STATE OF TENNESSEE

DEPARTMENT OF CONSERVATION

DIVISION OF GEOLOGY

REPORT OF INVESTIGATIONS No. 7

GEOLOGY AND GROUND-WATER RESOURCES OF THE DYERSBURG QUADRANGLE, TENNESSEE

By

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and

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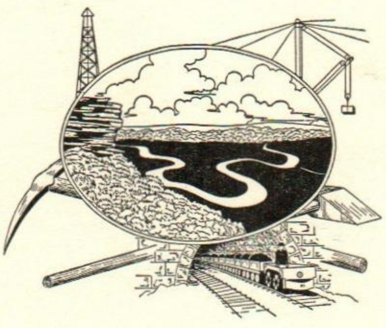

Prepared in cooperation with the U. S. Geological Survey

NASHVILLE, TENNESSEE

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GEOLOGY AND GROUND-WATER RESOURCES OF THE DYERSBURG QUADRANGLE, TENNESSEE

By

Raymond L. Schreurs and Melvin V. Marcher[1]

ABSTRACT

The Dyersburg 15-minute quadrangle, in northwestern Tennessee, lies on the eastern flank of the syncline that forms the Mississippi Embayment. Sedimentary rocks of Eocene age underlie the entire quadrangle. The lowermost unit, equivalent to the "1,400-foot" sand of the Memphis area and called by that name in this report, consists mainly of fine to medium sand. Although this unit probably is capable of supplying large quantities of water, none is pumped from it at present.

The upper unit in the lower part of the Eocene is clay and interbedded fine sand, which confines the underlying "1,400-foot" sand.

The lower unit in the upper part of the Eocene, called the "500-foot" sand in the Memphis area and called by that name in this report, is lithologically similar to the "1,400-foot" sand. About 2.3 mgd (million gallons per day) is pumped from this aquifer by the city of Dyersburg and several industries. An aquifer test on one of the city wells indicates that the coefficient of transmissibility is 140,000 gpd (gallons per day) per foot and the coefficient of storage is 3.9×10^{-4}.

The middle unit in the upper part of the Eocene is silt and clay locally containing thin sand lenses. These lenses are used as sources of water for domestic and stock supplies where the overlying Pliocene or Pleistocene is absent or fine grained. About 0.2 mgd is pumped from sand in the lower part of this unit for the city of Newbern's municipal supply.

No water is obtained from the uppermost portion of the Eocene, which consists of silty and sandy clay.

The dissected uplands in the west-central and northwestern parts of the area are underlain by gravel and sand of Pliocene age. Locally, the sand and gravel provide sufficient water for domestic or stock use.

Many domestic and stock wells in the southeastern part of the quadrangle are screened in Pleistocene terrace deposits consisting of sand and intermixed sand and clay.

The Mississippi alluvial plain and the Obion and Forked Deer River valleys are underlain by gravel, sand, and silt of Pleistocene age. Irrigationists pump about 0.5 mgd from these deposits. An aquifer test on an irrigation well in the Forked Deer valley gives a value of 65,000 gpd per foot for the coefficient of transmissibility and 1.3×10^{-3} for the coefficient of storage. A similar test on an irrigation well in the

[1] **Geologists, U. S. Geological Survey.**

Mississippi Valley gives a value of 280,000 gpd per foot and 8.5×10^{-4} for the coefficients of transmissibility and storage, respectively.

The total amount of ground water used in the area is estimated to be about 4 mgd. The cities of Dyersburg and Newbern use about 2.1 mgd. Water used by various industries amounts to about 0.8 mgd. About 0.6 mgd is pumped for rural domestic and stock use and about 0.5 mgd is pumped for irrigation.

Water from aquifers presently in use is of the calcium-bicarbonate type. Of 18 samples analyzed, the total hardness ranged from 49 to 406 ppm (parts per million). Iron, which ranged from 0.02 to 5.96 ppm, is the most objectionable mineral constituent.

INTRODUCTION

Purpose of Investigation

The withdrawal of ground water in the Dyersburg area has increased as a result of the expansion of industry and the consequent growth in population. Moreover, in recent years the deficiency of rainfall during the growing season has stimulated the development of irrigation in some parts of the area. Since 1950 withdrawal of ground water for municipal use has increased approximately by 0.35 mgd and for industrial use about 0.5 mgd. Pumpage for irrigation has grown from about 0.02 to 0.5 mgd.

The purpose of this study was to determine the lithology, thickness, and distribution of the sedimentary rocks and to correlate that information with the occurrence, quantity, and quality of ground water in the Dyersburg area.

This study, made in cooperation between the Tennessee Division of Geology and the United States Geological Survey, is a part of the statewide evaluation of the ground-water resources of Tennessee.

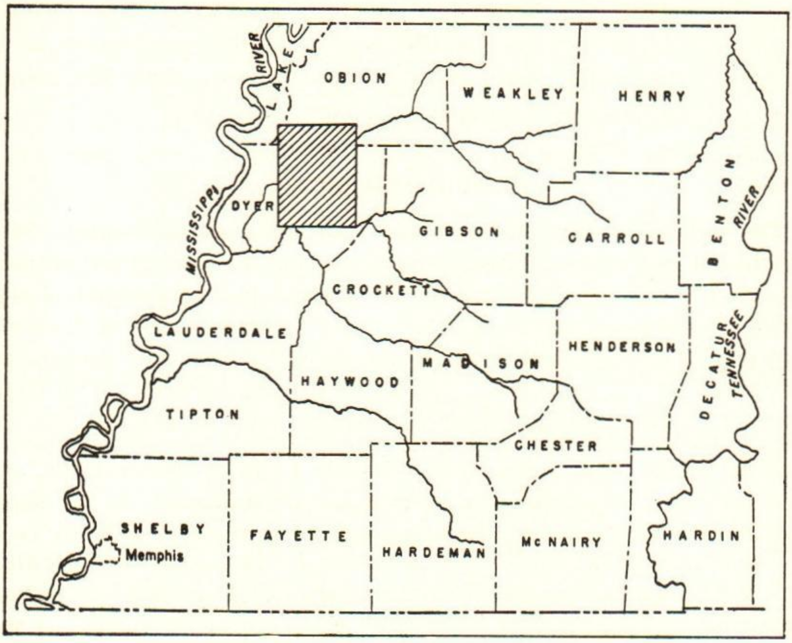
Location and Extent of Area

The area covered by this investigation is the Dyersburg 15-minute quadrangle in northwestern Tennessee (fig. 1). It includes an area of approximately 240 square miles, most of which is in Dyer County; a strip about 3 miles wide along the northern edge is in Lake and Obion Counties. The Dyersburg 15-minute quadrangle comprises the Dyersburg, Miston, Lane, and Newbern 7½-minute quadrangles.

Well-Numbering and Location System

The number of each well and test-hole is made up of three items, the first and second of which are separated by a colon, and the second and third by a hyphen. The first item represents the county in which the well is situated, the second the well field or owner, and the third the well itself. The counties in the State are numbered in alphabetical order. The well fields or owners are assigned arbitrary numbers. The well number is usually the number assigned by the owner. For example, the number 23:1-3 indicates county 23 (Dyer County); well field 1, the field consisting of municipal wells of the city of Dyersburg; and well 3 in that field, as numbered by the owner (in this instance, by the city).

Records of domestic, industrial, irrigation, public-supply, and observation wells and wells for which logs were obtained or water samples taken are presented in table 4. For a much larger group of wells,



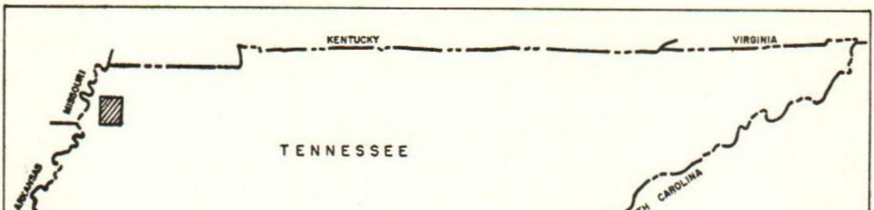


FIGURE 1.–Location of the Dyersburg quadrangle.

mostly domestic, only the reported depth was obtained. No numbers were assigned to these wells, and they are not included in table 4.

The wells and test holes considered in this report are located by means of the Tennessee Coordinate System. The coordinates are determined by the distance, measured in feet, north and east of base lines which lie outside the State on the south and west. For example, 613,450N.-998,850E. means that the well is at the intersection of the two given coordinates. Grid coordinates are shown along the margins of topographic maps of Tennessee.

Acknowledgments

The writers are grateful to those who aided in this study. Many residents of the area supplied information on, and permitted measurement of, their wells. The P & W Service Co. and McFarland, Teague & White Co. of Dyersburg, S. S. Holloway of Cloverdale, and R. Lawrence of Steele, Mo., furnished information on wells they had constructed, and permitted logs to be made during the drilling of wells. The Layne-Central Co., Memphis, supplied information from its files.

C. B. Hicks, Superintendent, Newbern Light & Water Dept., provided information on the municipal wells in Newbern. A. W. Klutts, Filter Superintendent, furnished data on the municipal wells in Dyersburg and assisted in making an aquifer test. Personnel of the Illinois Central Railroad at Dyersburg supplied data and allowed the railroad wells to be used during an aquifer test. Carney Calcutt and Henry Rice allowed aquifer tests to be made on their irrigation wells.

W. D. Hardeman, State Geologist of Tennessee, R. G. Stearns, Assistant State Geologist, and R. J. Floyd, Principal Geologist, reviewed the report and made valuable suggestions.

GEOGRAPHY

Physiography

The Dyersburg quadrangle is part of the upper Mississippi Embayment region of the Gulf Coastal Plain. The landforms present range from rugged hills and rolling uplands to flat-bottomed valleys and flood plains (pl. 1).

The most rugged areas within the quadrangle are in the north-central and west-central parts, where the land surface has been severely to moderately dissected. These areas are characterized by deep, V-shaped valleys and narrow, sinuous ridges. At the western edge of the dissected uplands the average altitude is about 480 feet.

Moderate to slight dissection in the southeastern part of the quadrangle has resulted in hilly to rolling topography. The highest altitude in this part of the area, 400 feet, is just south of Newbern. Along the Obion and Forked Deer Rivers, the average altitude is approximately 350 feet.

The broad valleys of the Obion and Forked Deer Rivers and associated terraces comprise a third physiographic unit. Two terraces are present in both valleys, but they are best developed and preserved in the Obion Valley. The upper, older valley terrace, which stands 20 to 60 feet above the present flood plain, is a remnant of a formerly extensive fill terrace. A generally well-defined scarp separates it from adjacent lower surfaces. The terrace tread has an average altitude of approximately 300 feet.

The lower, younger valley terrace is a cut terrace which stands 5 to 10 feet above the present streams and in some places appears to be part of the present flood plain. However, in a few places, such as east of Lane, it is separated from the plain by a well-defined scarp.

The Mississippi River alluvial plain occupies most of the northwestern quarter of the quadrangle. It is relatively undissected, and only a few natural levees and gullies provide relief.

Drainage

The Obion River flows southwestward across the northern part of the quadrangle. A broad loop of the North Fork Forked Deer River extends into the south-central and southwestern parts of the quadrangle.

Biffle and Clover Creeks, the largest tributaries of the Obion River in the Dyersburg quadrangle, drain the northeastern part of the area. Lewis Creek, which flows into the North Fork Forked Deer River, drains

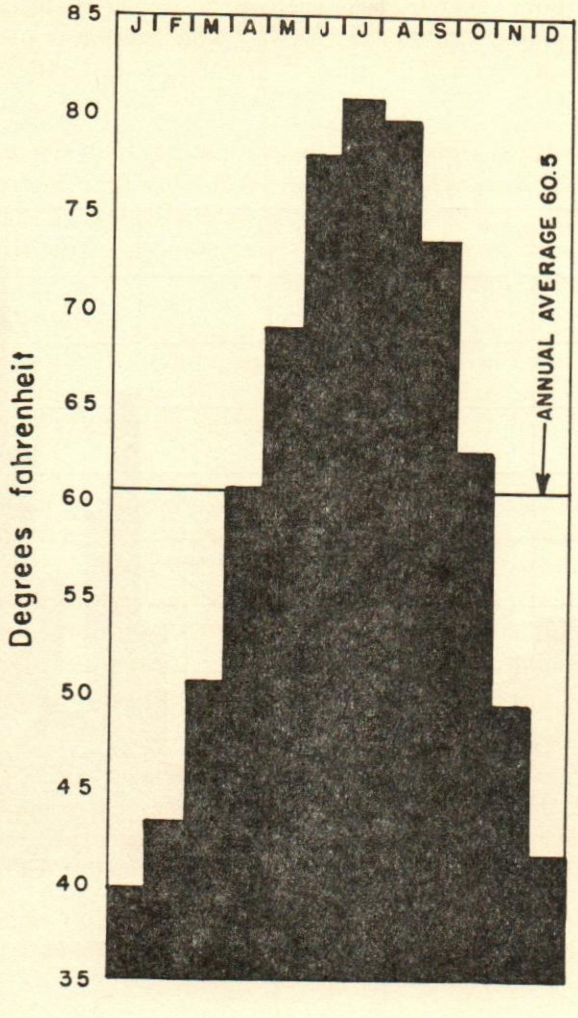


FIGURE 2.—Average monthly temperature at Newbern, Dyer County, Tenn., 1925-54.

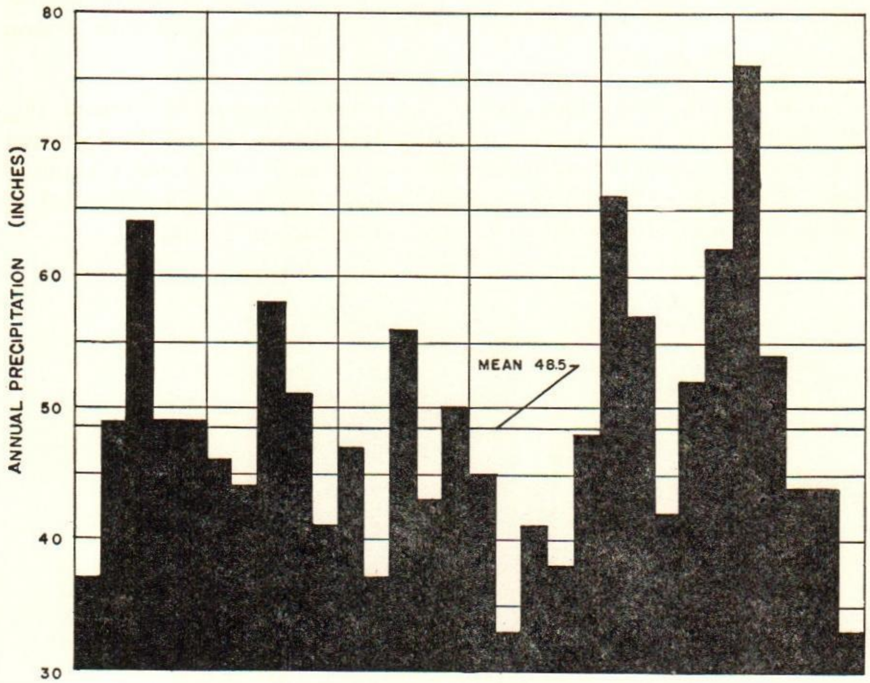


FIGURE 3.—Annual precipitation at Newbern, 1925-54.

most of the southern half of the quadrangle. Running Reelfoot Bayou drains the northwestern part of the quadrangle, but much of the drainage in that area is underground.

Climate

The climate of the area is temperate. Records of the United States Weather Bureau show that the average temperature at Newbern in the east-central part of the quadrangle is 60.5°F (fig. 2). The warmest month is July, the average temperature being 80.7°F, and the coldest month is January, the average temperature being 39.9°F. The frost-free period, from about March 25 through October 30, provides a growing season of about 220 days.

The area receives an average annual precipitation of 48.5 inches (fig. 3). During the driest year on record (1941) the maximum precipitation was only 32.6 inches, and during the wettest year (1950) the maximum was 75.9 inches. March, the wettest month, has an average rainfall of 5.6 inches and October, the driest, has an average of 3.0 inches.

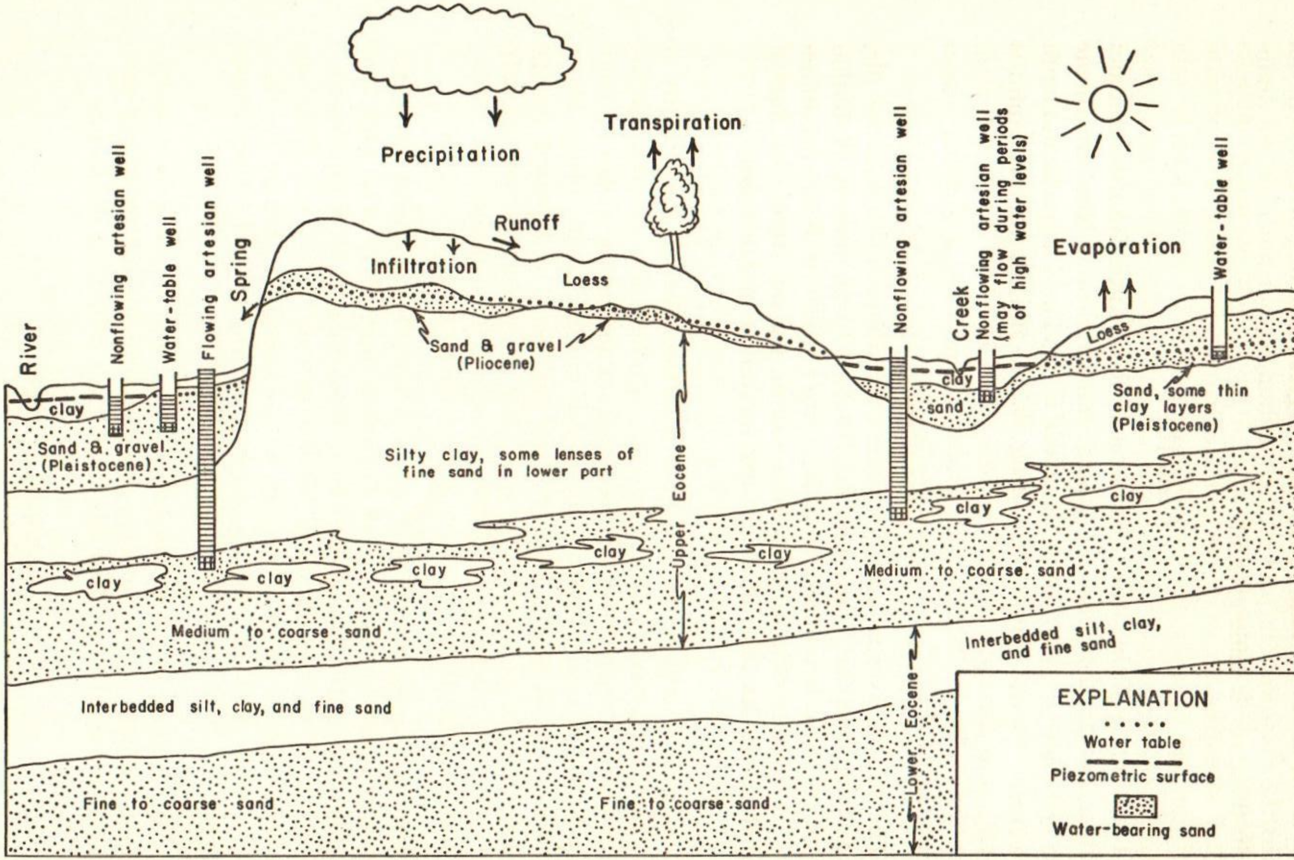


Figure 4.—Schematic cross section showing the hydrologic cycle in the Dyersburg quadrangle. (The piezometric surface of ground water in the Eocene sands is not indicated but is estimated to be 250 to 300 feet above sea level.)

WATER RESOURCES

Water is a dynamic resource, the investigation of which includes studies of movement, recharge and discharge, and changes in physical condition and chemical quality. Atmospheric water in the form of rain or snow becomes surface water, which may flow into a river or lake; it may return to the atmosphere by evaporation, or percolate into the soil and thus become subsurface water, part of which returns to the atmosphere later and part of which descends to the water table, later to discharge elsewhere. Figure 4 shows schematically the hydrologic cycle in the Dyersburg quadrangle.

Surface Water

The two major streams draining the Dyersburg quadrangle are the Obion River and the North Fork Forked Deer River. About 70 million gallons of water is pumped annually from the Obion River for irrigation. A considerable quantity of water is pumped from the Forked Deer River by the city of Dyersburg for use in the municipal power plant. The water is used for cooling and is returned to the river.

Discharge records of a stream afford a measurement of the quantity of water that may be available for irrigation or other uses. A stream-gaging station on the Obion River has been maintained by the Corps of Engineers, U. S. Army, since 1939. The gage is installed at the bridge about 2½ miles south of Bogota on U. S. Highway 78. The reported average discharge for the period 1939-54 was 3,069 cfs (cubic feet per second). The maximum discharge of 37,900 cfs occurred on January 18, 1951; the minimum discharge of 55 cfs is reported for August 11, 1944.

A stream-gaging station on the North Fork Forked Deer River has been maintained by the Corps of Engineers since 1947. The gage is at the south edge of Dyersburg just west of the bridge on U. S. Highway 51. The reported average discharge for the period 1947-54 was 1,573 cfs. The maximum discharge, 20,400 cfs, was measured on January 16, 1951; the minimum discharge, 106 cfs, occurred during the period September 5-8, 1953.

As the time of low flow usually coincides with the irrigation season, the best estimate of the amount of water available for irrigating with surface water can be obtained by studying the minimum discharges.

Ground Water

Source and Occurrence

The ultimate source of all ground water in the Dyersburg quadrangle is precipitation on this and nearby areas. The formations that underlie the area are unconsolidated and contain many small pore spaces or interstices. Water infiltrating the soil in excess of field capacity moves downward through these spaces, in response to gravity, to the water table and becomes ground water.

Some of the water that moves downward in the zone above the water table (zone of aeration) does not reach the zone of saturation; part is withdrawn by evaporation from the soil, part is transpired by plants, and part remains suspended because molecular forces counteract the force of gravity. Once water reaches the zone of saturation it moves slowly toward points of lower altitude. The water table can be defined as the upper surface of the zone of saturation, except where this surface is confined by relatively impermeable material.

Ground water occurs in two ways: under unconfined or water-table conditions, and under confined or artesian conditions. These conditions are illustrated in figure 4. Under water-table conditions the water level in a well coincides with the upper surface of the zone of saturation in the aquifer, or water-bearing formation. Under artesian conditions the water level in a well is above the upper surface of the zone of saturation and defines what is called the piezometric surface. If the water in a well rises above the land surface it is called flowing artesian water. Both confined and unconfined ground water is present in the Dyersburg quadrangle. Generally water-table conditions exist in the sand and gravel of Pliocene age and in the terrace deposits. Ground water usually is under slight artesian pressure in the valley deposits, and it is under greater artesian pressure in the sands of Eocene age.

CHEMICAL QUALITY

As the chemical quality of ground water may restrict its use, an evaluation of the ground-water resources of an area should include chemical analyses of the waters. During 1955, water samples were collected from nine wells in the Dyersburg quadrangle (pl. 3). The chemical analyses of these samples and the analyses previously recorded by Lanphere (1955) and Wells (1933) are included in this report. All analyses were made by the U. S. Geological Survey.

The geologic and hydrologic environment of ground water influences its chemical quality. Precipitation contains only small amounts of dissolved solids, but as water moves through the ground it dissolves soluble material and becomes more mineralized. The extent of solution is dependent on the solubility of the material, the temperature of the water, the constituents already in solution, and the length of time of contact. A decrease in dissolved solids may occur in areas where ground water is recharged, and diluted, by precipitation; either an increase or a decrease may occur where ground water is recharged by a stream. Therefore, study of the chemical quality of ground water may aid in determining the sources of the water.

The U. S. Public Health Service has defined the maximum limitations for certain chemical constituents in water used by interstate carriers. Table 3 lists these limitations and the results of analyses of ground water from the Dyersburg area.

The principal cause of hardness is the calcium and magnesium content. Hard water is recognized by the quantity of soap required to produce a lather and by the formation of an insoluble curd. Hardness caused by calcium and magnesium in combination with bicarbonate in the water is called carbonate hardness, and the remainder is called noncarbonate hardness. When hard water is boiled the bicarbonate is decomposed, and calcium and magnesium in a quantity equivalent to the bicarbonate are precipitated as calcium and magnesium carbonates. Hard water is objectionable because of the formation of scale in water heaters and pipes and cooking utensils, and because of heavy requirements of soap. However, a little calcium bicarbonate in water has the advantage of making the water less corrosive. Water having a hardness of less than 60 ppm is considered soft; of 60 to 120 ppm, moderately hard; of 120 to 200 ppm, hard; and above 200 ppm, very hard. Hardness in the ground water in the Dyersburg quadrangle ranges from 49 to 406 ppm.

A high iron content is objectionable because iron precipitates on exposure to air, forming an insoluble hydrated oxide which stains fixtures, utensils, and clothing. Water having a high iron content is objectionable to the taste, and its use in making coffee or tea is undesirable. Laundries, ice plants, and many other industries require water practically free from iron. Concentrations of iron in waters in the Dyersburg quadrangle range from 0.02 to 14 ppm. Thus, in some parts of the area the waters are of limited usefulness because of the iron content.

The silica content of water is important if the water is to be used in high-pressure boilers and steam turbines, where a scale may be formed, but it is unimportant for other uses.

The hydrogen-ion concentration, expressed as the pH, is a measure of the relative corrosiveness of a water. A value of 7.0 indicates that the water is neutral on the pH scale. Values progressively lower than 7.0 denote increasing acidity and corrosiveness, whereas values higher than 7.0 denote decreasing acidity and corrosiveness. Some of the waters in the Dyersburg area are appreciably acid, the pH ranging from 5.6 to 6.5. Such waters are probably mildly corrosive. In other samples the pH indicates that the waters are essentially neutral.

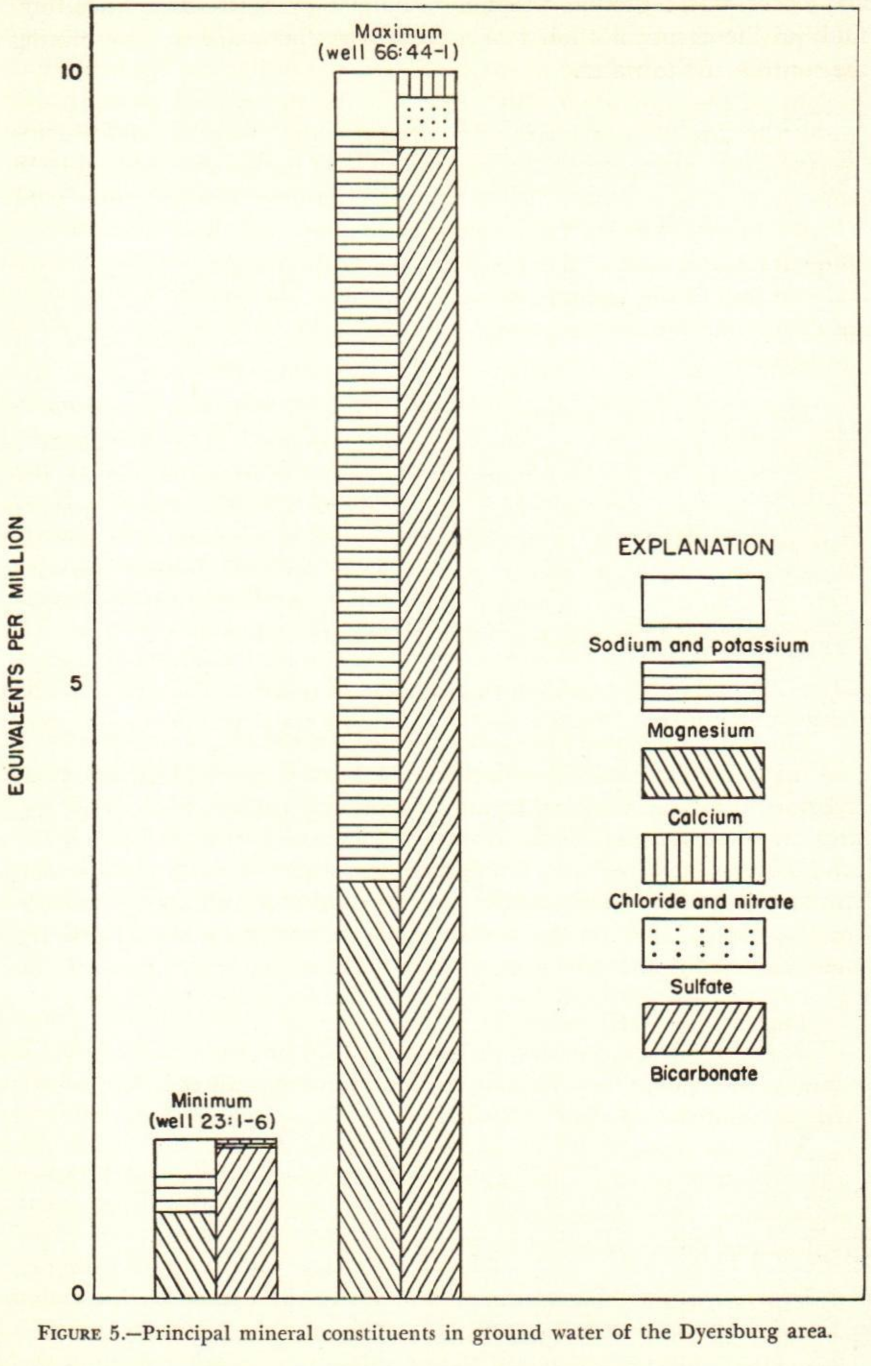


FIGURE 5.—Principal mineral constituents in ground water of the Dyersburg area.

Concentrations of constituents in a chemical system may be expressed as equivalents per million rather than parts per million. Equivalents per million are calculated by dividing parts per million by the combining weight of the individual ions. For any system reduced to equivalent form, the sum of equivalents per million of the positively charged ions (principally calcium, magnesium, sodium, and potassium) is equal to the sum of equivalents per million of the negatively charged ions (principally bicarbonate, sulfate, chloride, nitrate, and fluoride). Such a presentation in terms of equivalents per million expresses the chemical relationship of the various ions in the water. The chemical relationship of the various ions in the ground water from the Dyersburg area is shown on figure 5.

The total mineralization, percent sodium, and boron content of ground water are of concern to the irrigationist. The suitability of ground water in the Dyersburg quadrangle for irrigation is excellent to good in total mineralization and percent sodium. Boron was not determined. However, in this area it probably is not present in sufficient concentration to harm plants, as only small quantities are necessary to cause damage, and no damage has been reported as a result of watering lawn grasses and other plants with the water.

Water-Level Fluctuations

The water table and piezometric surfaces in the Dyersburg quadrangle are not stationary; they fluctuate in response to several factors. In unconfined aquifers water-table fluctuations are caused by recharge and discharge. If recharge exceeds discharge the water level in the well rises, and, conversely, if recharge is less than discharge the water level declines. In a confined (artesian) aquifer the fluctuation of the piezometric surface is complicated by the influence of barometric pressure and tidal forces, in addition to recharge and discharge.

The factors that control the rise of the water table are the amount of precipitation that passes through the soil to the water table, the amount of influent seepage that reaches the underground reservoir from streams, and the amount of underflow into the area. The relationship between the amount of precipitation and the stage of the water table is the result of several influences. Soil moisture is discharged largely by evaporation and transpiration. When it rains, the soil moisture is replenished before water descends to the water table.

The factors that control the decline of the water table are the amount of water discharged from wells, the amount transpired by plants or evaporated directly where the water table is shallow, the amount of underflow out of the area, the amount discharged into streams, and

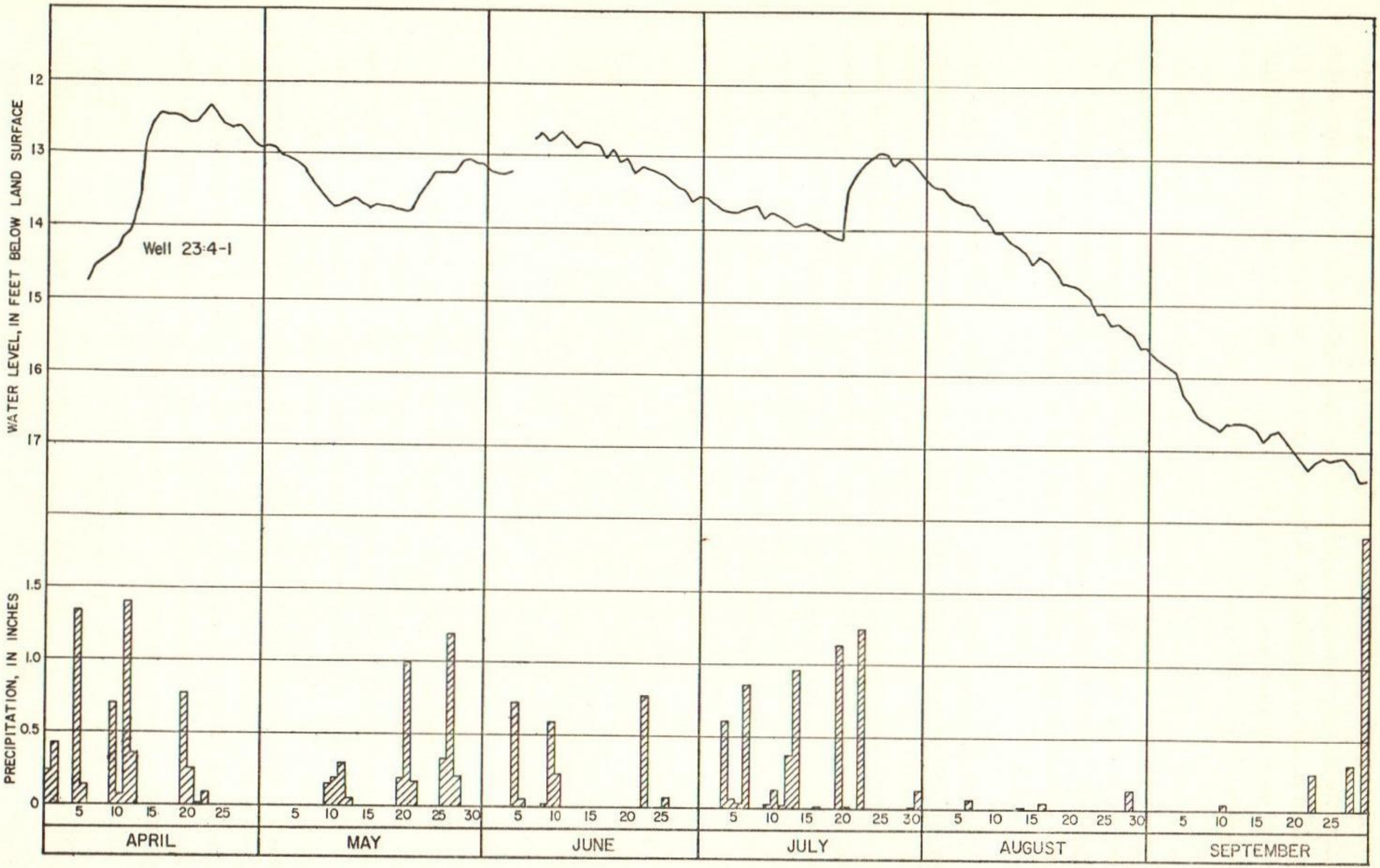


FIGURE 6.—Graph showing relation between water level and precipitation in the Forked Deer Valley.

the amount discharged by springs. Long-term records of water-level fluctuations are usually necessary to determine the extent to which ground-water reservoirs are being depleted or replenished. As long-term water-level records are unavailable for any wells in the Dyersburg quadrangle, only general conclusions can be drawn.

Figure 6 shows a 6-month record of water levels in a well in the Forked Deer River valley. A comparison of the daily precipitation and the water level indicates a close relationship. The rise of water level in response to precipitation is characteristically rapid, as is illustrated by the cloudburst and flash flood on July 20, 1955, when the water level rose 0.5 foot in 8 hours.

A continuous water-stage recorder was installed February 16, 1954, on an unused municipal well in Dyersburg. This artesian well, screened in the sand unit in the upper part of the Eocene, is 633 feet deep. The hydrograph of the well, the daily pumpage from municipal wells, and the well or wells pumped are shown on figure 7. This illustration shows that the water level in observation well 1-3 is influenced by the pumping from municipal wells 1-4, 1-5, and 1-6. In general, at the same rate of pumping, the water level in well 1-3 is 2 feet higher when well 1-5 (1,150 feet distant) is pumped than when well 1-6 (600 feet distant) is pumped. The graph shows also that, after prolonged periods of heavy pumping, considerable time elapses before the piezometric surface returns to the approximate level maintained prior to such pumping. The municipal wells were repaired in February and March 1955. This work included the pumping of considerable water that was not measured; hence the anomalies between pumpage and depth to water.

Hydrologic Properties of an Aquifer

The quantity of ground water that a water-saturated material will yield to a well over a long period depends principally upon the dimensions, permeability, and storage capacity of the aquifer. The last two properties are related to the size, shape, number, and degree of interconnection of the pore spaces of the material. The permeability of a water-saturated material is its capacity for transmitting water under a hydraulic gradient. The coefficient of permeability, in Meinzer units, is defined as the number of gallons of water at 60°F that will flow in 1 day through a cross-sectional area of 1 square foot under a unit hydraulic gradient (1 foot per foot). The field coefficient of permeability is the same unit except that it expresses the rate of flow at the prevailing temperature of the water. The coefficient of transmissibility is a related unit and is the product of the average field coefficient of permeability and the saturated thickness, in feet, of the aquifer.

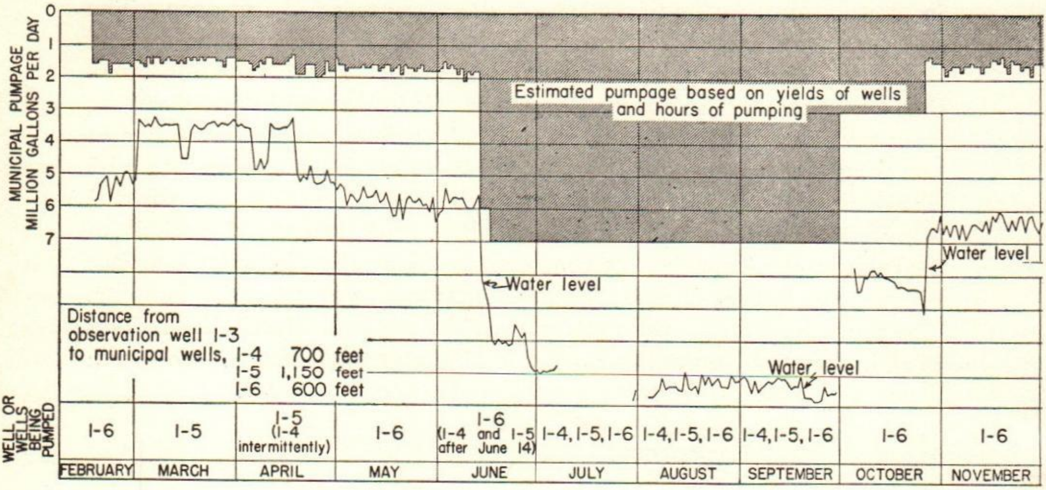
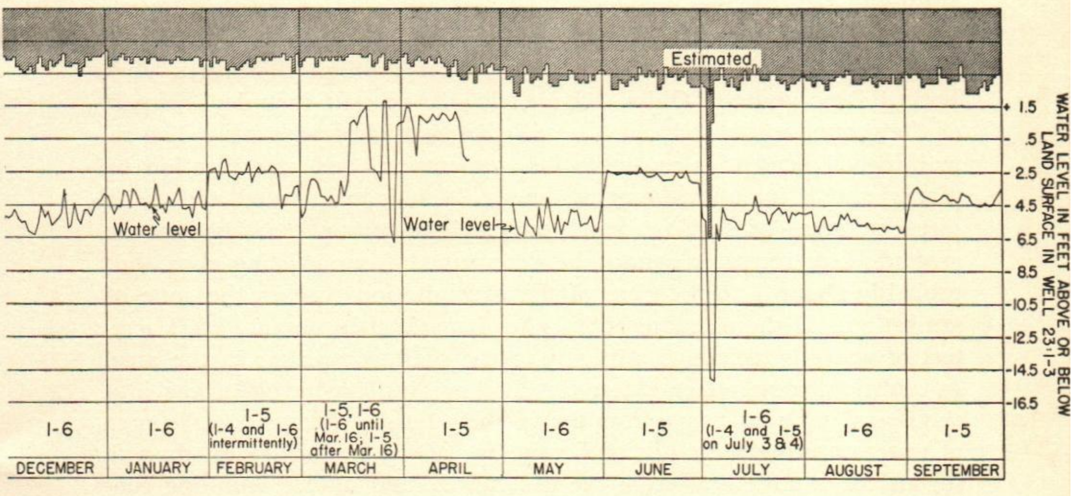


FIGURE 7.—Graph showing relations between pumpage, distance from pumped



well, and water level at Dyersburg, February 1954-September 1955.

The quantity of water that an aquifer will yield from storage depends upon its dimensions and the coefficient of storage. The coefficient of storage of an aquifer is the volume of water released from or taken into storage per unit surface area of the aquifer per unit change in head normal to that surface.

The coefficients of storage and transmissibility can be ascertained by field tests. Three tests made during the investigation are discussed separately in the section "Geology and Hydrology."

Recharge

Most of the ground-water recharge to the shallow aquifers in the area is from local precipitation. The average annual precipitation is 48.5 inches, and the total area comprises about 240 square miles; hence, approximately 615,000 acre-feet of water falls on the area each year. The records of stream discharge indicate that about 40 percent of the total precipitation leaves the area by runoff through the North Fork Forked Deer and the Obion Rivers; this 40 percent includes the part of the ground-water recharge that discharges to those streams. The remaining 60 percent is available for evaporation, and transpiration by plants, and it includes the ground water that is evaporated and transpired in areas of shallow water table. The annual recharge to the ground-water reservoir cannot be determined from existing data, but probably about 1 to 3 inches of the precipitation reaches the zone of saturation. If the estimate of 2 inches is used, then about 25,000 acre-feet of water is recharged annually to the shallow aquifers in the area. In addition, some water enters the shallow aquifers by underflow into the Dyersburg quadrangle from the north and east. The principal source of water entering the sands of Eocene age in the Dyersburg quadrangle subsurface is underflow from the east, north, and, under pumping conditions, possibly the west. Outside the Dyersburg quadrangle, in areas where the sand of Eocene age is exposed or near the surface, rain infiltrates the sand and moves downdip in response to gravity. The rate of movement is probably not more than a few feet per day. However, where the thickness and areal extent of water-bearing formations are great, the quantity of water transmitted through them may be relatively large despite the low velocity of the water.

The stages of the rivers and the stages of the adjacent water table in the Dyersburg quadrangle are interrelated. During periods of high river stage and low water table, the rivers probably recharge the shallow ground-water reservoir; most of the time, however, water is discharging from the shallow aquifer to the streams.

Discharge

Ground water leaves the area by the natural means of underflow, and as the result of discharge by evaporation, transpiration, streams, and springs. In addition to these natural means of discharge is that caused by man—the discharge of ground water through wells.

Natural discharge.—Ground water leaves the quadrangle by underflow toward the south. Where the water is at great depth, such as in the sands of Eocene age, underflow is the principal means of natural movement from the area.

Evaporation of water directly from the zone of saturation is restricted to small areas in the Dyersburg quadrangle where the water table is very shallow. Evaporation is most likely to occur in the river valleys where the clay overlying the sand and gravel is thin or absent. The rate of evaporation depends on the proximity of the water table to the land surface, the type of surface material, and climatic conditions. The high temperatures that are common in the area no doubt cause a relatively high rate of evaporation.

Transpiration of ground water takes place in lowland areas where the roots of plants draw water directly from the zone of saturation or from the capillary fringe above it. In the upland area, plants obtain their water supply from soil moisture. Although upland transpiration does not constitute a direct loss of ground water, it does result in an indirect loss as moisture intercepted by plants is returned to the atmosphere, thereby reducing the amount available for recharge. The total amount of moisture transpired by plants is large, accounting for most of the 60 percent of the precipitation that does not run off in streams.

Ground water is discharged into a stream wherever the water table slopes toward and intersects the stream. A map showing the direction of ground-water movement in the Dyersburg area is not available; however, it is believed that ground water makes a substantial contribution to the flow of streams at times of low river stage. The quantity of ground water moving toward or away from a river is dependent upon the permeability of the water-bearing materials, the hydraulic gradient, and the dimensions of the cross section through which the water moves.

Numerous springs are present in the bluffs along the major streams in the area. Some of the springs discharge ground water constantly, whereas others flow only during periods of high water table. At one time springs were the sole source of water supply for some residents of the area. The advent of rural electrification, better methods of well drilling, and installation of water systems in farm homes have reduced greatly the use of springs.

Artificial discharge.—Most of the people in the area obtain their water supply from wells. A few families, possibly 50, living on the high ridges northwest of Dyersburg, near the community of Millsfield, and in the vicinity of Woodward Chapel obtain their water supply from cisterns and springs. Dyersburg and Newbern are the only municipalities having public water systems. Several industries in the city of Dyersburg have their own water supplies.

Prolonged droughts during the growing season in recent years have furnished the impetus for the development of irrigation systems. At the present time (1956) irrigation is on a supplemental basis, but in the future it may be used to a greater extent. The quantity of water pumped annually for irrigation (table 1) was computed from information (based on a dry year) supplied by the irrigationists. The weighted average amount of water applied to those portions of the area being irrigated was 13 inches. Data on pumpage are included in table 1; records of wells are given in table 4.

GEOLOGY AND HYDROLOGY

The sedimentary rocks present in the Dyersburg quadrangle are of Eocene, Pliocene, and Pleistocene age (pl. 2). Most of them are unconsolidated. The oldest rocks discussed are of Eocene age and consist mainly of sand and clay. Except where the uppermost beds have been exposed by erosion, as in the north-central and west-central parts of the area, the rocks of Eocene age are concealed by younger deposits.

Rocks of Pliocene age in the area consist generally of unconsolidated gravel and sand and minor amounts of clay. The sand and gravel crop out in the north-central and west-central parts of the area.

Terrace deposits, valley deposits, and loess, all of Pleistocene age, are the youngest rocks present in the area. The terrace and valley deposits consist mainly of sand and clay. A blanket of loess mantles the older rocks throughout the area except in the few places where it has been eroded away.

The thickness and lithologic and hydrologic characteristics of the geologic units that are recognized in the area and considered in the present study are shown in the generalized geologic section (table 2).

Eocene Series (Lower Part)

Geology

The only information regarding the lower part of the Eocene, which is provided by electric logs, indicates that it underlies the entire Dyersburg area. The base of the Eocene, which is considered to be the base of the "1,400-foot" sand of the Memphis area (Schneider and Cushing, 1948), ranges from 950 feet below sea level in the eastern part of the Dyersburg area to about 1,200 feet below sea level in the western part. The top of the lower part of the Eocene, which is considered to be the base of the "500-foot" sand of the Memphis area (Kazmann, 1944), is 600 feet and about 800 feet below sea level in the eastern and western parts of the quadrangle, respectively. Hence, the lower part of the Eocene ranges in thickness from 350 to 400 feet.

Lithologically, the lower part of the Eocene consists of two units. The lower unit, which ranges in thickness from 150 to 300 feet, consists mainly of fine to coarse sand and interbedded gray sandy clay. In the Memphis area it is known as the "1,400-foot" sand. Gray and brown sandy clay interbedded with fine sand composes the upper unit, which is 100 feet to about 200 feet thick. Carbonaceous material is abundant in both lower and upper units.

Wherever the lower part of the Eocene is present, it conformably overlies rocks of Paleocene age and is overlain by the upper part of the Eocene. No fossils have been found which can be used to determine the age of the lower part of the Eocene. However, electric logs and well-sample data indicate that it is lithologically similar to the Wilcox group (Stearns and Armstrong, 1955, p. 4-5), which is known to be of early Eocene age along the Gulf Coast. Similarity in lithology and stratigraphic position indicate that the lower part of the Eocene is equivalent to the Wilcox group.

Hydrology

Supplies of water adequate for present needs are obtained from aquifers above the sand in the lower part of the Eocene. However, if water levels in younger and shallower aquifers should decline greatly as a result of local pumping, it might become economical to drill deeper wells to the lower part of the Eocene. Electric logs of oil test holes, which pass through the Eocene, indicate that the top of the "1,400-foot" sand is about 800 feet below mean sea level in the eastern part of the area and about 150 feet lower in the western part. About 11 mgd is pumped from this artesian sand in the Memphis area.

Chemical Quality of the Water

No analyses could be made of water from the lower part of the Eocene, for no water wells have been constructed in the sand in this area. However, in areas outside the Dyersburg quadrangle, notably Memphis, the "1,400-foot" sand contains water of good quality. Dissolved solids are about 100 ppm. The water is very soft, the average hardness being 10 ppm. The major constituents are sodium and bicarbonate. An objectionable characteristic is the iron content, which ranges from 0.45 to 1.7 ppm. As Dyersburg is closer to the recharge areas of the sand than is Memphis, it is possible that the mineralization in the Dyersburg area is less than that downdip near Memphis.

Eocene Series (Upper Part)

Geology

In the Dyersburg area, the base of the "500-foot" sand is the lower boundary of the upper part of the Eocene, and the top of the Jackson (?) formation (Roberts and Collins, 1926, p. 240; Roberts, 1928, p. 441-442) is the upper boundary.

Subsurface data indicate that the upper part of the Eocene is present throughout the quadrangle. However, except for a narrow band of outcrops along the Chickasaw Bluffs (pl. 2), it is concealed by younger deposits. In 3 oil test holes, 2 in the northwestern part of the quadrangle and 1 about 5½ miles southwest of Finley, the average thickness of the upper part of the Eocene is about 1,200 feet. Along the Chickasaw Bluffs, where the uppermost beds have not been removed by erosion, it is approximately 1,450 feet thick. The average thickness throughout the Dyersburg quadrangle probably is between 1,200 and 1,300 feet.

Although there are considerable lateral and vertical changes in the lithology of the upper part of the Eocene, it can be divided into three units. The lower unit, considered equivalent to the "500-foot" sand of the Memphis area, consists mainly of fine to coarse gray sand and occasional lenses and thin layers of clay or silt. Quartz, both milky and colorless varieties, is the dominant mineral. Carbonaceous material is abundant and characteristic of both the lower and the middle units of the upper part of the Eocene.

The "500-foot" sand becomes more silty and clayey toward the top and grades into the interbedded fine sand, silt, and clay that constitute the middle unit. Carbonaceous material, which is very abundant, imparts a dark-gray to nearly black color to the sand and silt. The clay layers also are gray.

The interbedded sand, silt, and clay of the middle unit become finer grained upward and finally grade into slightly silty to very silty clay of the upper unit. This clay varies in color but is commonly gray or greenish gray. Where it has been exposed to weathering, it shows various shades of red, brown, and purple. Carbonaceous material, so abundant in the middle and lower units, is almost completely absent in the upper unit. Lenses and discontinuous layers of indurated clayey siltstone are present locally. These indurated masses apparently formed where the permeability was great enough to allow ground water to circulate and deposit cementing material.

The available well records indicate that the upper part of the Eocene overlies the lower part of the Eocene throughout the area, although the contact between them is not exposed. The lower contact is locally unconformable (Stearns and Armstrong, 1955, p. 8). The surface of the upper part of the Eocene is eroded and very uneven (pl. 2). Where it crops out along the Chickasaw Bluffs, the upper Eocene is overlain by gravel of Pliocene age. Elsewhere in the area the gravel is commonly absent, and the Eocene is overlain by terrace deposits, valley deposits, or loess of Pleistocene age.

The upper part of the Eocene is unfossiliferous, but it probably is equivalent to some parts of the Claiborne and Jackson groups.

The upper unit of the upper part of the Eocene consists of silty clay and does not yield water to wells.

The middle unit is a source of small to moderate supplies of ground water. In areas where the overlying Pliocene or Pleistocene is dry or thin, drillers complete wells in the fine sand of the middle unit (pl. 3). It is difficult to predict the yield and the depth at which sand will be penetrated because the lithology of the middle unit is extremely variable, both vertically and laterally. In general, water-bearing sand in this unit is penetrated at progressively shallower depths in an eastward direction. The M. Roney irrigation wells near Newbern are constructed in this sand, and the city of Newbern obtains its water supply from three wells completed in it.

The lower unit of the upper part of the Eocene (the "500-foot" sand) is an excellent aquifer. Although 2.3 mgd is pumped from this sand by the city of Dyersburg, Dyersburg Cotton Products, Illinois Central Railroad, and Dyersburg Ice and Coal Co., considerably more could be pumped without a significant lowering of the water level. The yield of these wells ranges from 200 to 2,500 gpm. The drawdown for the largest yield was 69 feet, in a well 18 inches in diameter.

The water in the upper part of the Eocene is under artesian pressure. According to Wells (1933), the original static head at Dyersburg was about 283 feet above mean sea level. The head has declined so that only a slight flow occurs during the winter from well 23:1-3 at an altitude of 271.6 feet. The position of this sand unit in relation to other geologic units in the area is shown on figure 4.

Aquifer test.—A brief test of the "500-foot" sand was made at Dyersburg on July 6, 1955. Well 23:1-6 was pumped at 1,500 gpm for 24 hours before the test. From 8:15 a. m. to 4:55 p. m. it was pumped at an average rate of 1,980 gpm, an increase of 480 gpm, and the depth to water was measured in 5 wells. One minute after the pumping rate was increased the water level had declined 0.09 foot in well 23:1-4, 278 feet north of the pumped well. In well 23:1-5, 542 feet west of well 1-6, the water level declined 0.80 foot in 1 minute. In well 1-3, 602 feet east of well 1-6, the water level dropped 0.01 foot in 2 minutes.

Well 23:2-1, which supplies the Dyersburg Coal and Ice Co., is 700 feet northeast of well 1-6. Well 2-1 had been pumped for several weeks at an estimated rate of 200 gpm, and a series of measurements made prior to the test showed that the depth to water was relatively stable. One hour and 20 minutes after the start of the test on well 23:1-6 the water level in well 23:2-1 had declined 0.86 foot.

The two supply wells (23:12-1 and 2) of the Illinois Central Railroad are about 1,200 feet east of well 1-3. These wells have a combined yield of about 425 gpm and are pumped intermittently. They were turned off at 7 a. m. July 6. The first decline of the water level was 0.02 foot at 8:50 a. m., which was 20 minutes after the pumping rate was increased in the municipal well. Just before the railroad wells were turned on at 3:30 p. m., the water level had declined 0.48 foot in well 12-1.

Analysis of the observation-well data was made by the Theis non-equilibrium method (Theis, 1935).

The drawdown in well 1-3 (fig. 8) was selected for the solution because the well is equipped with an automatic water-stage recorder. The analysis indicates that the coefficient of transmissibility is 140,000 gpd per foot and the coefficient of storage is 3.9×10^{-4}.

On the basis of the above values the drawdown in well 1-5 was greater than expected, whereas that in well 12-1 was less than expected. This anomaly, plus subsurface data, suggests that the "500-foot" sand thins toward the west and thickens toward the east.

Chemical Quality of the Water

Analyses of water from 8 wells screened in the upper part of the Eocene show that the water is essentially of the calcium-bicarbonate type. The water is low to moderate in dissolved solids and is soft to hard. The dissolved solids range from 74 to 210 ppm, and the hardness ranges from 54 to 185 ppm. The high iron content, which is an objectionable characteristic, apparently increases with depth and ranges from 0.11 to 14 ppm. The water is slightly corrosive; thus the casings of wells finished in this aquifer are subject to corrosion.

Pliocene Series

Geology

Because of their similarity to Pleistocene terrace deposits, and because of the absence of fossils, the deposits of Pliocene age are difficult to trace over large areas; hence they are not given a formal name in this report. The Pliocene deposits are defined as the high-level gravel and sand underlying the loess and overlying the uppermost Eocene clay in the dissected uplands. Except where they have been exposed by erosion, the Pliocene deposits are overlain by Pleistocene loess.

The deposits of Pliocene age are restricted to the north-central and west-central parts of the quadrangle (pl. 2), where they crop out along the higher hills and ridges. On those ridges where the entire unit is

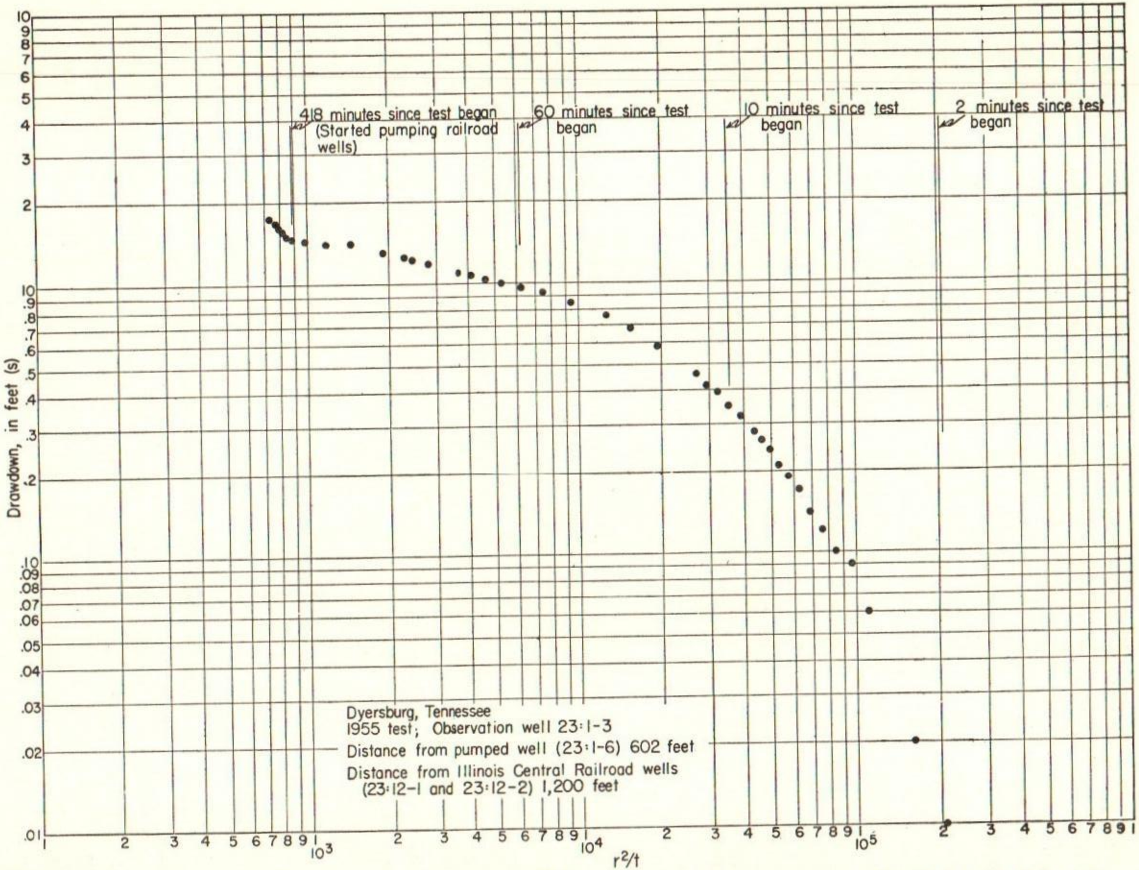


FIGURE 8.—Logarithmic graph of the drawdown in well 23:1-3 produced by pumping wells 23:1-6, 23:12-1, and 23:12-2.

present it probably does not exceed 40 feet in thickness. At many places in the area a thickness of 15 to 20 feet is exposed. In several wells that have completely penetrated this unit, its average thickness is about 20 feet.

Minor amounts of clay are included in the Pliocene deposits. Sorting is generally very poor, and bedding is either poorly defined or absent. On the outcrop the gravel and sand is stained red or brown by iron oxide. Boulders and layers of conglomerate cemented by iron oxide are present locally. In the north-central part of the area the lower part of this unit consists mainly of sand. Thin lenses and layers of clay, which are commonly some shade of red or brown, also are more abundant in the lower part.

The age of the high-level gravel and sand is not easily determined without fossils. Recently, however, Potter (1955) has presented evidence which suggests that these deposits were formed during Pliocene time. If the gravel and sand is of Pliocene age, it may be equivalent to some part of the Citronelle formation of the Gulf Coast.

Hydrology

The Pliocene deposits are restricted in areal extent, and their use as an aquifer is similarly restricted. The average thickness is 20 feet, and only small domestic water supplies can be developed from the sand and gravel. Along the bluffs at the edge of the Obion and Mississippi valleys, and near the many gullies, the Pliocene sediments are dry or only partly saturated. In these marginal areas most of the residents obtain water from cisterns, from dug wells in the loess, or from springs at the contact between the Eocene and Pliocene. The Pliocene deposits are known to yield water to wells in only four small areas (pl. 3). No wells on the upland west of Dyersburg are screened in the Pliocene, but it is believed that this sand and gravel would supply sufficient water for small domestic wells.

Chemical Quality of the Water

One sample of water from the sand and gravel of Pliocene age contains more dissolved solids and is harder than that from other aquifers sampled in the area. However, as the iron content of the sample, and of the water in the Pliocene generally, is low, the water is considered good by residents of the area. A comparison of the one sample with analyses of samples from the Pliocene in adjacent areas shows the sample to be representative.

Pleistocene Series

Geology

Upland terrace deposits.—Sand and some intermixed clay are present locally in the southeastern part of the area. The only exposures are north of the high school in Dyersburg, along the Forked Deer River southeast of RoEllen, and along the Obion River west of Locust Grove. Clastic sediments also underlie the valley terrace (pl. 2B), but as they are believed to be simply a lateral extension of the valley deposits, they are described in the discussion of that unit.

Well logs (table 5) show that the terrace deposits range from 2 to 96 feet in thickness. Their average thickness is probably between 30 and 50 feet.

The terrace deposits consist mainly of sand, sandy clay, and minor amounts of gravel. Most of the sand and gravel is stained red by iron oxide, but where the stain is absent the deposits are white or gray. Milky or colorless quartz and brown or white chert are the chief constituents. Sorting ranges from poor to fair. The gravel consists mostly of chert and occurs as thin layers or scattered pebbles in the sand. The clay, which also occurs in thin layers and lenses, is yellow or gray and, although more or less sandy, is usually quite plastic.

As far as is known the Pleistocene terrace deposits, wherever they occur in the area, unconformably overlie the upper Eocene and are everywhere overlain by Pleistocene loess.

No fossils have been reported from the terrace deposits; hence, their age is not definitely known. However, erosion has removed all the Pliocene gravel in the southeastern part of the area and has cut into the bedrock nearly 100 feet. This indicates that deposition of the sand and clay was post-Pliocene. Planation must have taken place prior to Illinoian time, for the Loveland loess (as used by Wascher, Humbert, and Cady, 1948, and Leighton and Willman, 1950) overlies the sand in the vicinity of Dyersburg. Therefore, an early to middle Pleistocene age is suggested for the upland terrace deposits.

Valley deposits.—The Pleistocene valley deposits are the clastic materials present in the valleys of the Obion, Forked Deer, and Mississippi Rivers and their larger tributaries. A thin veneer of reworked loess, colluvium, and alluvium, part of which may be of Recent age, also is included.

The largest area of Pleistocene valley deposits is in the northwestern part of the quadrangle, where it constitutes the Mississippi alluvial plain.

The valleys of the Obion and Forked Deer Rivers and their major tributaries compose the remaining areas where valley deposits are present.

A test hole about 1 mile east of Broadmoor, on the Mississippi alluvial plain, shows the fill to be 150 feet thick in that area. The fill in the Forked Deer valley is 110 feet thick, as shown by a test hole about 1 mile southeast of Finley. The thickness of the fill in the Obion Valley is not known but is at least 65 feet, as that much was penetrated in a well about 2 miles northwest of Lane. The thickness is 56 feet in the valley of Biffle Creek, a tributary of the Obion, and 75 feet in the valley of Lewis Creek. The thickness in the other tributary valleys is not known but probably does not exceed 100 feet.

In the northwestern part of the quadrangle the lower part of the valley deposits consists of poorly sorted sand and gravel derived from igneous and sedimentary rocks. The upper part consists of gray and brown silt and fine sand. Elongate bodies of clay also are present in the upper part. In the Obion and Forked Deer Valleys the fill consists mostly of fine to coarse sand, although some scattered gravel is present. Chert and quartz are the chief constituents of the sand, which is generally white or gray. Thin beds of gray clay and carbonaceous material are present throughout the fill but are more abundant in the lower part. The upper part of the fill in the smaller valleys consists of dark-gray, yellow, and brown clayey silt, which appears to be reworked loess. Brown sand and gravel and beds of yellow or brown clay make up the lower part. As far as is known, the Pleistocene valley deposits overlie silty and sandy clay of Eocene age.

Glacially derived gravel present in the Mississippi Valley fill shows that it is Pleistocene or post-Pleistocene in age. The fills in the Obion and Forked Deer Valleys are apparently continuous with the upper part of the Mississippi Valley fill; hence it is concluded that they are of equivalent age. The valley fill is believed to be late Pleistocene in age because it is overlain by a thin veneer of Peorian loess (as used by Leighton and Willman, 1950).

Loess.—Three loess sheets in the Dyersburg area have been correlated by earlier authors (Wascher, Humbert, and Cady, 1948; Leighton and Willman, 1949 and 1950) with similar ones in Iowa and Illinois, where the names applied to the sheets are Peorian, Farmdale, and Loveland. An older loesslike silt which crops out a few miles south of the Dyersburg area was tentatively identified by Leighton and Willman (1949 and 1950) as pre-Loveland loess. They point out, however, that further study is needed to determine whether the silt is a separate loess sheet.

Because none of these units have been formally extended into the Dyersburg area by the U. S. Geological Survey, they are not separated in this discussion.

Loess is at the surface throughout the area (pl. 2), except on valley walls and a few isolated hills where Pliocene or Eocene strata are exposed locally. Along the Chickasaw Bluffs, where the loess is thickest, a maximum of about 100 feet is exposed. Toward the east it thins rapidly, and along the eastern edge of the quadrangle it is only about 15 to 20 feet thick. The average thickness of loess throughout the area is probably not greater than 50 feet.

The loess consists of sandy to clayey silt. Although gray and brown are most common, the color of the loess depends primarily on the degree of leaching. Gastropod fossils and calcareous concretions are abundant locally in the unleached part of the loess.

According to Wascher, Humbert, and Cady (1948) and Leighton and Willman (1949 and 1950), the Peorian, Farmdale, and Loveland loess sheets are late Wisconsin, early Wisconsin, and Illinoian in age, respectively. Leighton and Willman (1949 and 1950) tentatively date the loesslike silt as Kansan in age.

Hydrology

About three-fourths of the area is mantled by terrace or valley deposits of Pleistocene age, but these are a source of water supply for only about half the Dyersburg quadrangle (pl. 3). In local areas, the fills in the tributary valleys and the terrace deposits in the southeastern part of the quadrangle are too thin or fine grained to supply sufficient water even for domestic or stock use. In such areas wells are screened in the Eocene.

The water in the terrace deposits is generally under water-table conditions, but there is a slight artesian pressure around the margins when the water level is high. This aquifer probably is too thin and discontinuous to yield sufficient water for large irrigational or industrial use, although it supplies many domestic and stock wells.

The deposits in the Obion Valley furnish water to many domestic and stock wells and probably could supply quantities sufficient for irrigation near the center of the valley, where these deposits are relatively thick and coarse. Toward the valley walls, however, they are probably too thin or fine-grained to serve as an aquifer for large wells. Transmissibility tests have not been made on this material, and as no large wells are screened in it the water-yielding capacity is not known.

Aquifer tests.—During this investigation, two tests were made in valley deposits of Pleistocene age. The first test was made on August 11 and 12, 1955, on the C. Calcutt farm in the Forked Deer valley about a mile southeast of Finley. An irrigation well (23:5-1) 6 inches in diameter was pumped at the rate of 250 gpm, and after 24 hours and 20 minutes the drawdown in an observation well 19 feet distant (23:5-3) was 5.56 feet. At the same time the drawdown in a well 51 feet distant (23:4-2) was 3.59 feet and the drawdown in a well 105 feet distant (23:4-3) was 2.29 feet. Well 23:4-1, located 2,575 feet from the pumped well, is equipped with an automatic water-stage recorder. A slight increase in the rate of decline suggests that this well was affected by the pumping, although the exact time the cone of depression reached the well was not discernible.

The drawdown during the first part of the test in the wells 51 and 105 feet distant is shown graphically in figure 9.

Usually the ground water is under slight artesian pressure in this valley. However, water-table conditions prevail in the vicinity of discharging wells where the head has been lowered below the bottom of the confining bed. This complicates the interpretation of an aquifer test because the coefficient of storage (S) is considerably smaller when the water is confined than when it is unconfined. Therefore the calculated S is a composite of the S afforded by that portion of the cone of depression under water-table conditions and the S afforded by that portion under artesian conditions. The determined transmissibility (T) is similarly composite. In the early seconds of a test the effect of artesian conditions is more pronounced than that of water-table conditions. Conversely, the effect of water-table conditions is greater during the latter part of a test. Generally it is most accurate to use the values for T determined from data from the latter part of the test for predictions of the effect of pumping on water levels; the most accurate value for T, as determined in this test, is 65,000 gpd per foot.

The determined values for T indicate that wells yielding 1,000 gpm would be possible in this part of the Forked Deer River valley. The saturated thickness of the sand is 100 feet (table 5), and the average field coefficient of permeability of the aquifer is 65,000/100, or 650 gpd per square foot.

An aquifer test of the sand and gravel in the Mississippi alluvial plain was made on October 11 and 12, 1955, on the H. Rice farm about 3 miles north of Bogota. An 8-inch irrigation well (23:7-3) was pumped at the rate of 640 gpm for 28 hours. The depth to water was measured in 4 wells located 50, 102, 367, and 1,830 feet from the pumped well. The sand and gravel was 83 feet thick in a test hole (23:4-5) drilled 102

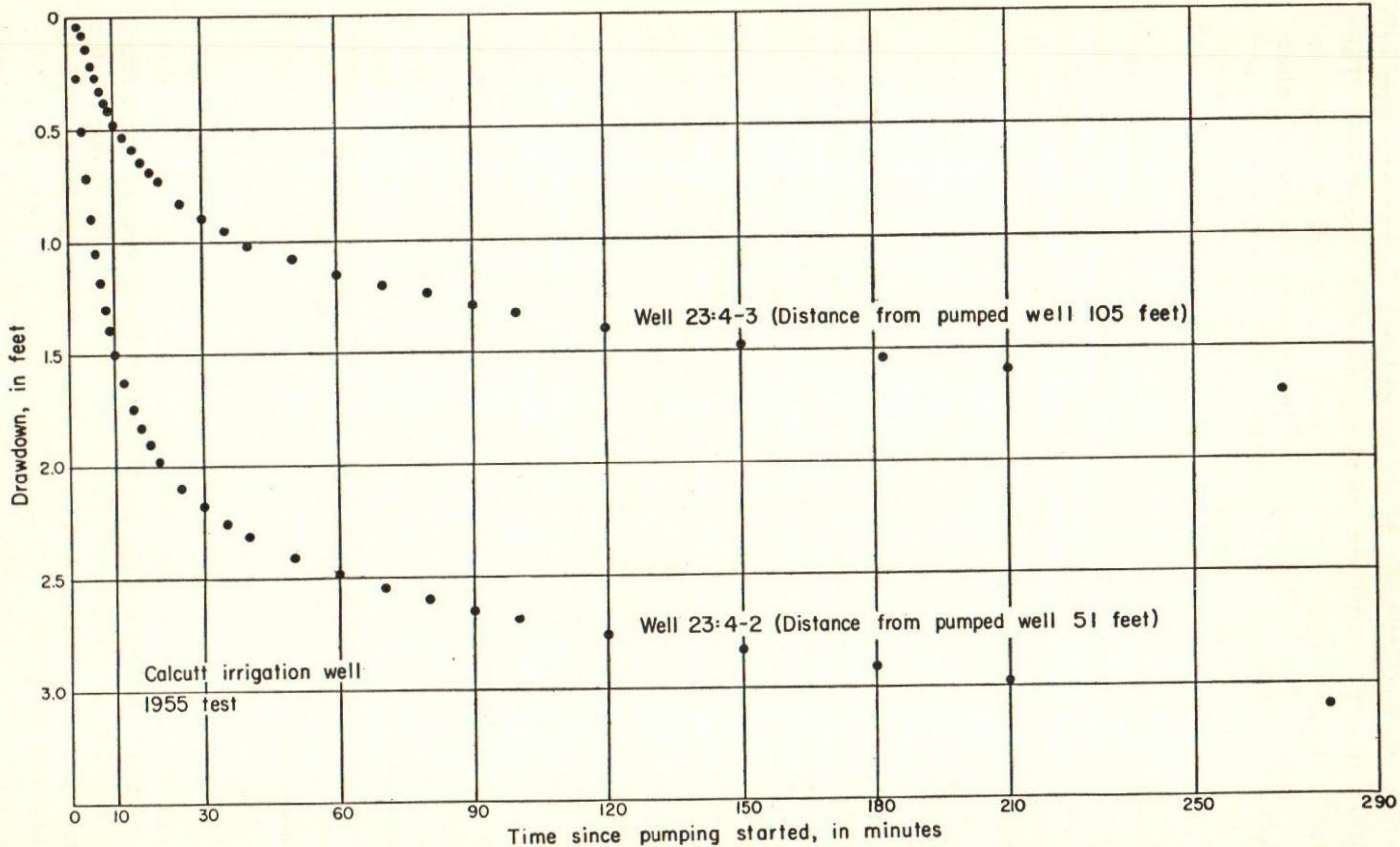


FIGURE 9.—Graph of the drawdown in wells 23:4-2 and 23:4-3 produced by pumping well 23:5-1.

feet from the pumped well. It is estimated that the aquifer ranges in thickness from 75 to 100 feet in the vicinity of the tested well. The ground water is confined above by a layer of clay and silt ranging in thickness from 27 to 73 feet, and below by a layer of clay and silt, which in the vicinity of the well is 67 feet thick. The upper layer of clay and silt thins southward to 14 feet or less. Therefore, the ground water may not be confined at some distance south of the pumped well.

Another means of analyzing aquifer-test data is an abbreviated and approximate version of the type-curve solution that was used for the Dyersburg city test (Cooper and Jacob, 1946). In this straight-line solution, the drawdown is plotted on an arithmetic scale and time is plotted on a logarithmic scale. The formula used is:

$$T = \frac{264\ Q}{\Delta s}$$

where T is as previously defined, Q is rate of pumping, in gpm, and Δs is the change in the drawdown per log cycle. Figure 10 shows the drawdown data for the Rice test. The solution can be used only when the factor u, as taken from the Theis type curve, is less than 0.02.

The times at which $u = 0.02$ are shown on figure 10. The plotted points for the three closer wells assume straight lines from those times. From this it is apparent that the straight-line solution cannot be used for well 23:7-1 unless a longer test is made.

If the properties of an aquifer depart radically from the restrictive assumptions of the Theis method, the plotted data will not assume a straight line. If the plotted data curve upward it indicates that the cone of depression has reached some area of recharge or area of different hydrologic conditions—greater transmissibility or higher storage coefficient. It is evident (fig. 10) that this occurred during the Rice test. This change was effected by one, or some combination, of three causes. The cone of depression may have reached a stream; it may have reached an area of water-table conditions; or the lowered pressure caused by pumping may have induced water to move into the sand and gravel from the underlying sediments. The time when the recharge effect reaches the observation wells is, in part, a function of distance. The time required for the recharge effect to reach the wells was not long enough to indicate that the cone of depression intersected a stream. The fact that the recharge effect reached the distant wells before it reached the nearer wells suggests the existence of an area of water-table conditions. Subsurface data and information regarding depths of wells in the area (pl. 3) support this possibility.

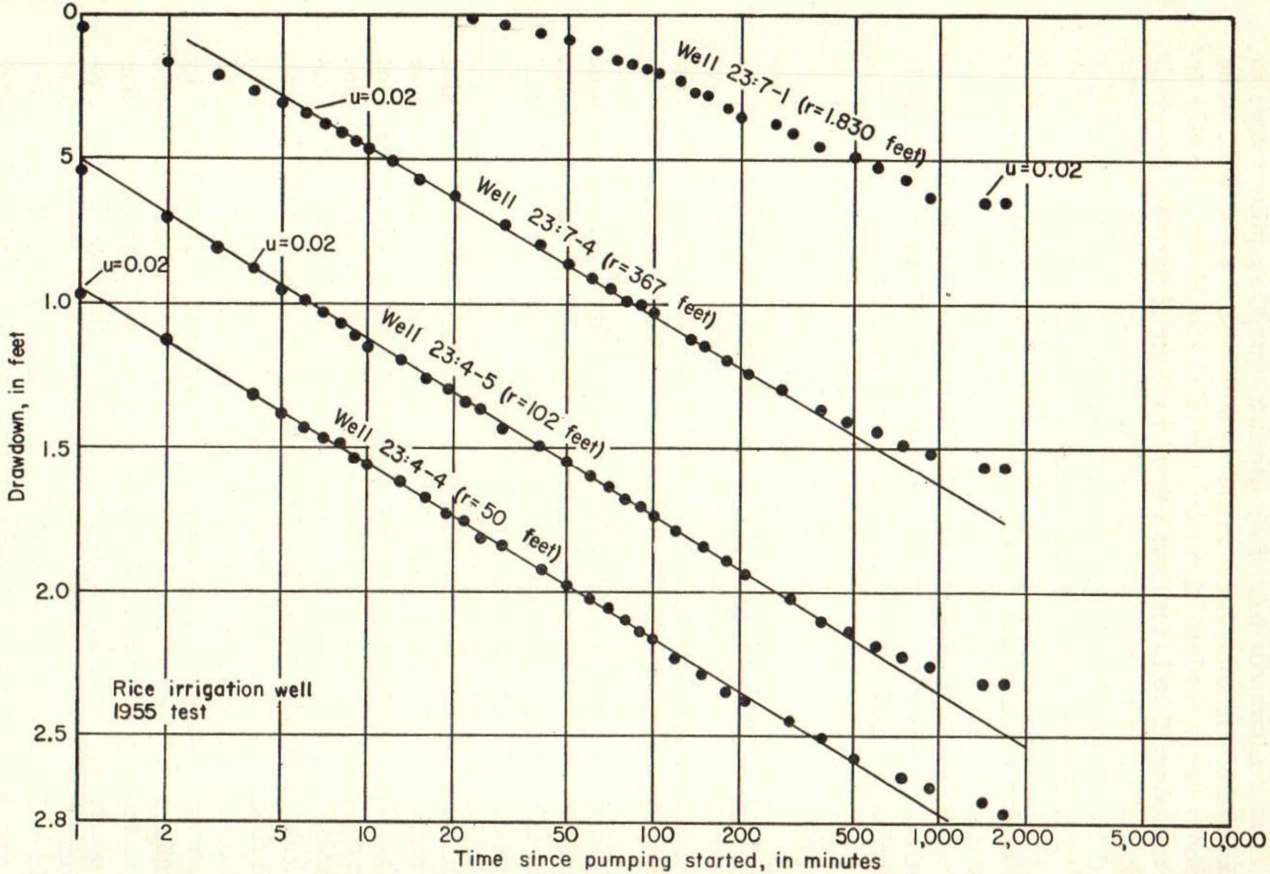


FIGURE 10.—Semilogarithmic graph of the drawdown in four observation wells during the aquifer test on the Rice well. (The symbol *r* represents the distance between the pumped well and the observation well.)

The T determined by the straight-line method is 280,000 gpd per foot. The S determined by the type-curve method is 8.5×10^{-4}. As the thickness of the sand and gravel in well 23:4-5 is 83 feet, the field coefficient of permeability is computed as 3,400 gpd per square foot.

The values for T and S indicate that it would be possible for wells in the Mississippi alluvial plain to yield as much as 4,000 gpm. An irrigation well in Lake County 6 miles northwest of the Rice farm is reported to yield 2,500 gpm.

Chemical Quality of the Water

On the basis of its chemical composition, ground water in the deposits of Pleistocene age may be divided into two classes—water from terrace deposits and water from valley deposits. The water in the Pleistocene terrace deposits, according to two analyses, is lower in dissolved solids, softer, and more uniform in chemical composition than water in other aquifers in the area. The iron content generally is low.

The principal constituents in ground water in the Dyersburg quadrangle are calcium and bicarbonate. The calcium carbonate in unleached loess and alluvial silt is a major source of these constituents. Loess usually is not calcareous where it is relatively thin. This fact probably accounts for the low dissolved-solids content in water from the terrace deposits in the southeastern part of the area.

The water from wells completed in Pleistocene valley deposits is usually hard, high in iron and dissolved solids, and not uniform in chemical composition. There appears to be some relation between the extent of mineralization and the presence or absence of a thick clay layer overlying the sand and gravel. Wells 23:7-3 and 23:43-1 are in the same aquifer, only 1½ miles apart, but the water from them differs considerably in chemical quality (table 3), that from well 23:7-3 being more highly mineralized. There is 75 feet of clay at well 23:7-3 but only a few feet at well 23:43-1. Thus it appears that movement of water beneath the clay is more restricted than it is where the clay is absent. On the other hand, the presence of significant amounts of chloride, nitrate, and sodium in water from well 23:43-1 suggests the possibility of surface contamination.

STRUCTURE

The Dyersburg quadrangle lies on the eastern flank of the syncline that forms the upper Mississippi Embayment. Although the axis of deposition, which generally parallels the Mississippi River, varied slightly during Cenozoic time, the regional strike is essentially north. The base of the lower part of the Eocene dips westward at approximately 30 feet per mile, whereas the base of the upper part of the Eocene dips only about 18 feet per mile, thus indicating regional subsidence throughout Eocene time.

It is quite possible that minor structures may be present in the Dyersburg area, but none are known. The terrace and loess deposits obscure any structures that may be present in the Eocene. Although the surface of the upper Eocene is very irregular (pl. 2), that surface is chiefly the result of erosion rather than of structure.

SUMMARY OF GEOLOGIC HISTORY

The following summary of the geologic history during Eocene time is taken largely from Stearns and Armstrong (1955).

During early Eocene time the Dyersburg area was part of a broad lowland adjacent to a shallow sea. Reworking of stream-deposited sand by a transgressing sea resulted in formation of the "1,400-foot" sand. Shoaling of the sea resulted in the deposition of the carbonaceous sand and clay that form the upper unit of the lower part of the Eocene. Complete or partial retreat of the sea then took place. A readvance of the sea caused deposition of a second sand, the "500-foot" sand, which was followed again by deposition of carbonaceous sand and clay.

Long-continued erosion after retreat of the sea reduced the Eocene surface to a low-lying, relatively featureless plain. Uplift in the Ozark and Highland Rim areas resulted in the deposition of gravel in the form of large, coalescing alluvial fans during Pliocene time (Potter, 1955). Subsequent to regional uplift, local stripping of the gravel and dissection of the bedrock took place. Remnants of the post-Pliocene plain occur as gravel-capped highs below the loess in the highly dissected parts of the area.

During the ensuing period of stability the Obion and Forked Deer Rivers reached their local base levels and commenced lateral planation of the bedrock. Simultaneously, sand and clay were deposited locally in the southeastern part of the area.

Later, in response to lowering of their base levels, the Obion and Forked Deer Rivers entrenched themselves into the bedrock nearly 100 feet. The upper valley terrace was formed by partial filling of the entrenched valleys with alluvial material. During the same time, the Loveland and Farmdale loesses (as used by Leighton and Willman, 1950) were being deposited throughout the area.

Two periods of downcutting, the first followed by a period of lateral erosion, resulted in the development of lower valley terraces and the present flood plain. While the valley terrace was being formed, Peorian loess (as used by Leighton and Willman, 1950) was being deposited throughout the area.

TABLE 1.—PUMPAGE OF GROUND WATER IN THE DYERSBURG QUADRANGLE (millions of gallons)[1]

(A) MUNICIPAL AND RURAL

Owner	*Number of wells*	*Annual*	*Daily*
City of Dyersburg	3	700	1.90
City of Newbern	3	[2] 66	.18
Remainder of Dyersburg quadrangle	549	[2]219	.60
Total	555	985	2.68

(B) INDUSTRIAL

Owner	*Number of wells*	*Annual*
Bowen Lumber Co.	3	[2] 1.7
Colonial Rubber Co.	1	[2]60.0
Dyersburg Cotton Products, Inc.	2	50.0
Dyersburg Ice & Coal Co.	1	[2]35.6
Food Sales Co.	2	[2]86.0
Illinois Central RR	2	53.8
Meadowbrook Dairy	2	[2] 5.0
Total	13	292.1

(C) IRRIGATION

Owner	*Number of wells*	*Annual*	*Acres irrigated*
Boal Brothers	4	[2]64.8	260
C. Calcutt	2	[2]34.3	65
Cannon & Pritchett	1	[2]17.3	35
W. Putman	1	[2] 1.5	22
H. Rice	3	[2]79.9	180
Total	11	197.8	562
Total of A, B, and C	579	1,475	

[1] Average daily pumpage estimated to be 4 million gallons.
[2] Estimated.

TABLE 2.—GENERALIZED GEOLOGIC SECTION FOR THE DYERSBURG QUADRANGLE

ERA	PERIOD	EPOCH	THICKNESS (FEET)		LITHOLOGIC CHARACTERISTICS	HYDROLOGIC CHARACTERISTICS
CENOZOIC	QUATERNARY	PLEISTOCENE		10-100	**Loess:** Gray, brown, or red sandy to clayey silt.	Yields small amounts of water to large-diameter wells; water high in calcium and bicarbonate.
				0-150	**Valley deposits:** Sand and gravel, silty and clayey in upper part; thin layers of clay and carbonaceous material in lower part.	Yield large amounts of water for irrigation and industrial uses; 7 analyses show moderately mineralized water high in calcium, bicarbonate, and iron.
				0-100	**Terrace deposits:** Sand and gravel and minor amounts of gray, yellow, or brown clay.	Yield moderate amounts of water for domestic use and possibly for small irrigation systems; 2 analyses show soft water of low mineral content.
	TERTIARY	PLIOCENE		0-40	**High-level gravel deposits:** Gravel and sand and some vari-colored clay.	Yield small to moderate amounts of water for domestic use; one analysis shows moderately mineralized water high in magnesium, calcium, and bicarbonate.
		EOCENE	UPPER PART	1,200-1,450	**Upper unit:** Gray or greenish gray silty clay and lenses of fine gray sand in lower part.	Sand lenses yield moderate amounts of water for domestic use; water moderate to high in iron and bicarbonate.
					Middle unit: Very carbonaceous (lignitic) fine gray sand interbedded with silty gray clay.	Sand layers yield moderate amounts of water for domestic use; water moderate to high in iron and bicarbonate.
					Lower unit: Medium to coarse gray carbonaceous sand and some silt and clay beds ("500-foot" sand of Memphis area).	Yields large amounts of water for municipal and industrial use; water moderate to high in iron and bicarbonate.
			LOWER PART	350-400	**Upper unit:** Dark-gray carbonaceous sandy clay and interbedded fine sand.	Sand lenses may yield small amounts of water; water high in iron, sodium, and bicarbonate in the Memphis area.
					Lower unit: Fine to coarse carbonaceous sand and interbedded gray sandy clay ("1,400-foot" sand of Memphis area).	Probably would yield large amounts of water; water high in iron, sodium, and bicarbonate in the Memphis area.

TABLE 3.—MINERAL CONSTITUENTS AND RELATED PHYSICAL MEASUREMENTS OF GROUND WATER IN THE DYERSBURG QUADRANGLE (Chemical constituents in parts per million)

Map number	Well number	Location (Tennessee coordinates)	Owner	Date of collection [1]	Well depth (feet)	pH	Temperature (°F)	Specific conductance (micromhos at 25°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Total	Hardness as $CaCO_3$: Non-carbonate	Percent sodium
Standard maximum [2]										0.3		125				250	250	1.5		1,000			
UPPER EOCENE																							
63	23: 1-1	613,650 N. 999,000 E.	City of Dyersburg	9- 9-29	810	......	....	......	14	5.9	12	6.9	6.2	1.4	79	8.6	1.6	....	0.05	84	58	....	16
66	1-5	613,600 N. 998,350 E.	do.	3-25-51	720	6.3	65	127	8.3	4.0	12	6	5.4	1.2	74	4.1	2.5	0.0	.4	76	55	0	16
67	1-6	613,450 N. 998,850 E.	do.	7- 5-51	637	6.2	65	134	9.4	3.4	11	6.5	4.9	.7	74	4.6	2.8	.2	.3	74	54	0	15
68	16-1	In Newbern a few feet north of the waterworks	City of Newbern	8-28-29	160	......	....	......	5	.7	31	6	[3]7	......	91	22	13	....	.3	140	102	....	....
69	16-2	do.	do.	9- 9-29	260	......	....	......	4	.8	27	5	[3]3	......	98	7	5	....	.1	105	89	....	....
70	16-3	do.	do.	7- 9-52	190	6.4	61	237	33	.11	22	11	10	1	92	17	11	.1	12	177	100	25	18
42	21-1	614,000 N. 999,650 E.	Dyersburg Oil Mill	3-24-30	950	......	....	......	26	9.5	43	19	6.5	4.1	238	7.1	1.6	....	0	210	185	....	7
35	44-1	662,300 N. 1,007,300 E.	M. Willis	4-29-55	168	6.5	63	344	22	14	29	17	10	5.8	210	10	1.5	.0	.1	208	155	0	12
PLIOCENE																							
5	66: 14-1	693,050 N. 997,950 E.	F. Harrison	4-29-55	114	7.2	61	834	13	.28	67	74	9.7	1.1	576	19	5.0	.2	1.3	504	477	0	4
PLEISTOCENE UPLAND TERRACE DEPOSITS																							
24	23: 33-1	611,600 N. 1,023,850 E.	J. Lyon	4-29-55	100	6.8	66	121	37	.02	7.6	.5	7.2	.2	69	2.5	1.5	.1	3.8	102	49	0	24
25	34-1	604,100 N. 1,035,600 E.	J. Mallard	7- 8-55	57	6.3	66	131	35	2.11	12	4.8	6.2	.9	78	1.3	1.8	.1	.2	104	49	0	21

50	23: 5-1	612,950 N.	974,050 E.	C. Calcutt	4-28-55	81	8.1	61	421	25	3.66	56	21	6.1	1.3	275	11	2.5	.1	.4	262	226	1	6
58	7-3	678,900 N.	983,500 E.	H. Rice	3-30-55	111	6.9	61	641	33	8.1	69	21	9.1	1.9	432	1.2	3.2	.0	1.6	370	341	0	6
21	30-1	Finley		R. Finlay	8-29-29	53	......	......	......	6.7	.6	115	18	[3]2	......	400	30	3	....	.2	387	361	....	....
28	37-1	673,000 N.	1,003,000 E.	R. Pardue	4-29-55	65	7.5	63	259	17	.15	27	15	3.5	1.2	149	7.9	.8	.1	9.7	160	130	8	6
31	40-1	676,750 N.	1,017,550 E.	H. Simrell	4-29-55	86	7.1	63	723	18	5.96	68	51	17	2	496	5.8	6.2	.2	2.5	429	380	0	9
33	42-1	Lenox		G. Smith	8-29-29	50	......	......	......	5	.6	148	9	[3]3	......	484	7	5	....	.4	426	406	....	....
34	43-1	671,450 N.	981,900 E.	J. Welch	10-13-55	22	5.6	62	384	25	.39	27	9.4	28	1.6	16	40	44	.0	63	258	108	95	37

[1]Analyses dated 1929-30 obtained from U. S. Geol. Survey Water-Supply Paper 656; those dated 1951-52 obtained from Tenn. Div. Geology Report of Investigations No. 1; those dated 1955 analyzed by U. S. Geol. Survey.

[2] U. S. Public Health Service drinking-water standards.

[3] Figure given represents both Na and K as Na.

TABLE 4.—RECORDS OF WELLS IN THE DYERSBURG QUADRANGLE

Map number	Well number	Location (Tennessee coordinates)		Owner	Depth of well (feet)	Diameter (inches)	Yield (gpm)	Geologic source[1]	Water level below land surface[2]	Date of measurement	Remarks[3]
				DOMESTIC							
1	66: 10-1	683,600 N.	1,011,200 E.	N. Cutler	79	2	....	Te	....	....	L
2	11-1	688,700 N.	1,016,500 E.	A. Dozier	268	3	....	Te	....	....	L
3	12-1	692,150 N.	1,000,900 E.	H. Faulk	89	2	....	Tp	....	....	L
4	13-1	683,850 N.	1,010,200 E.	P. Green	76	2	....	Qt	....	....	L
5	14-1	693,050 N.	995,300 E.	F. Harrison	114	2	....	Tp	96	6-15-55	Ca, L
6	15-1	687,550 N.	1,028,300 E.	S. Holloway	119	2	....	Qv	39	7-18-55	L
7	16-1	690,200 N.	1,009,700 E.	M. Lavender	74	2	....	Tp	....	....	L
8	17-1	680,950 N.	1,032,650 E.	R. Lawson	85	2	....	Qv	15	6-17-55	L
9	18-1	690,600 N.	1,031,900 E.	S. Luker	70	1¼	....	Qv	....	....	L
10	19-1	683,000 N.	1,035,550 E.	M. Webb	85	2	....	Qv	....	....	L
11	20-1	688,700 N.	1,012,950 E.	E. Wisinger	262	2	....	Te	....	....	L
12	21-1	685,700 N.	1,001,750 E.	B. Yates	219	2	....	Te	....	....	L
13	23: 22-1	650,300 N.	986,950 E.	Asphalt Plant	86	4	....	Tp	....	....	L
14	23-1	617,100 N.	1,027,150 E.	P. Barker	73	2	....	Qt	....	....	L
15	24-1	652,900 N.	1,033,350 E.	B. Biffle	90	2	....	Qt	....	....	L
16	25-1	626,800 N.	992,600 E.	R. Buttman	364	2	....	Te	....	....	L
17	26-1	634,700 N.	992,900 E.	L. Cobb	264	2	....	Te	70	7-20-55	L
18	27-1	645,300 N.	985,550 E.	R. Dudley	235	2	....	Te	....	....	L
19	28-1	616,450 N.	1,024,050 E.	Ellis	93	2	....	Qt	85	7-17-55	L
20	29-1	663,250 N.	1,038,550 E.	Ferguson	99	2	....	Qt	50	7-27-55	L
21	30-1	In Finley		R. Finlay	53	1	....	Qv	20	1929	Ca
22	31-1	636,650 N.	1,014,050 E.	C. Hambrick	100	2	....	Te	....	....	L
23	32-1	631,750 N.	1,004,950 E.	A. Johns	153	2	....	Te	....	....	L
24	33-1	611,600 N.	1,023,850 E.	J. Lyon	98	3	....	Qt	....	....	Ca, L
25	34-1	604,100 N.	1,035,600 E.	J. Mallard	57	2	....	Qt	....	....	Ca, L
26	35-1	638,300 N.	991,350 E.	Nauvoo School	198	....	....	Te	....	....	L
27	36-1	637,450 N.	983,500 E.	R. Palmer	183	2	....	Te	....	....	L
28	37-1	673,000 N.	1,007,000 E.	R. Pardue	65	2	....	Qv	....	....	Ca
29	38-1	642,600 N.	994,200 E.	A. Perminter	154	2	....	Te	....	....	L

30	39-1	622,650 N.	973,200 E.	E. Pritchett	106	2	....	Te	....	....	L
31	40-1	676,750 N.	1,017,550 E.	H. Simrell	86	2	....	Qv	9.84	3-23-55	Ca, L
32	41-1	659,200 N.	1,000,350 E.	J. Sipes	276	2	....	Te	....	....	L
33	42-1	In Lenox		G. Smith	50	2	....	Qv	....	....	Ca
34	43-1	671,450 N.	981,900 E.	J. Welch	22	2	....	Qv	....	....	Ca
35	44-1	662,300 N.	1,007,300 E.	M. Willis	168	2	....	Te	....	....	Ca, L
				INDUSTRIAL							
36	23: 11-1	613,550 N.	991,900 E.	Bowen Lumber	75	4	....	Qv	....	....	
37	11-2	613,550 N.	991,900 E.	do.	75	4	....	Qv	....	....	
38	10-1	613,550 N.	996,550 E.	Colonial Rubber	79	8	240	Qv	....	....	
39	2-1	613,750 N.	999,450 E.	Dyersburg Coal & Ice	666	8- 6	200	Te	Artesian flow	During winter	
40	3-1	616,350 N.	1,004,350 E.	Dyersburg Cotton Products	947	10- 6	400	Te	54	8-45	
41	3-2	616,600 N.	1,004,450 E.	do.	922	10- 6	695	Te	55	8-53	
42	21-1	614,000 N.	999,650 E.	Dyersburg Oil Mill (Phoenix Compress)	950	8	400	Te	Artesian flow	....	Ca, not in use
43	8-1	613,600 N.	997,350 E.	Food Sales	120	8	245	Qv	....	....	
44	8-2	613,750 N.	997,450 E.	do.	120	6	245	Qv	....	....	
45	12-1	613,100 N.	1,000,700 E.	Illinois Central R. R.	....	....	220	Te	1.22	7- 6-55	
46	12-2	613,100 N.	1,000,725 E.	do.	....	....	220	Te	....	....	
47	14-1	614,650 N.	999,550 E.	Kenney Market	239	4	....	Te	8.07	6-30-55	L
48	9-1	614,300 N.	1,002,800 E.	Meadowbrook Dairy	144	....	40	Te	....	....	
49	9-2	614,300 N.	1,002,800 E.	do.	144	....	40	Te	....	....	
				IRRIGATION							
50	23: 5-1	612,950 N.	974,050 E.	C. Calcutt	86	6	253	Qv	7.02	6- 7-55	Ca
51	5-2	615,750 N.	975,250 E.	do.	71	4	35	Qv	....	....	
52	6-1	613,000 N.	972,250 E.	Boal Brothers	82	6	350	Qv	9	7-15-52	
53	6-2	615,300 N.	973,350 E.	do.	80	6	350	Qv	11	8-52	
54	6-3	616,950 N.	967,950 E.	do.	80	6	350	Qv	12	8-54	
55	6-4	611,900 N.	972,200 E.	do.	80	6	350	Qv	9.38	5-19-55	
56	7-1	677,150 N.	983,850 E.	H. Rice	82	8	600	Qv	7.32	6-22-55	
57	7-2	675,000 N.	976,000 E.	do.	82	8	600	Qv	11.60	8-10-55	
58	7-3	678,900 N.	983,500 E.	do.	111	8	645	Qv	11.83	4-27-55	Ca

[1] Qt, terrace deposits; Qv, valley deposits; Te, upper Eocene series; Tp, Pliocene series.

[2] Measured depths given in feet, tenths, and hundredths; reported depths given in feet.

[3] Ca, chemical analysis given in table 3; L, log given in table 5.

TABLE 4.—RECORDS OF WELLS IN THE DYERSBURG QUADRANGLE (continued)

Map number	*Well number*	*Location (Tennessee coordinates)*		*Owner*	*Depth of well (feet)*	*Diameter (inches)*	*Yield (gpm)*	*Geologic source*[1]	*Water level below land surface*[2]	*Date of measurement*	*Remarks*[3]
59	15-1	614,500 N.	975,900 E.	Cannon & Pritchett	82	6	400	Qv	17	6-54	
60	17-1	658,250 N.	1,031,200 E.	M. Roney	280	10	....	Te	8.52	11-14-55	L
61	17-2	656,200 N.	1,037,550 E.	do.	158	10	....	Te	....	....	L
62	45-1	618,050 N.	972,150 E.	W. Putman	80	4	40	Qv	30	4-55	
				MUNICIPAL							
63	23: 1-1	613,650 N.	999,000 E.	City of Dyersburg	810	10	250	Te	....	....	Ca, not in use
64	1-3	613,400 N.	999,450 E.	do.	633	24-10	1,825	Te	Artesian flow	During winter	Observation well
65	1-4	613,750 N.	998,850 E.	do.	655	24-10	1,150	Te	13	6-29-55	
66	1-5	613,600 N.	998,350 E.	do.	720	18	1,800	Te	12	....	Ca
67	1-6	613,450 N.	998,850 E.	do.	637	18	2,475	Te	Artesian flow	During winter	Ca
68	16-1	In Newbern a few feet north of the waterworks.		City of Newbern	160	10	250	Te	80	....	Ca, destroyed
69	16-2			do.	260	8	150	Te	80	....	Do.
70	16-3			do.	190	10- 8	250	Te	75	1953	Ca, not in use
71	16-4			do.	190	10- 8	180	Te	75	1953	
72	16-5			do.	172	....	350	Te	76	1954	L
				OBSERVATION							
73	23: 4-1	615,550 N.	974,850 E.	U. S. Geol. Survey	70	4	....	Qv	15.32	3-29-55	
74	4-2	612,950 N.	974,100 E.	do.	87	1½	....	Qv	6.30	5-31-55	
75	4-3	612,950 N.	974,150 E.	do.	90	1½	....	Qv	6.09	5-31-55	L
76	4-4	678,850 N.	983,500 E.	do.	106	1½	....	Qv	8.69	6- 9-55	
77	4-5	678,800 N.	983,500 E.	do.	109	1½	....	Qv	11.17	6- 9-55	L

[1] Qt, terrace deposits; Qv, valley deposits; Te, upper Eocene series; Tp, Pliocene series.
[2] Measured depths given in feet, tenths, and hundredths; reported depths given in feet.
[3] Ca, chemical analysis given in table 3; L, log given in table 5.

TABLE 5.—LOGS OF WELLS IN THE DYERSBURG QUADRANGLE

WELL NUMBER	*MAP NUMBER*	*OWNER*	*ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL*[1]	*DRILLING COMPANY*	*TENNESSEE COORDINATES*	
23: 4-3	**75**	**U. S. GEOL. SURVEY**	**270**	**P & W SERVICE**	**612,950 N.**	**974,150 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Silt, clayey, sandy, brown to dark-gray and yellowish-gray	11	11
Sand, very fine to fine, brown, carbonaceous	2	13
Sand, very fine to coarse, gray, carbonaceous	6	19
Sand, very fine to medium, gray, carbonaceous	7	26
Sand, medium to coarse, gray, carbonaceous	2	28
Sand, very fine to medium, gray, carbonaceous	7	35
Sand, very fine to fine, gray, carbonaceous	11	46
Sand, fine to coarse, gray, carbonaceous	25	71
Sand, fine to medium, gray, carbonaceous	5	76
Sand, fine to medium, and fine gravel	2	78
Sand, medium to very coarse, white; thin beds of clay from 101 to 107 feet	30	108
Sand, fine to medium, gray	2	110
EOCENE SERIES		
Upper		
Clay, silty, brownish-gray	1	111
Silt, very clayey, gray	9	120

23: 4-5	**77**	**U. S. GEOL. SURVEY**	**280**	**McFARLAND, TEAGUE & WHITE**	**678,800 N.**	**983,500 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Silt, gray-brown	13	13
Clay, silty, dark bluish-gray	54	67
Sand, medium to coarse, and fine to coarse carbonaceous gravel	83	150
EOCENE SERIES		
Upper		
Clay, brown and gray, carbonaceous	5	155

23: 14-1	**47**	**KENNEY MARKET**	**285**	**P & W SERVICE**	**614,650 N.**	**999,550 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
No log	6	6
Terrace fill		
Sand, fine to coarse, brown	14	20
Sand, fine to medium, clayey	8	28

[1] Taken from topographic map.

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23: 14-1 (continued)	47	KENNEY MARKET	285	P & W SERVICE	614,650 N.	999,550 E.

	Thickness (feet)	Depth (feet)
EOCENE SERIES		
Upper		
Silt, clayey, gray	62	90
Silt, sandy, gray	10	100
Silt, clayey, gray	10	110
Silt, sandy, gray	6	116
Silt, clayey, gray	44	160
Sand, fine, gray	8	168
Clay, silty, gray	47	215
Sand, fine, gray	25	240
Clay, silty, gray, interbedded with fine sand	33	273
Clay, slightly sandy, gray, carbonaceous	42	315

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
23:16-5	72	CITY OF NEWBERN	370	LAYNE-CENTRAL	642,600 N	1,036,950 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	45	45
EOCENE SERIES		
Upper		
Clay, hard, bluish-gray	55	100
Sand, fine, silty	60	160
Sand, very fine, gray	70	230
Sand, coarse, gray	30	260

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
23:17-1	60	M. RONEY	300	R. LAWRENCE	658,250 N.	1,031,200 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Silt, clayey, dark brownish-gray	1.5	1.5
Silt, clayey, light brownish-gray, iron-stained	1.5	3
Silt, clayey, dark-gray	2	5
Silt, clayey, light to dark bluish-gray, iron-stained; contains wood and bones	15	20
Silt, clayey, slightly sandy, gray and brown	5	25
Silt, clayey, yellowish-brown; contains a trace of sand and gravel	7	32
Sand, very fine to coarse, in part clayey, gray	3	35
Gravel and sand, a few layers of clay	21	56

[1] Taken from topographic map.

TABLE 5.–LOGS OF WELLS (continued)

WELL NUMBER	*MAP NUMBER*	*OWNER*	*ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL*[1]	*DRILLING COMPANY*	*TENNESSEE COORDINATES*	
23:17-1 (continued)	60	M. RONEY	300	R. LAWRENCE	658,250 N.	1,031,200 E.

	Thickness (feet)	Depth (feet)
EOCENE SERIES		
Upper		
Clay, very sandy, dark-gray, plastic	54	110
Sand, fine, gray	20	130
Clay, sandy, plastic, dark-gray, carbonaceous	108	238
Sand, fine to medium	42	280

23:17-2	61	M. RONEY	335	R. LAWRENCE	656,200 N.	1,037,550 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Clay, brown	25	25
EOCENE SERIES		
Upper		
Clay, gray	35	60
Sand	6	66
Siltstone, clayey	10	76
Sand, coarse	7	83
Clay, gray	4	87
Sand, fine	10	97
Sand, medium	10	107
Clay, white	11	118
Sand, coarse	40	158
Clay	?	?

23:22-1	13	ASPHALT PLANT	430	McFARLAND, TEAGUE & WHITE	650,300 N.	986,950 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, clayey, brown, gray, and red	62	62
PLIOCENE SERIES		
Gravel, fine to medium, and fine to coarse sand	3	65
EOCENE SERIES		
Upper		
Clay, very plastic, gray and white	9	74
Sand, fine to medium, gray	12	86
Clay, plastic, yellow	25	111

[1] Taken from topographic map.

TABLE 5.–LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:23-1	14	BARKER	340	McFARLAND, TEAGUE & WHITE	617,100 N.	1,027,150 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	35	35
Terrace fill		
Sand, red	5	40
Clay, white	3	43
Sand, red	32	75

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:24-1	15	B. BIFFLE	310	McFARLAND, TEAGUE & WHITE	652,900 N.	1,033.350 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, clayey, reddish-brown	25	25
Terrace fill		
Sand, fine, red, and white	5	30
Sand, fine to medium, interbedded with white and gray clay	50	80
Sand, fine to medium, white	10	90

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:25-1	16	R. BUTTMAN	360	McFARLAND, TEAGUE & WHITE	626,800 N.	992,600 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	60	60
PLIOCENE SERIES		
Gravel	10	70
EOCENE SERIES		
Clay, hard, interbedded with fine sand	280	350
Sand, fine to medium	14	364

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:26-1	17	L. COBB	340	P & W SERVICE	634,700 N.	992,900 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	70	70
Valley fill		
Sand and gravel	5	75
EOCENE SERIES		
Upper		
Clay, silty	165	240
Sand, dark-gray	24	264

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:27-1	18	R. DUDLEY	475	McFARLAND, TEAGUE & WHITE	645,300 N.	985,550 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
No log	40	40
Silt, slightly clayey, dark-brown to yellowish-brown	2	42
Silt, clayey, yellowish-brown, abundant gastropods	8	50
Silt, brownish-gray	7	57
Silt, slightly to moderately clayey, light to dark reddish-brown	7	64
Silt, slightly clayey, grayish-yellow, noncalcareous	8	72
Silt, very sandy, light yellowish-gray	3	75
PLIOCENE SERIES		
Sand and gravel, poorly sorted, a few thin gray and red sandy clay beds	5	80
Gravel, fine to coarse, chert and quartz	11	91
Sand, fine, and fine to coarse gravel	4	95
EOCENE SERIES		
Upper		
Clay, very plastic, yellow	2	97
Clay, silty and sandy, white to light-gray	3	100
Clay, silty; a few thin sand beds, interbedded purple, yellow, and white	28	128
Clay, very plastic, white to light yellowish-gray	7	135
Clay, hard, light yellowish-gray	35	170
Clay, moderately silty, light-gray	58	228
Sand, fine to coarse, mostly quartz	7	235

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:28-1	19	ELLIS	370	P & W SERVICE	616,450 N.	1,024,050 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	30	30
Terrace fill		
Sand, brown	10	40
Clay, brown	16	56
Sand, brown	17	73
Clay, white and pink	6	79
Sand, red, interbedded with gray clay	35	114
Sand, white	1	115
Clay, white and yellow, interbedded with sand, white	9	124
Sand, white	2	126
EOCENE SERIES		
Upper		
Clay, white and gray, carbonaceous	6	132

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:29-1	20	FERGUSON	335	FERGUSON	663,250 N.	1,038,550 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, reddish-brown	45	45
Terrace fill		
Clay, hard, dark-gray	15	60
Sand, medium to coarse, red	18	78
Clay, plastic, gray	12	90
Sand, medium to coarse, brown	9	99

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:31-1	22	C. HAMBRICK	330	McFARLAND, TEAGUE & WHITE	636,650 N.	1,014,050 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, clayey, reddish-brown	4	4
Silt, brown, mottled with gray	19	23
Silt, brown	5	28
Silt, olive-gray	7	35
Silt, reddish-brown	4	39
Silt, yellowish-brown, scattered fine to medium gravel	3	42
Terrace fill		
Clay, light-gray, iron-stained, scattered gravel	3	45
Sand, fine to medium, clayey, interbedded with clay, gray, and fine gravel	7	52
Clay, very sandy, light-gray	1	53
Gravel, fine to medium	1	54
EOCENE SERIES		
Upper		
Clay, yellow, and scattered sand and gravel	1	55
Clay, very plastic, yellowish-gray	3	58
Clay, very plastic, light-gray	7	65
Silt, clayey, sandy, dark-gray	27	92
Sand, fine to medium, gray	8	100

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
23:32-1	23	A. JOHNS	350	McFARLAND, TEAGUE & WHITE	631,750 N.	1,004,950 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, reddish-brown mottled with gray	6	6
Silt, reddish-brown	4	10
Silt, reddish-brown mottled with gray	2	12
Silt, light brownish-gray	12	24
Silt, dark brownish-gray	9	33
Silt, olive-gray	3	36
Silt, reddish-brown mottled with gray	4	40
Silt, yellowish-brown; scattered fine gravel	1	41
Terrace fill (?)		
Gravel, fine, and yellow silt	1	42
EOCENE SERIES		
Upper		
Clay, brownish-pink, containing some fine gravel	1	43
Clay, very plastic, red and gray	2	45
Clay, plastic, silty, light-gray	59	104
Clay, silty, dark-gray, carbonaceous	19	123
Sand, very fine to medium, silty, gray	30	153

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:33-1	24	J. LYON	350	P & W SERVICE	611,600 N.	1,023,850 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	38	38
Terrace fill		
Sand, fine to coarse, red and brown	30	68
Sand, fine to medium, white	32	100
EOCENE SERIES		
Upper		
Clay, silty, gray	3	103

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:34-1	25	J. MALLARD	300	McFARLAND, TEAGUE & WHITE	604,100 N.	1,035,600 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, reddish-brown mottled with gray	4	4
Silt, reddish-brown	17	21
Terrace fill		
Sand, fine to medium, brown	7	28
Sand, fine to medium, white	4	32
Sand, fine to medium, gray; contains thin layers of gray, brown, and yellow clay; carbonaceous	25	57

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
23:35-1	26	NAUVOO SCHOOL	390	P & W SERVICE	638,300 N.	991,350 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	60	60
PLIOCENE SERIES		
Gravel	5	65
EOCENE SERIES		
Upper		
Clay, gray	105	170
Sand, fine to medium	28	198

[1] Taken from topographic map.

WELL NUMBER	*MAP NUMBER*	*OWNER*	*ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL*[1]	*DRILLING COMPANY*	*TENNESSEE COORDINATES*	
23:36-1	**27**	**R. PALMER**	**450**	**McFARLAND, TEAGUE & WHITE**	**637,450 N.**	**983,500 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, clayey, brown and red	84	84
PLIOCENE SERIES		
Gravel, fine to coarse	3	87
EOCENE SERIES		
Upper		
Clay, white	13	100
Sand, fine, white	20	120
Clay, white	20	140
Sand, fine, interbedded with clay	18	158
Sand, fine, white	7	165
Sand, fine, interbedded with clay	10	175
Sand, fine to medium, white	8	183

23:38-1	**29**	**A. PERMINTER**	**380**	**McFARLAND, TEAGUE & WHITE**	**642,600 N.**	**994,200 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	70	70
PLIOCENE SERIES		
Gravel and clay, interbedded	5	75
EOCENE SERIES		
Upper		
Clay, gray	65	140
Sand, white	14	154

23:39-1	**30**	**E. PRITCHETT**	**320**	**P & W SERVICE**	**622,650 N.**	**973,200 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	60	60
PLIOCENE (?) SERIES		
Sand and gravel	10	70
EOCENE SERIES		
Upper		
Clay, gray	30	100
Sand, fine to medium	6	106

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	*MAP NUMBER*	*OWNER*	*ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL*[1]	*DRILLING COMPANY*	*TENNESSEE COORDINATES*	
23:40-1	**31**	**H. SIMRELL**	**285**	**HOLLOWAY**	**676,750 N.**	**1,017,550 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Clay, gray and brown	25	25
Sand, fine to medium, white, interbedded with white sandy plastic clay	50	75
Sand, fine to coarse, white	11	86

23:41-1	**32**	**J. SIPES**	**470**	**McFARLAND, TEAGUE & WHITE**	**659,200 N.**	**1,000,350 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	40	40
PLIOCENE SERIES		
Gravel, fine to medium, and fine to coarse sand	8	48
EOCENE SERIES		
Upper		
Clay, white, and fine to medium gray sand	94	142
Clay, plastic, varicolored	58	200
Clay, blue, interbedded with thin layers of very fine to fine, dark-gray carbonaceous sand	70	270
Sand, fine to medium, gray	11	281

23:44-1	**35**	**M. WILLIS**	**325**	**P & W SERVICE**	**662,300 N.**	**1,007,300 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Silt, yellow	16	16
Silt, clayey, blue-gray	34	50
PLIOCENE SERIES		
Gravel, fine to medium	8	58
EOCENE SERIES		
Upper		
Clay, silty, gray	62	120
Clay, silty, gray, and fine gray sand	40	160
Sand, fine to medium, silty, gray, carbonaceous	8	168

[1] Taken from topographic map.

TABLE 5.—LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:10-1	1	N. CUTLER	340	CHURCH & FRENCH	683,600 N.	1,011,200 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Clay, yellow and gray	69	69
Terrace fill		
Gravel, fine to medium, and fine to coarse yellow and brown sand	10	79
EOCENE SERIES		
Upper		
Clay, plastic, gray	75	154
Sand, fine to medium, gray	6	160

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
66:11-1	2	A. DOZIER	335	ALEXANDER	688,700 N.	1,016,500 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Silt, brown	50	50
PLIOCENE SERIES		
Gravel, fine to medium	8	58
EOCENE SERIES		
Upper		
Clay, silty, gray	192	250
Sand, fine to medium, gray	18	268

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
66:12-1	3	H. FAULK	440	P & W SERVICE	692,150 N.	1,000,900 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	65	65
PLIOCENE SERIES		
Gravel, fine to medium, and fine to coarse sand	24	89

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE	DRILLING COMPANY	TENNESSEE COORDINATES	
66:13-1	4	P. GREEN	350	R. C. SANFORD	683,850 N.	1,010,200 E.

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	32	32
Silt, gray, gastropods	32	64
Terrace fill		
Sand, fine to coarse, brown, and plastic yellow clay	9	73
Sand, fine to coarse, yellow	3	76

[1] Taken from topographic map.

TABLE 5.–LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:14-1	**5**	**F. HARRISON**	**440**	**P & W SERVICE**	**693,050 N.**	**995,300 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	88	88
PLIOCENE SERIES		
Gravel, fine to medium, and fine to coarse sand	26	114

66:15-1	**6**	**S. HOLLOWAY**	**310**	**S. HOLLOWAY**	**687,550 N.**	**1,028,300 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Silt, clayey, brown	40	40
Clay, silty, dark-gray	40	80
Sand, coarse, white	20	100
Sand, coarse, white, interbedded with clay	19	119

66:16-1	**7**	**M. LAVENDER**	**425**	**M. LAVENDER**	**690,200 N.**	**1,009,700 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Silt, clayey, brown	40	40
PLIOCENE SERIES		
Sand, fine to coarse, yellow, and gravel, fine to medium	34	74
EOCENE SERIES		
Upper		
Clay, silty, white	3	77

66:17-1	**8**	**R. LAWSON**	**280**	**R. LAWSON**	**680,950 N.**	**1,032,650 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Clay, silty, gray	40	40
Sand, fine to coarse, red	25	65
Sand, fine to coarse, white	20	85

[1] Taken from topographic map.

TABLE 5.–LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:18-1	**9**	**S. LUKER**	**300**	**HOLLOWAY**	**690,600 N.**	**1,031,900 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Clay, silty, gray	65	65
Gravel, fine to medium, and sand, fine to coarse, brown	10	75
EOCENE SERIES		
Upper		
Clay, silty, gray and brown	125	200

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:19-1	**10**	**M. WEBB**	**290**	**HOLLOWAY**	**683,000 N.**	**1,035,550 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Valley fill		
Clay, silty, brown and gray	80	80
Sand, fine to coarse, and fine to medium gravel	10	90
EOCENE SERIES		
Upper		
Clay, hard, dark-gray	50	140
Sand, fine to medium, white	20	160
Clay, silty, light-gray	40	200
Sand, very fine to fine, dark-gray	30	230

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:20-1	**11**	**E. WISINGER**	**340**	**P & W SERVICE**	**688,700 N.**	**1,012,950 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown and gray	65	65
EOCENE SERIES		
Upper		
Clay, dark-gray	186	251
Sand, very fine to medium, gray	11	262

[1] Taken from topographic map.

TABLE 5.–LOGS OF WELLS (continued)

WELL NUMBER	MAP NUMBER	OWNER	ALTITUDE, IN FEET ABOVE MEAN SEA LEVEL[1]	DRILLING COMPANY	TENNESSEE COORDINATES	
66:21-1	**12**	**B. YATES**	**400**	**P & W SERVICE**	**685,700 N.**	**1,001,750 E.**

	Thickness (feet)	Depth (feet)
PLEISTOCENE SERIES		
Loess		
Silt, brown	39	39
Silt, bluish-gray, gastropods	19	58
Silt, dark greenish-gray	12	70
Silt, yellowish-brown	2	72
PLIOCENE SERIES		
Sand, fine to coarse, and fine to medium, brown gravel, in part clayey, brown and yellow	18	90
EOCENE SERIES		
Upper		
Clay, plastic, slightly silty and sandy, yellow	16	106
Silt, very clayey, grayish-green	18	124
Rock	1	125
Clay, very plastic, light-gray	5	130
Rock	1	131
Clay, silty, gray	2	133
Rock	3	136
Clay, silty, gray	74	210
Sand, fine to medium, bluish-gray, carbonaceous	9	219

[1] Taken from topographic map.

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