tributary valleys, the sand and gravel of the terraces and flood plains grade laterally into lacustrine silt and clay.

The Ohio River valley aquifer is confined in some places and is unconfined in other places. According to available data, water-table conditions prevail in the area of the terrace deposits (pl. 2), except near the valley wall where artesian conditions exist. Artesian conditions prevail in the area of the flood-plain deposits (pl. 2) as a result of the overlying layer of silt and clay. Here the silt and clay layer is thickest, and, therefore, its ability to confine the water is greatest. This is especially true in the area adjacent to the Ohio River, where the confining layer reaches its maximum thickness of about 30 feet.

The saturated thickness of the Ohio River valley aquifer in September 1965 is shown in figure 17. The thickness of the saturated zone is determined by the fluctuations of the water table. These fluctuations represent the balance between water entering the aquifer by precipitation, bedrock seepage, and flooding and that leaving the aquifer by evapotranspiration, drainage, and pumpage. Figure 18 shows the correlation of the water level in the observation well Vanderburgh 3 which is in the Ohio River valley aquifer (SE 1/4 SE 1/4 sec. 22, T. 6 S., R. 10 W.,), with the cumulative departure from normal monthly precipitation at Evansville. Figure 18 shows that climatic conditions are almost simultaneously reflected by water-level fluctuations, which indicates direct infiltration during periods of precipitation. As shown by the hydrograph, the amount of water-level fluctuation over the entire length of record (10 years) was less than 5 feet, and

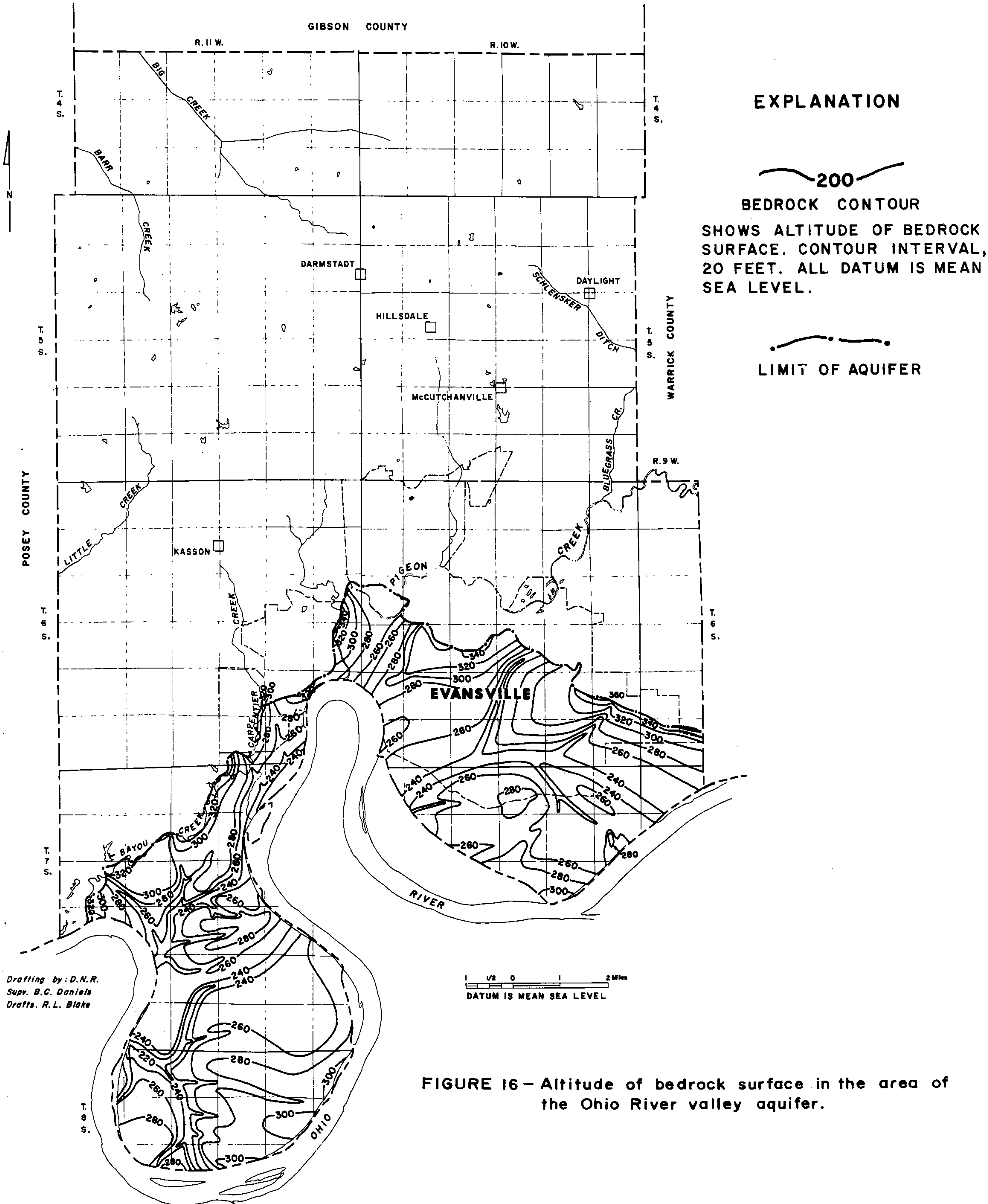
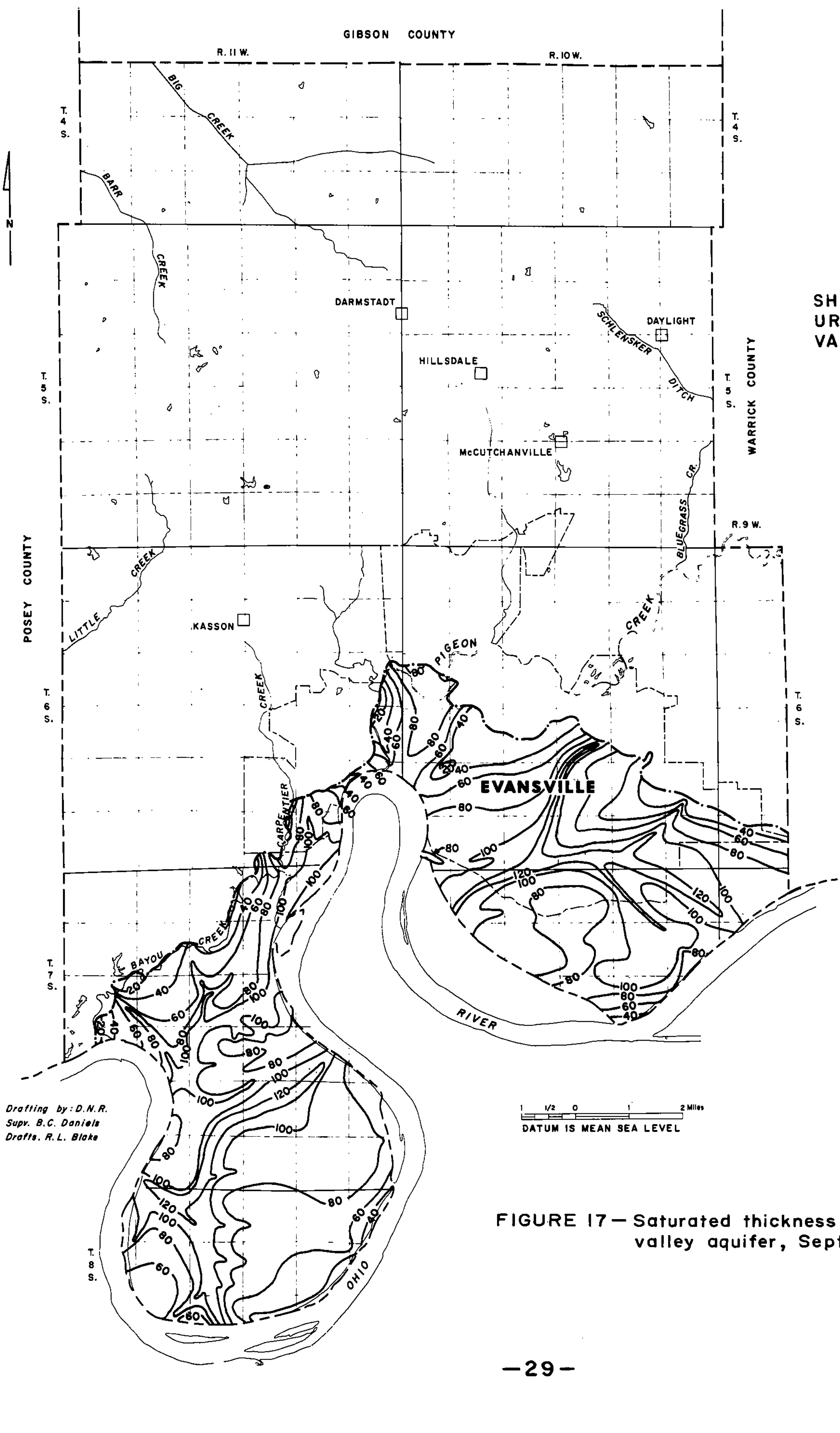


FIGURE 16 – Altitude of bedrock surface in the area of the Ohio River valley aquifer.



EXPLANATION

80 — ISOPACH
SHOWS THICKNESS OF SATURATED DEPOSITS. INTERVAL 20 FEET.

LIMIT OF AQUIFER

FIGURE 17 — Saturated thickness of the Ohio River valley aquifer, September 1965.

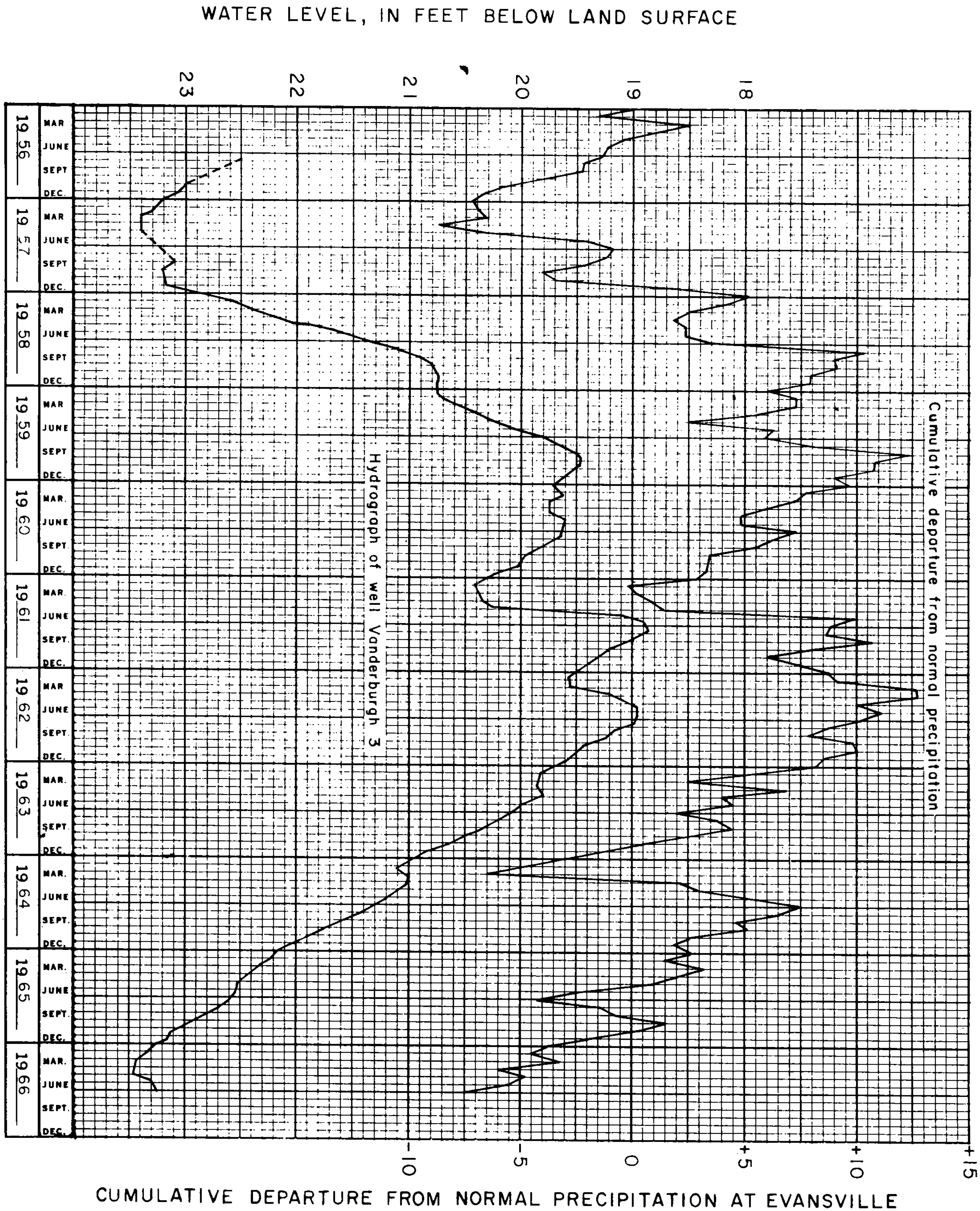


FIGURE 18 – Hydrograph of the observation well Vanderburgh 3 and cumulative departure from normal precipitation at Evansville.

the total fluctuation over any one year was less than 2 feet. In wells adjacent to the Ohio River, however, the amount of water-level fluctuation may be somewhat greater.

The saturated thickness of the Ohio River valley aquifer can be expected to increase after the completion of the larger navigation locks and dams now (1966) being constructed along the Ohio River. The resulting higher pool stages will raise the water table in the aquifer along the river and increase the amount of ground water in storage. In Vanderburgh County the greatest increase of saturated thickness of the aquifer will occur along the river downstream from the present Dam No. 48.

How Good is the Aquifer?

The Ohio River valley aquifer is the only aquifer in Vanderburgh County capable of accommodating high-yield wells. Based on water well drillers' reports, yields up to 1,000 gpm can be expected from efficient, vertically screened wells in this aquifer. Yields of 4,300 gpm are reported for 3 collector wells in the Ohio River valley deposits of Kentucky (Gallaher, 1964). These wells are opposite secs. 15 and 16, T. 8 S., R. 11 W., in Vanderburgh County. Yields should be similar from collector wells placed near the Ohio River in Vanderburgh County.

An aquifer-performance test was conducted by U S. Geological Survey personnel in April 1951 at the Evansville Waterworks Department. The test shows that the aquifer has a coefficient of transmissibility of 185,000 gpd per ft and a coefficient of storage of 0.0014 in the vicinity of the Evansville Waterworks. The test further shows that a free hydraulic connection exists between the aquifer and the river and that by pumping a well long enough to create a favorable hydraulic gradient, water can be induced to flow from the Ohio River into the aquifer.

Specific-capacity tests conducted by local drillers on wells completed in the Ohio River valley aquifer in the Evansville area indicate that the transmissibility is relatively high throughout the thicker part of the aquifer. Toward the valley wall, however, where the aquifer is thinner and the grain size is finer, there is a decrease in transmissibility. Figure 19 is a map of the Ohio River valley aquifer showing the estimated coefficient of transmissibility of the aquifer based on a regional field coefficient of permeability of 2,000 gpd per sq. ft.

The total amount of water presently (1966) being withdrawn from the Ohio River valley aquifer by pumping is estimated to be not more than 1 mgd. This figure includes the estimated pumpage for municipal (400,000 gpd), industrial (400,000 gpd), and other (200,000 gpd) needs. Currently, the pumpage from the aquifer is cyclical rather than uniform, with the bulk of the withdrawal occurring during the months of July, August, and September.

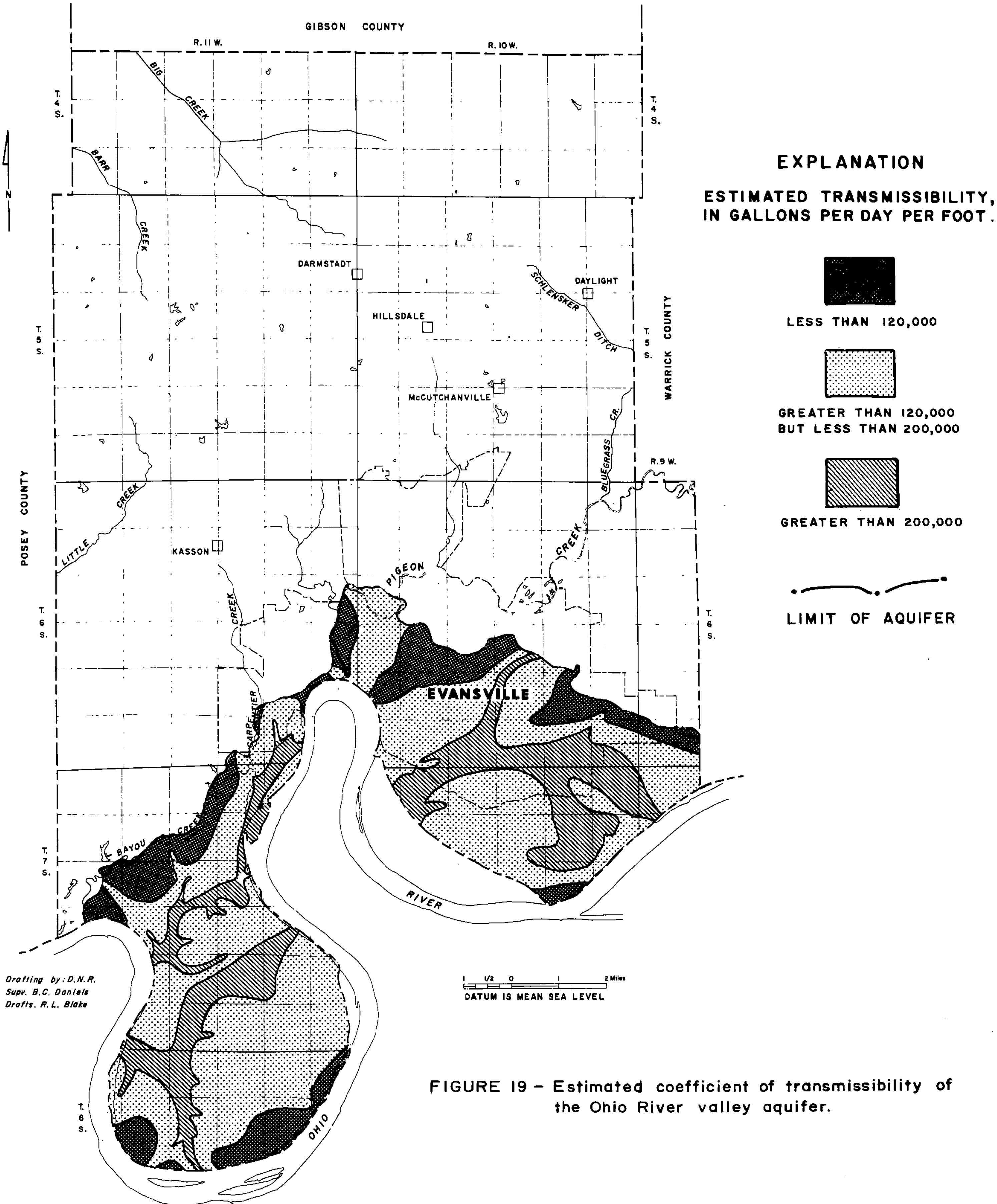


FIGURE 19 – Estimated coefficient of transmissibility of the Ohio River valley aquifer.

What is the Chemical Quality of the Water?

The chemical quality of ground water in the Ohio River valley aquifer varies throughout the county. The chemical quality of the water is related to several factors including depth, composition of rock materials, time of exposure to the rock materials, chemical composition of water derived from the bedrock, and the results of the activities of man. Nowhere in the aquifer was water encountered whose dissolved content exceeded 1,000 ppm.

The results of the laboratory analyses of water samples from wells in the aquifer are listed in table 2. The analyses show the water to be of the very hard (table 3) calcium bicarbonate type with high amounts of iron. Of the samples analyzed the hardness (as $CaCO_3$) ranged from 76 to 695 ppm with an average value of 298 ppm, and bicarbonate content ranged from 27 to 525 ppm with an average value of 285 ppm. The iron content of the water averaged 1.7 ppm and ranged from 0.1 to 7.5 ppm.

The sulfate content of the water ranged from 18 to 314 ppm with an average of 79 ppm. Of the samples analyzed, the sulfate content was found to be generally low, except in samples from wells in or near areas of relatively dense population (analyses 13, 14, 15, table 2). This agrees with the finding of Gallaher and Price (1966, p. 32) that a noticeable buildup in concentration of sulfate occurs in the ground water of the alluvial deposits of the Ohio River valley in densely populated areas and is attributed to the effects of the activities of man upon the water environment.

Discharge and Recharge

The hydraulic gradient in the Ohio River valley aquifer (and thus the direction of water movement) is toward the Ohio River--the major discharge boundary of the aquifer. The amount of water being discharged from the aquifer directly into the river is estimated to be 40 mgd in Vanderburgh County. This figure was determined with the following modified form of the Darcy equation:

$$Q = TIL$$

where:

Q = discharge, in gallons per day
T = coefficient of transmissibility, in gallons per day per foot
I = hydraulic gradient, in feet per mile
L = width of flow cross section, in miles

The amount of daily discharge was computed for each mile of the Ohio River in Vanderburgh County by using the transmissibilities given in figure 19 and an average hydraulic gradient of 7 ft per mile. The sum of the daily discharge rates for each of the 36 river miles equals approximately 40 million gallons.

The Ohio River valley aquifer is recharged from two sources: (1) the subsurface flow of ground water from the alluviated valleys and bedrock formations of the uplands, and (2) directly from precipitation. Because the amount of pumpage from the aquifer is insignificant, recharge must be approximately equal to discharge. Therefore, recharge to the aquifer is also estimated to be 40 mgd.

Other Rocks of Quaternary Age

Other unconsolidated rocks of Quaternary age in Vanderburgh County include the lacustrine deposits and stream alluvium of the tributary valleys and the loess which mantles the bedrock hills. (See pl. 2.) The lacustrine deposits consist mostly of thick layers of clay and silt. The stream alluvium consists of relatively thin deposits of reworked slope wash and lacustrine deposits. These are not considered to contain any significant aquifers except locally where some sand and gravel may occur at or near the base of these deposits. The loess deposits consist of wind-laid silt which was picked up from the stream areas and deposited on the surrounding hilltops during Pleistocene time. The hydrologic significance of these deposits is that they serve as a transmission medium for the infiltration of precipitation to the underlying bedrock aquifers and thus affect the recharge rate and the chemical character of the water.

SUMMARY

Sand and gravel of Quaternary age and sandstone units of Middle and Late Pennsylvanian age are the sources of fresh ground water in Vanderburgh County, Ind. Aquifers are present in older rocks, but, owing to their depth, the water is too highly mineralized to be useful for most purposes. The sand and gravel deposits of the Ohio River valley, which are herein named the Ohio River valley aquifer, constitute the thickest and most permeable aquifer in the county. Properly constructed wells in this aquifer could easily yield 1,000 gpm and more. Aquifer thicknesses in excess of 120 feet are noted. Based on a regional field coefficient of permeability of 2,000 gpd per sq. ft., the coefficient of transmissibility of the aquifer ranges from 120,000 gpd per ft or less in areas near the valley wall to 200,000 gpd per ft and more in the thickest parts of the aquifer. For the most part the Ohio River valley aquifer is unconfined; however, relatively thick layers of silt and clay near the Ohio River may produce artesian conditions. The water in the aquifer is predominantly a very hard calcium bicarbonate type with a high iron content. A noticeable buildup in sulfate concentration occurs in the densely populated areas and is attributed to the effects of the activities of man upon the ground-water environment.

Three sandstone units occur that are partially or totally fresh-water bearing and areally extensive enough to be important aquifers. These sandstone aquifers are in the Linton, the Dugger, and the Patoka Formations and are referred to in this report as the Linton aquifer, the Dugger aquifer, and the Patoka aquifer, respectively. At present (1966) the Linton aquifer is not used as a source of water in Vanderburgh County, but in the eastern part of the county near the Vanderburgh-Warrick County line the aquifer is near enough to land surface to be fresh-water bearing. The Dugger aquifer is used extensively as a source of fresh water in eastern and southern Vanderburgh County. The aquifer is discontinuous and has a highly irregular areal distribution. The Patoka aquifer is used as a source of fresh water throughout central and northwestern Vanderburgh County. More water wells are supplied from the Patoka aquifer than from any other aquifer in the county. Yields reported from wells in the sandstone aquifers range from less than 1 gpm to approximately 20 gpm. Most wells, however, are reported to yield 5 gpm or less. The estimated field coefficient of permeability of the sandstone aquifers is 10 gpd per sq. ft., and the maximum coefficient of transmissibility is estimated to be 1,000 gpd per ft. Where the sandstone aquifers are relatively thick, indications are that the coarsest material and, therefore, the highest permeability are in the lower part of the aquifer. The water in the Dugger aquifer is mostly a moderately hard sodium bicarbonate type and generally low in iron content. Locally, areas occur in the Dugger aquifer in which the water is not fresh due to the presence of abnormally large amounts of sodium, bicarbonate, and chloride. The water in the Patoka aquifer is a hard to very hard calcium bicarbonate type with an average iron content of 2.4 ppm and is fresh throughout Vanderburgh County.

GLOSSARY

Permeability, Field Coefficient of --Measure of a material's capacity to transmit water; expressed as rate of flow of water in gallons per day through a cross sectional area of 1 square foot under a hydraulic gradient of 1 foot per foot at the prevailing water temperature.

Specific capacity --Yield of a well in gallons per minute per foot of drawdown for a given period of continuous pumping.

Transmissibility, Coefficient of --Rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated height of the aquifer under a hydraulic gradient of 1 foot per foot.

LITERATURE CITED

Andresen, M. J., 1961, Geology and petrology of the Trivoli Sandstone in the Illinois Basin: Illinois State Geol. Survey Circ. 316, 31 p.

Ashley, G. H., 1899, The coal deposits of Indiana: Indiana Dept. Geol. and Nat. Resources, Ann. Rept. 23, 1573 p.

Durfor, C. N., and Chase, E. B., 1964, Public water supplies of the 100 largest cities in the United States, 1962: U.S. Geol. Survey Water-Supply Paper 1812, 364 p.

Friedman, S. A., 1954, Distribution, structure, and mines areas of coals in Vanderburgh County, Indiana: Indiana Dept. Conserv., Geol. Survey Preliminary Coal Map 5.

Fuller, M. L., and Ashley, G. H., 1902, Description of the Ditney quadrangle (Indiana): U.S. Geol. Survey Geol. Atlas, Folio 84.

Fuller, M. L., and Clapp, F. G., 1904, Description of the Patoka quadrangle (Indiana and Illinois): U.S. Geol. Survey Geol. Atlas, Folio 105.

Gallaher, J. T., 1964, Geology and hydrology of alluvial deposits along the Ohio River in the Henderson area, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-91.

Gallaher, J. T., and Price, W. E., Jr., 1966, Hydrology of the alluvial deposits in the Ohio River valley in Kentucky: U.S. Geol. Survey Water-Supply Paper 1818, 80 p.

Greenburg, S. S., 1960, Petrography of Indiana sandstones collected for high-silica evaluation: Indiana Dept. Conserv., Geol. Survey Bull. 17, 64 p.

Hopkins, M. E., 1958, Geology and petrology of the Anvil Rock Sandstone of southern Illinois: Illinois State Geol. Survey Circ. 256, 49 p.

Indiana State Board of Health, 1960, Data on Indiana public water supplies: Indiana State Bd. Health, Bull. S.E. 10.

Kosanke, R. M., Simon, J. A., Wanless, H. R., and Willman, H. B., 1960, Classification of the Pennsylvanian strata of Illinois: Illinois State Geol. Survey Rept. Inv. 214, 84 p.

Malott, C. A., 1948, The geology of the Dicksburg Hills, Knox County, Indiana: Indiana Acad. Sci. Proc., v. 57, p. 125-141.

Robinove, C. J., Langford, R. H., and Brookhart, J. W., 1958, Saline-water resources of North Dakota: U.S. Geol. Survey Water-Supply Paper 1428, 72 p.

Vessel, A. J., Wade, J. G., and Myers, Sutton, 1944, Soil survey of Vanderburgh County, Indiana: U.S. Dept. Agriculture, Soil survey Series 1939, No. 2.

Wier, C. E., and Girdley, W. A., 1962, Distribution of the Inglefield and Dicksburg Hills Sandstone Members in Posey and Vanderburgh Counties, Indiana: Indiana Acad. Sci. Proc. v. 72, p. 212-217.

Wier, C. E., and Gray, H. H., 1961, Geologic map of the Indianapolis 1°x2° quadrangle, Indiana and Illinois: Indiana Dept. Conserv., Geol. Survey.