STATE OF ARKANSAS

Arkansas Geological and Conservation Commission

Norman F. Williams, Geologist-Director

WATER RESOURCES CIRCULAR No. 2

GROUND-WATER RESOURCES IN A PART OF SOUTHWESTERN ARKANSAS

By

H. B. Counts, D. B. Tait, Howard Klein, and G. A. Billingsley

U. S. GEOLOGICAL SURVEY

Prepared in Cooperation with the U. S. Geological Survey and the University of Arkansas Institute of Science and Technology

Little Rock

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ABSTRACT

This report gives information about the geography, geology, and ground-water resources of an area about 3,900 square miles located in southwestern Arkansas. The topography consists of low rounded hills or low ridges trending in a general easterly direction with some terraces and flat bottomland along the major streams. The area is drained by the Red River, Little River, and the Little Missouri River. The climate is mild, with an average growing season of 226 days and the average annual precipitation ranges from about 45 to 50 inches. Agriculture is the principal industry.

Formations exposed in the area range from Paleozoic to Quaternary in age. Formations of Cretaceous age have a general southerly or southeasterly dip and are exposed as eastward or northeastward trending bands through the report area. Sediments of Tertiary age overlie the Cretaceous deposits in the southern part and rocks of Paleozoic age crop out in the northern part. Deposits of Quaternary age overlie the older formations, either as terraces or alluvial deposits in the major stream valleys.

Ground water is used in the area at an average rate of about 8.5 million gallons per day of which approximately 3 million gallons per day are used by municipalities. Ground water is wasted at an estimated rate of about 2 million gallons per day. The total combined use for domestic, industry, and irrigation is about 3.5 million gallons per day.

There is a considerable difference in the quality of water from the different water-bearing formations as indicated by the analyses of samples from 328 wells. Also, the water in the Cretaceous formations is progressively more mineralized down dip.

The most important water-bearing units are the Trinity group, the Tokio formation, and the Nacatoch sand, all of which are of Cretaceous age.

GROUND-WATER RESOURCES IN A PART OF SOUTHWESTERN ARKANSAS

INTRODUCTION

This is one of a series of reports on the ground-water resources of Arkansas made under a program of investigations with the United States Geological Survey, cooperating with the University of Arkansas, Bureau of Research and Institute of Science and Technology from 1946 to 1950, the Arkansas Resources and Development Commission from 1950 to present, and with the University of Arkansas, Agricultural Experiment Station.

The areas in Arkansas covered by these reports are shown on Figure 1. Other reports giving information about ground water in Arkansas are Hale and others (1947), Branner (1937), Stephenson and Crider (1916), and Veatch (1906). The last report is particularly complete for southwest Arkansas to the date of its publication. These and other references will be found at the end of this report.

The investigation upon which this report is based was begun in the summer of 1950. The field work was started by Howard Klein in August 1950 and was completed by H. B. Counts and D. B. Tait from March to September of 1951. The work was under the direct supervision of R. C. Baker, District Geologist, and under the general direction of A. N. Sayre of the U. S. Geological Survey. Chemical analyses of water samples were made by the U. S. Geological Survey.

PURPOSE AND SCOPE OF INVESTIGATION

The purpose of this report is to present information about the occurrence and quality of ground water in part of southwestern Arkansas, with particular reference to the deposits of Cretaceous age. Records of 397 wells and chemical analyses of water from 328 wells are listed. Maps are given showing well locations, the outcrop areas of and quality of water in the Tokio formation and the Nacatoch sand, the outcrop area for the Trinity group and location of wells tapping the Trinity, Woodbine formation, Brownstown marl, Ozan formation, Wilcox formation, and deposits of Quaternary age.

LOCATION OF AREA

The area covered in this report consists of about 3,900 square miles located in the southwestern part of Arkansas. It includes all of Little River, Hempstead and Sevier Counties, the southern part of Howard, Pike and Clark Counties, and the northern part of Miller and Nevada Counties. The area is roughly rectangular in shape, with Texarkana near the southwest corner, Rosston near the southeast corner, Arkadelphia near the northeast corner, and DeQueen near the northwest corner.

ACKNOWLEDGMENTS

The writers are grateful to all persons who gave information or help in the investigation, including Clyde Zinn and Dennis Bell of Hope Light and Water Co.; F. E. Wells, Wallace Elliot, Howard Hipp, R. H. Herron, Milton Garrison, and Erman Williamson, water well drillers; K. Scott of Carter Oil Co.; L. Bartells of McAlester Fuel Oil Co.; Nonus Harris and H. Harris, guides.

WELL-NUMBERING SYSTEM

The well-numbering system used in this report is based upon the location of the wells with respect to the federal land-survey used in Arkansas. The component parts of a well number are the township number, the range number, the section number, and three lower-case letters which indicate respectively, the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section in which the well is located. The lower-case letters are assigned in counter-clockwise order beginning with *a* in the northeast quarter or quarter-quarter or quarter-quarter-quarter section. Serial numbers are appended to each well located within the quarter-quarter-quarter section.

This system of numbering wells according to their location is illustrated in Figure 2.

Map numbers were also assigned to each well as they were tabulated in Table 11. It was thought that the regular well numbers would be hard to read on the maps, especially where there

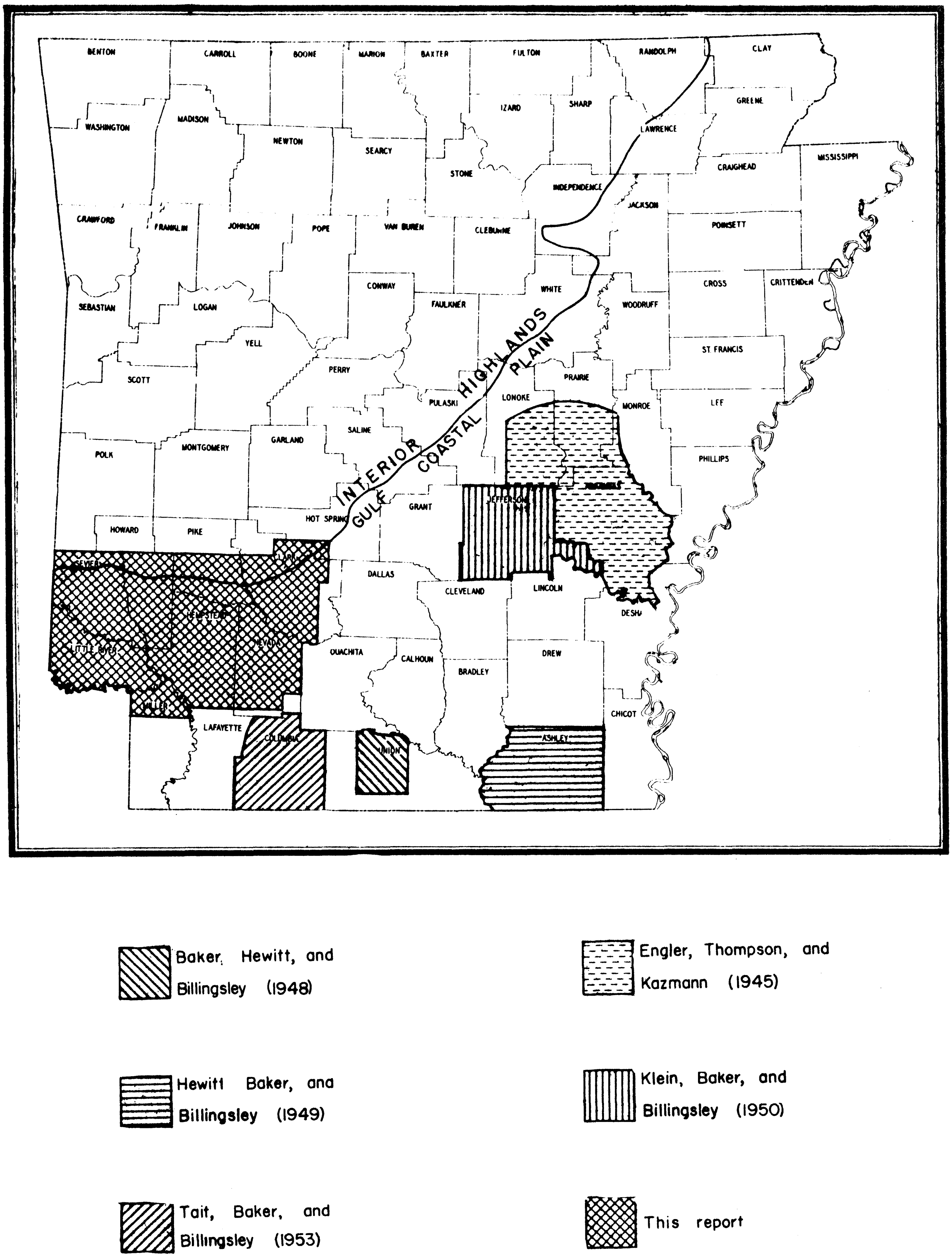


Figure 1. Areas in Arkansas Covered by Recent Ground-Water Reports.

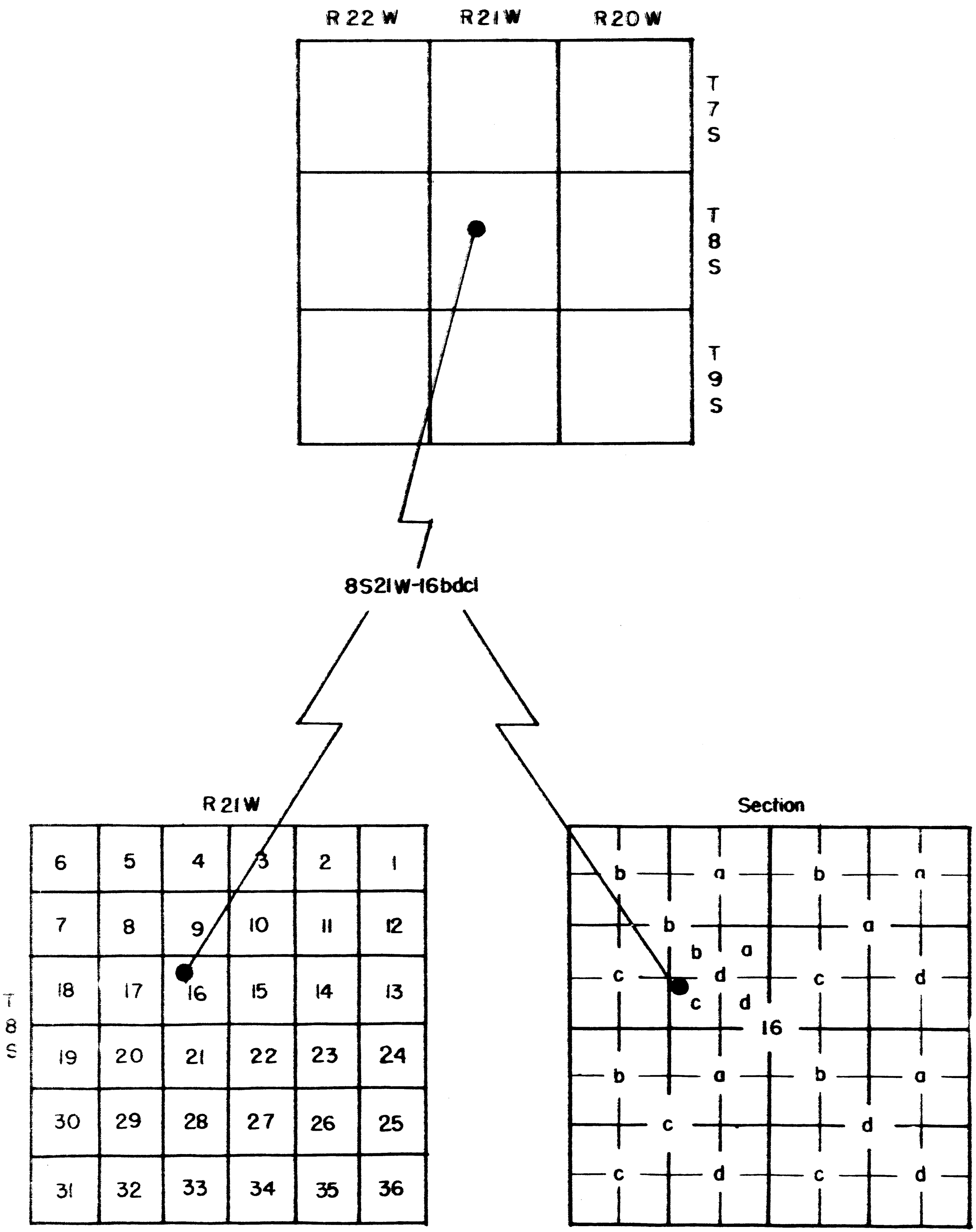


Figure 2. Sketch Showing Well-Numbering System.

are a large number of wells in a small area, and that the shorter map number would be easily referred to in the text of this report.

GEOGRAPHY

Topography and Drainage

The area lies entirely in the Gulf Coastal Plain except for a small part on the north which lies in the Interior Highlands.

The land surface has a general slope to the south, the highest elevations being about 800 feet above sea level for hill tops at the northern edge of the area and the lowest elevations being about 165 feet in the flood plains of streams near the southern boundary of the area. Elevations in the inter-stream areas average from 300 to 600 feet above sea level.

About 2,500 of the 3,900 square miles of the area covered by this report lie directly on the outcrop area of the formations of Cretaceous age. The surface expression of the Cretaceous area is characterized by low rounded hills, aligned in a general northeastward direction, the trend conforming to the outcrop bands of the formations. The more resistant formations, such as the Nacatoch sand and the Tokio formation, stand up as low ridges.

The larger streams, such as the Little, Saline, Little Missouri, Ouachita, and Red rivers flow to the south or southeast across the area from the upland of Paleozoic rocks. They have breached the series of alined hills and ridges and have eroded their valleys to about 100 or 200 feet below the higher hills. The major streams have broad, flat alluvial valleys which range from one to six miles wide, generally being widest at the confluence of major streams or where the streams cross less resistant formations, at which places alluviation is caused by a decrease in velocity. The largest alluviated area is in the southwest part of the area in the valley of the Red and Little rivers. Where the streams have become sluggish and meander over a wide, flat area, frequent floods occur. The bottomlands and backwater areas may remain swampy for extended periods of time after flooding.

The alluvial valleys of the streams are at many places flanked by older terrace deposits. The altitude of the highest noted terrace in the area is about 500 feet above sea level and it occurs about 10 miles east of Nashville in an old valley of the Little Missouri River. The surface slopes southward and drops to an altitude of 470 feet in a distance of 4 miles. Occasional patches of gravel may indicate older terraces. Near Prescott younger terraces occur about 100 feet above the present flood plain of the Little Missouri River. A wide terrace north and south of Ashdown in the southwestern part of the area lies at about the same elevation and was probably formed at the same time. A terrace along the Red River east and south of Fulton stands at about 60 feet above the bottomland of the river.

Climate

Growing season and rainfall information for selected weather stations in the area are shown on Tables 1 and 2. Growing season, temperature and rainfall information for Hope, near the center of the area, are shown on Figure 3. The average frost-free growing season varies over the area with a maximum of about 233 days at Hope and a minimum of 216 days reported for Index, in Little River County, with an overall average of 226 days. The average annual precipitation varies from 44 inches to 51 inches for an 80 year period. The maximum and minimum over the area are about 60 to 40 inches respectively.

In general, the summers are hot and the winters are mild. Rainfall is plentiful for most agri-

TABLE 1

Average Dates of Earliest and Latest Killing Frosts and Lengths of Frost-Free Growing Seasons for Selected Weather Stations

	Average date of last killing frost	Average length of growing season (days)	Average date of first killing frost
Hope	March 20	233	Nov. 8
Index	March 28	216	Oct. 30
Prescott	March 24	228	Nov. 7
Texarkana	March 21	232	Nov. 8
White Cliffs	March 26	225	Nov. 6
Average	March 24	226	Nov. 5

TABLE 2

Average Monthly Precipitation for Selected Weather Stations

Station	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
Arkadelphia	4.63	3.82	4.88	5.23	5.20	4.49	3.71	3.65	2.77	3.09	3.85	5.04	50.36
Fulton	4.57	3.28	4.55	4.60	4.51	3.81	3.56	2.82	2.49	2.58	3.79	4.10	44.66
Hope	4.99	4.07	5.08	5.31	5.09	3.74	4.35	3.28	3.06	3.19	4.65	4.64	51.35
Index	4.28	3.51	4.56	4.65	4.31	3.21	3.91	2.97	2.47	2.86	4.24	4.66	45.63
Prescott	4.74	3.80	4.56	5.12	4.89	3.72	3.54	3.16	2.92	2.63	3.71	4.66	47.45
Texarkana	4.48	3.37	4.30	4.94	4.52	3.71	4.11	3.37	2.67	3.41	3.67	4.61	47.16
White Cliffs	3.96	3.44	4.47	5.47	4.81	3.51	2.69	2.90	2.51	3.13	3.33	4.64	44.86

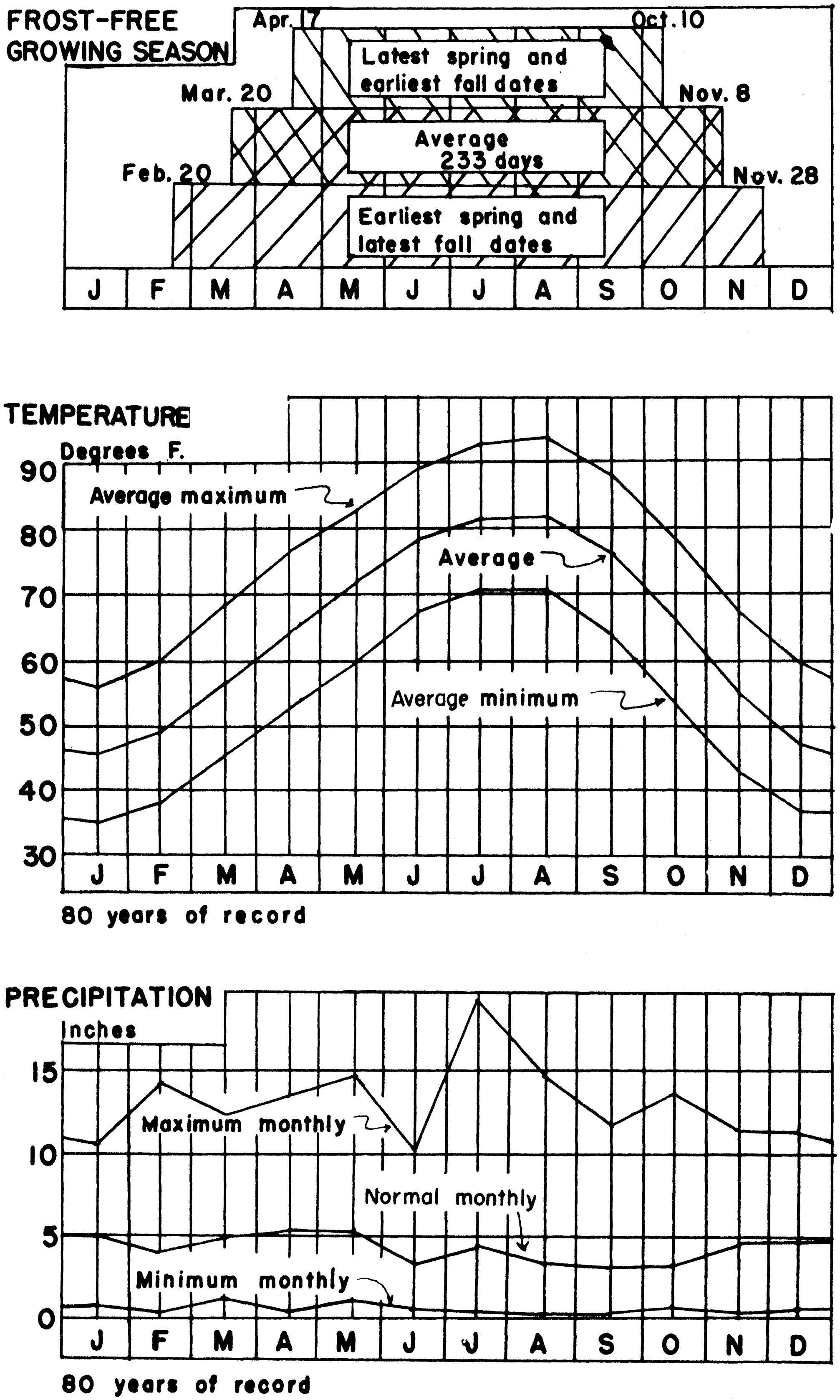


Figure 3. Selected Climatological Data for Hope, Ark.

cultural needs with the largest amounts falling in the winter and spring months. Extended droughts are unusual but occur occasionally. The summer of 1951 brought a fairly long drought which was not too damaging to crops, but the summer of 1952 brought a damaging drought.

Cultural Development

The population of the area has been variable. In general it increased up to about 1920, was about constant from 1920 to 1940, and has decreased since 1940. The decrease in population during the last few years can be attributed to the general migration from farms to industry during the war years, to a decrease in cotton acreage, and to an increase in the beef cattle industry which takes less labor than other types of farming and also tends to combine several small farms into larger ones.

Most of the people live on farms and are employed in agriculture. The towns generally have grown in size and some of them have had remarkable increases in population.

The population of counties and of principal municipalities is given in Tables 3 and 4 respectively.

Farming is the most important occupation of the area. The soils of the area range from heavy clay to light sandy loams. A large variety of crops are grown in the area and several places are noted for specific crops, such as Hope for watermelons, and Nashville for peaches. The beef cattle industry and the production of corn and hay have increased during the past few years. Cotton production generally has decreased. Radishes, strawberries, and cucumbers are other important crops.

Lumbering, although not a large industry, is a stable one and is of long standing.

The only cement plant in Arkansas is located about 12 miles south of Nashville where there are large reserves of raw material.

GENERAL GEOLOGY

Published reports by Miser and Purdue (1929) and Dane (1929) give information about the geology of the area, particularly with reference to the surface geology. The following statements about the geology are taken largely from those reports.

Rocks of Paleozoic age crop out along the northern part of the area. The formations at

TABLE 3
Population of Counties by Decades from 1890 to 1950[1]

County	1950	1940	1930	1920	1910	1900	1890
Clark	22,958	24,402	24,932	25,632	23,686	21,289	20,997
Hempstead	25,045	32,770	30,847	31,602	28,252	24,101	22,796
Howard	13,360	16,621	17,489	18,565	16,898	14,076	13,789
Little River	11,232	15,932	15,515	16,301	13,597	13,731	8,903
Miller	31,382	31,874	30,586	24,021	19,555	17,558	14,714
Nevada	14,761	19,869	20,407	21,934	19,344	16,609	14,832
Pike	9,995	11,786	11,792	12,397	12,565	10,301	8,537
Sevier	12,244	15,248	16,364	18,301	16,616	16,339	10,072
Totals	140,977	168,502	167,932	168,753	150,513	134,004	114,640

[1]The total county population is given in this table. Only three counties, Hempstead, Little River and Sevier, are completely within the area covered by this report.

TABLE 4
Populations of Principal Municipalities by Decades from 1890 to 1950

Municipality	1950	1940	1930	1920	1910	1900	1890
Arkadelphia[1]	6,819	5,078	3,380	3,311	2,745	2,739	2,455
Ashdown[2]	2,738	2,332	1,607	2,052	1,247	400	....
DeQueen[2]	3,015	3,055	2,938	2,517	2,018	1,200	....
Dierks[1]	1,253	1,459	1,544	1,495	272	....	....
Foreman[2]	907	1,007	1,056	1,408	612	....	....
Gurdon[2]	2,390	2,045	2,172	1,469	1,284	1,045	802
Hope[2]	8,605	7,475	6,008	4,790	3,639	1,644	1,937
Murfreesboro[2]	1,079	835	733	730	516	200	159
Nashville[1]	3,548	2,782	2,469	2,144	2,374	928	810
Prescott[2]	3,960	3,177	3,033	2,691	2,705	2,005	1,287
Texarkana[3]	15,875	11,821	10,764	8,257	5,655	4,914	3,528

[1] Uses surface water.
[2] Uses ground water.
[3] Uses surface water and ground water.

the surface consist of the Stanley shale, the Jackfork sandstone, and the Atoka formation. The rocks extend to the south but they are overlain by younger formations. The contact with the younger formations dips in a general south or southeasterly direction at a rate of about 120 feet per mile.

Over most of the area the Paleozoic rocks are overlain by sediments of Cretaceous age. In the southern part of the area rocks of Jurassic age occur between the Paleozoic rocks and the Cretaceous formations but they are deeply buried and do not crop out in Arkansas.

The deposits of Cretaceous age have the form of a wedge, thinning to a feather edge to the north against the Paleozoic rocks and thickening rapidly to the south. Stratigraphically the Cretaceous deposits have been divided into the Lower Cretaceous (Comanche) series and the Upper Cretaceous (Gulf) series. A generalized geologic column of the area covered by this report is given in Table 5. Plate 1 shows the geologic sequence and the dip of the Cretaceous formations and Plate 2 shows the surface geology of the area.

The Lower Cretaceous deposits crop out in a wedge shaped east-west trending band bordering the Interior Highlands. About 10 miles east of Murfreesboro the outcrop is about 3 miles wide and reaches a width of more than 12 miles about 4 miles east of DeQueen. The dip of the strata averages about 80 to 120 feet per mile southward.

The majority of the Lower Cretaceous deposits in Arkansas are near-shore gravel, sand, clay, and lime, parts of which have become indurated. To the south there is a change in facies from a shallow water or marginal environment to a deeper water type material. The thickness of the Lower Cretaceous strata ranges from about 500 feet at the outcrop to more than 6,000 feet in northern Louisiana.

The only major outcrop area of the Lower Cretaceous strata in Arkansas is of beds of the Trinity group. Of minor importance are small outcrop areas of the Goodland limestone and Kiamichi formation, located at the Arkansas-Oklahoma boundary just south of the place where the Little River enters Arkansas from Oklahoma. These formations are younger than the Trinity.

Deposits of Upper Cretaceous series overlie Lower Cretaceous deposits. The position of Upper Cretaceous strata in relation to the Lower Cretaceous suggest a shift in the direction of the shore line during the times of flooding, for instead of striking parallel to older strata the formations seem to pivot to northeast-southwest. Such a discordance in strike could be the result of eastward tilting and downwarping of the Paleozoic floor (Veatch 1906). The downwarping was probably continuous during late Cretaceous time since the older formations at their outcrops became thinner to the northeast. However, it is recognized that an eastward thinning of these deposits could have been the result of more rapid erosion or of lesser deposition in this area than in the west. The beds dip to the south and southeast at rates of from about 40 to 80 feet per mile.

Igneous rocks represented by peridotite plugs are exposed in 4 places about 3 miles southeast of Murfreesboro in Pike County. The peridotite is generally believed to be similar in character and mode of occurrence to that of South Africa. Many diamonds have been taken from 3 of these intrusions. The peridotite is considered to be of early late Cretaceous age (Miser and Purdue 1929).

The deposits of the Cretaceous system have been divided into 12 groups or formations and they are described in this report in connection with their water-bearing properties.

Along the southern edge of the area sediments of Tertiary age overlie the Cretaceous deposits. These deposits yield water to wells mainly in Little River, Miller and Nevada Counties. They consist of the Midway formation of the Paleocene series and the Wilcox formation of the Eocene series. The Wilcox yields water to wells in the southern part of the area and is described in connection with its water-bearing properties.

Deposits of Quaternary age overlie the older formations occurring as terraces and in the bottomlands along the major stream valleys. These deposits yield water to wells mainly in Little River, Miller and Nevada Counties. They are described later in connection with their water-bearing properties.

GROUND WATER

Occurrence and Movement

Only a brief discussion of the principles of occurrence and movement of ground water will be given in this report. A comprehensive description of these principles is given by Meinzer (1923) and most of the following discussion is of their application to the Southwestern Arkansas area.

TABLE 5
Generalized Geologic Column of Deposits in Southwestern Arkansas

Era	System	Series	Group or formation	Thickness (feet)	Character of materials	Water supply
Cenozoic	Quaternary.		Alluvium and terrace deposits.	0-90	Sand, gravel, silt, and clay.	Yields moderate supplies of hard water to domestic wells and to public supply wells at Ashdown and Foreman.
	Tertiary.	Eocene.	Wilcox formation.	0-600	Lignitic sand and clay.	Yields water to domestic wells and to one public supply well at Rosston.
		Paleocene.	Midway formation. –Unconformity.–	0-600	Clay, blue plastic. Clay, blue fossiliferous, bottom 30 to 50 feet.	Does not yield water to wells.
Mesozoic	Cretaceous	Upper Cretaceous (Gulf)	Arkadelphia marl.	0-150	Clay, fossiliferous, calcareous with interbedded limestone. Shale, blue in subsurface.	Does not yield water to wells.
			Nacatoch sand.	0-500	Sand massive cross-bedded, limestone lenses and calcareous clay.	Yields moderate supplies of good quality water to domestic, industrial, and public supply wells on outcrop area and a distance of 2 to 15 miles downdip to the south.
			Saratoga chalk. –Unconformity.–	0-60	Chalk, hard white with interbedded blue marl. Fossiliferous.	Does not yield water to wells.
			Marlbrook marl.	0-200	Marl, blue to gray, fossiliferous.	Does not yield water to wells.
			Annona chalk. –Unconformity.–	0-100	Chalk, massive white.	Does not yield water to wells.
			Ozan formation.	0-250	Clay, bluish to tan and clay and marl, sandy. Sand glauconitic at base from 0-20 feet thick.	Yields small amounts of very highly mineralized water to wells.
			Brownstown marl. –Unconformity.–	0-200	Clay, gray to tan, fossiliferous calcareous.	Yields small amounts of highly mineralized water to wells.
			Tokio formation. –Unconformity.–	0-350	Sand, cross-bedded quartz, gravels and clay, gray lignitic.	Yields moderate supplies of good quality water to domestic, industrial, and public supply wells. Locally water has high iron content.
			Woodbine formation. –Unconformity.–	0-250	Clay, red and gray, sand and gravel, yellowish cross-bedded.	Yields small amounts of poor quality water to a few domestic wells.
		Lower Cretaceous (Comanche)	Kiamichi formation.	0-20	Clay, soft gray, marl fossiliferous and lenses of limestone. Present in very small area in Little River County.	Does not yield water to wells.
			Goodland limestone.	0-50	Limestone gray sandy and clay gray. Present in very small area in Little River County.	Does not yield water to wells.
			Trinity group.	0-900	Sand, fine, white, interbedded with red and clay, and limestone.	Yields moderate supplies of fair quality water in Howard and Sevier counties.
				0-100	Limestone, interbedded gray, clay and gypsum, gray.	Does not yield water to wells.
				0-40	Gravel.	Yields moderate supplies of fair quality water in DeQueen and vicinity.
				0-400	Clay, red, interbedded with gray sand.	Does not yield water to wells.
				0-40	Limestone interbedded with dark shale.	Does not yield water to wells.
				0-50	Gravel.	Yields moderate supplies of fair quality water in DeQueen and vicinity.
	Jurassic.			0-?	Red beds and anhydrite.	Not a source of fresh water.
Paleozoic	Mississippian and Pennsylvanian		Atoka formation. Jackfork sandstone. Stanley shale.	0-?	Sandstone and shale, highly folded.	Yields small amounts of hard water to domestic wells.

Ground water is derived chiefly from water that falls as rain or snow. A part of the precipitation runs off in streams, a part is returned to the atmosphere by evaporation and/or by transpiration from vegetation, and a part sinks into the zone of saturation in which all of the openings of the rocks are filled with water.

In most places ground water is slowly but steadily moving under the influence of gravity from areas of intake to areas of discharge. In the more permeable rocks, such as coarse sand, gravel and porous limestone, the water moves with comparative freedom although the movement is very slow, as compared to the flow of a stream. Such rocks are capable of yielding abundant supplies of water to wells. In less permeable rocks, such as shale or clay, molecular attraction and surface tension retard the movement of the water and the movement may be almost infinitely slow. Such rocks yield little or no water to wells.

On the outcrop of water-bearing beds, the water is usually unconfined and does not rise in wells above the water table, which is the upper surface of the zone of saturation and the level at which water is first encountered.

Where water-bearing beds are inclined and are enclosed between relatively impermeable strata, the water is under artesian pressure and will rise in wells above the level at which it is struck. If the altitude to which the water will rise is greater than the altitude of the land surface, flowing wells will result.

The deposits of Cretaceous age consist chiefly of clay, shale, limestone, chalk and marl interbedded with sand and at some places gravel. They dip south and southeastward. The land surface also slopes in the same direction. Hence, artesian conditions exist in all parts of the area, and in many places, mainly in the river valleys, flowing wells are obtained.

Water gets into the formations of southwestern Arkansas by percolation of surface water through the permeable portions of the outcrop areas. The locations of the outcrop areas for the main aquifers in southwestern Arkansas are shown on Plates 3, 4, and 5. Water moves from these areas down the dip of the formations which is south, southeast. On the basis of a few pumping tests and an approximation of the gradient, the rate of ground-water movement is on the order of about 5 feet per year. This figure is not exact but it does illustrate the slow rate at which the water is moving.

The water levels in most wells are subject to fluctuations of varying magnitude. These fluctuations are due to many different causes, but the larger ones are generally a result of a change in the ratio between the rate of ground-water intake or recharge and the rate of loss or discharge. Most water-table wells are supplied in part from intake areas close at hand and respond to changes in rainfall with only a moderate lag. In shallow wells the water level may rise several feet after heavy rains and then decline during dry periods. During prolonged droughts such wells may go dry. The water levels in artesian wells, located at considerable distances from the outcrop area of the water-bearing beds, are not affected immediately or strongly by seasonal or yearly changes in rainfall. Instead there is a time lag and the magnitude of the fluctuations is not as great. Large fluctuations may be caused by a series of wet or dry years. Large fluctuations in pressure in such wells and the accompanying rise and fall in water levels are generally caused by withdrawals of groundwater from the wells themselves or from other wells in the vicinity. Minor fluctuations are caused by changes in barometric pressure, earth tides, passing trains, and other temporary loads upon the aquifer.

When a well is pumped or allowed to flow the water level in the well declines, a hydraulic gradient is developed toward the well from all directions, and water flows toward the well. Within limits the amount of water that will enter a well varies directly with the amount the water-level is lowered. The difference between the static (pre-pumping) water level and the pumping water level in the well is called the drawdown.

Large withdrawals of ground water are almost certainly to be accompanied by a general lowering of the water table or artesian pressure. A cone of depression gradually spreads out in all directions from the center of pumping until large areas may be affected. However, this is usually not very serious unless the rate of decline persists or the trend is such as to indicate that the pumping lift may eventually exceed the economic limit, or that the water-bearing beds will be unwatered.

PERMEABILITY OF WATER-BEARING MATERIALS

The rate of movement of ground water is determined by the size, shape, number, and degree of interconnection of the interstices, by the density and viscosity of the water, and by the hydraulic gradient. The capacity of a water-bearing material for transmitting water under a hydraulic gradient is known as its permeability. Meinzer's coefficient of permeability may be expressed in field terms as the number of gallons of water a day, at 60°F., that is conducted laterally through each mile of the water-bearing bed under investigation (measured at right angles to the direction of flow), for each foot of thickness of the bed and for each foot per mile of hydraulic gradient (Stearns 1928).

The field coefficient of permeability, as determined from aquifer tests, is the same as Meinzer's coefficient defined above except that it is at the existing temperature. This is the coefficient of permeability that is generally used by the U. S. Geological Survey.

The coefficient of transmissibility is a similar measure for the entire thickness of the water-bearing formation and may be defined as the number of gallons of water a day, under prevailing temperature, transmitted through each 1-mile strip extending the height of the aquifer under a hydraulic gradient of 1 foot per mile. It is the field coefficient of permeability multiplied by the thickness of the aquifer in feet.

The coefficient of permeability of the Nacatoch sand and of the Tokio formation at Hope, in Hempstead County, were determined by aquifer tests on wells 309 and 207 of the Hope Water and Light Co. Measurements of discharge were made with permanent meters in the discharge lines and measurements of drawdown and recovery were made with a steel tape. The recovery formula of Theis (1935), which was used in computing transmissibility at each well, may be expressed as follows:

$$T = \frac{264\ Q}{s} \log_{10} \frac{t}{t^1}$$

in which:

T = coefficient of transmissibility, in gallons per day per foot

Q = pumping rate, in gallons per minute

t = time since pumping began, in minutes

t^1 = time since pumping stopped, in minutes

s = residual drawdown at the pumped well, in feet at time t^1.

The residual drawdown (s) is computed by subtracting the static water-level measurement (Tables 6 and 7) from water-level measurements made after pumping stops (Figure 8).

The proper ratio $\frac{\log \frac{t}{t^1}}{s}$ is determined graphically by plotting $\log_{10} \frac{t}{t^1}$ on the logarithmic coordinate of semi-logarithmic paper as shown on Figures 4 and 5.

TABLE 6
Data on Aquifer Test on Well 309 in the Nacatoch Sand

Time since pumping started (minutes) t	Time since pumping stopped (minutes) t^1	$\frac{t}{t^1}$	Depth to water level (feet)	Residual drawdown (feet) (s)	Remarks
			205.22		Static water level
0					Pump started
220	0				Pump stopped
228	8	28.5	234.48	29.26	
230	10	23	232.39	27.17	
233	13	17.9	230.24	25.02	
236	16	14.7	228.54	23.32	
239	19	12.6	226.98	21.76	
242	22	11.0	225.70	20.48	
250	30	8.33	223.37	18.15	
255	35	7.3	221.92	16.70	
260	40	6.5	220.83	15.61	
267	47	5.69	219.69	14.47	
272	52	5.23	218.99	13.77	
280	60	4.67	217.90	12.78	
300	80	3.75	215.92	10.70	
310	90	3.45	215.17	9.95	
325	105	3.10	214.19	8.97	
340	120	2.83	213.45	8.23	
359	139	2.57	212.64	7.42	
370	150	2.46	212.17	6.95	
385	165	2.33	211.68	6.46	
388	168	2.30	211.60	6.38	
406	186	2.18	211.09	5.87	
418	198	2.10	210.82	5.60	
433	213	2.03	210.51	5.29	
445	225	1.98	210.28	5.06	
460	240	1.92	210.04	4.82	

TABLE 7
Data on Aquifer Test on Well 207 in the Tokio Formation

Time since pumping started (minutes) t	Time since pumping stopped (minutes) t^1	$\frac{t}{t^1}$	Depth to water level (feet)	Residual drawdown (feet) (s)	Remarks
			66.92		Static water level
0					Pump started
440	0				Pump stopped
441	1	441	88.95	22.03	
442.5	2.5	177	84.20	17.28	
443.5	3.5	127	82.52	15.60	
445.5	5.5	81	80.63	13.71	
447	7	64	78.77	12.85	
450	10	45	78.08	11.16	
452	12	37.6	77.33	10.41	
455	15	30	76.49	9.57	
457	17	27	76.03	9.11	
461	21	22	75.27	8.35	
465	25	18.5	74.66	7.74	
472	32	14.7	73.88	6.96	
482	42	11.5	73.05	6.13	
492	52	9.5	72.46	5.54	
503	63	8	71.94	5.02	
516	76	6.8	71.47	4.55	
530	90	5.9	71.06	4.14	
550	110	5	70.60	3.68	
572	132	4.3	70.21	3.29	
615	175	3.5	69.65	2.73	
705	265	2.66	68.91	1.99	
770	330	2.34	68.57	1.65	
800	360	2.22	68.43	1.51	
915	475	1.92	68.07	1.15	

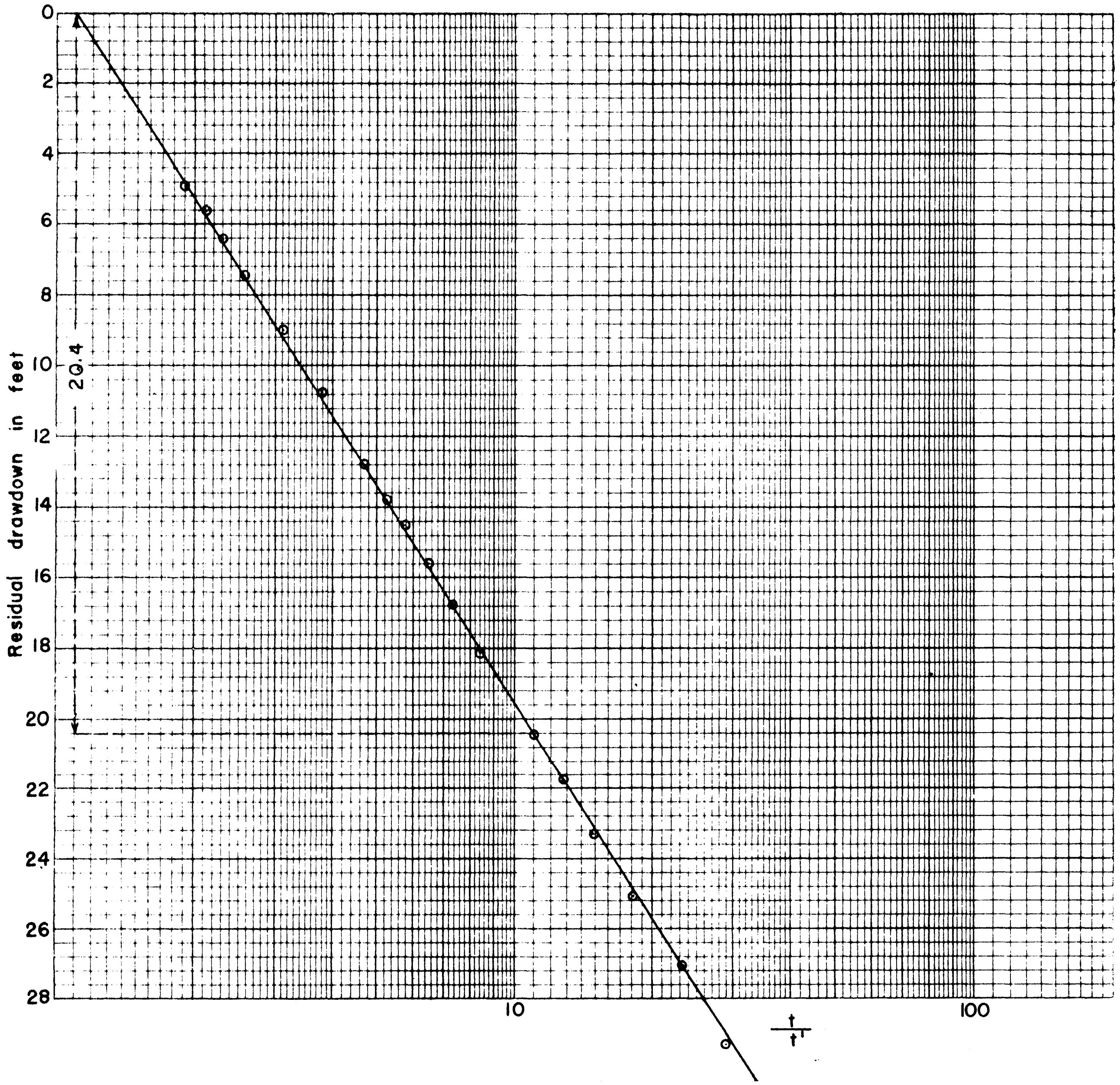
The average discharge (Q) of well 309 in the Nacatoch sand was 280 gallons per minute. When values for s, $\log_{10}\frac{t}{t^1}$, and Q are substituted in the Theis recovery formula (Figure 4), the coefficient of transmissibility of the Nacatoch sand near the pumped well is found to be about 3,600 gallons per day per foot. The coefficient of permeability, which is determined by dividing the coefficient of transmissibility by the thickness of the water-bearing material, m, (230 feet), was found to be about 16 gallons per day per square foot. This figure may be too low because well 309 has 230 feet of open hole in the Nacatoch sand which contains some shale and clay that are not water-bearing. The effective thickness in this well is probably about 100 feet which would give a coefficient of permeability of 36.2 gallons per day per square foot.

The average discharge of well 207 in the Tokio formation was 184 gallons per minute. When values for s, $\log_{10}\frac{t}{t^1}$, and Q are substituted in the Theis recovery formula (Figure 5) the coefficient of transmissibility of the sand layer in the Tokio formation, near the pumped well, is found to be about 4,500 gallons per day per foot. This figure may seem high when compared to 1,300 gallons per day per foot obtained from a test on well 175 in the same formation as shown on the following page. Although no samples are available to make comparisons, it is believed that the difference reflects the true character of the materials because drillers report that the Tokio formation is much coarser in the vicinity of Hope than in Howard County where well 175 is located.

The late points on Figure 5 indicate that there is probably leakage from some sand above or below into the aquifer, therefore, these were not used when drawing the line for calculations of the transmissibility.

The thickness of the sand is 49 feet (see drillers log 207), and, therefore, the coefficient of permeability is about 90 gallons per day per square foot.

Another aquifer test in the Tokio formation was made at the Ideal Cement Company, in Howard County. Well 175 was pumped at 70 gallons per minute and water-level measurements were made in well 177. Table 8 shows the drawdown in well 177 with well 175 pumping. The coefficient of transmissibility and the coefficient of storage were determined by the Theis nonequilibrium method. The coefficient of storage is defined as the amount of water, in



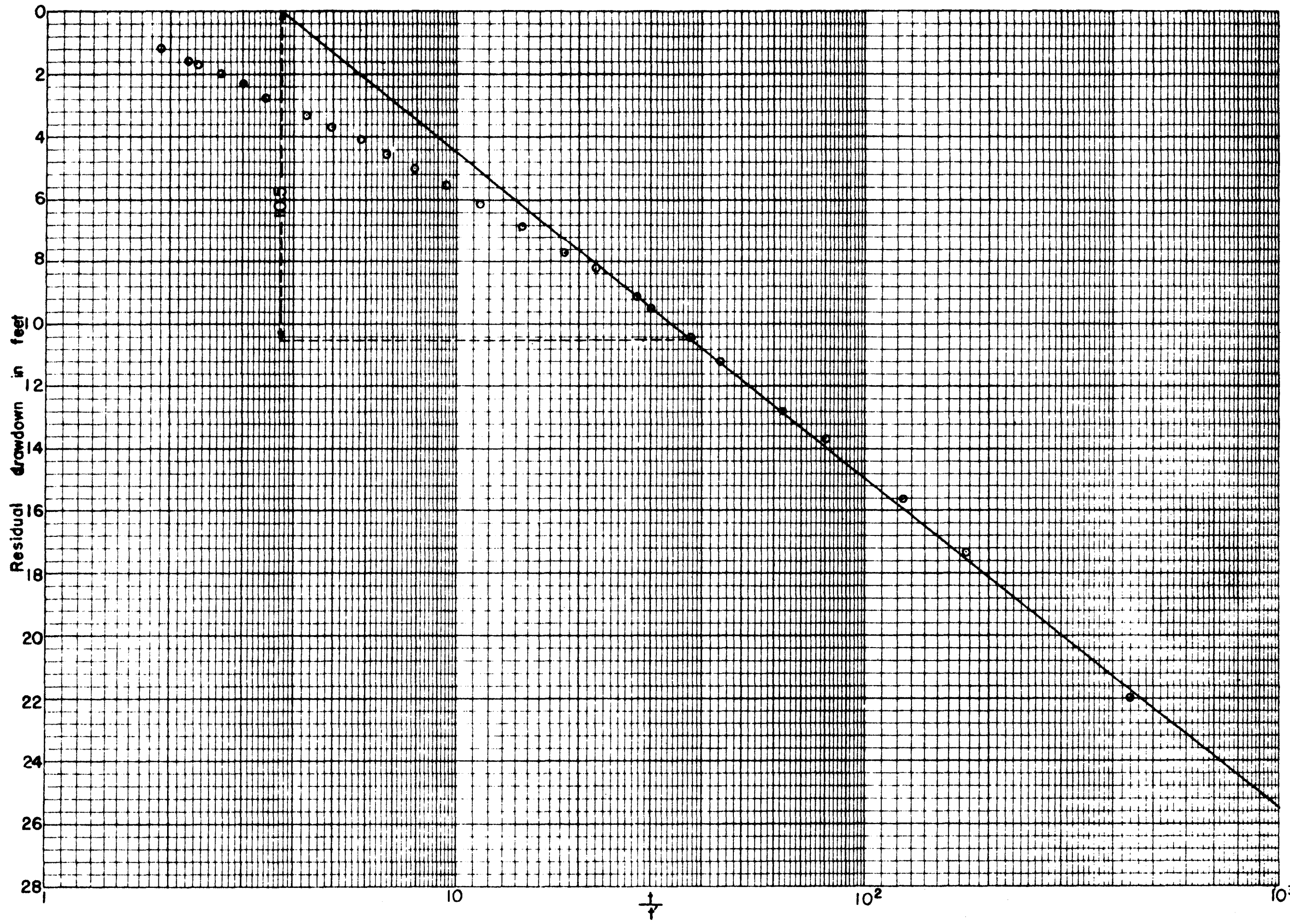
Q = 280 gpm

m = 230 feet

$T = \frac{264\,Q}{s}\ \log_{10} \frac{t}{t'} = \frac{264 \times 280}{20.4} = 3600\ gpd/ft$

$P = \frac{3600}{230} = 16\ gpd/ft^2$

Figure 4. Curve for Aquifer Test on Well 309 in the Nacatoch Sand.



Q = 184 gpm

m = 49 feet

$$T = \frac{264Q}{\log 10\frac{t}{t'}} = \frac{264 \times 184}{10.5} = 4500 \text{ gpd/ft}$$

$$P = \frac{4500}{49} = 90 \text{ gpd/ft}^2$$

Figure 5. Curve for Aquifer Test on Well 207 in the Tokio Formation.

TABLE 8

Data on Aquifer Test in the Tokio Formation with Well 175 Pumping 70 gpm and with Water-Level Measurements Made in Well 177

Time since pumping started (minutes) t	r = 2,080 feet = distance from pumping well $\frac{r^2}{t\ (\text{min})}$	Depth to water level (feet)	Drawdown (feet)	Remarks
		115.95		Static water level
0				Pump started Q=70 g.p.m.
22	1.97×10^5	115.95	0	
53	8.15×10^4	115.96	0.01	
69	6.27×10^4	115.96	0.01	
84	5.15×10^4	115.98	0.03	
98	4.41×10^4	115.99	0.04	
123	3.5×10^4	116.03	0.08	
176	2.46×10^4	116.17	0.22	
193	2.24×10^4	116.22	0.27	
207	2.09×10^4	116.27	0.32	
230	1.88×10^4	116.36	0.41	
275	1.57×10^4	116.59	0.64	
308	1.4×10^4	116.76	0.81	
355	1.22×10^4	117.03	1.08	
405	1.07×10^4	117.30	1.35	
455	9.5×10^3	117.60	1.65	
505	8.55×10^3	117.87	1.92	
555	7.8×10^3	118.15	2.20	
620	6.96×10^3	118.48	2.53	
675	6.4×10^3	118.87	2.92	
755	5.72×10^3	119.27	3.22	
840	5.15×10^3	119.59	3.64	
925	4.67×10^3	119.95	4.00	
1015	4.25×10^3	120.33	4.38	
1110	3.89×10^3	120.70	4.75	
1205	3.58×10^3	120.91	4.96	
1325	3.26×10^3	121.29	5.34	Pump stopped

cubic feet, that will be discharged from a vertical column of the aquifer having a basal area of one square foot when the water level is lowered one foot (Theis 1935). The Theis nonequilibrium formula may be written as follows:

$$s = \frac{114.6q}{T}\int_{\frac{1.87r^2S}{Tt}}^{\infty}\frac{e^{-u}}{u}du \qquad (1)$$

Where:

s = drawdown of water level, in feet.

Q = discharge of pumped well, in gallons per minute.

r = distance of observation well from pumped well, in feet.

T = coefficient of transmissibility, in gallons per day per foot.

S = coefficient of storage.

t = time well has been pumped, in days.

The exponential integral of formula (1) is replaced by the term W(u) which is read "Well function of u", and the equation is rewritten as follows:

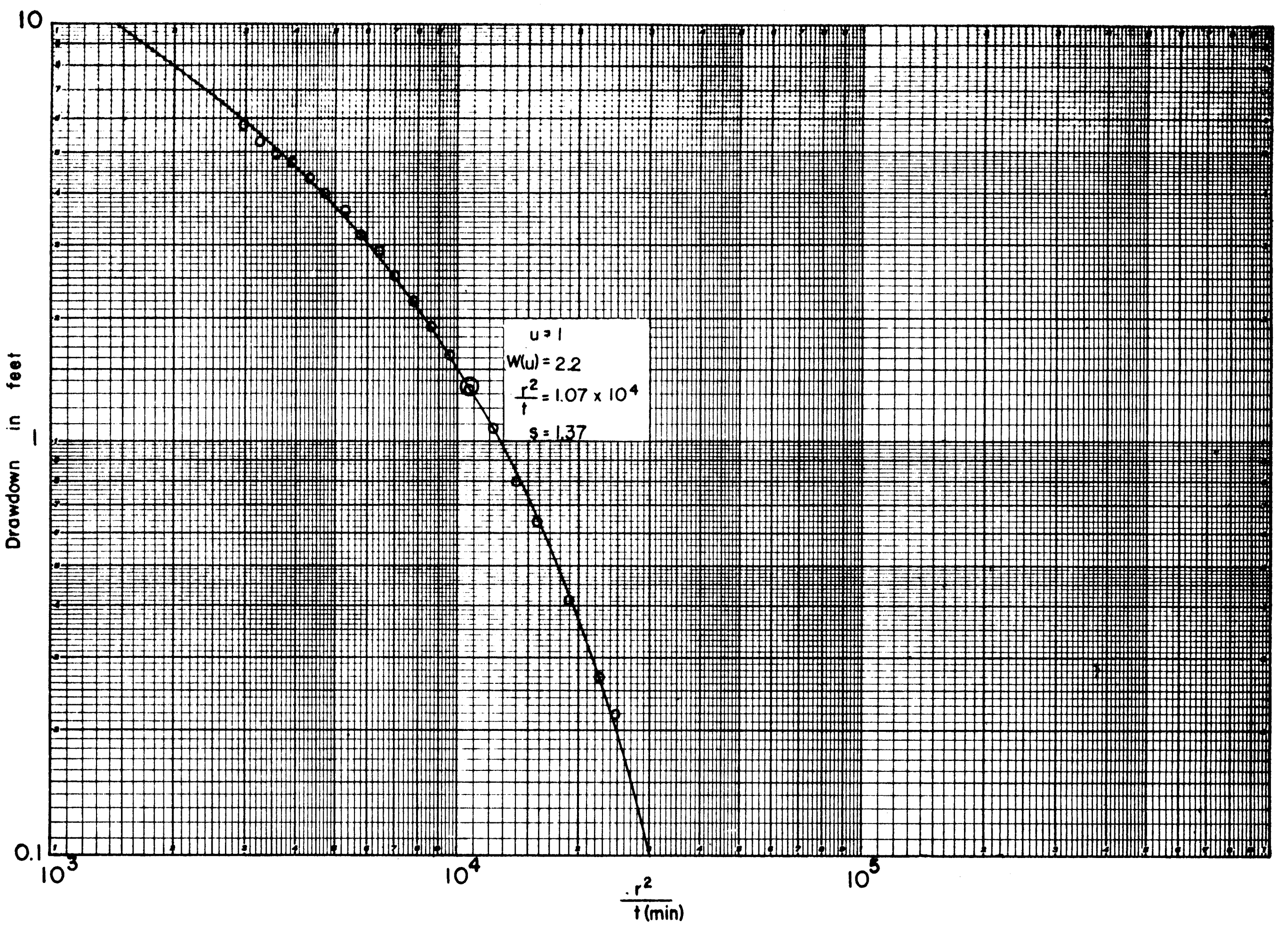
$$s = \frac{114.6\ Q}{T} W(u) \qquad (2)$$

The value of the integral is given by the following series:

$$W(u) = -0.577216 - \log_e u + u - \frac{u^2}{2.2!} + \frac{u^3}{3.3!} - \frac{u^4}{4.4!} \qquad (3)$$

$$\text{where } u = \frac{1.87r^2S}{Tt} \qquad (4)$$

Values of W(u) for values of u between 9.9 and 1.0×10^{-15} are given by Wenzel (1942). The "well function of u" is plotted against u on log-log paper to form a type curve for determining the transmissibility and the storage coefficients of the formation tested. The observed drawdowns are plotted versus $\frac{r^2}{t}$ on log-log paper (Table 8). The graph of the observed data (Figure 6) is matched with the type curve by superposition, keeping the axes of the two graphs parallel, and the values of $\frac{r^2}{t}$, s, W(u),



Q = 70 gpm

m = 21 feet

$$T = \frac{114.6\ Q\ W(u)}{s} = \frac{114.6 \times 70 \times 2.2}{1.37} = 1300\ \text{gpd/ft}$$

$$S = \frac{u\ T}{1.87\ \frac{r^2}{t\,(days)}} = \frac{1 \times 1300}{1.87 \times 1.07 \times 10^4 \times 1440} = 0.000044$$

$$P = \frac{1300}{21} = 62\ \text{gpd/ft}^2$$

Figure 6. Curve for Aquifer Test in the Tokio Formation with Well 175 Pumping 70 gpm and with Water-Level Measurements Made in Well 177.

and u are selected for any convenient point on the graph. The value of transmissibility is obtained from equation 2, and the value of the storage coefficient is then obtained from equation 4 (Figure 6). The coefficient of transmissibility near wells 175 and 177 is found to be 1,300 gallons per day per foot. The thickness of the water-bearing sand is 21 feet, therefore the coefficient of permeability is 62 gallons per day per square foot. The coefficient of storage was found to be 0.000044. This means that for each foot that the water level falls, 0.000044 cubic feet of water will be released from storage in each column the height of the aquifer with a base 1 foot square.

A fourth aquifer test was made on the city of Ashdown water supply wells in deposits of Quaternary age. Well 383 was pumped at 80 gallons per minute and water level measurements were made in an abandoned well 85 feet from well 383 (Table 9). The aquifer coefficients were determined by the Theis nonequilibrium method. The coefficient of transmissibility was found to be about 5,000 gallons per day per foot. The aquifer thickness is about 30 feet, therefore, the coefficient of permeability is about 170 gallons per day per square foot (Figure 7). The coefficient of storage is found to be 0.0012. This storage coefficient is considered to be in the semi-artesian or leaky-aquifer range. It is too high for artesian aquifers and too low for water table aquifers. This is reasonable because the wells are screened with 20 feet of screen set in about 14 feet of sand at the bottom of the well with about 6 feet of the screen extending up into 11 feet of clay which overlies the sand. Another sand layer about 18 feet thick overlies the clay. The clay in these deposits is usually sandy and silty and water from the upper sand layer probably leaked through the clay into the sand layer tapped by the well. Under these conditions the coefficient of storage would increase with time and if this test could have been run much longer the storage coefficient would probably increase to about 0.1. Calculations of drawdowns made with the coefficient determined by this test would be greater than the actual drawdowns.

TABLE 9

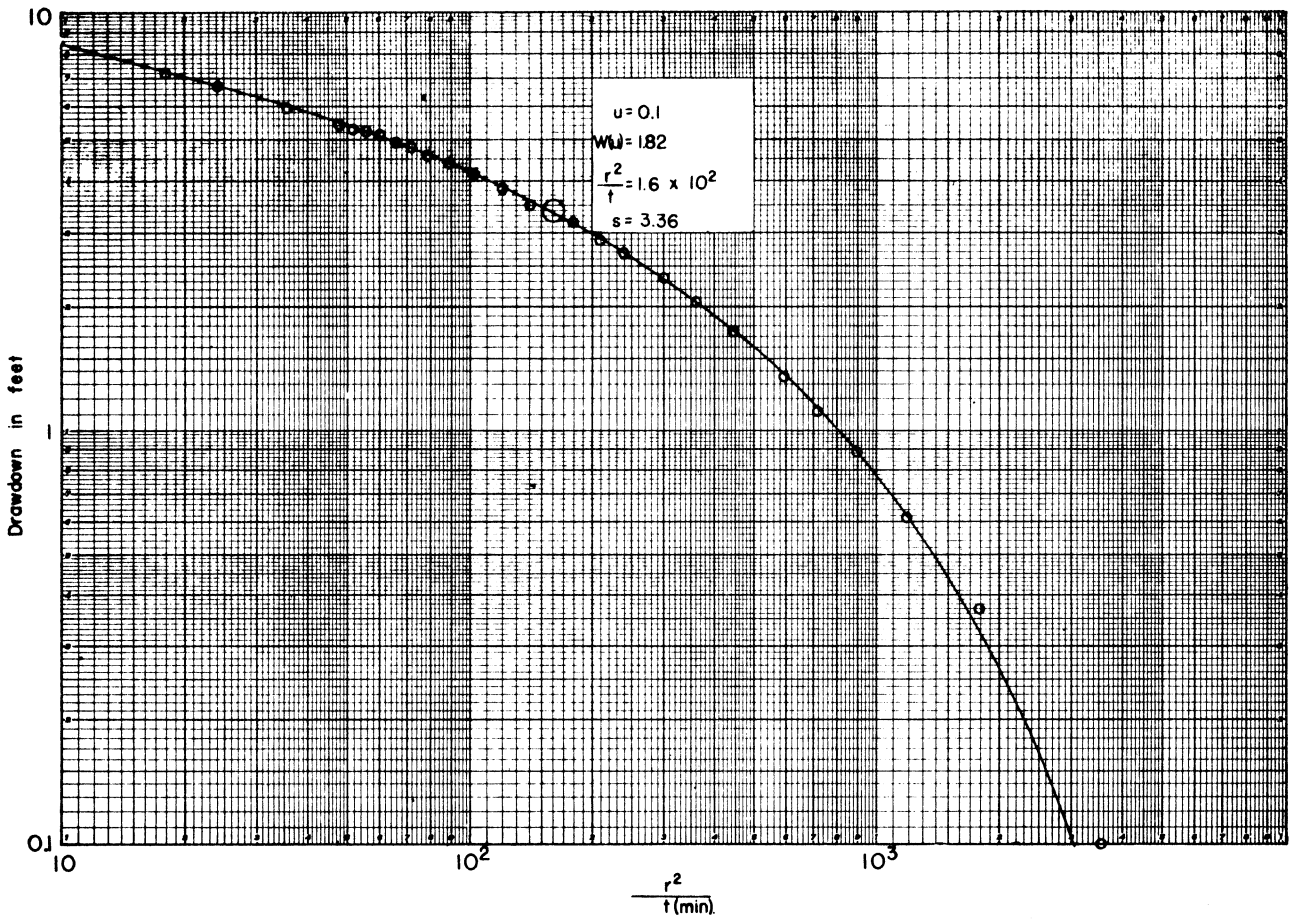
Data on Aquifer Test in Deposits of Quaternary Age with Well 383 Pumping 80 gpm with Water-Level Measurements Made in an Old Abandoned Well

Time since pumping started (minute)	r=85 feet= distance from pumping well; r^2/t (min.)	Drawdown (feet) s
2	3.6 x 10^3	0.10
4	1.8 x 10^3	0.37
6	1.2 x 10^3	0.62
8	9.0 x 10^2	0.88
10	7.2 x 10^2	1.12
12	6.0 x 10^2	1.35
16	4.5 x 10^2	1.75
20	3.6 x 10^2	2.07
24	3.0 x 10^2	2.32
30	2.4 x 10^2	2.70
35	2.1 x 10^2	2.90
40	1.8 x 10^2	3.18
50	1.4 x 10^2	3.55
60	1.2 x 10^2	3.85
70	1.03 x 10^2	4.15
80	9.0 x 10	4.36
90	8.0 x 10	4.60
100	7.2 x 10	4.80
110	6.6 x 10	4.98
120	6.0 x 10	5.10
130	5.55 x 10	5.20
140	5.15 x 10	5.30
150	4.8 x 10	5.40
200	3.6 x 10	5.95
300	2.4 x 10	6.70
400	1.8 x 10	7.18

Recovery of Ground Water from Wells

When a well is pumped, the water level in the well, and for some distance from the well, declines and the water table or prezometric surface takes a form similar to that of an inverted cone, called the cone of depression. The greater the pumping rate of a well the greater the drawdown (difference between static and pumping water levels) and the deeper the cone of depression. The rate of discharge of a well per unit of drawdown is the specific capacity of the well. The Hope Light and Water Company well 309, in the Nacatoch sand, for example, yielded 280 gallons per minute with a drawdown of 118 feet, hence its specific capacity was 2.5 gallons per minute per foot of drawdown. The specific capacity of well 207 of the Hope Light and Water Company, in the Tokio formation, is 2 gallons per minute per foot of drawdown and for well 175 of the Ideal Cement Company, also in the Tokio formation, the specific capacity is 0.7 gallons per minute per foot of drawdown.

When a well is pumped, the water level drops rapidly at first and then more slowly, but it may continue to drop for several hours or even for many days or years. In testing the specific capacity of a well, it is important to pump the well until the water level declines only very slowly. When a pump is stopped, the water level in the well rises rapidly at first and then more slowly until it approaches or reaches its original position. Figure 8 is a graph showing the rate of recovery of the water level in well 207 of the Hope Light and Water Company after it had been pumped at a rate of 184 gallons per minute for 7.5 hours. After the water level had been



$Q = 80 \text{ gpm}$

$m = 30 \text{ feet}$

$$T = \frac{114.6\ Q\ W(u)}{s} = \frac{114.6 \times 80 \times 1.82}{3.36} = 5000 \text{ gpd}/_{ft}$$

$$S = \frac{u\ T}{1.87\ r^2/t\ (\text{days})} = \frac{0.1 \times 5000}{1.87 \times 1.6 \times 10^2 \times 1440} = 0.0012$$

$$P = \frac{5000}{30} = 170 \text{ gpd}/_{ft^2}$$

Figure 7. Curve for Aquifer Test in Deposits of Quaternary Age with Well 383 Pumping 80 gpm with Water-Level Measurements Made in an Old Abandoned Well.

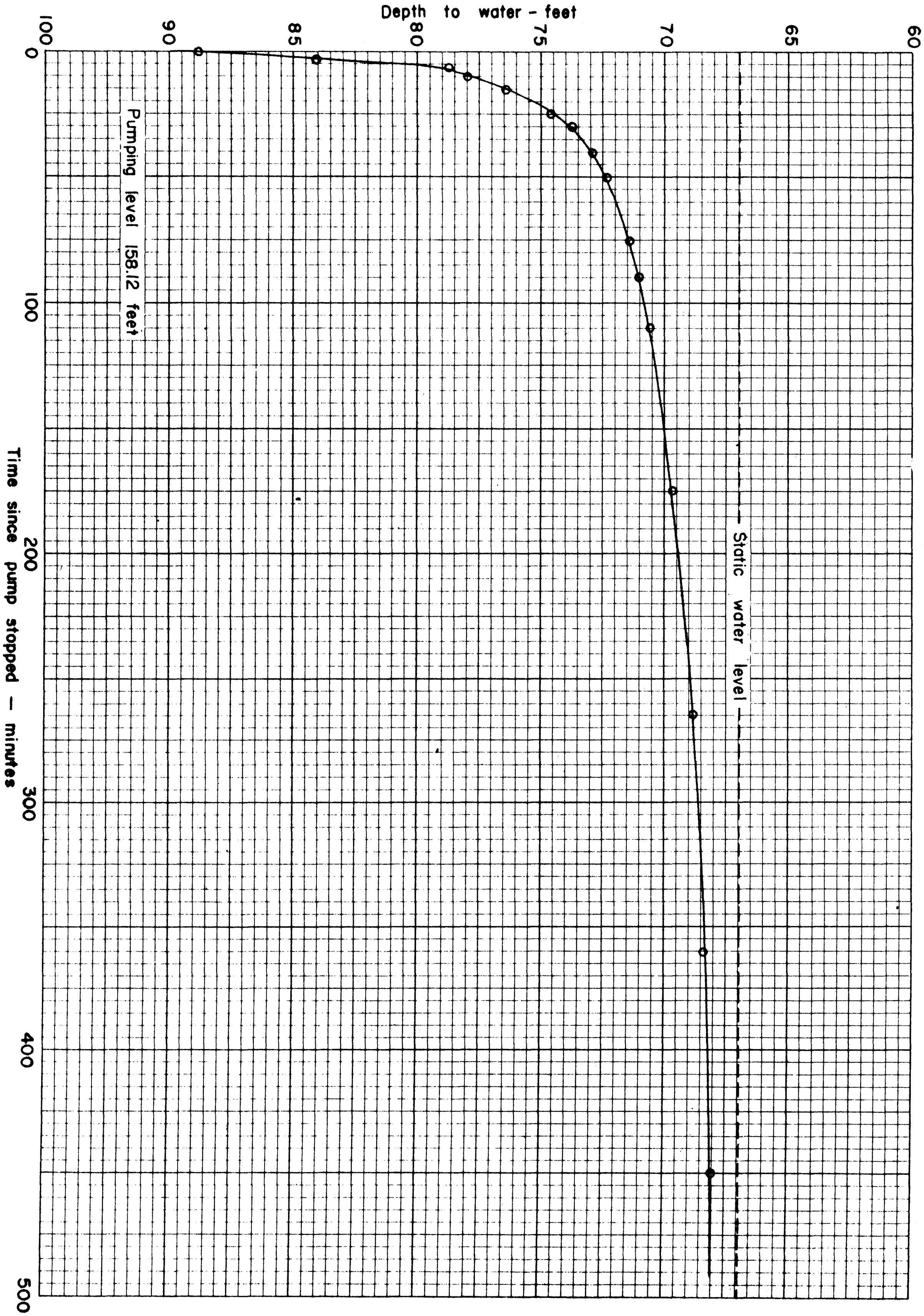


Figure 8. Recovery Curve for Well 207 of the Hope Light and Water Company.

allowed to recover for almost 8 hours it lacked 1.15 feet of returning to the original static level.

The character and thickness of the water-bearing materials have a definite bearing on the yield and drawdown of a well and, therefore, on the specific capacity of a well. Drawdown increases the height that the water must be lifted in pumping a well, thus increasing the cost of pumping. If the water-bearing material is coarse and uniform in size it will readily yield large quantities of water to a well with relatively small drawdown; if the water-bearing material is fine and poorly-sorted, as in most of the water-bearing formations in the area covered by this report, it will offer more resistance to the flow of water into the well thereby decreasing the yield and increasing the drawdown. Other things being equal, the drawdown of a well is inversely proportional to the transmissibility of the water-bearing material.

Utilization of Ground Water

There are many wells in the area covered by this report. All of the larger wells and approximately three-fourths of all the wells in the area were studied and the data obtained on these 397 wells are given in Table 11. The ground water withdrawn from these and other wells is estimated to average about 8.5 million gallons per day. The rates of use (in million gallons per day) for different purposes are: Public Supplies 3, Industrial 0.5, Domestic Use 3, Wastage 2, and Irrigation less than 0.1.

These figures are based on city pumpage records, industrial pumpage, not including industrial use from city supplies, per capita use of 50 gallons per day per person, including water for stock, of rural population, actual measurement of water from flowing wells going to waste, and acreage irrigated.

Public Supplies

There are 11 municipalities in the area that use ground water as a source of public supply. Eight of these supplies are described briefly in the following paragraphs.

Ashdown.—The city of Ashdown is supplied by 4 drilled wells, (383, 384, 385 and 386), in deposits of Quaternary age. The wells are 90 feet deep except well 385 which is 96 feet deep, and they are 10 inches in diameter except well 386 which is 8 inches in diameter. They contain approximately 20 feet of screen from about 70 feet to the bottom. The wells are equipped with electrically-driven turbine pumps with a reported capacity of about 80 gallons a minute each. The output of well 383 was measured at 80 gallons per minute during the aquifer test at Ashdown.

The water is pumped from a 75,000 gallon ground reservoir with an electrically-driven centrifugal pump into a 50,000 gallon elevated tank. The water, which is distributed through the mains by gravity, is hard but suitable for most uses (see analysis well 386 in Table 12).

DeQueen.—The water supply for DeQueen is obtained from 3 wells (2, 4, and 5) that have a reported yield of 150 to 200 gallons per minute each. These wells yield water from sand and gravel in the Trinity group from a depth of 145 to 450 feet. The water is pumped from the wells with turbine pumps, driven by electric motors, into a 150,000 gallon ground reservoir. It is pumped from the ground reservoir into a 50,000 gallon elevated tank. The city has another well (3) that is not used except in emergencies because it pumps sand. It yields water from the same strata.

Analyses of the 4 wells (Table 12) indicate a total hardness of 58 to 180 parts per million.

Foreman.—The town of Foreman obtains its water supply from 2 dug wells (390 and 391) in deposits of Quaternary age. Their yields are 38 and 15 gallons per minute. The water is stored in an 11,000 gallon ground reservoir and a 50,000 gallon elevated tank.

An analysis for well 390 is given in Table 12.

Gurdon.—Gurdon is supplied with water from 2 wells (250 and 251) tapping the Nacatoch sand. They are 4 inches in diameter and are 245 feet deep. A third well (252) of the same depth is reported to yield water mixed with asphalt and is used only in emergencies. The wells are equipped with electrically-driven turbine pumps and the reported yield in gallons per minute are 60 for well 250, 50 for well 251, and 100 for well 252. The water is pumped into an elevated tank for distribution.

An analysis of water from well 250 is given in Table 12.

Hope.—Water is supplied to the city of Hope by 5 wells. Wells 208 and 209 are 1,480 and 1,500 feet deep, respectively, and yield water from the Tokio formation. Well 208, drilled in 1918, has 50 feet of perforated casing from 1,430 feet to 1,480 feet, and well 209, drilled in 1950, has 120 feet of screen from 1,380 feet to 1,500 feet. Wells 309, 310 and 314 are 620 feet deep and yield water from the Nacatoch sand. Well 314 is a gravel-wall well with 76 feet of screen and wells 309 and 310 have no screen. They draw water through the open end of casing from about 230 feet of uncased hole. The city has 2 old Nacatoch wells (311 and 312) 620 feet deep that have no screen. They are not cased below 370 feet and have been abandoned. Wells 206 and 207, about 4 miles north of Hope, are on the former Army Air Force Proving Ground now owned by the city of Hope. These wells yield water from the Tokio formation. Well 206 is used to furnish water to a housing area near the well.

Water from the wells is pumped by electrically-driven turbine pumps into a ground reservoir and then pumped into an elevated tank for distribution through the city mains. The average rate of use is about one million gallons per day.

Analyses of water from wells 207, 208, 209, 309, 311 and 312 are given in Table 12.

Murfreesboro.—The city of Murfreesboro is supplied by one well (1) 8 inches in diameter yielding water from sand in the Trinity group. The depth of this well is not known. Water is stored in a 25,000 gallon ground reservoir and distributed from a 55,000 gallon elevated tank.

An analysis of water from well 1 is given in Table 12.

Prescott.—Prescott is supplied with water by 3 wells (152, 280, and 281). Well 152 is 1,070 feet deep, 8 inches in diameter, and yields water from the Tokio formation. Wells 280 and 281 are 250 and 325 feet deep and yield water from the Nacatoch sand. All of the wells are equipped with electrically driven turbine pumps. Storage capacity is 250,000 gallons.

Analyses of water from all 3 wells are given in Table 12.

Texarkana.—The city of Texarkana is supplied with surface water from Bringle Lake and ground water from 3 well fields. Two of these well fields are in Texas and are not described in this report. The Arkansas Station well field has 22 wells (397) ranging in depth from 40 to 50 feet and yielding water from deposits of Quaternary age. Their combined yield is about 700,000 gallons per day. They are equipped with vacuum pumps operated from a common power source.

A composite analysis (397) of water from all 22 wells is given in Table 12.

Industrial Supplies

Industries in the area use ground water at an estimated rate of 0.5 million gallons per day. The largest industrial user is a cement company, located in southern Howard County, which uses about 0.2 million gallons per day. Numerous small industries such as lumber companies, ice plants, railroads, and a brick factory also use ground water.

Domestic Supplies

Many wells in the area furnish water for domestic use. The estimated rate for domestic use is 1.5 million gallons per day. The wells are dug or drilled and they range from 25 to 950 feet in depth. The drilled wells range from 2 to 4 inches in diameter. Water flows from some of the wells and some have sufficient pressure to pipe the water directly into the houses. Others have to be pumped and are generally equipped with small electrically powered pumps.

Irrigation Supplies

A small amount of ground water is used for irrigation in the area. Two wells located in the Red River valley, east of Texarkana, supply water for the irrigation of rice and the supplemental irrigation of dry crops. These wells each have yields of about 400 gallons per minute, and tap alluvium deposited by the Red River.

Water Wastage

In southwestern Arkansas there are two large areas and one small area in which water will flow from wells. The large areas are located in the Little Missouri bottoms in northern Hempstead County, southern Pike County, and northern Nevada County, and southwest of Nashville in southwestern Howard County. The small area is located in southern Sevier County in the Little River bottoms. In these areas there are numerous uncapped wells from which water is flowing and is not being used. The wells were drilled to furnish drinking water for people working in fields, for stock watering, and for use in connection with the lumber industry. Many of the wells are located a considerable distance from habitation. A total of 102 wells were found from which water was flowing and was being wasted. The rate of flow from these ranged from 1 gallon to 90 gallons per minute, averaging about 11. The total rate of flow from the observed wells was about 1.6 million gallons per day (see Table 10). Considering that all of the flowing wells were not found during the study it is likely that the total flow of water being lost was at a rate of about 2 million gallons per day.

TABLE 10
Water Wastage from Flowing Wells

County	Number of wells	Estimated flow (gallons per day)
Hempstead	15	530,000
Howard	32	360,000
Nevada	10	60,000
Pike	24	410,000
Sevier	21	240,000
Total	102	1,600,000

It is estimated that in the Little Missouri bottoms the water level has been lowered as much as 8 feet during the last 20 years. On higher ground nearby, wells, from which water originally flowed, have ceased to flow and at present have to be pumped or have been abandoned.

Many of the flowing wells could be capped thus preventing the loss of water and the lowering of artesian pressure. The water from some of the wells might be used for supplemental irrigation.

Quality of Water

The chemical character of the ground water utilized in the report area is shown by 328 analyses of water listed in Table 12. The analyses were made by the U. S. Geological Survey, using standard procedures that are based on methods found in authoritative publications (Collings 1928 and Am. Public Health Assoc. 1946).

The analyses relate to the dissolved mineral constituents which determine the fitness of the water for municipal, industrial, agricultural, and domestic uses without reference to the sanitary quality of the sample. In most cases a single sample from a well is regarded as being representative of the chemical quality of the water because the concentration of the dissolved minerals of water in individual wells seldom changes appreciably. Exceptions to this generality include very shallow wells, where the concentration is modified by rainfall; wells tapping aquifers that are subject to salt-water encroachment; or wells recharged by streams that fluctuate in mineral concentrations.

Chemical Constituents in Relation to Use

The following discussion of the chemical constituents of ground water in relation to use was adapted from publications of the U. S. Geological Survey and is limited to only those constituents given in Table 12.

Iron.—Iron is dissolved from many rocks and soils and frequently from the pipes through which the water flows. The quantity of this constituent in ground water may differ greatly from one locality to another, even though the waters are derived from the same formation. Waters with a low pH value (high in acidity) tend to dissolve iron readily. Large amounts of iron may interfere with efficient operation of silicate water softeners, and may prove more detrimental than either excessive hardness or dissolved solids. Reddish-brown stains on white porcelain or enameled ware and fixtures, and on clothing or other fabrics washed in water, are often caused by iron. The U. S. Public Health Service Drinking Water Standards, for interstate carriers, recommend a maximum of 0.3 part per million (ppm) of iron and manganese together in potable water. Many industries cannot tolerate any iron in their supply of process water; however, iron is readily removed by aeration and filtration. Unless otherwise noted, values of iron reported in Table 12 are for total iron. The iron content of water sampled in this area ranged from 0.01 part to 54 ppm. Of a total of 328, 241 samples contained less than 1.0 ppm; 59 contained 1.0 part to 5.9 ppm; and 16 contained more than 7.0 ppm iron.

Carbonate and bicarbonate.—Bicarbonate in natural water results from the action that dissolved carbon dioxide has on carbonate rocks. The carbonate radial (CO_3) is generally not found in appreciable quantities in natural waters. Aside from the effect on the palatability of the water where present in excessive amounts, bicarbonate is of little significance in public water supplies.

Carbonate ranged from none in most samples to 98 ppm. Bicarbonate ranged from 3 parts to 773 ppm; most samples had less than 300 ppm.

Sulfate.—Sulfate, when present in sufficient quantities, combines with calcium to form hard, boiler scale, calcium sulfate. The sulfate ranged from 1.0 part to 560 ppm with most samples having less than 100 ppm. All but 11 samples had less than 250 ppm of sulfate, the U. S. Public Health Service recommended limit.

Chloride.—Since the chloride of calcium, magnesium, and sodium is readily soluble, chloride is normally present in most water. Sodium chloride (common table salt) in higher concentrations gives the water a salty taste, and also causes foaming and priming in boilers. Magnesium chloride in waters is believed to form hydrochloric acid by hydrolysis when heated, and such waters would be corrosive. The limit recommended by the U. S. Public Health Service is 250 ppm. The samples ranged from 3.0 parts to 3,850 ppm with all but 49 samples being below the recommended limit.

Nitrate.—Nitrate in water may result largely from the complete oxidation of nitrogenous materials. The quantities usually found in Arkansas waters are not sufficient to be objectionable. The nitrate content of water sampled from this area ranged from 0 parts to 560 ppm with 19 samples having more than 5.0 ppm and 6 samples having more than 40 ppm. Five of the 6 wells with a nitrate content greater than 40 ppm were shallow wells, ranging in depth from 22 to 60 feet; the depth of the other well is not reported. The high concentrations of nitrates are probably due to pollution by surface water, which has been in contact with fertilizers or other nitrate salts, leaking into the wells. Recent studies indicate that nitrates in water may be the cause of methemoglobinemia ("blue babies"). In a report published by the National Research Council, (Maxcy 1950) concludes that a nitrate content in excess of 44 ppm as NO_3 should be regarded as unsafe for infant feeding.

Hardness.—When choosing a water supply for either municipal, industrial, or domestic use, the hardness of the water is probably one of the most important factors considered. It is easily recognized by the increased quantity of soap required to produce lather, by the formation of the insoluble curd that is objectionable in all washing process, and by the deposits of insoluble salts formed when the water is heated or evaporated. In addition to its soap-consuming capacity, hard water is objectionable because of the formation of scale in boilers, water heaters, radiators, and pipes, with a resulting loss in heat transfers, possible boiler failure and loss in flow.

Calcium and magnesium are usually the chief causes of water being hard. Iron and aluminum likewise cause hardness, but are usually present in much smaller quantities than calcium and magnesium. When present as bicarbonate or normal carbonates, the hardness is called carbonate hardness; when present in the form of sulfates, chlorides, nitrates, and other soluble salts of calcium and magnesium, it is called noncarbonate hardness.

Water that has less than 60 ppm of hardness is usually rated as soft and suitable for most uses without further softening. Water with hardness ranging between 60 and 120 ppm may be considered moderately hard, but this amount does not seriously interfere with the use of water for many purposes, except in high-pressure steam boilers and in some industrial processes. Water with hardness ranging from 120 to 200 ppm is considered hard. Where the hardness is in the upper range, laundries and some industries may profitably soften their supplies. Water with hardness greater than 200 ppm needs some softening before it can be used satisfactorily for most purposes, though much harder water is used without treatment, especially for domestic purposes. Analyses of water from the wells sampled for this report show a range in hardness from 3 parts to 790 ppm, but generally less than 100 ppm, except for the aquifers of Quaternary age where it is usually more than 300 ppm.

Specific conductance.—The specific conductance of a water, a measure of its capacity to conduct a current of electricity, is dependent on the concentration and degree of ionization of the different minerals present. Although the conductance value does not give an indication of the relative quantities of the different constituents, it does give an indication of the total quantity of the dissolved minerals. The conductance is of particular use in those instances where the dissolved solids are not determined, since, for Arkansas waters, the dissolved solids value, expressed in ppm, is roughly half the conductance value, expressed in micromhos.

Hydrogen-ion concentration (pH).—The degree of acidity or alkalinity of water, as indicated by the hydrogen-ion concentration, or pH, is related to the corrosive properties of water and must be known for proper treatment for coagulation at water-treatment plants. The pH is the logarithm of the reciprocal of the hydrogen-ion concentration. For practical purposes, the pH scale ranges between the numbers 0 and 14, denoting various degrees of acidity or alkalinity. Neutral water has a pH of 7. Values below 7 and approaching 0 are increasingly acid, while values from 7 to 14 are increasingly alkaline. As the pH becomes less than 7.0, and especially less than about 5.0, the water becomes more corrosive to certain metal surfaces. The pH of the water sampled for this report ranged from 4.7 to 9.2, but in most cases the pH was above 8.0.

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

Mississippian and Pennsylvanian Systems

The Stanley shale, Jackfork sandstone, and Atoka formations crop out on the northern edge of the area covered by this report (Plate 2). These formations consist of folded and faulted hard shale and sandstone. The rocks contain little ground water but sufficient amounts usually can be obtained for domestic use. Veatch (1906) states that water-bearing sandstones occur throughout this area but that it is quite possible to drill 1,000 feet or more without obtaining a good supply.

Jurassic System

Oil geologists have reported rocks of Jurassic age in deep oil tests in the southern part of the area covered by this report. They consist of dark shale, shaley limestone, sandstone, red beds, and anhydrite. These rocks have been overlapped by Cretaceous, Tertiary and younger deposits. They do not crop out and do not yield fresh water to wells. The section shown on Plate 1 does not go deep enough to show the Jurassic deposits.

Cretaceous System—

Lower Cretaceous (Comanche) Series

The Lower Cretaceous of southwestern Arkansas consists of the Trinity group and Kiamichi and Goodland formations. The Trinity is the only unit of early Cretaceous age that yields fresh water to wells in Arkansas. The Kiamichi formation and the Goodland limestone occur in a very small area near Cerrogardo in western Sevier County near the Arkansas-Oklahoma state line.

Trinity Group Undifferentiated

Character, distribution, and thickness.—The outcrop of the Trinity is shown on Plate 3. It includes the lowermost rocks of Cretaceous age in Arkansas. In the northern part of the area it overlies the Mississippian and Pennsylvanian rocks but in the southern part of the area it lies directly on truncated beds of Jurassic age. At its outcrop and for a short distance downdip the Trinity deposits indicate a shallow water, and occasionally a marginal, environment of deposition. The most common materials are clay, sand, gravel, and limestone. Some carbonaceous material is present in the clay and limestone beds.

The Trinity is divided into 6 units for this report. The lowermost unit is gravel. It ranges from 20 to 50 feet thick near its outcrop to a maximum known thickness of about 100 feet downdip. At its zone of contact with the Paleozoic rocks, the gravel is sometimes cemented with iron oxide. At other places it is composed of an unconsolidated mass of rounded pebbles and cobbles ranging in size from one-half inch or less to ten inches in diameter, intermixed and interbedded with sand and clay. The lower gravel unit represents the northern edge of the Lower Cretaceous outcrop and is seen as a very irregular band or as outliners capping many of the hills in the area. Apparently the gravels are thinner to the west and overlapped to the east by younger beds.

The second unit of the Trinity is a limestone that overlies the lower gravel. It thins to the west and extends from the Cossatot River eastward to southeastern Pike County where it is overlapped by younger rocks. It ranges in thickness from 10 feet to about 40 feet and is composed of fossiliferous limestone and some green clay.

The third unit of the Trinity is mostly clay mixed with fine sand. It is thin at its outcrop and reaches a known thickness of nearly 400 feet downdip.

The fourth unit is a gravel lithologically similar to the lower gravel but finer grained. This gravel attains its maximum thickness of about 40 feet near the state line.

The fifth unit is a limestone and immediately overlies the upper gravel. It extends into Oklahoma on the west and to a point about four or five miles south of Murfreesboro on the east where it is overlapped by younger rocks. This upper limestone unit is about 60 feet thick and is composed of interbedded gray fossiliferous limestone and clay with small amounts of gypsum. Downdip the limestone lenses out and is replaced by anhydrite and red shale.

The uppermost unit of the Trinity consists of interbedded sand and red and gray clay and shale. Locally there are thin gravel lenses in this upper unit, but on the whole the sand is usually fine-grained and well sorted. The sand unit wedges out in western Hempstead County.

Near the southern part of the southwest Arkansas area, the Trinity group reaches a probable thickness of more than 2,500 feet.

Water supply.—The Trinity yields water to a part of the wells in southern Howard County and all of the wells in central Sevier County. Records of 37 wells are given in Table 11 and the locations of these wells are shown on Plate 3. The chemical character of water from 33 wells is given in Table 12.

The upper sand unit of the Trinity group is the principal source of water in the group. Flowing wells from this sand may be obtained at the lower altitudes in Howard and Sevier Counties. The largest yield observed from the upper Trinity is from well 34 in the Saline River bottoms which flows about 100 gallons per minute.

The quality of water from the upper sand is variable and similar to water from the overlying Woodbine formation. The Woodbine overlies the truncated edges of these sands and may be interconnected to some extent. The water in the Trinity would require some treatment for most industrial processes.

At and around DeQueen, the upper and lower gravels yield water of fair quality to wells. Wells in these gravels at DeQueen have reported yields of as much as 200 gallons per minute.

There are many dug wells in the outcrop area of the Trinity group that yield small amounts of water for domestic use.

Goodland Limestone

Character, distribution, and thickness.—The only outcrop of the Goodland limestone in Arkansas is at the extreme western edge of the area in the northwest corner of Little River County at the Oklahoma State line. The formation is probably less than 50 feet thick, being made up of hard sandy, light gray, fossiliferous limestone. The Goodland limestone crops out over a large area in Oklahoma.

Water supply.—The Goodland limestone does not yield water to wells in Arkansas.

Kiamichi Formation

Character, distribution, and thickness.—The Kiamichi formation overlies the Goodland limestone. It is probably less than 20 feet thick and is composed of alternating hard and soft, gray, fossiliferous marl and lenses of limestone. The outcrop of the formation also is limited to the extreme northwest corner of Little River County.

Water supply.—The Kiamichi formation does not yield water to wells in Arkansas.

Upper Cretaceous (Gulf) Series

The Upper Cretaceous includes all of the strata above the base of the Woodbine formation and below the base of the Midway formation of Tertiary age. The sequence of formations is shown on Table 5. Deposits of Gulf series rest unconformably on the sand of the Trinity group in the western part of the area but east of the vicinity of the Little Missouri River and in the vicinity of Arkadelphia they rest directly on rocks of Paleozoic age. The formations of late Cretaceous age crop out in parallel bands striking in general northeast-southwest directions. They crop out in a nearly continuous belt from the Ouachita River on the east to the Little River valley on the west. In the west and southwest part of the area, from the Little River valley to the Oklahoma State line, the Gulf sediments are covered by Quaternary terrace and alluvial deposits except for small outliers near Foreman. In general the Gulf formations thicken from east to west.

Woodbine Formation

Character, distribution, and thickness.—The Woodbine is the oldest formation of the Upper Cretaceous series. It overlies unconformably the lower Cretaceous series in all of the area south of the outcrop area of the Trinity group and west of the Little Missouri River in Pike, Howard, and Sevier Counties. The thickness of the Woodbine formation ranges from a feather edge in eastern Hempstead County to 250 feet in Little River County.

The Woodbine formation is composed largely of reworked volcanic material with some sand, gravel, and some red and gray clay. The basal Woodbine consists of a lenticular gravel member which thickens eastward from a few feet to about 60 feet. The component materials range in size from pea gravel to large cobbles. Rounded and sub-rounded novaculite, chert and quartzite are most common with some pieces of well weathered igneous material.

The upper part of the Woodbine is made up chiefly of cross-bedded, yellowish sand containing reworked volcanic materials and some red and gray clay.

Water supply.—There are only a few wells in southwest Arkansas that yield water from the Woodbine formation. All of these are in south-central Howard County. One well in southern Sevier County was reported to have been drilled into the basal gravels in the Woodbine formation. At this location the gravels were cemented and did not yield water and the well was abandoned. A well drilled for the former White Cliffs School at White Cliffs reached the gravel in the Woodbine. The water was reported to have been too salty to drink and the well was abandoned. No known wells tap the Woodbine formation in Hempstead County, probably because water is available from the overlying Tokio formation. It appears that the Woodbine might yield small amounts of water to wells in the northwestern part of Hempstead County.

Records of 10 wells are given in Table 11 and the locations of these wells are shown on Plate 3. Chemical analyses of water from 8 wells is given in Table 12.

The quality of water from the Woodbine formation is variable but usually high in sulfate and bicarbonate and low in chloride. The amount of chloride probably increases downdip as indicated by the reported "salt water" obtained in a well at White Cliffs School. Hardness is generally low.

Tokio Formation

Character, distribution, and thickness.—The Tokio formation unconformably overlies the Woodbine formation west of the Little Missouri River and the Trinity formation and Paleozoic rocks east of the Little Missouri River. The Tokio formation crops out in a northeastward trending band that is covered in stream valleys, and across most of Little River County by overlying Quaternary deposits. The outcrop area of the Tokio formation is shown on Plate 4. The outcrop area in general increases in width westward with an increase in formation thickness. The Tokio formation increases in thickness from about 50 feet near the edge of its outcrop to about 300 feet in Little River County, and probably continues to thicken westward and southward. Eastward it thins rapidly and is overlapped by the Brownstown marl a few miles east of the Little Missouri River in Clark County. The Tokio underlies all of southwest Arkansas south of the area in which it crops out and west of the Little Missouri River.

The Tokio formation is composed chiefly of cross-bedded sand and clay interbedded and intertongued with scattered carbonaceous material and some gravels. The basal gravel is the most persistent part of the Tokio formation but other lenticular beds of gravels occur higher in the formation. Sub-rounded pebbles of light-gray to brown novaculite are the most common constituents and range from pea size to six inches in diameter. The gravel is thickest in Hempstead and Howard Counties and thins eastward and westward. The dip of the gravel bed is not precisely known but is probably about 70 feet per mile south and southeast. The gravels lense out westward in Sevier and Little River Counties and are replaced by medium to fine sand.

The remainder of the formation consists largely of medium, cross-bedded, brown and gray sand with intertonguing and interbedded gray leaf-bearing, fossiliferous, clay, with varying amounts of lignite. The sand beds are usually poorly sorted. In southeastern Sevier County, southern Howard County, and western Hempstead County, there are three distinct sand beds within the Tokio as illustrated in Plate 6. They have not been named and will be referred to in this report as upper, middle, and lower sands of the Tokio. The upper sand occurs at the top of the formation. The middle sand occurs about 60 to 80 feet stratigraphically below the upper sand. The lower sand, which is equivalent to the basal gravel in the outcrop area of the Tokio formation, occurs about 100 feet below the middle sand. To the east the clay layers, separating the sand beds, becomes thinner and in Hempstead County the three sand beds merge to form a massive sand which is prevalent over most of Hempstead County, southern Pike County, and northern Nevada County.

Much of the Tokio formation at the outcrop is sandy and weathers into a sandy soil. A mantle such as this is sufficiently permeable to allow percolation of surface and rain water into the sand.

Water supply.—The Tokio formation yields water to wells in southern Pike County, northern Nevada County, northern and central Hempstead County, southern Howard County, and southeastern Sevier County. Records of 165 wells are given in Table 11 and their locations are shown on Plate 4. Plate 4 also gives the altitude of the top of the Tokio by means of contours. From these contours, the approximate depth to the top of the Tokio may be determined by adding to the altitude of the land surface the values read from the contours where the top of the Tokio is below sea level or by subtracting from the altitude of the land surface, the values read from the contours where to top of the Tokio is above sea level. The upper water-bearing sands are immediately below the top of the formation.

Yields of up to 300 gallons per minute may be obtained in central Hempstead County. Flowing wells may be obtained in the bottom-land areas adjacent to streams. Wells flowing as much as 90 gallons per minute occur in these areas. Most of the water wastage from flowing wells given under utilization of water is from the Tokio formation.

Chemical analyses of water from 143 wells in the Tokio formation are given in Table 12. Isochlors for water from the Tokio are given on Plate 4. They are contoured on equal parts per million (ppm) of chloride. The approximate ppm chloride content for water from the Tokio can be ascertained in advance of drilling from the isochlors shown on Plate 4.

The quality of water from the sand and/or sands of the Tokio is fairly uniform, but there is wide variation in sulfate and iron content. In general the amount of chloride increases gradually downdip in the formation. However, the chloride increases abruptly in extreme western Clark and northwestern Nevada Counties.

The same abrupt rise in chlorides occurs in southern Sevier County (see Plate 4).

The iron content of the Tokio water is high near the center of northern Hempstead County and in parts of southern Howard County, ranging up to as much as 54 ppm.

Bicarbonate and sulfate are high indicating a moderately high sodium bicarbonate and sodium sulfate water. The water is generally soft with only a few exceptions.

Brownstown Marl (Restricted)

Character, distribution, and thickness.—The Brownstown marl unconformably overlies the Tokio formation and in Clark County overlies the rocks of Paleozoic age. The Brownstown marl crops out in an interrupted band which parallels and lies southeast of the outcrop of the Tokio formation. The chief exposures of the formation extend from the valley of the Little River northeastward to the Ouachita River valley. It is covered by Quaternary deposits in Little River County and in the stream valleys. The Brownstown marl is about 150 feet thick in Howard County, thinning slowly westward and more rapidly eastward, and it underlies all of the Cretaceous area south of its outcrop.

West of the Clark-Pike, and Clark-Nevada County lines the Brownstown marl is uniformly a gray marl with small quantities of sand and numerous large oyster shells. On weathering it turns a light tan. In Clark County the marl grades into a shallow water facies containing numerous sandy beds and sandy clay. In places the sand contains small quantities of chert pebbles which occur within hard calcareous sandstone lenses.

Water supply.—The Brownstown marl, being relatively impermeable, is not important as an aquifer in the Cretaceous area; however, it will yield small amounts of water for domestic purposes, mainly in Clark County where the amount of sand in the formation increases. The single analysis of water from the Brownstown in Clark County shows a highly mineralized water (see Table 12). Downdip from the outcrop the formation becomes less sandy and less permeable, and therefore the possibility of getting highly mineralized water is greater with increasing depth.

Ozan Formation

Character, distribution, and thickness.—The Ozan formation is unconformable with the underlying Brownstown marl. The basal unit of the Ozan, which crops out in southeastern Sevier County, southern Howard County, and western Hempstead County, is known as the Buckrange sand lentil, a thin fossiliferous, very glauconitic sandy marl containing chert pebbles and phosphatic material. The Buckrange is not known to crop out in the eastern part of the Cretaceous area. The remainder of the Ozan formation, near its western outcrops in Arkansas, is composed of micaceous, fossiliferous gray sandy marl with a few beds of sand and sandy limestone. In Little River County, where it is largely overlain by deposits of Quaternary age, the Ozan changes facies from a sandy clay and marl to chalk and marl.

The Ozan formation in Clark County is similar in appearance and lithology to the Overlying Brownstown marl; however, the Ozan may be differentiated either by a glauconitic sand bed at the base, if present, or by the prevalence of smooth, convex oyster shells.

The Ozan is about 200 feet thick in Little River County, thinning to 150 feet in Howard and Hempstead Counties, and probably less than 75 feet in Clark County.

Water supply.—Records of 13 wells in the Ozan formation are given in Table 11 and the locations of these wells are given on Plate 3. Chemical analyses of water from 12 of the wells are given in Table 12. The Ozan formation yields small amounts of very highly mineralized water to wells in Clark County. This water is used only for domestic purposes and some of it is not suitable for that. Chlorides range from 32 parts per million to 2,100 parts per million. There is one well in southern Sevier County that yields water from the Ozan, but it contains 1,100 parts per million chloride and is not used. One well in Hempstead County yields water from the Ozan. It is least mineralized of the samples taken from wells in the Ozan formation containing only about 400 or 500 ppm total solids.

Annona Chalk

Character, distribution, and thickness.—The Annona chalk crops out near the southern edge of Howard County, the western edge of Hempstead County, and the northeastern and southwestern corners of Little River County. The Annona reaches a maximum thickness of about 100 feet at the outcrop in Little River County. It consists of massive white to gray, fossiliferous chalk, which in some places is sandy or marly. It is absent on the surface in the eastern half of the Cretaceous area but it may be present in the subsurface.

Water supply.—The Annona chalk does not yield water to wells in Arkansas.

Marlbrook Marl (Restricted)

Character, distribution, and thickness.—The Marlbrook marl is exposed as a discontinuous band extending from the vicinity of Arkadelphia southeastward to the Saline River with one exposure in western Little River County. East of the Howard-Hempstead County line the Marlbrook lies directly on the Ozan and the contact is sharp; but to the west it overlies the Annona chalk and the contact is often transitional. The Marlbrook reaches a thickness of about 200 feet to the west and thins gradually eastward.

The Marlbrook marl is a uniform massive to thick-bedded, fossiliferous, chalky marl. It is blue gray in color when wet and when dry and exposed to weathering, it is a chalky white. Near the eastern edge of its outcrop area, the basal portion immediately overlying the Ozan formation is sandy and glauconitic.

Water supply.—The Marlbrook marl does not yield water to wells in Arkansas.

Saratoga Chalk

Character, distribution, and thickness.—The Saratoga chalk unconformably overlies the Marlbrook marl throughout the Cretaceous area south of its outcrop. The unconformity marks a break in both lithology and fossil content. Thin outcropping bands of the Saratoga chalk extend southwestward from two miles west of Arkadelphia to the Little River bottoms. The formation is covered by Quaternary deposits in the stream valleys and in Little River County. The Saratoga chalk reaches a maximum thickness of about 60 feet.

The lower contact of the formation is characterized by a very thin glauconitic and phosphatic zone, with numerous fossil fragments. The greater part of the formation is white, very fossiliferous, sandy chalk.

Water supply.—The Saratoga chalk does not yield water to wells in Arkansas.

Nacatoch Sand

Character, distribution, and thickness.—The Nacatoch sand crops out as a wide, low ridge extending from the valley of the Little River in western Hempstead County northeastward to Arkadelphia. It is overlain by Quaternary deposits in the Little Missouri River valley, and Little River County. The outcrop area is shown on Plate 6. The outcrop averages from five to seven miles wide. The beds dip southeastward at about 40 feet per mile. The Nacatoch decreases in thickness from about 400 feet at the Little River to about 150 feet near Arkadelphia.

The Nacatoch sand may be divided into three lithologic units. The lower unit consists of interbedded gray clay, sandy clay, and marl; dark clayey fine grained sand; and hard irregular concretionary beds, and contains lenses of calcareous, fossiliferous, slightly glauconitic sand. The middle unit consists of a dark-greenish sand, which contains coarse grains of glauconite and weathers to lighter shades of green. It is generally fossiliferous where it is glauconitic. This unit also contains irregular concretionary beds. The upper unit is composed of unconsolidated gray, fine-grained quartz sand. Cross-bedding is common in this sand. Locally the sand is massive and contains a few hard lenses and beds of fossiliferous sandy limestone. This upper unit is the principal water-bearing part of the Nacatoch.

Water supply.—Records of 150 wells in the Nacatoch sand are given in Table 11 and the locations of these are shown on Plate 5. Plate 5 also gives the altitude of the top of the Nacatoch by means of contours. From these contours, the approximate depth to the top of the Nacatoch may be determined by adding, to the altitude of the land surface, the values read from the contours where the top of the Nacatoch is below sea level or by subtracting, from the altitude of the land surface the values read from the contours, where the top of the Nacatoch is above sea level. The main water-bearing portion of the Nacatoch is immediately below the top of the formation. The Nacatoch sand yields water to wells in southwestern Clark County, north central Nevada County, central Hempstead County, northern Miller County, and extreme southeastern Little River County (see Plate 5). Flowing wells with yields of one or two gallons per minute, may be obtained in the lowest stream valleys in Clark and Nevada Counties. The Nacatoch sand will produce yields of 150 to 300 gallons per minute in Hempstead County and western Nevada County. In Miller County, eastern Nevada County, and Clark County yields are generally smaller and the water may contain considerable chloride.

Chemical analyses of water from 114 wells are given in Table 12. Isochlors for water from the Nacatoch sand are shown on Plate 5. They are contoured on equal parts per million (ppm) of chloride. The approximate ppm chloride content for water from the Nacatoch can be determined from the isochlors on Plate 5.

The Nacatoch sand yields a moderately soft alkaline water whose total mineral content differs considerably from place to place. Downdip 2 to 20 miles from the outcrop area, the water generally is too salty for most uses. The change between fresh and salt water is often very sharp going from less than 100 to over 1,000 ppm chloride in about 4 miles. In northern Miller County and in southern Clark and northeastern Nevada Counties the salt water occurs close to the exposed area of the Nacatoch. Veatch (1906) gives the following explanation for the occurrence of salt water near the outcrop area of the Nacatoch:

> "Apparently the soluble salts have been dissolved and carried down by the continued inflow of rain water, and so the beds have been leached near the outcrop and the salts concentrated at a greater or less distance from it. The line between fresh and salt water is often very sharp, . . . where, from the same horizon fresh water is obtained in one well and salt water in another not 200 feet away."

A more likely explanation might be, since the Nacatoch is a marine deposit, that the sea water that was entrapped in the formation while it was being deposited has never been flushed out. There is not enough discharge downdip from the outcrop to allow very much movement of water through the formation, and the flushing process has been and still is very slow.

Sulfate and nitrate in solution are usually low, exceeding a combined total of 100 parts per million in only 3 of the 114 samples. Bicarbonate concentrations are moderate, varying from 2 to about 400 parts per million with the usual range of from 200 to 300 parts per million. Iron is low with very few exceptions.

Arkadelphia Marl

Character, distribution, and thickness.—The Arkadelphia marl overlies the Nacatoch sand south of its outcrop throughout the Cretaceous area. It is made up principally of blue to brownish clay-marl with occasional thin stringers of limestone. It is moderately fossiliferous. The formation's thickness varies from 100 to 150 feet.

Water supply.—The Arkadelphia marl does not yield water to wells in Arkansas.

Tertiary System—Paleocene Series

Midway Formation

Character, distribution, and thickness.—The Midway formation overlies the Arkadelphia marl and is separated from it by an unconformity which represents a considerable length of geologic time. The lower 30 to 50 feet consists normally of bedded calcareous clay containing at some places beds of dense gray limestone. The upper part of the formation consists of uniform gray clay with siderite concretions. The thickness ranges from about 20 feet at the outcrop to about 400 feet at the southern edge of the area. The Midway underlies all of the area south of the Arkadelphia marl outcrop.

Water supply.—The Midway formation does not yield water to wells in Arkansas.

Tertiary System—Eocene Series

Wilcox Formation

Character, distribution, and thickness.—The Wilcox formation overlies the Midway in northern Miller County, southern Hempstead County, southern Nevada County, and southern Clark County. It ranges in thickness from a few feet on its outcrop to about 600 feet in the southern edge of the area. The Wilcox is composed of a series of dark finely laminated beds of sand and clay containing much vegetable matter, mostly in the form of lignite.

Water supply.—The Wilcox supplies water to numerous shallow dug wells along the southeastern edge of the area except in Miller County where it is overlain by Quaternary deposits. There it is necessary to drill wells into the Wilcox. The yield of wells is small but large enough for domestic supplies. Many of the wells in southern Hempstead County, southern Nevada County, and southern Clark County are so shallow that they bottom well above the bottoms of the drainage channels and therefore tend to go dry during extended dry periods. Well locations are shown on Plate 3.

The hardness of 4 samples of water from the Wilcox formation ranged from 32 to 110 ppm which is considerably softer than the water in deposits of Quaternary age. The iron content was high in three of the samples but all were low in chloride. One sample had 86 ppm nitrate, which may indicate pollution from the surface.

Quaternary System—Pleistocene and Recent Series

Alluvial and Terrace Deposits

Character, distribution, and thickness.—Alluvial deposits underlie the flood plains of the Ouachita, Little Missouri, Saline, Little River, and Red Rivers and their tributaries. They consist of sand, silt, gravel and clay, and range in thickness from 0 to about 50 feet. Terrace deposits underlie most of Little River County, northeastern Hempstead County, and northeastern Nevada County. They consist of sand, clay and gravel, and range in thickness from a few feet in Nevada County to about 90 feet in Little River County.

Water supply.—Records of 17 wells that yield water from deposits of Quaternary age are given in Table 11 and locations of the wells are shown on Plate 3. Water is obtained from the alluvial and terrace deposits mainly in Little River County and northeastern Miller County. Yields of as much as 150 gallons per minute are reported at Ashdown, in Little River County, and yields of an estimated 400 gallons per minute are reported in eastern Miller County where the water is used for irrigation. Numerous shallow, dug, or driven wells yield water from Quaternary deposits in the stream valleys but the yields are small and the water (see Table 12) is frequently hard. Soft water is obtained by the city of Texarkana from local deposits of Quaternary age in the eastern edge of the city. The yield of 22 wells about 45 feet deep is about 700,000 gallons per day.

SUMMARY OF WATER SUPPLY BY COUNTIES

Clark County

In northern Clark County ground water is available in small quantities from the sandstone and shale of Mississippian and Pennsylvanian age. Wells may obtain supplies at depths of 100 to 300 feet but it is quite possible to drill 1,000 feet or more without obtaining a good supply (Veatch 1906).

In central Clark County, the amount of sand increases in the Brownstown marl and it will yield small amounts of highly mineralized water to domestic wells (see analysis 213, Table 12). Downdip from the outcrop the formation becomes less sandy and the possibility of getting highly mineralized water is greater.

The Ozan formation, overlying the Brownstown marl, yields small amounts of very highly mineralized water to wells (see Table 12). The water is used only for domestic purposes and some of it is not fit for that. Chlorides range from 32 to 2,100 parts per million.

The Nacatoch sand yields water to wells in central and southwestern Clark County. Wells range in depth from less than 100 feet in the central part of the county, near the outcrop, to 568 feet in the southwestern part of the county. Reported yields of up to 100 gallons per minute have been obtained by the city of Gurdon and the Gurdon Lumber Company. Flowing wells, with yields of one or two gallons per minute, may be obtained in the lowest stream valleys.

The Nacatoch sand yields a moderately soft alkaline water whose total mineral content differs considerably from place to place. In Clark County the Nacatoch water becomes salty close to its outcrop. The change between fresh and salt water is often very sharp going from less than 100 to 1,000 parts per million chloride in about 4 miles.

The Tokio formation is present along the western edge of Clark County but it contains water high in chloride content. Well 53 in Clark County and well 52 in northeastern Nevada County have 1,200 and 920 parts per million chloride respectively. Any wells drilled to the Tokio in western Clark County will likely yield salt water unless they are located very close to its outcrop area.

The record of wells and chemical analyses of water for Clark County are given in Tables 11 and 12. The locations of wells are given on Plates 3, 4, and 5.

Hempstead County

In northern and central Hempstead County water is obtained from sands in the Tokio formation. Wells vary in depth from 16 feet in the northwestern part of the county in or near the Tokio outcrop area to 1,500 feet at Hope. Reported yields of up to 300 gallons per minute are obtained at Hope. Flowing wells from the Tokio may be obtained in northeastern Hempstead County in the Little Missouri bottoms. Well 72 (Table 4) had a measured flow of 90 gallons per minute.

In central Hempstead County the Nacatoch sand yields water of good quality to wells. Yields of 150 to 300 gallons per minute have been reported at Hope. Depth of wells range from a few feet in the outcrop area (Plate 5) to about 700 feet in the southwestern part of the county.

In the extreme southern part of Hempstead County water is obtained for domestic use from shallow wells in sands in the Wilcox formation.

The record of wells and chemical analyses of water for Hempstead County are given in Tables 11 and 12. The location of wells are given on Plates 3, 4, and 5.

Howard County

In northern Howard County ground water may generally be obtained in small quantities from sandstone and shale.

Sands in the upper part of the Trinity group supply highly mineralized water to wells in central Howard County south and southwest of Nashville. Flowing wells may be obtained at the lower altitudes that flow from 1 to about 50 gallons per minute. The sands of the upper Trinity may be interconnected to the basal gravel of the overlying Woodbine formation. Flowing wells with similar yields and quality of water are obtained from the Woodbine in southern Howard County.

There are many wells in southern Howard County that derive their water from the middle and lower sands of the Tokio formation. In the extreme southern end of the county wells yield water from the upper sand of the Tokio. Wells vary in depth from a few feet in the outcrop area (Plate 4) to about 500 feet in the southern part of the county.

The quality of Tokio water is generally good. Exceptions are high iron and sulfate content in local areas. Chloride increases gradually downdip in the formation (Plate 4).

Tables 11 and 12 give the records of wells and chemical analyses of water from wells in Howard County. The locations of wells are given on Plates 3 and 4.

Little River County

Little River County is almost completely covered by deposits of Quaternary age. These deposits yield water to wells from sand and gravel about 30 to 90 feet below the surface. The cities of Ashdown and Foreman obtain water from wells in these deposits. The water is generally hard.

The only Cretaceous deposits that yield fresh water are the Nacatoch sands in southern Little River County. Wells range in depth from about 100 to 365 feet.

A Trinity well (37) has a flow of highly mineralized water (see Plate 3). This well was drilled for an oil test. It is not known at what depth the flow of water is from. Any well drilled into the Trinity group in Little River County will likely yield salt water.

The Woodbine formation is reported to yield salt water at White Cliffs. The Woodbine overlies the Trinity except for a small area in northwestern Little River County. The Woodbine would likely yield salt water in Little River County.

The Tokio formation is reported to have been tested at various places in Little River County but it yields only salt water except for one well (204) in the western part of the county. It is a shallow dug well, 22 feet deep, where the Quaternary covering the Tokio is thin. An analysis of water (204, Table 12) from this well shows 102 parts per million chloride, hardness of 92 parts per million and iron of only 0.7 parts per million. Nitrate is 130 parts per million, which probably indicates that the water is contaminated by surface water.

Tables 11 and 12 give the records of wells and chemical analyses of water from wells in Little River County. The locations of wells are shown on Plates 3, 4, and 5.

Miller County

In northern Miller County the Nacatoch sand is the only Cretaceous aquifer that yields fresh water to wells. The chloride content of water from the Nacatoch increases from about 100 parts per million in the extreme northern part of the county to over 3,000 parts per million near Texarkana (Table 12). Wells in the Nacatoch vary in depth from 250 feet in the northern part of the county to about 1,000 feet at Texarkana.

Sands of the Trinity group, Woodbine formation, and Tokio formation would likely yield salt water in Miller County as they do further to the north in Little River County.

The Wilcox formation supplies water to domestic wells near Texarkana where water is not available from overlying deposits of Quaternary age and where the Quaternary is missing (see Plate 2). Wilcox wells have small yields but generally the quality of water is better than that from the Quaternary (see Table 12).

Deposits of Quaternary age cover the northern part of Miller County northeast of Texarkana. Sand and gravel in these deposits can generally be reached at depths from 40 to 80 feet. These deposits in the Red River valley east of Texarkana yield about 400 gallons per minute of poor quality water to irrigation wells (see Table 12).

Tables 11 and 12 give the records of wells and chemical analyses of water from wells in Miller County. The locations of wells are shown on Plates 3 and 5.

Nevada County

In extreme northern Nevada County, in the bottoms of the Little Missouri River, flowing wells yield water from the Tokio formation. These wells vary from about 225 feet to 600 feet deep. The city of Prescott and the Arkansas Louisiana Gas Company each has a well yielding water from the Tokio. These wells are 1,070 feet and 1,217 feet deep. They yield water that has a high chloride content (see wells 152 and 205, Table 12). Any wells drilled into the Tokio more than 10 miles south or east of Prescott would likely yield salty water (see Plate 4).

The Nacatoch sand crops out across the northern end of Nevada County. It yields water of good quality to dug wells in and near its outcrop and to drilled wells at and south of Prescott. Nacatoch wells will flow a few gallons per minute in the lowest stream valleys. Five flowing wells in T. 11 S., R. 20 W., yield water with more than 500 ppm chloride (see Plate 6). Wells range in depth from a few feet in the outcrop area to over 600 feet about 15 miles south of Prescott.

In the southern part of the county dug and drilled wells yield water from the Wilcox formation. The town of Rosston has the only known municipal well yielding water from the Wilcox in the area.

The record of wells and chemical analyses of water in Nevada County are given in Tables 11 and 12. Locations of wells are shown on Plates 3, 4, and 5.

Pike County

In the part of Pike County north of the Trinity outcrop (Plate 3), domestic supplies can usually be obtained above 300 feet. In the region of the Trinity outcrop (Plate 3) very little ground water is available. The Trinity group is here a calcareous clay of practically no water bearing value (Veatch 1906).

South of the Tokio formation outcrop (Plate 4) flowing wells can be obtained along the Little Missouri River valley and some of its tributaries. The depth of wells, in the Tokio here, range from a few feet in the outcrop to about 250 feet near the Little Missouri River. The quality of water from the Tokio is good.

The records of wells and chemical analyses of water from Pike County are given in Tables 11 and 12. The locations of wells are shown on Plates 3 and 4.

Sevier County

In northern Sevier County north of the Trinity outcrop area, water may usually be obtained from Mississippian and Pennsylvanian rocks in sufficient quantities for domestic use.

In the vicinity of DeQueen, the two gravel units of the Trinity group, yield water of fair quality to wells at depths of from 145 feet to 450 feet. Trinity wells at other places throughout central Sevier County vary in depth from a few feet to 415 feet.

The Tokio formation yields water to wells in southern Sevier County. The wells range in depth from about 100 feet, near the outcrop area, to about 400 feet near the southern tip of the county. Many Tokio wells flow a few gallons per minute in the Cossatot River bottoms.

The records of wells and chemical analyses of water from Sevier County are given in Tables 11 and 12. The locations of wells are shown on Plates 3 and 4.

WELL LOGS

Listed on the following pages are the drillers' logs of 10 wells in southwestern Arkansas. The descriptions of the materials given in the logs are as they were reported by the driller.

The geological classification of the logs was made by the senior author. Many of the logs are either too generalized or too incomplete to permit an accurate geological classification, so that the formation boundaries are not exact and their thicknesses may not be accurate.

WELL 4

Owner: City of DeQueen

Location: SW¼ NE¼, sec. 30, T. 8 S., R. 31 W.

Altitude: 450 ft. (approx.)

Driller: —

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
Surface material	12	12
Gravel	6	18
Trinity group		
Limestone	4	22
Clay, red	8	30
Limestone	7	37
Clay, blue	9	46
Limestone	3	49
Clay, blue	3	52
Limestone	15	67
Clay, yellow	10	77
Limestone	1	78
Clay, yellow	3	81
Limestone	9	90
Gravel and clay, red	18	108
Limestone	5	113
Slate, blue	32	145
Sand and gravel	15	160
Limestone	7	167
Gravel and clay	12	179
Limestone	1	180
Gravel and clay	12	192
Sandstone	1	193
Gravel	58	251

WELL 205

Owner: Arkansas Louisiana Gas Company
Location: SW¼ NE¼, sec. 3, T. 12 S., R. 23 W.
Altitude: 320 ft. (approx.)
Driller: H. Cox

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
Surface clay	40	40
Arkadelphia marl		
Shale	183	223
Nacatoch sand		
Sand rock	8	231
Sand	17	248
Sand and gravels	57	305
Sand and gravels (shell and rocks)	20	325
Shale	10	335
Broken sand rock	15	350
Sand	100	450
Saratoga chalk and Marlbrook marl		
Gummy shale	290	765
Sand	25	765
Ozan formation		
Gummy shale	85	850
Shale and boulders	50	900
Gumbo	30	930
Grownstown marl		
Shale and boulders	30	960
Shale	40	1,000
Gummy shale	29	1,029
Sand	6	1,035
Shale	10	1,045
Sand	6	1,051
Gummy shale	19	1,070
Sand	15	1,085
Tokio formation		
Gumbo	35	1,120
Shale	20	1,140
Gumbo	18	1,158
Sand	14	1,172
Gumbo	6	1,178
Sand	39	1,217

WELL 206

Owner: Hope Light and Water Co.
Location: SE¼ NE¼, sec. 3, T. 12 S., R. 23 W.
Altitude: 340 feet
Driller: Layne-Arkansas Co.

	Thickness (feet)	Depth (feet)
Arkadelphia marl		
Yellow clay	35	35
Blue shale	72	107
Nacatoch sand		
Fine sand	5	112
Rock	4	116
Rock, not so hard	6	122
Break	3	125
Fine sand	6	131
Rock	6	137
Fine sand	12	149
Hard rock	5	154
Fine hard sand	6	160
Hard spot	2	162
Fine sand	2	164
Sand with hard spot	2	166
Sandy shale	4	170
Rock	1	171
Fine sand	20	191
Rock	1	192
Break	1	193

WELL 206—Continued

	Thickness (feet)	Depth (feet)
Rock	1	194
Fine sand	22	216
Finer sand	18	234
Rock	2	236
Breaks with rocks	6	242
Rock	3	245
Fine black sand	18	263
Rock	2	265
Fine black sand	5	270
Rock	1	271
Sandy shale	4	275
Rock	1	276
Sandy shale with hard spots	14	290
Rock	1	291
Sandy shale	4	295
Rock	1	296
Sandy shale	11	307
Rock	1	308
Hard shale	42*	450
Saratoga chalk		
Tough clay or shale	113	563
Marlbrook marl		
Hard spot	8	571
Hard tough shale	92*	763
Ozan formation		
Hard spot	6	769
Soft shale	14	783
Hard spot	3	786
Hard shale	27	813
Soft shale	13	826
Hard spot	3	829
Hard shale	64	893
Shale and boulders	8	901
Tough shale	1	902
Boulders	1	903
Tough shale	1	904
Soft gummy shale	51	955
Brownstown marl		
Rock	1	956
Hard shale	95	1,051
Rock	1	1,052
Sandy shale	8	1,060
Rock	1	1,061
Soft shale	13	1,074
Hard spot	1	1,075
Soft shale	10	1,085
Hard spot	2	1,087
Tokio formation		
Soft shale	22	1,109
Shale and boulders	6	1,115
Sand	7	1,122
Sand (last 5 ft. not so good)	33	1,155
Sandy shale	16	1,171
Hard rock	1	1,172
Sand	15	1,187
Rock	2	1,189
Tough shale	14	1,203

*Error either in thickness or depth of material. It is assumed that depth is correct; therefore the thickness should read 142 and 192 feet.

WELL 207

Owner: Hope Light and Water Company
Location: SE¼ SW¼, sec. 6, T. 12 S., R. 24 W.
Altitude: 340 feet
Driller: Layne-Arkansas Company

	Thickness (feet)	Depth (feet)
Arkadelphia marl		
Soft yellow clay	10	10
Blue clay	14	24
Hard clay	16	40

WELL 207—Continued

	Thickness (feet)	Depth (feet)
Shale	46	86
Hard spot	2	88
Soft sandy shale	7	95
Hard rock	4	99
Soft sandy shale	3	102
Nacatoch sand		
Rocks with soft spots	7	109
Shale	7	116
Rock	2	118
Shale	3	121
Rock	1	122
Sandy shale	7	129
Rock	3	132
Soft sandy shale	8	140
Rock	2	142
Sandy shale	8	150
Hard rock	3	153
Hard shale	8	161
Hard spot	2	163
Shale	3	166
Sandy shale	10	176
Hard spot	1	177
Soft sandy shale	37	214
Hard spot	1	215
Fine black sand	15	230
Rock	4	234
Sandy shale	11	245
Rock	1	246
Blue shale	10	256
Rock	1	257
Blue shale	19	276
Rock	1	277
Shale with hard spot	5	282
Hard spot	1	283
Shale	13	296
Tough clay	26	322
Clay, some softer	10	332
Tough shale	60	392
Boulders	4	396
Shale	18	414
Hard shale	2	416
Shale and boulders	9	425
Gumbo	18	443
Saratoga chalk and Marlbrook marl		
Hard shale	173	616
Shale (not so hard)	22	638
Hard shale	22	660
Hard gumbo	3	663
Sandy shale	19	682
Soft shale	11	693
Fine sand	2	695
Soft shale	35	730
Tough shale	15	745
Sandy shale	15	760
Ozan formation		
Tough shale	10	770
Sandy shale	4	774
Shale	71	845
Hard shale	30	875
Sandy shale	7	882
Hard tough shale	5	887
Sandy shale	3	900
Soft shale	25	925
Hard tough shale	7	932
Soft shale	12	944
Brownstown marl		
Shale	16	960
Sandy shale	19	979
Boulders	1	980
Sandy shale	3	983
Tough clay	2	985
Soft sandy shale	11	996
Hard shale	7	1,003
Soft shale	1	1,004
Hard shale	5	1,009
Tough shale	34	1,043
Boulders	1	1,044
Sandy shale	23	1,067
Lignite	2	1,069
Sandy shale	8	1,077
Tough shale	17	1,094
Tokio formation		
Water bearing sand	49	1,143

WELL 209

Owner: Hope Light and Water Company
Location: SE¼ SW¼, sec. 28, T. 12 S., R. 24 W.
Altitude: 353 feet
Driller: Holliday Well Company

	Thickness (feet)	Depth (feet)
Surface soil	14	14
Midway formation		
Sand and clay	61	75
Shale and small rocks	156	231
Arkadelphia		
Shale and large boulders	139	370
Nacatoch sand		
Sand, shell, and large boulders all this section mixed conglomerate	234	604
Shale blue, gumbo	46	650
Sandy shale	52	702
Saratoga chalk and Marlbrook marl		
Shale and lime	102	804
Chalk	236	1,040
Ozan formation		
Gray shale	17	1,057
Sand and sandy shale	43	1,100
Chalk and shale	160	1,260
Brownstown marl		
Sandy shale	40	1,300
Gray shale	80	1,380
Tokio formation		
Sandy shale	70	1,450
Water sand-fine grain	40	1,490
Black shale	10	1,500

WELL 299

Owner: Arkansas-Louisiana Gas Company
Location: SW¼ NE¼, sec. 3, T. 12 S., R. 23 W.
Altitude: —
Driller: H. Cox

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
Surface clay	40	40
Arkadelphia marl		
Shale	80	120
Broken sand rock	5	125
Sticky shale	100	225
Nacatoch sand		
Sand and rock	3	228
Sandrock	6	234
Sand	11	245
Sandrock	3	248
Sand	8	256
Sandrock	6	262
Sand and gravel	10	272
Sandrock	3	275
Sand and gravels (hard shells)	9	284
Sand and gravels (hard shell rock)	17	301

WELL 300

Owner: Arkansas-Louisiana Gas Company
Location: SW¼ NE¼, sec. 3, T. 12 S., R. 23 W.
Altitude: —
Driller: H. Cox

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
Surface clay	25	25
Arkadelphia marl		
Shale	35	60
Slicky shale	75	135
Gumbo	20	155
Shale	67	222
Nacatoch sand		
Sandrock	9	23
Water sand	17	248
Rock	2	250
Sand and gravel	10	260
Rock	2	262
Sand and gravel	10	272
Water sand	8	280
Rock	6	286
Sandrock	14	300
Rock	3	303
Sand	15	318
Rock	2	320
Sand and gravels	5	325

WELL 308

Owner: Hope Brick Company
Location: NW¼ SW¼, sec. 27, T. 12 S., R. 24 W.
Altitude: 350 feet.
Driller: Holliday Well Company

	Thickness (feet)	Depth (feet)
Surface clay	30	30
Midway formation		
Shale	48	78
Boulders	0′ 2″	78′ 2″
Arkadelphia		
Shale	261′ 10″	340
Nacatoch sand		
Sand—fair	24	364
Rock	2′ 6″	366′ 6″
Sandy	1′ 6″	368
Rock	2	370
Sand	2	372
Rock	1	373
Sandy	2	375
Rock	1	376
Sandy	8	384
Rock	5	389
Sandy	21	410
Rock	4	414
Sandy	11	425
Rock	0′ 4″	425′ 4″
Sandy	1′ 8″	427
Sandy shale	7	434
Rock	0′ 8″	434′ 8″
Shale and shell	5′ 4″	440
Rock	3	443
Sandy shale	22	465
Shale and boulders	15	480
Shale	117	597

WELL 337

Owner: Henry Mack
Location: NW¼ NE¼, sec. 23, T. 13 S., R. 26 W.
Altitude: 270 feet
Driller: F. E. Wells

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
River dirt	64	64
Gravels	1	65
Arkadelphia marl		
Blue dirt	165	230
Nacatoch sand		
Rock	4	234
Sand	31	265
Rock—below 265		

WELL 386

Owner: City of Ashdown
Location: NE¼ SW¼, sec. 32, T. 12 S., R. 29 W.
Altitude: 330 feet
Driller: Shirly

	Thickness (feet)	Depth (feet)
Deposits of Quaternary age		
Clay	8	8
Sand	30	38
"Joint clay"	9	47
Sand	18	65
Clay	11	76
Sand	14	90
Marlbrook marl		
Shale	....	below 90

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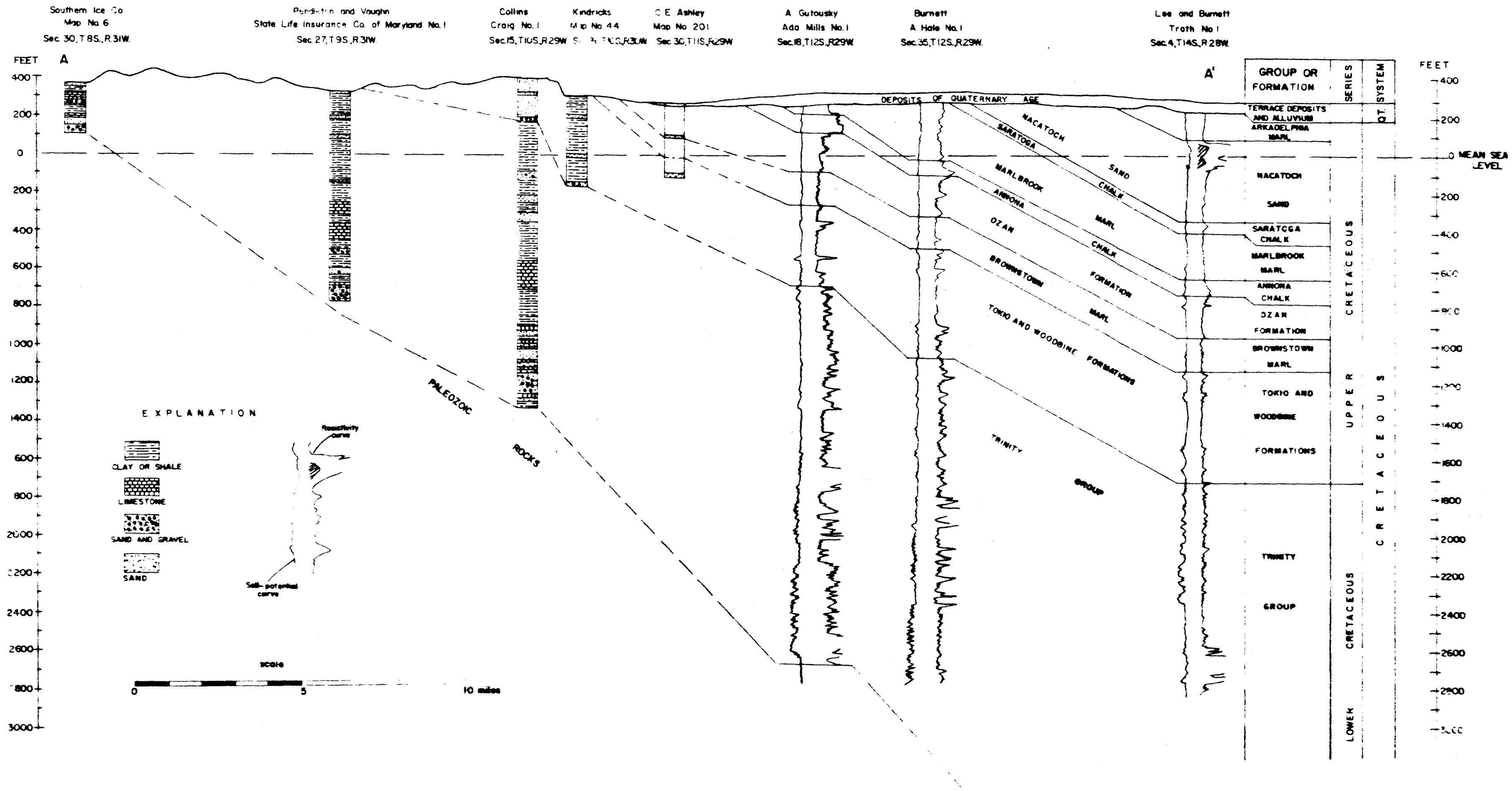


Plate I. Generalized geologic section from DeQueen to southeastern Little River County

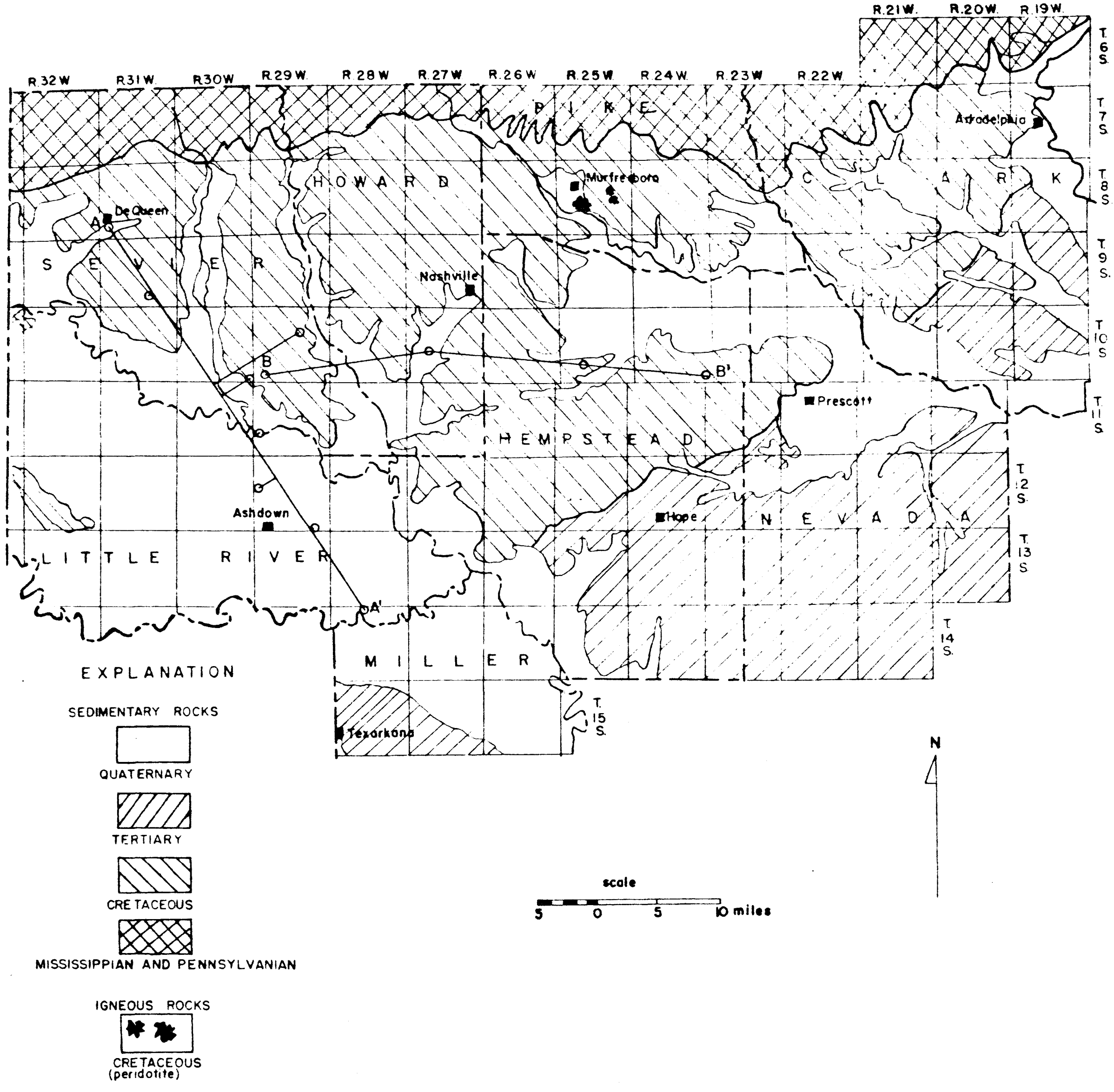
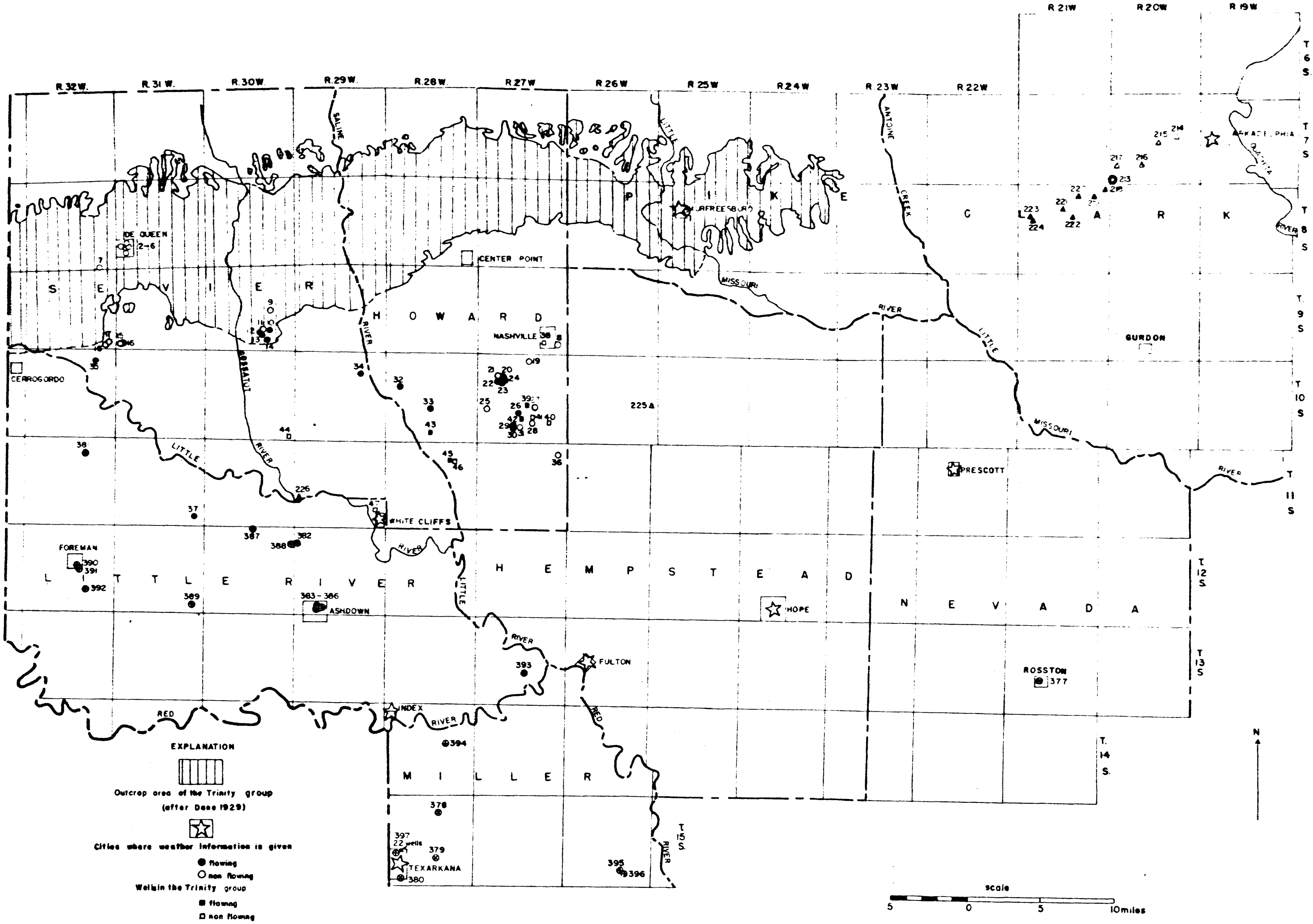


Plate 2. Geologic map of southwestern Ark. (after Dane 1929)



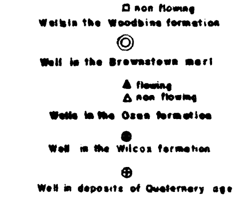


Plate 3. Map of the outcrop area of the Trinity group and location of wells producing from Coastal Plane deposits other than the Tokio formation and Nacatoch sand.

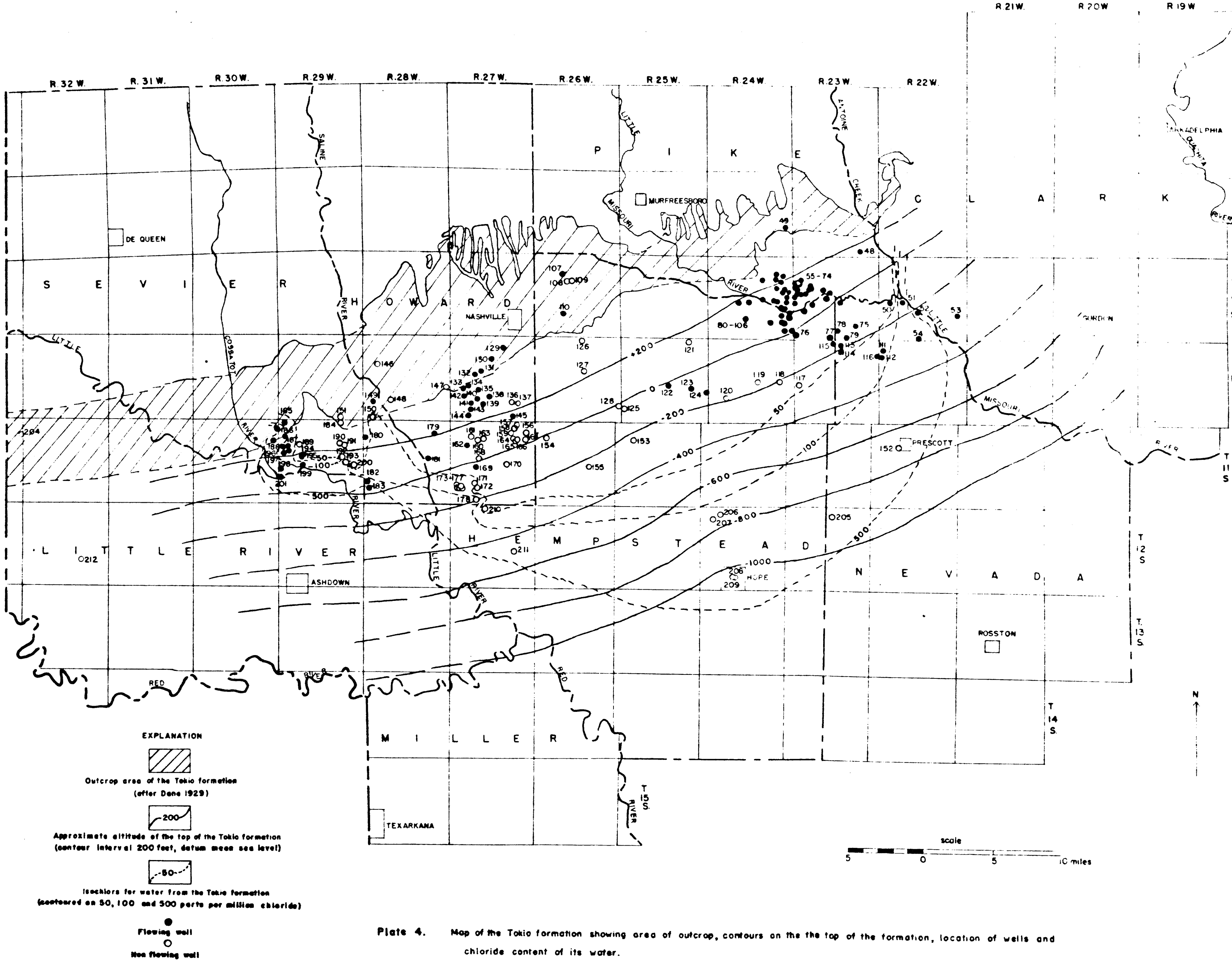


Plate 4. Map of the Tokio formation showing area of outcrop, contours on the the top of the formation, location of wells and chloride content of its water.

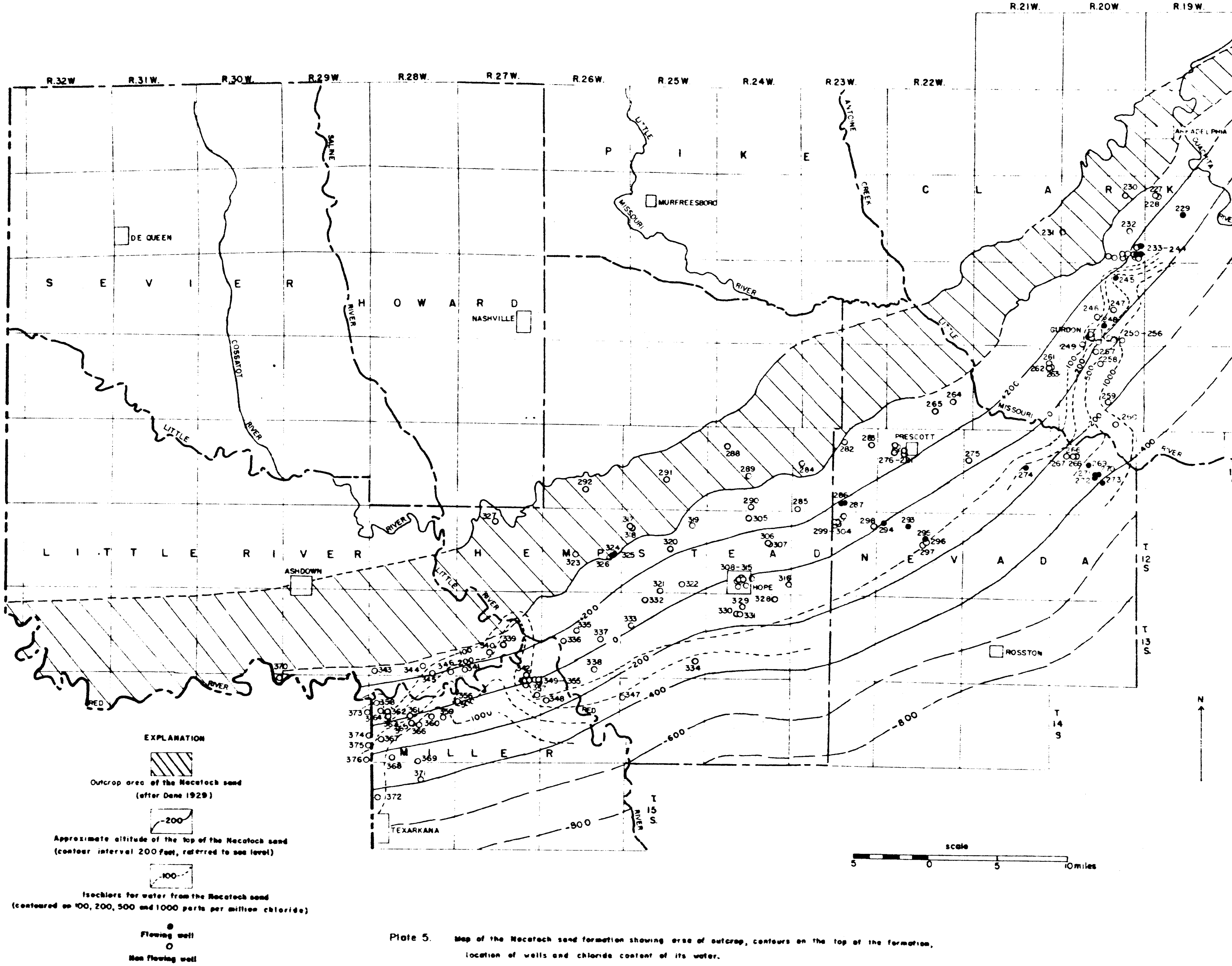


Plate 5. Map of the Nacatoch sand formation showing area of outcrop, contours on the top of the formation, location of wells and chloride content of its water.

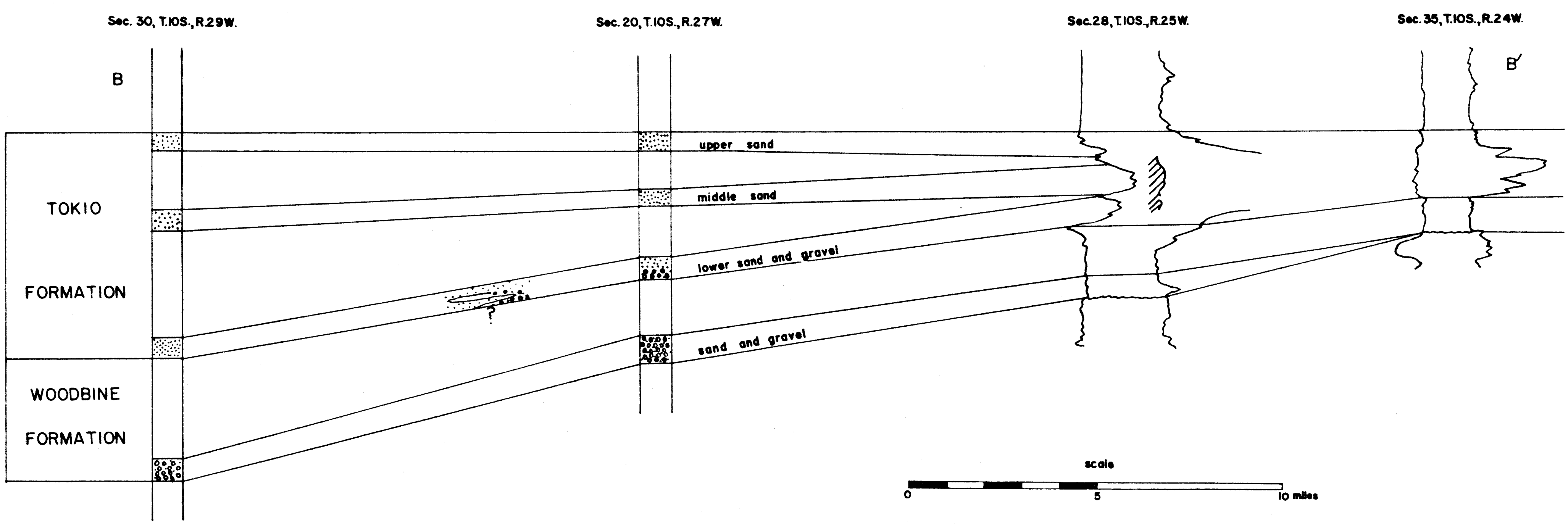


Plate 6 Diagrammatic cross section of sands of the Tokio and Woodbine from southeastern Sevier County to eastern Hempstead County

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
					Trinity group								
(1)	8S25W-17acc1[4]	Pike	City of Murfreesboro		1936			6				PS	
(2)	8S31W-30acd1	Sevier	City of DeQueen			450	145				200	PS	
(3)	-30acd2	Sevier	City of DeQueen		1902	450	251	8	20R	- -51	125	PS	See log
(4)	-30acd3	Sevier	City of DeQueen			450	251	8			150	PS	See log
(5)	-30bdd1	Sevier	City of DeQueen		1949		450				200	PS	
(6)	-30dbc1	Sevier	Southern Ice Co.			445	249	10			5	I	
7	8S32W-35ddd1	Sevier	Dierks Creosoting Plant		1948		326	8			60	I	
(8)	9S27W-36bbb1	Howard	Southern Ice Co.			370	250±	8			15	I	
(9)	9S30W-23bda1	Sevier	City of Locksburg			440						PS	
(10)	-26cbc1	Sevier	Loel Phillips			345	150±	4	flowing	8-15-51	30	D	
(11)	-27daa1	Sevier	L. D. Jackson			360	25		almost dry	8-15-51		D	
(12)	-27dca1	Sevier	L. D. Jackson			360	140±		flowing	8-15-51	1	D	
(13)	-27dcc1	Sevier	L. D. Jackson			340	140±	5	flowing	8-15-51	10	D	
(14)	-35bbb1	Sevier	Loel Phillips			335	150±	10	flowing	8-15-51	10	D	
15	9S31W-31cba1	Sevier	Interstate Pipe Line Co.		1910	460	275					I	
16	-31cba2	Sevier	Interstate Pipe Line Co.		1910	460	275					I	
17	9S32W-36cac1	Sevier	City of Horatio		1921	385	175	6				PS	
(18)	-36cac2	Sevier	City of Horatio		1946	385	290	10			75	PS	
(19)	10S27W-3bdd1	Howard	W. H. Toland	Howard Hipp		358	265	2				D	
(20)	-8acc1	Howard	Guy Coleman	Howard Hipp		350	391	2	flowing	8-14-51	2	D	
(21)	-8bdc1	Howard	Mrs. Joe Coleman	Howard Hipp		375	590	2	1.5R	- -51	10	D	
(22)	-8cdb1	Howard	W. H. Toland	Howard Hipp		325	265	1.25	flowing	8-14-51	1	D	
(23)	-8dac1	Howard	O. B. Tommey	Howard Hipp		350	390	2	flowing	8-14-51	1	D	
(24)	-8dcb1	Howard	W. H. Toland	Howard Hipp		345	365	2	flowing	8-14-51	20	D	
(25)	-19dbb1	Howard	Town of Mineral Springs	F. E. Wells	1936	345	408	6			50	PS	
(26)	-21ddc1	Howard	Laverne Hardin		1927	315	950±	14	flowing	6-27-51		D	Oil test well
(27)	-22add1	Howard	B. J. Barton	Howard Hipp		328	416	2			5	D	
(28)	-27dba1	Howard	W. H. Toland	Howard Hipp		365	510	2	15R	- -50		D	
(29)	-28cdb1	Howard	M. B. Stone	Howard Hipp		310	454	4	flowing	6-27-51	4	D	
(30)	-28cdc1	Howard	Mrs. C. M. Dyer	Howard Hipp	1928	295	415	2	flowing	6-27-51	1	D	
(31)	-28dac1	Howard	J. V. Toland	Howard Hipp		322	510	2				D	
(32)	10S28W-18aac1	Howard	W. H. Toland	Howard Hipp		320	340	2	flowing	7-10-51	1	D	
(33)	-21daa1	Howard	Mrs. Curtis Nutt	Howard Hipp	1943	328	415	2	flowing	7-10-51	2	D	
(34)	10S29W-11bdc1	Sevier	Nichels Farm			300		12	flowing	8- -51	100	D	
(35)	10S32W-2dbd1	Sevier				300		3	flowing	1-8-52	5	N	
(36)	11S27W-1cda1	Howard	Randolph Webb	W. K. Elliot	1951	380	780	3-2-1.5	25R	- -51	15	I	Upper Trinity
(37)	11S31W-36bae1	Little River	Roy R. Spikes			335		8	flowing	7-25-51	2	D	Upper Trinity—Oil test well
					Woodbine formation								
(38)	9S27W-35bab1	Howard	J. D. Scott Lumber Co.	Ed Mooney	1951	375	100	6			40	I	
(39)	10S27W-22bdc1	Howard	Frank Moss	Howard Hipp		320	364	2	flowing	6-27-51		D	
(40)	-26adc1	Howard	Alton Mitchell	W. K. Elliot	1951	360	570	4-1.25	20	- -51	5	D	
(41)	-27acc1	Howard	J. L. Hardin	Howard Hipp		330	380	2			5	D	
(42)	-28dab1	Howard	W. H. Toland	Howard Hipp		305	400	2	flowing	6-27-51	1	D	
(43)	10S28W-33adc1	Howard	J. D. Scott			290	347	3	flowing	8-16-51	30	D	
44	10S30W-36dbd1	Sevier	C. K. Kendricks	Howard Hipp	1951	310	465	3	dry hole			N	
(45)	11S28W-11bbc1	Howard	W. H. Toland	Howard Hipp		305	460	3	flowing	6-27-51	2	D	
(46)	-11bbd1	Howard	J. E. Delaney	Howard Hipp		304	468	3	10R	- -51		D	
47	11S29W-25cca1	Little River	White Cliffs School	Howard Hipp		365	720	2				N	Water reported too salty to use
					Tokio formation								
(48)	8S23W-35dbd1	Pike	S. D. Snowden	Walter Brown	1940		125	4	flowing	11-27-51	25	D	
(49)	8S24W-24dac1	Pike	Ozan Lumber Co.				150	3	flowing	11-27-51	5	PS	
(50)	9S22W-19aab1	Nevada	Duff Buchanan			200	300-400	3	flowing	4-18-51	20	N	
(51)	-20abb1	Nevada	Dave Crowley			200	400±	3	flowing	4-18-51	20	D	
(52)	-21dcc1	Nevada	D. C. Tippits	Wells		200	400±	3	flowing	4-18-51	30	D	
(53)	-25bab1	Clark	Buren Hardin	R. H. Herron	1948	240	500±	4-2	flowing	9-13-50		D	
(54)	-33dcc1	Nevada	Cooper Estate		1900	225	677	3	flowing	4-18-51	7	D	
(55)	9S23W-7ccc1	Pike	W. B. Horton			290	164	4	flowing	4-20-51	2	D	
56	-7cdc1	Pike	W. B. Horton			290	164	2	flowing	4-20-51	2	D	
57	-7cdc2	Pike	W. B. Horton			330	190	2	22R	- -51		N	
58	-7dbb1	Pike	Mr. Avery	Mr. Avery			240		flowing	9-8-50		D	
(59)	-16bcc1	Pike	Henry Hendricks				200±	4	flowing	5-1-51	43	D	
(60)	-16cdd1	Hempstead	E. R. Hendricks				230	3	flowing	5-1-51	20	D	
(61)	-16dba1	Pike	Quincy Starling				240±	3	flowing	5-1-51	20	D	
(62)	-17bbc1	Pike	Ray Bowen	F. Brown	1931		228	3	flowing	5-4-51	10	D	
(63)	-17bac1	Pike	O. Whitten				200±	3	flowing	5-4-51	5	D	
64	-17bcc1	Pike	O. Whitten				200±	3	flowing	9-8-50	13	D	
(65)	-18bbb1	Pike	J. J. Howell			283	160	2	flowing	4-19-51	1	D	
(66)	-18bdb1	Pike	W. B. Horton			270	160		flowing	4-20-51	33	D	
(67)	-18cac1	Pike	J. L. Johnson			265	200	3	flowing	4-19-51	37	D	
(68)	-18ccc1	Pike	A. C. Avery			265	200	4	flowing	4-19-51	1	D	
(69)	-18daa1	Pike	Clarence Belt				200±	3	flowing	5-4-51	22	D	
(70)	-18dbc1	Pike	Ray Bower			300	240	2	flowing	5-4-51	1	D	
(71)	-19bcb1	Pike	M. L. Avery			260	200±	4	flowing	4-19-51	40	D	
(72)	-19dad1	Hempstead	George May				244	3	flowing	5-1-51	90	D	
(73)	-20add1	Hempstead	Mr. Lamb				200±	4	flowing	5-1-51		D	
(74)	-22baa1	Nevada	Mr. Gordon				225±	3	flowing	9-7-50	8	D	

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS—Continued

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
			Tokio formation—Continued										
(75)	9S23W-26cdc1[4]	Nevada				250	300±	3	flowing	4-18-51	7.5	D	
(76)	-31cac1	Hempstead	O. B. Rodden	F. E. Wells	1925	295	412	2	flowing	4-19-51	5	D	
(77)	133dcc1	Hempstead	J. O. Phillips	F. E. Wells	1936		467	2	flowing	5-4-51		D	
(78)	-34bac1	Nevada	H. L. King			240	300±		flowing	4-18-51	2.5	D	
(79)	-34ddc1	Nevada	T. E. Moore	T. E. Moore			460	3	flowing	4-18-51		D	
(80)	9S24W-10dda1	Pike	David Garner			300	100	2	flowing	4-19-51	1	D	
81	-11aac1	Pike	Jack Langley			300	70±	4	flowing	4-19-51	1	D	
82	-11adc1	Pike	Newt Langley			300	80	4	flowing	4-19-51	1	D	
83	-12bcb1	Pike	A. S. Hill			305	100±	2	flowing	4-19-51	5	D	
84	-12cbc1	Pike	Joe Whitehorn			300	90	4	flowing	4-19-51	1	D	
(85)	-13bcb1	Pike	B. F. Slatton			285	170	4	flowing	4-19-51	11	D	
86	-13bdd1	Pike	W. Barton			290	160±	3	flowing	4-19-51	1	D	
87	-13cab1	Pike	Ray Avery			280	165	4	flowing	4-20-51	1	D	
88	-13dcc1	Pike	Ray Avery			268	170	4	flowing	4-20-51	1	D	
(89)	-14aac1	Pike	J. V. Slatton			285	140	3	flowing	4-18-51	1	D	
(90)	-21aac1	Hempstead	Gene Hill			280	200	2	flowing	4-17-51	7.5	D	
(91)	-21bcb1	Hempstead	Sanders Moses			282	200	2	flowing	4-17-51	16.8	D	
92	-22aac1	Pike	Ben Scroggins			275	150	3	flowing	5-4-51		D	
(93)	-23aad1	Pike	M. Harris			265	200	3	flowing	4-18-51	10	D	
94	-23abb1	Pike	Coy Watts			265	150±	3	flowing	- -51		D	
(95)	-24abc1	Pike	T. S. Slatton			260	200±	3	flowing	5-1-51	25	D	
(96)	-24ccb1	Pike	M. Harris			270	200±	4	flowing	4-18-51		D	
(97)	-24cda1	Pike	Jeff Stead			260	196	3	flowing	5-1-51	5	D	
(98)	-24dcd1	Hempstead	J. L. Lee			265	185	4	flowing	4-17-51	13.8	D	
99	-25acb1	Hempstead	Tom Slatton	Walter Brown		265	287	4	flowing	4-17-51	16.8	D	
(100)	-25bbb1	Hempstead	Guy Brock			268	270	3	flowing		47	D	
(101)	-25cbb1	Hempstead	M. Harris			264	280	3	flowing		1.8	D	
(102)	-25cbd1	Hempstead	M. Harris			263	290	4	flowing		30	D	
(103)	-26cab1	Hempstead	Barto Hill	F. E. Wells	1937	268	240	2	flowing	4-5-41	37.5	D	
(104)	-28acc 1	Hempstead	Eli Hill	F. E. Wells	1938	288	200	2	flowing	4-17-51	3.3	D	
(105)	-36ada1	Hempstead	Bryant & Wilson			260	300±	2	flowing	4-16-51	10.8	D	
(106)	-36bac1	Hempstead	M. Harris			260	300	2	flowing	4-17-51	21.5	D	
(107)	9S26W-8add1	Hempstead	Barney Smith	Homer Smith	1931	435	25	24	flowing	3-28-51	1	D	
(108)	-9ccd1	Hempstead	Claude Werley	Howard Hipp	1949	485	120	2	30R	- -49		D	
(109)	-9cda1	Hempstead	Nashville School Dist.			415	16				5	PS	
(110)	-29aaa1	Hempstead	Clell Flemister			385			spring			D	
(111)	10S22W-6cbd1	Nevada	Prescott Fishing Club			250	600±	3	flowing	4-18-51	10		Used for fish lake
112	-7bbb1	Nevada	Prescott Fishing Club			250	600	4	flowing	4-18-51	5		Used for fish lake
(113)	10S23W-3bac1	Nevada	Hamby Rinkle		1920		430-450	2	flowing	9-7-50		D	
114	-3cdb1	Nevada	Mr. Harris	Wells	1932		540	2				D	
(115)	-4aaa1	Hempstead	Grady Harris	A. B. Wells	1944		459	2	flowing	9-7-50	5	D	
(116)	-12aaa1	Nevada	Prescott Fishing Club			250	600±	4	flowing	4-18-51			Used for fish lake
(117)	-18bab1	Hempstead	W. T. Yarberry	A. B. Wells	1940	400	684	3	90R	- -41	5	D	
(118)	10S24W-14ddd1	Hempstead	Jess Woods	A. B. Wells	1937	395	643	2	90R	- -37	5	D	
(119)	-16cdd1	Hempstead	Blevins School Dist. No. 2	W. K. Elliot	1949	422	670	4	70R	- -49	15	PS	
(120)	-30bbb1	Hempstead	G. D. Royston	F. Cornelius	1933	324	693	2	35R	- -33	5	D	
(121)	10S25W-2abb1	Hempstead	Bert Scott	F. E. Wells	1936	446	375	2	90R	- -36	5	D	
(122)	-22bbb1	Hempstead	Chester McCaskill	Kirk Merchant	1930?	312	350	2	flowing	3-28-51	1	D	
(123)	-23acd1	Hempstead	Earnest McWilliams	F. E. Wells		305	300±	2	flowing	3-28-51	5	D	
(124)	-24daa1	Hempstead	G. D. Royston			310	300±	2	flowing	3-30-51	5	D	
(125)	-30ccc1	Hempstead	Town of Ozan		1918	390	555	4-2				D	Not used for town water supply
(126)	10S26W-3bbb1	Hempstead	C. M. Lewis	George Hipp	1918	384	162	3	32R	- -18	5	D	
(127)	-15bba1	Hempstead	Clow Training School	Howard Hipp	1940	427	350-400	3			5	PS	
(128)	-25dad1	Hempstead	Mrs. H. A. King	Phillips	1880?	398	485	2			5	D	
(129)	10S27W-3dba1	Howard	W. H. Toland	Howard Hipp		334	100	2	flowing	8-16-51	2	D	Lower sand
(130)	-9add1	Howard	J. V. Toland	Howard Hipp		325	120	2	flowing	8-14-51	2	D	
(131)	-16bbc1	Howard	Will Wesson	Howard Hipp		325	215	2	flowing	8-14-51	1	D	Lower sand
(132)	-17acb1	Howard	J. V. Toland	Howard Hipp		325	220	2	flowing	8-14-51	1	D	Lower sand
(133)	-19daa1	Howard	J. D. McCullough	Howard Hipp		325	200±	2	flowing	8-14-51	10	D	Lower sand
(134)	-20bca1	Howard	Bo Nutt	Howard Hipp		320	195	2	flowing	8-14-51	2	D	Lower sand
(135)	-20daa1	Howard	J. V. Toland	Howard Hipp		295	103	4	flowing	6-27-51	20	D	Middle sand
(136)	-26bdc1	Howard	Singer Farm	Howard Hipp		320	320	2				D	Lower sand
(137)	-26dba1	Howard	Robert Dyer	Howard Hipp		350	315	2				D	Lower sand
(138)	-28aba1	Howard	Lump Delaney	Howard Hipp		315	280	2	flowing	6-27-51	1	D	Lower sand
(139)	-28cdb2	Howard	M. B. Stone	Howard Hipp		300	128	2	flowing	6-27-51	2	D	Middle sand
(140)	-29ada1	Howard	J. V. Toland	Howard Hipp		290	115	3	flowing	6-26-51	10	D	Middle sand
(141)	-29cad1	Howard	J. V. Toland	Howard Hipp		285	115	3	flowing	6-26-51	20	D	Middle sand
(142)	-30aaa1	Howard	J. V. Toland	Howard Hipp		300	220	3	flowing	6-26-51	20	D	Lower sand
(143)	-32baa1	Howard	J. V. Toland			285	215	3	flowing	6-26-51	2	D	Middle sand
(144)	-32cbd1	Howard	W. Dillard			280	200±	4	flowing	6-27-51	2	D	Middle sand
(145)	-35cbd1	Howard	A. P. Webb	Howard Hipp		350	515	4	flowing	6-27-51	15	D	
(146)	10S28W-7ddd1	Howard	Jim A. Barrett			318	200	2				D	Lower sand
(147)	-24adc1	Howard	Mrs. Edna Swinney			360	282	2			5	D	Lower sand
(148)	-29dab1	Howard	R. P. Graves	Howard Hipp		275	86	3	flowing	6-27-51	1	D	Middle sand
(149)	-30dbb1	Sevier	Shoates Farm			280	100±	2	flowing	7-12-51		D	
(150)	-31dcc1	Sevier	G. W. Polley	Howard Hipp		330	122	2				D	
(151)	10S29W-35ccd1	Sevier	Augustus Goforth	Mr. Garrison		335	280	2	12R	- -49		D	

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS—Continued

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
				Tokio formation—Continued									
(152)	11S22W-8ddb1[4]	Nevada	City of Prescott		1912	319	1,070	8	104R	- -43	307	PS	
(153)	11S25W-8bac1	Hempstead	Moss Rowe	F. Cornelius	1940	402	665	2	85R	- -40		D	
(154)	11S26W-8bbb1	Hempstead	E. L. Cox	W. K. Elliot	1950	365	550	3-2	50R	- -50	15	D	
(155)	-23bbb1	Hempstead	V. M. Lee	W. K. Elliot	1951	419	820	4-2	104.40	4-16-51	8	D	
(156)	11S27W-1cda2	Howard	Randolph Webb	W. K. Elliot	1951	380	516	3-1.25	50R	- -51	5	D	Lower sand
(157)	-2abb1	Howard	Robert Cowell	Howard Hipp		360	400	2				D	Middle sand
(158)	-2bdd1	Howard	Burleigh Webb	Howard Hipp		330	350	2				D	Middle sand
(159)	-2cca1	Howard	T. J. Webb	George Hipp		350	400	2			5	D	Middle sand
(160)	-8add1	Howard	Howard County Training Sch.	Howard Hipp		355	388	2			5	D	Upper and middle sand
(161)	-8baa1	Howard	William Dillard			345	380	3			5	D	Middle sand
(162)	-8cbc1	Howard	William Dillard			270	320	4	flowing	6-27-51	60	D	Middle sand
(163)	-9bca1	Howard	Lillie Draper	Howard Hipp		360	407	2				D	Middle sand
(164)	-11aca1	Howard	Bud Stone	Howard Hipp		370	395	2				D	Middle sand
(165)	-11acc1	Howard	Warren Citty			355	415	2	40R	- -47	5	D	Middle sand
(166)	-11bda1	Howard	Jess Schooley	Howard Hipp		345	386	3-2	30R	- -47		D	Middle sand
(167)	-12bbd1	Howard	Othhel Smith	Howard Hipp		370	522	3			5	D	Lower sand
(168)	-17dab1	Howard	Thomas E. Bell, Sr.	C. Cornelius	1905 ?	310	362	2	27.25	7-9-51		D	Upper sand
(169)	-20aca1	Howard	Milburn Jeanes	Howard Hipp		285	416	2	flowing	7-9-51	1	D	Upper sand
(170)	-22aaa1	Howard	Joe Wilson	C. Cornelius		312	400±	2	12R	- -49	5	D	Upper sand
(171)	-29acc1	Howard	Ed Fontaine	Howard Hipp		310	475	2				D	Upper sand
(172)	-29ddb1	Howard	Gilbert Smith	Howard Hipp		343	500±	2				D	Upper sand
(173)	-30caa1	Howard	Ideal Cement Co.			280	496	8	50.65	7-12-51		I	Upper sand
174	-30cad1	Howard	Ideal Cement Co.			290	503	10	118.50	7-12-51	200	I	
175	-30dbb1	Howard	Ideal Cement Co.		1929	280	527	8	44.77	7-12-51	70	I	
176	-30dbd1	Howard	Ideal Cement Co.			318	544	6	93.24	7-12-51		N	
177	-30dcd1	Howard	Ideal Cement Co.			340	547	8	112.83	7-12-51		N	
(178)	-32dac1	Howard	Joe Fontaine			400	800±	2			5	D	Middle sand
(179)	11S28W-2ddd1	Howard	School and Church	Howard Hipp		309	240	3	flowing	6-27-51	1	D	Middle sand
(180)	-7bbb1	Sevier	Ortho Johnson			295	120	2	flowing	7-12-51		D	
(181)	-14cad1	Howard	W. H. Toland	Howard Hipp		275	260	3	flowing	6-27-51	1	D	Upper sand
(182)	-30bcc1	Sevier	Ideal Cement Company			275	300±	2	flowing	- -51		D	
(183)	-30cdb1	Sevier	Ideal Cement Company			265	300±	2	flowing	- -51		D	
(184)	11S29W-2baa1	Sevier	O. A. Mitchell			335	150±	2			5	D	
(185)	-6baa1	Sevier	Guy McCullough			335	150±	4	flowing	8-16-51	5	D	
(186)	-7baa1	Sevier	Lewis Walker			285		3	flowing	8-16-51	1	D	
(187)	-7bbd1	Sevier	Edwin Polk			283	200±	2	flowing	8-16-51	2	D	
(188)	-7dcc1	Sevier	J. K. Polk			278		2	flowing	7- -51	1	D	
(189)	-8cad1	Sevier	J. W. Roberts	Howard Hipp		465	379	3	95R	- -51	5	D	
(190)	-11cab1	Sevier	Milton Garrison	M. Garrison		430	387	2			5	D	
(191)	-11dcb1	Sevier	Loyd Garrison			395	307	2				D	
(192)	-14dbc1	Sevier	Dave Holt	Howard Hipp		355	391	2	98R	- -40		D	
(193)	-14ddc1	Sevier	Ben Savage	Howard Hipp		370	380	2				D	
(194)	-17adc1	Sevier	J. C. Walker			285	250±	2	flowing	8-16-51	1	D	
(195)	-17dbb1	Sevier	Mrs. W. C. Sutton			275	250±	3	flowing	8-16-51	1	D	
(196)	-18aba1	Sevier	C. I. Brewer			276	250±	3	flowing	8-16-51	2	D	
(197)	-18bdb1	Sevier	Vaughn			268		2	flowing	7- -51	5	D	
(198)	-19cbb1	Sevier	Dierks Lumber Co.			269	300±	2	flowing	8-15-51	1	D	
(199)	-20abd1	Sevier	Ralph Penny			265	200±	2	flowing	8-16-51	2	D	
(200)	-24bab1	Sevier	Frank Moore	Howard Hipp	1938	355	347	3-1.25				D	
(201)	-30bbb1	Sevier	C. E. Ashley	Howard Hipp		270	380	2	flowing	7-16-51	5	D	
(202)	11S30W-1dad1	Sevier	Mrs. Rhyne			290	360±	3	flowing	8-16-51	2	D	
(203)	-12daa1	Sevier	Bob Grady			271		2	flowing	8-16-51	1	D	
(204)	11S33W-12aaa1	Little River	Roland Oglesby			400	22					D	
(205)	12S23W-3acd3	Nevada	Ark. La. Gas Co.	H. Cox	1926		1,217	10-6				I	See log
206	12S24W-5bdd1	Hempstead	Hope Lt. & Water Co.	Layne-Ark. Co.	1941	340	1,143	10-8	72.36	1-10-50		N	See log
(207)	-6cdd1	Hempstead	Hope Lt. & Water Co.	Layne-Ark. Co.	1941	340	1,202	10-8	66.92	1-11-50	184	PS	See log
(208)	-28cdc2	Hempstead	Hope Lt. & Water Co.		1918	353	1,480	8-4	100R	- -47	292	PS	City No. 1
(209)	-28cdd1	Hempstead	Hope Lt. & Water Co.	Holliday Well Co.	1950	353	1,500	12-8	104R	- -50	240	PS	See log
(210)	12S27W-4bbc1	Hempstead	Saratoga School	W. K. Elliot	1950	395	870	4-1.25	177R	- -50	6	PS	
(211)	-23bda1	Hempstead	T. M. Bemis	A. B. Wells	1940	395	800±	4	175R	- -50	5	D	
212	12S32W-27aaa1	Little River	Dennison Walker	W. K. Elliot	1950	445	800±	3				N	Reported salt water
				Brownstown marl									
(213)	7S20W-31cbb1	Clark	W. H. Ross	R. H. Herron	1948		330	4-2				D	
				Ozan formation									
214	7S20W-14cdc1	Clark	R. C. Daily				285	4-2	34.54	10-11-50		D	
(215)	-22bbb1	Clark	Charles B. Welch	R. H. Herron	1950		306	4-2				D	
(216)	-28cbc1	Clark	W. R. Burrow	R. H. Herron	1948		462	4-2				D	
(217)	-30dcb1	Clark	D. H. Ryan	R. H. Herron	1929		220-230	4-2				D	
(218)	8S21W-1acd1	Clark	Buck Arnold	Wells Well Co.	1929			4	flowing	9-14-50		D	
(219)	-2cdd1	Clark	R. W. Kelly	Wells Well Co.	1924		196	4-2	flowing	8-30-50		D	
(220)	-3ddd1	Clark	J. B. Hank		1940		165	4	flowing	8-29-50		D	
(221)	-9dda1	Clark	V. W. Hardin	J. Gardner	1925	230		4-2	flowing	8-30-50		D	
(222)	-15abc1	Clark	R. N. McIlhannon	R. H. Herron	1945		150	4-2	flowing	8-30-50		D	
(223)	-18aac1	Clark	Baswell Farms	G. N. Marman	1917	235	165	4-2	flowing	8-30-50		D	
(224)	-18aac2	Clark	Baswell Farms	R. H. Herron	1945	240	163	4-2	flowing	8-30-50		D	
(225)	10S26W-24abc1	Hempstead	T. J. Draper	Sam White	1941	363	27	18	3R	- -51		D	
(226)	11S29W-30bbb2	Sevier	C. E. Ashley	Howard Hipp		270	180	6	flowing	7-16-51	1	N	

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS—Continued

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
				Nacatoch sand									
(227)	8S19W-7aba1[1]	Clark	Earl Manning	R. H. Herron	1949		100	4-2				D	
228	-7aba2	Clark	Earl Manning	R. H. Herron			100	4-2	29.59	7-27-50		D	
229	-16caa1	Clark						3.5	flowing	10-12-50		D	
(230)	8S20W-11abc1	Clark	N. W. Crawford	R. H. Herron	1946		85	4-2				D	
(231)	-19ccc1	Clark	Henry Crawford	R. H. Herron	1940		98	4-1	8.66	8-31-50		D	
(232)	-23dda1	Clark	Ro Vern Court	R. H. Herron	1946		150	4-2				PS	
(233)	-25cdd1	Clark	Lonnie Mitchell	R. H. Herron	1947		175	4-1.25	12R	- -47		D	
(234)	-25dbd1	Clark	Grover Wells						flowing	10-12-50		D	
235	-34caa1	Clark	Jesse Johnson	R. H. Herron	1949	170	102	4-2			5	D	
236	-34dab1	Clark	F. J. Rogers	R. H. Herron	1947	170	110	4-2			5	D	
237	-35adc1	Clark	D. C. Thomas	R. H. Herron	1949	200	185	402			5	D	
238	-35adc1	Clark	F. A. Evans	R. H. Herron	1930	170	116	3	13.05	8-29-50	5	D	
(239)	-35caa1	Clark	R. H. Herron	R. H. Herron	1948	170	120	4-2	12.01	7-27-50		D	
240	-36adb1	Clark	Ewing						flowing	10-12-50		D	
241	-36bdd1	Clark	Thomas Lumber Co.	R. H. Herron	1929	200	160	3-1.25	10.96	8-31-50		PS	
(242)	-36bdd2	Clark	Thomas Lumber Co.	J. H. Sheppard	1930	200	160	4-2				I	
243	-36bdd3	Clark	Thomas Lumber Co.	R. H. Herron	1938	200	165	6-4	9.45	8-31-50		I	
244	-36caa1	Clark							flowing	10-12-50		D	
(245)	9S20W-10aaa1	Clark		Williams		160	140		flowing	9-14-50	5	D	
(246)	-21dcc1	Clark	W. C. Wray				220	4-2				D	
(247)	-22adb1	Clark	R. E. Allen			205		4-2	14.28	8-31-50		D	
(248)	-27bcc1	Clark	Arkansas Power & Light	R. H. Herron	1949	200	200	3-1.25	flowing	8-31-50		PS	
(249)	-32dcc1	Clark	Gurdon Lumber Company	Wells Well Co.	1937	225	220	4-2	16R	- -37	5	PS	
(250)	-33bbc1	Clark	City of Gurdon	J. H. Sheppard	1925	200	245	6-4			60	PS	
251	-33bbc2	Clark	City of Gurdon	J. H. Sheppard	1925	200	245	6-4			50	PS	
252	-33bbc3	Clark	City of Gurdon	Barnwell Drilling	1948	200	245	12-6	37.47	7-26-50	100	PS	Reported to pump asphalt
(253)	-33ddb1	Clark	F. E. Knight	John Hulen	1950	215	300	4			5	D	
(254)	-34abc1	Clark	Marium Anderson	R. H. Herron	1945		360	4-2				D	
(255)	-34dab1	Clark	Conrad Nelson	John Hulen	1950		360	4-2	55R	- -50		D	
(256)	-35caa1	Clark	William Wells	R. H. Herron	1945		420					D	
(257)	10S20W-4acb1	Clark	Earl Frizzell	R. H. Herron	1950	230	330	4-2				D	
(258)	-9aaa1	Clark	Melvin Gates	Wells Well Co.	1943	250	340	4-2				D	
(259)	-22cdd1	Clark	Barringer Lumber Co.	J. H. Sheppard		230	480-500	4-2				D	
(260)	-35bcb1	Clark	McKinney Lumber Co.	Wells Well Co.	1950	235	568	6				PS	
(261)	10S21W-12bba1	Clark	Gurdon Lumber Co.		1930	225	200	4-2			5	PS	
262	-12bbd1	Clark	Gurdon Lumber Co.	Wells Well Co.	1930	230	265	4			50	I	
(263)	-12bdd1	Clark	Gurdon Lumber Co.			230	200-250	4			100	PS	
(264)	10S22W-23dcb1	Nevada	Baptist Church			250	45±	3	1.91	4-19-51		PS	
(265)	-27caa1	Nevada	T. Formby			250	65±	2				D	
266	11S20W-8ccc1	Nevada	M. Cuttingham	Sid Wells		200	530					D	
267	-8dcc1	Nevada	Brad Dewoody	Sid Wells	1930	200	525					D	
(268)	-8dcd1	Nevada	Mrs. G. Dewoody	Sid Wells	1915	200	525					D	
(269)	-16acd1	Nevada	P. H. Gullick	B. Wells	1919	170	565±	3	flowing	4-18-51		D	
(270)	-22baa1	Nevada	R. L. Cunningham	B. Wells	1925	170	565±		flowing	4-18-51		D	
271	-22bbb1	Nevada	J. W. Barlow	Sid Wells		175	550±	3	flowing	4-18-51	1	D	
272	-22bcb1	Nevada	W. A. Barlow	Sid Wells		175	550±	3	flowing	4-18-51	1	D	
(273)	-22dbd1	Nevada	Ella Shell	Sid Wells	1925	170	440	3	flowing	4-17-51		D	
(274)	11S21W-14cac1	Nevada	Mr. Barns	Sid Wells		200±	500-600		flowing	4-18-51	1	D	
(275)	-18baa1	Nevada	Ed Clark			255	300-400					D	
(276)	11S22W-8bbd1	Nevada	Southern Ice Co.			320	200	8				I	
277	-8bbd2	Nevada	Southern Ice Co.			320	200	8				I	
278	-8dbc1	Nevada	Ozan LumberCo.	Mr. Barnwell			325	6				I	
279	-8dbc2	Nevada	Ozan LumberCo.	Mr. Barnwell			325	6				I	
(280)	-8ddb2	Nevada	City of Prescott	Sid Wells	1925	319	250	8-6	60R	- -45	150	PS	
(281)	-8ddb3	Nevada	City of Prescott	Mr. Barnwell	1948	319	325	8-6	60R	- -50	150	PS	
(282)	11S23W-3dcd1	Nevada	C. L. Miller	Sid Wells	1926	350	135	2				D	
(283)	-12abb1	Nevada	Dennis Ledbetter		1925	350	300±	2				D	
(284)	-18acd1	Hempstead	B. J. Ellis		1914	325	60	4	42R	- -50	5	D	
(285)	-31ccd1	Hempstead	J. D. Allen	F. E. Wells	1950	322	185	2				D	
(286)	-34abc1	Nevada	Boyd Brothers	Wells	1925	250	240±		flowing	4-19-51	1	D	
(287)	-34abd1	Nevada	Mrs. Cliff Arnold	Wells		250	240±	2	flowing	4-19-51	1	D	
(288)	11S24W-8dbd1	Hempstead	H. E. Sutton			470	32		28R	- -51	5	D	
(289)	-21add1	Hempstead	Roy B. Roberts			401	50		42R	- -51	5	D	
(290)	-34cbc1	Hempstead	Sidney Cash	F. E. Wells	1941	312	31	2.5	6R	- -51	5	D	
(291)	11S25W-22ccb1	Hempstead	W. M. Frazier	F. Cornelius	1911	442	105	2				D	
(292)	11S26W-27bdd1	Hempstead	Hempstead County	Paul Clark	1943	430	32	24	19.55	3-29-51	5	PS	
293	12S22W-4ccc1	Nevada	D. McSwain	Wells			260±	2	flowing R	9-6-50		D	
294	-6cad1	Nevada	W. W. Mohon	Wells			265	2	flowing R	9-6-50		D	
(295)	-10bcb1	Nevada	Layward Dickson				265±		flowing R	9-6-50		D	
(296)	-10cdd1	Nevada	Mrs. Reva Wren	Wells	1939		500±	3				D	
(297)	-15bab1	Nevada	Mrs. W. K. Martin	Wells	1904		500±	2				D	
298	12S23W-1ddd1	Nevada	W. W. Mohon	Wells			317	2				D	
(299)	-3acd1	Nevada	Ark. La. Gas Company	H. Cox	1926		301	10				I	See log
300	-3acd2	Nevada	Ark. La. Gas Company	H. Cox	1926		325	10				I	See log
301	-3cbc1	Nevada	Emmitt Colored School	Wells			290	2				PS	
(302)	-3cbd1	Nevada	M. Crumby		1918		268	2				D	
303	-3cbd2	Nevada	Odie De Han	Wells			290	2				D	
304	-3cdb1	Nevada	Emmett Public School	Wells			400	3				PS	

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS—Continued

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
				Nacatoch sand—Continued									
(305)	12S24W-4add1[4]	Hempstead	W. T. Schooley	F. E. Wells	1942	360	160	2				D	
306	-14bac1	Hempstead	Ark. Agri. Exp. Sta.			350		2	101.90	3-22-51	5	PS	
(307)	-14bac2	Hempstead	Ark. Agri. Exp. Sta.			353	220	3			10	PS	
(308)	-27cbc1	Hempstead	Hope Brick Co.	Holliday Well Co.	1950	350	597	6	158R	-50	80	I	See log
(309)	-28cdc1	Hempstead	Hope Lt. & Water Co.	Layne-Ark. Co.	1943	353	620	10	119R	-43	300	PS	City No. 4
310	-28cdc3	Hempstead	Hope Lt. & Water Co.	Layne-Ark. Co.	1949	357	620	12	206.29	3-15-51	290	PS	Water level was 108 ft. below land surface when drilled
(311)	-28cdd2	Hempstead	Hope Lt. & Water Co.		1933	353	620	8	119R	-47	156	N	City No. 3
(312)	-28cdd3	Hempstead	Hope Lt. & Water Co.		1933	353	620	8	119R	-47	147	N	City No. 2
(313)	-28dca1	Hempstead	Southern Ice Co.			350	520	4			10-15	I	
314	-33aac1	Hempstead	Hope Lt. & Water Co.	Vaught	1942	340	620		155R	-42	250	PS	
(315)	-33bcd1	Hempstead	Hope Basket Co.	F. E. Wells	1932	340	512	4			12	I	
(316)	-36aaa1	Hempstead	Earnest McWilliams	F. E. Wells	1946	445	600±	2			5	D	
(317)	12S25W-7abb1	Hempstead	Mrs. P. M. Gilbert	F. E. Wells	1942	435	100±	2			5	D	
(318)	-7abd1	Hempstead	H. B. Gilbert	Sam Houston	1949	418	42	24	37R	-51	10	D	
(319)	-11add1	Hempstead	Hope Air Field		1946	350	207		38R	-46		PS	
(320)	-15dbc1	Hempstead	R. E. Long	F. E. Wells	1947	315	202	2				D	
(321)	-33ddc1	Hempstead	Guernsey Public School		1928	287	300	2	15R	-50	8	PS	
(322)	-34bac16	Hempstead	M. E. Patrick		1900	320	300	2				D	
(323)	12S26W-21aac1	Hempstead	Lee Cheetum			395	60		50R	-51		D	
(324)	-24abc1	Hempstead	E. R. Calhoon	F. Cornelius	1920	317	108	2	flowing	3-29-51	10	D	
325	-24bda1	Hempstead	D. E. Goodlit	F. Cornelius	1928	312	104	2	flowing	3-29-51	5	D	
(326)	-24cca1	Hempstead	T. E. Edwards	F. Cornelius	1933	310	125	2				D	
(327)	12S27W-4ddc1	Hempstead	W. M. Dillard	W. W. Hughes	1936	395	55	18	49.54	3-29-51	10	D	
(328)	13S24W-2ada1	Hempstead	A. S. Williams	A. B. Wells	1947	440	635	2			5	D	
329	-4dcb1	Hempstead	Hope Flooring & Lbr. Co.	B. F. Eddington	1948[7]	340	709	6				N	
(330)	-9bda1	Hempstead	G. Anthony Lbr. Co.	A. B. Wells	1942	353	637	4	160R	-51	5	I	
(331)	-9bdc1	Hempstead	G. Anthony Lbr. Co.		1943	356	400±	6			5	D	
(332)	13S25W-5abd1	Hempstead	N. B. Coleman			285	300±	3			5	D	
(333)	-18aab1	Hempstead	Roy Woods	A. B. Wells	1951	283	335	2	35R	-51		D	
(334)	-25ccb1	Hempstead	Spring Hill School Dist.	W. K. Elliot	1948	350	850	4	112R	-47	10	PS	
(335)	13S26W-16dda1	Hempstead	Hope School District	F. E. Wells	1942	280	225	2				PS	
(336)	-20add1	Hempstead	Mo. Pac. R. R.	Layne-Ark. Co.	1947	260	465	8				I	
337	-23abb1	Hempstead	Henry Mack	F. E. Wells	1951	270	265	2	22.00	4-4-51		D	See log
(338)	-35bcc1	Hempstead	Jesse Smith	Howard Hipp	1942	285	384	3-2				D	
339	13S27W-22cab1	Little River	Smith Place			265	100±	2				N	
(340)	-28bbd1	Little River	H. H. Horton, Jr.			260	165	2				D	
(341)	-31acd1	Little River	J. B. Davis			260	100±	2				D	
(342)	-35ddd1	Miller	R. G. Reed			260	450	2				D	
(343)	13S28W-31cdb1	Little River	J. B. Davis	W. K. Elliot		300	270	3	30R	1950	3	PS	
(344)	-34adb1	Little River	Temple Brothers			260	165	2			5	D	
(345)	-35cba1	Little River	J. B. Davis			260	100±	2				D	
(346)	-36dca1	Little River	E. E. Paxton			265	100±					D	
(347)	14S25W-7bbc1	Hempstead	Mary Jefferson	F. Cornelius	1930	285	700±	4-2				D	
(348)	14S26W-7caa1	Miller	R. G. Reed			250	390	2				D	
(349)	14S27W-1aaa1	Miller	R. G. Reed			250	390	2				D	
350	-1aad1	Miller	R. G. Reed			250	390	2				D	
(351)	-1abb1	Miller	R. G. Reed			255	350	2				D	
(352)	-1bbb1	Miller	R. G. Reed			260	400	2			5	D	
(353)	-2aaa1	Miller	R. G. Reed			260	425	2			5	D	
(354)	-2aab1	Miller	R. G. Reed			255	390	2				D	
(355)	-2add1	Miller	R. G. Reed			255	450	2				D	
(356)	-7cbc1	Miller	A. P. Cox	W. K. Elliot		255	364	3			5	D	
(357)	-12aab1	Miller	R. G. Reed			250	375	2				D	
(358)	14S28W-7cca1	Miller	J. D. Harris	W. K. Elliot		265	426				5	D	
(359)	-13ccc1	Miller	Walter Clement			260	400				5	D	
(360)	-14cbd1	Miller	E. J. Miller			260	400±				5	D	
(361)	-16dac1	Miller	Texarkana Const. Co.			260	400±				5	D	
(362)	-17bbc1	Miller	T. L. Sinham	E. Williamson		270	360				5	D	
(363)	-17cba1	Miller	M. A. Parker			270	300-400				5	D	
(364)	-18aac1	Miller	Mrs. Wallace Dunn	E. Williamson		270	500		25R	-51	5	D	
(365)	-21aaa1	Miller	D. L. Thompson			270	450±				5	D	
(366)	-22bda1	Miller	H. C. Shuffield	E. Williamson		270	600±				5	D	
(367)	-30aca1	Miller	Mrs. Dan Gillham			270	500	3			5	D	
(368)	-32dcb1	Miller	Chester Stanley	W. K. Elliot		300±	600	4			5	D	
369	-34cdc1	Miller	Williams Candy Co.	E. Williamson			700±	3				N	
(370)	14S30W-1daa1	Little River	Kelly Budd				375	3			5	D	
(371)	15S28W-10aab1	Miller	Roy Steuber				800	3			5	PS	
(372)	-18acc1	Miller	Mildred Pencantet	W. K. Elliot		340	950	6			20	I	
(373)	East. Bowie Co., Tex.	Bowie, Texas	J. B. Richardson	W. K. Elliot	1948	300	700		50R	-48	10	D	
(374)	East. Bowie Co., Tex.	Bowie, Texas	Walter Clement	W. K. Elliot		270	800				5	D	
(375)	East. Bowie Co., Tex.	Bowie, Texas	Ed McKee			270	500	4			5	D	
(376)	East. Bowie Co., Tex.	Bowie, Texas	H. T. Ham			270	360					I	

TABLE 11. RECORD OF WELLS IN SOUTHWESTERN ARKANSAS—Continued

Map number[1]	Location number	County	Owner	Driller	Date drilled	Approx. altitude (feet)	Depth (feet)	Casing diam. (in.)	Water level feet below land surface[2]	Date of measurement	Yield or capacity (gpm)	Use[3]	Remarks
					Wilcox formation								
(377)	13S21W-21cda1[4]	Nevada	Town of Rosston	....	1928	......	......	6	125R	1- -45	......	PS	
(378)	15S28W-10aab2	Miller	Roy Steuber	....	......	......	30	....	......	......	......	D	
(379)	-27aba1	Miller	Miss Osteen Phillips	E. Williamson	......	......	270	3	35.30	1-28-51	5	D	
(380)	-32cab1	Miller	W. K. Elliot	W. K. Elliot	......	340	150	3	......	......	......	D	
					Deposits of Quaternary age								
(381)	11S32W-2ccc1	Little River	W. D. Cason	....	......	......	30	....	1$R	- -51	......	D	
(382)	12S29W-6ccc1	Little River	Ada Mills	....	......	......	35	....	......	......	......	D	
383	-32cab1	Little River	Ashdown Water Works	....	1915	330	90	10	......	......	80	PS	
384	-32cab2	Little River	Ashdown Water Works	....	1915	330	90	10	41.65	7-24-51	80	PS	
385	-32cab3	Little River	Ashdown Water Works	Howard Hipp	1944	330	96	10	41.40	7-24-51	80	PS	
(386)	-32cab4	Little River	Ashdown Water Works	Shirly	1950	330	90	8	......	......	80	PS	See log
(387)	12S30W-3bab1	Little River	S. M. Beck	....	......	......	50	....	......	......	......	D	
388	-12aaa1	Little River	Ada Mills	....	......	......	65	....	......	......	5	D	
(389)	12S31W-36bcc1	Little River	Lloyd Wright	....	......	342	55-60	....	10R	- -51	......	D	
(390)	12S32W-15dbb1	Little River	Town of Foreman	....	......	......	......	....	3	- -46	38	PS	
391	-15dbb2	Little River	Town of Foreman	....	......	......	......	....	3	- -46	15	PS	
(392)	-26bca2	Little River	Magnolia Pipe Line Co.	....	......	400	22	....	......	......	......	I	
(393)	13S27W-22cab-	Little River	Smith Place	....	......	......	30±	....	......	......	......	D	
(394)	14S28W-14cbd2	Miller	E. J. Miller	....	......	260	40±	....	......	......	......	D	
(395)	15S26W-26dcc1	Miller	Luther Lowe	....	......	......	50±	....	......	......	400?	Irr.	
(396)	-35aab1	Miller	Shelly Frank	....	......	......	50±	....	......	......	400?	Irr.	
(397)	15S28W-19ddd1	Miller	Texarkana Water and Sewage Co.	....	......	300	40-50	6	26.95	7-25-51	......	PS	22 wells pumped with common pump in 1951

[1] Well number in parenthesis indicates that analysis of water is given in table 12.
[2] Water level: R, reported.
[3] Use: PS, public supply; I, industrial; D, domestic; Irr., irrigation; N, not used.
[4] This means: T. 8 S., R. 25 W., sec. 17, SW¼, SW¼, NE¼. See well numbering system page 6.

TABLE 12. CHEMICAL ANALYSES OF WATER FROM WELLS IN SOUTHWESTERN, ARKANSAS

Map number	Location number	Owner	Depth (feet)	Date of collection	Temperature °F	Iron (Fe)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-Carbonate	Specific Conductance (Micromhos)	pH	Remarks
						Trinity group										
1	8S25W-17acc1	City of Murfreesboro		7-13-46		1.5	0	197	85	22	1.5	200	38	326	7.6	
2	8S31W-30acd1	City of DeQueen	145	1-9-52	63	.03	0	196	5.7	4.0	0	163	3	304	7.4	
3	-30acd2	City of DeQueen	251	1-9-52		11	0	160	18	6.0	2.8	146	15	290	8.1	
4	-30acd3	City of DeQueen	251	1-9-52	64	1.1	0	208	6.3	5.5	0	180	10	328	7.6	
5	-30bdd1	City of DeQueen	450	1-9-52	66	5.9	0	74	6.3	5.0	.2	58	0	143	7.7	
6	-30dbc1	Southern Ice Co.	249	1-8-52	63	4.7	7	162	1	7.5	0	144	0	274	8.5	
8	9S27W-36bbb1	Southern Ice Co.	250±	8-16-51	...	3.5	0	226	81	12	.6	60	0	517	8.0	
9	9S30W-23bba1	City of Locksburg	...	7-12-46		2.2	0	20	1.4	5.0	.5	13	0	49	6.1	
10	-26cbc1	Loel Phillips	160±	8-15-51	64	.92	0	164	5.0	5.2	1.2	136	2	278	7.2	
11	-27daa1	L. D. Jackson	25	8-15-51	...	.09	0	30	116	695	130	348	323	2,050	7.2	
12	-27dca1	L. D. Jackson	140±	8-15-51	66	.98	0	172	7	5.0	1.4	119	0	282	8.3	
13	-27dcc1	L. D. Jackson	140±	8-15-51	66	.54	0	183	8	6.0	.4	132	0	283	8.1	
14	-35bbb1	Loel Phillips	150±	8-15-51	64	.13	0	188	8	5.8	1.8	134	0	325	7.5	
18	9S32W-36caa2	City of Horatio	290	7-11-46	...	3.2	0	87	4.7	4.2	0	63	0	150	6.5	
19	10S27W-3bdd1	W. H. Toland	265	8-16-51	...	.40	22	387	110	8.5	.8	8	0	846	8.7	
20	-8acc1	Guy Coleman	391	8-14-51	68	.42	31	270	22	8.5	.3	6	0	552	9.0	
21	-8bdc1	Mrs. Joe Coleman	590	8-14-51	...	.07	25	270	22	11	1.4	21	0	588	8.9	
22	-8cdb1	W. H. Toland	265	8-14-51	70	.12	8	274	100	9.8	2.8	22	0	649	8.4	
23	-8dac1	O. B. Tommey	390	8-14-51	68	.05	38	270	18	7.8	.6	6	0	557	9.0	
24	-8dcb1	W. H. Toland	365	8-14-51	68	.01	12	260	18	10	.8	9	0	506	8.6	
25	-19dbb1	Town of Mineral Springs	408	6-27-51	...	.23	0	256	26	7.0	1.1	5	0	429	8.0	
26	-21ddc1	Laverne Hardin	950±	6-27-51	72	.02	34	257	14	4.0	1.1	4	0	538	9.0	
27	-22add1	B. J. Barton	416	6-27-51		.10	16	327	26	4.5	1	12	0	610	8.7	
28	-27dba1	W. H. Toland	510	6-27-51	67	.30	32	431	38	4.8	2	6	0	781	8.8	
29	-28cdb1	M. B. Stone	454	6-27-51	71	.08	8	433	21	4.2	.2	8	0	742	8.7	
30	-28cdc1	Mrs. C. M. Dyer	415	6-27-51	...	3.5	0	65	14	6.5	1.5	12	0	148	8.4	
31	-28dac1	J. V. Toland	510	8-16-51	...	.13	10	445	68	15	1.8	15	0	825	8.5	
32	10S28W-18acc1	W. H. Toland	340	7-10-51	...	.14	23	275	8	3.0	1.1	10	0	495	9.0	
33	-21daa1	Mrs. Curtis Nutt	415	7-10-51	70	.10	44	226	9	4.8	1.2	8	0	512	9.2	
34	10S29W-11bdc1	Nichols Farm	...	7-13-51	66	.17	0	188	9.1	8.8	1.2	58	0	324	8.0	
35	10S32W-2dbd1	...		1-8-52	65	3.5	0	130	4	3.0	0	98	0	213	7.9	
36	11S27W-1cda1	Randolph Webb	780	3-21-51	...	.90	17	546	104	9.0	.4	8	0	1,090	8.5	
37	11S31W-36bac1	Roy R. Spikes	...	7-23-51	77	2.7	41	773	560	365	2.8	41	0	3,340	7.8	
						Woodbine formation										
38	9S27W-35bab1	J. D. Scott Lbr. Co.	100	8-16-51	...	5.1	0	20	7	4.8	.1	16	0	82.8	7.0	
39	10S27W-22bdc1	Frank Moss	364	6-27-51	...	.27	7	519	56	8.2	1.8	12	0	918	8.4	
40	-26adc1	Alton Mitchell	570	6-27-51		.14	27	447	114	8.0	.6	8	0	986	8.7	
41	-27acc1	J. L. Hardin	380	6-27-51		.51	0	360	57	72	1.7	86	0	902	7.9	
42	-28dab1	W. H. Toland	400	6-27-51	70	.13	43	536	24	5.2	2.5	7	0	980	8.9	
43	10S28W-33adc1	J. D. Scott	347	8-16-51	68	.07	38	256	106	9.5	.8	6	0	729	9.1	
45	11S28W-11bbc1	W. H. Toland	460	6-27-51	71	.15	18	362	166	13	.9	6	0	987	8.7	
46	-11bbd1	J. E. Delaney	468	6-27-51	...	.22	27	475	46	38	1.1	9	0	951	8.8	
						Tokio formation										
48	8S23W-35dbd1	S. D. Snowden	125	11-27-51	64	1.6	0	50	24	19	0	21	0	189	6.9	
49	8S24W-24dac1	Ozan Lumber Co.	150	11-27-51	65	5.1	0	31	9	3.5	0	33	8	78.9	7.6	
50	9S22W-19aab1	Duff Buchannon	300-400	4-18-51	68	.22	16	239	46	13	.3	9	0	549	8.7	
51	-20abb1	Dave Crowley	400±	4-18-51	68	.14	15	266	84	217	.6	35	0	1,280	8.6	
52	-21dcc1	D. C. Tippits	400±	4-18-51	69	.12	10	436	187	920	.4	81	0	3,820	8.4	
53	-25bab1	Buren Hardin	500±	9-13-50	75	.28		298	397	1,200	3.5	111	0	4,760	8.0	
54	-33dcc1	Cooper Estate	677	4-18-51	73	.23	20	366	110	193	.3	20	0	1,390	8.8	
55	9S23W-7ccc1	W. B. Horton	164	4-19-51	64	11	0	83	8	5.0	.8	63	0	159	7.2	
59	-16bcc1	Henry Hendricks	200±	5-1-51	66	.79	0	29	19	5.0	.5	20	0	99	7.6	
60	-16cdd1	E. R. Hendricks	230	5-1-51	65	.76	0	51	19	5.2	.6	9	0	150	7.9	
61	-16dba1	Quincy Starling	240	5-1-51	65	1.6	0	43	19	5.0	.5	13	0	129	8.0	
62	-17bbc1	Ray Bowen	228	5-4-51	65	.43	0	21	19	4.5	.5	24	7	86.4	7.6	
63	-17bac1	O. Whitten	200±	9-8-50	68	.36	0	26	24	4.8	1.9	30	9	94.6	6.7	
65	-18bbb1	J. J. Howell	160	4-19-51	64	.60	0	28	14	4.5	.8	31	8	93.9	6.4	
66	-18bdb1	W. B. Horton	160	4-20-51	65	.40	0	13	12	4.2	.9	22	11	70.9	6.6	
67	-18cac1	J. L. Johnson	200	4-19-51	65	.36	0	14	12	4.2	.9	19	8	71	6.3	
68	-18ccc1	A. C. Avery	200	4-19-51	64	1.7	0	104	10	4.8	.8	45	0	206	7.8	
69	-18daa1	Clarence Belt	200±	5-4-51	66	.89	0	25	17	4.5	.3	26	6	92.5	7.7	
70	-18dbc1	Ray Bower	240	5-4-51	65	1.2	0	27	18	4.2	.4	27	5	95.6	7.8	
71	-19bcb1	M. L. Avery	200±	4-19-51	64	.54	0	35	13	4.5	.8	18	0	108	6.6	
72	-18dad1	George May	244	5-1-51	65	.33	0	32	18	4.8	.4	16	0	113	8.0	
74	-22baa1	Mr. Gordon	225±	9-7-50	68	.65	0	185	50	12	.9	12	0	399	8.3	
75	-26cdc1	...	300±	4-19-51	70	.15	0	255	57	10	.2	18	0	523	8.3	
76	-31cac1	O. B. Rodden	412	4-19-51	...	.11	0	201	48	12	.8	12	0	421	8.6	
77	-33dcc1	J. D. Phillips	467	5-4-51	...	.10	22	220	54	25	.3	7	0	593	8.9	
78	-34bac1	H. L. King	300±	4-18-51	69	.17	0	228	64	21	.4	5	0	527	7.9	
79	-34ddc1	T. E. Moore	460	4-18-51		.11	8	268	69	24	.2	10	0	592	8.6	
80	9S24W-10dda1	Dard Gardner	100	4-19-51	64	.57	0	18	11	4	.7	21	6	69.9	6.7	
85	-13bcb1	B. F. Slatton	170	4-19-51	65	1.0	0	11	6	5.2	.8	17	8	62	5.9	
88	-13dcc1	Ray Avery	170	4-20-51	65	2.1	0	29	20	4.8	.8	27	3	95.7	7.2	
89	-14aac1	J. V. Slatton	140	4-18-51	64	.66	0	30	7	4.2	.1	31	6	95.9	6.8	
90	-21aac1	Gene Hill	200	4-17-51	66	.45	0	48	11	4.5	.5	13	0	127	7.3	

TABLE 12. CHEMICAL ANALYSES OF WATER FROM WELLS IN SOUTHWESTERN, ARKANSAS — Continued

Map number	Location number	Owner	Depth (feet)	Date of collection	Temperature °F	Iron (Fe)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-Carbonate	Specific Conductance (Micromhos)	pH	Remarks
		Tokio formation — Continued														
91	9S24W-21bcb1	Sanders Moss	200	4-17-51	66	.83	0	36	24	3.5	.1	16	0	106	7.2	
93	-23aad1	M. Harris	200	4-18-51	64	.42	0	34	9	4.2	.3	20	0	109	6.8	
95	-24abc1	T. S. Slatton	200±	5-1-51	65	.76	0	35	18	4.8	1.1	20	0	109	7.8	
96	-24ccb1	M. Harris	200±	4-18-51	65	.36	0	132	55	6.8	.1	13	0	308	7.8	
97	-24cda1	Jeff Stead	196	5-1-51	65	1.5	0	169	38	6.5	.4	19	0	369	7.2	
98	-24dcd1	J. L. Lee	185	4-17-51	65	.99	0	182	56	6.5	.3	24	0	378	8.2	
100	-25bbb1	Guy Brock	270	4-5-51	65	1.5	0	137	49	6.8	.5	47	0	300	8.2	
101	-25cbb1	M. Harris	280	4-17-51	67	1.6	0	147	54	7.2	.5	21	0	330	8.1	
102	-25cbd1	M. Harris	280	4-17-51	67	.47	0	167	68	6.2	.3	36	0	346	8.3	
103	-26cab1	Barto Hill	240	4-5-51	65	1.4	0	99	23	5.0	.3	17	0	224	7.9	
104	-28acc1	Eli Hill	200	4-17-51	66	1.4	0	86	12	3.8	.1	19	0	177	7.5	
105	-36ada1	Bryant and Wilson	300±	4-16-51	67	.16	0	212	64	8.2	.3	29	0	429	8.1	
106	-36bac1	M. Harris	300	4-17-51	68	.26	0	205	23	7.0	.2	42	0	418	8.0	
107	9S26W-8aad1	Barney Smith	25	3-28-51	65	.76	8	220	95	9.2	8.6	196	2	560	8.4	
108	-9ccd1	Claude Werley	16	3-29-51		3.3	0	32	1	3.5	7	21	0	68.3	7.3	
109	-9cda1	Nashville School District	120	3-29-51		.51	0	13	3	8.2	18	31	20	97	7.1	
110	-29aaa1	Clell Flemister		3-29-51	58	.30	0	13	1	3.8	1.0	9	0	40.7	7.6	
111	10S22W-6cbd1	Prescott Fishing Club	600	4-18-51	74	.15	25	303	85	97	.3	12	0	982	8.8	
113	10S23W-3bac1	Hamby Rinkle	435-450	9-7-50	71	.14	16	274	50	22	.3	6	0	596	8.6	
115	-4aaa1	Grady Harris	459	4-5-51	72	.21	17	230	72	21	.5	23	0	572	8.9	
116	-12aaa1	Prescott Fishing Club	600±	4-18-51	74	.08	25	298	83	82	.2	14	0	932	8.8	
117	-19bab1	W. T. Yarberry	684	4-5-51		.22	9	229	90	45	1.1	25	0	673	8.5	
118	10S24W-14ddd1	Jess Woods	643	4-5-51		.29	0	187	58	18	.5	20	0	435	8.5	
119	-16cdd1	Blevins School District No. 2	670	4-5-51		.27	0	169	47	10	.9	23	0	352	7.8	
120	-30bbb1	G. D. Royston	693	3-30-51	64	2.5	0	192	115	43	.3	106	0	621	7.9	
121	10S25W-2abb1	Bert Scott	375	3-28-51	65	41	0	32	5	4.5	.3	36	10	67.1	7.8	
122	-22bbb1	Chester McCaskill	350	3-28-51	68	4.0	0	79	2.4	6.0	.7	26	0	173	8.2	
123	-23adc1	Earnest McWilliams	300±	3-28-51	65	9.4	0	104	7	5.8	.3	3	0	211	7.3	
124	-24daa1	G. D. Royston	300±	3-30-51	68	24	0	107	29	6.5	.7	6	0	235	8.0	
125	-30ccc1	Town of Ozan	555	3-28-51	65	3.9	6	139	1	16	1.1	19	0	277	8.5	
126	10S26W-3bbb1	C. M. Lewis	162	3-29-51	62	54	0	3	33	4.8	.04	26	24	90.4	6.1	
127	-15bba1	Clow Training School	350-400	4-10-51		1.9	0	64	22	5.2	.2	52	0	152	7.4	
128	-25dad1	Mrs. H. A. King	485	3-28-51	60	.08	31	370	5	61	1.1	21	0	810	8.9	
129	10S27W-3dba1	W. H. Toland	100	8-17-51	67	.23	0	206	8.0	5.0	1.5	79	0	350	7.8	Lower sand
130	-9add1	J. V. Toland	120	8-14-51	66	.11	5	241	20	7.0	1.7	75	0	409	8.5	
131	-16bbc1	Well Wesson	215	8-14-51	68	.08	24	307	81	11	2.1	9	0	680	8.7	Lower sand
132	-17acb1	J. V. Toland	220	7-10-51		.04[1]	10	322	175	14	1.9	19	0	926	8.4	Lower sand
133	-19daa1	J. D. McCullough	200±	8-14-51	68	.09	24	280	100	10	1.4	11	0	741	8.8	Lower sand
134	-20bca1	Bo Nutt	195	8-14-51	68	.11	15	314	143	12	.3	8	0	853	8.6	Lower sand
135	-20daa1	J. V. Toland	108	6-27-51	65	4.4	0	103	8	5.2	.8	14	0	205	7.1	Middle sand
136	-26dbc1	Singer Farm	320	6-27-51		20	0	63	32	7.2	.4	25	0	173	6.8	Lower sand
137	-26dba1	Robert Dyer	315	6-27-51		42	0	48	1	4.0	.3	18	0	97.7	7.7	Lower sand
138	-28aba1	Lump Delaney	280	6-27-51	68	.10	10	420	44	5.5	2.1	14	0	768	8.5	Lower sand
139	-28aba2	M. B. Stone	128	7-12-51	66	5.1	0	61	11	4.5	.8	21	0	145	8.3	Middle sand
140	-29ada1	J. V. Toland	115	6-27-51	65	3.3	0	77	14	45	1.7	10	0	165	8.0	Middle sand
141	-29cad1	J. V. Toland	115	6-27-51	66	1.2[1]	6	96	17	5.8	.8	8	0	221	8.3	Middle sand
142	-30aaa1	J. V. Toland	220	7-10-51	67	.10	30	314	133	11	1.3	14	0	862	9.0	Lower sand
143	-32baa1	J. V. Toland	215	6-27-51	65	.06[1]	0	144	17	9.8	1.2	5	0	295	8.4	Middle sand
144	-32cbd1	W. Dillard	200±	6-27-51	67	1.5	0	133	22	6.5	.8	6	0	271	8.4	Middle sand
145	-35cdb1	A. P. Webb	515	6-27-51	72	.06[1]	52	466	47	10	.8	7	0	922	9.0	Sand and gravel
146	10S28W-7ddd1	Jim A. Barrett	200	7-10-51		5.5	0	208	91	9.8	2.7	55	0	522	8.4	Lower sand
147	-24adc1	Mrs. Edna Swinney	282	7-11-51		49	0	42	8	5.2	1.8	36	2	103	6.6	Lower sand
148	-29dab1	R. P. Graves	86	6-27-51	64	.13	42	452	17	16	3.1	12	0	855	9.0	Middle sand
149	-30dbb1	Shoates Farm	100±	7-11-51	67	.10[1]	12	282	123	30	.8	16	0	831	8.5	
150	-31dcc1	G. W. Polley	122	7-12-51		33	0	256	390	70	.8	558	348	1,230	7.4	
151	10S29W-35cdd1	Augustus Goforth	280	7-11-51		.04[1]	8	120	70	7.8	.5	21	0	372	8.4	
152	11S22W-8ddb1	City of Prescott	1,070	2-18-46		.04[1]	0	406	157	342	.8	34	0	2,040	8.0	
153	11S25W-8bac1	Moss Rowe	665	3-29-50	67	10	0	123	23	8.0	.1	4	0	277	7.9	
154	11S26W-8bbb1	E. L. Cox	550	3-21-51		.37	0	186	35	6.8	.3	41	0	348	8.1	
155	-23bbb1	V. M. Lee	820	6-26-51	76	.61	0	133	58	14	1.9	3	0	316	8.6	
156	11S27W-1cda2	Randolph Webb	516	3-21-51		1.5	0	84	5	4.5	.7	12	0	178	7.8	Lower sand
157	-2abb1	Robert Cowell	400	6-27-51	66	3.7	0	65	13	5.2	.4	21	0	139	7.3	Middle sand
158	-2bdd1	Burleigh Webb	350	6-27-51		8.8	0	127	21	7.8	.6	9	0	247	7.5	Middle sand
159	-2cca1	T. J. Webb	400	6-27-51		.40	0	146	22	9.5	1.0	4	0	287	8.4	Middle sand
160	-8add1	Howard County Training School	388	7-9-51		1.9	0	141	18	7.5	1.2	8	0	292	8.5	Upper and middle sand
161	-8baa1	William Dillard	380	6-27-51	70	1.4	0	133	23	6.8	1.2	6	0	272	8.6	Middle sand
162	-8cbc1	William Dillard	320	6-27-51	70	.34	8	182	40	12	2.0	10	0	410	8.7	Middle sand
163	-9bca1	Lillie Draper	407	8-16-51		.67	0	134	15	6.2	.6	6	0	254	7.6	Middle sand
164	-11aca1	Bud Stone	395	6-27-51	66	2.6	0	136	22	6.0	1.8	5	0	270	8.2	Middle sand
165	-11acc1	Warren Citty	415	6-27-51		1.6	0	123	24	6.2	.1	6	0	258	8.3	Middle sand
166	-11bda1	Jess Schooley	386	6-27-51		.38	0	170	30	8.2	1.4	5	0	339	8.3	Middle sand
167	-12bbd1	Othel Smith	522	6-27-51		.13	12	319	24	3.8	1.5	6	0	319	8.6	Lower sand
168	-17dab1	Thomas E. Bell, Sr.	362	7-9-51		1.3	0	230	23	14	1.5	7	0	443	8.4	Upper sand
169	-20aca1	Milburn Jeanes	416	7-9-51	70	.12[1]	16	225	24	18	1.6	7	0	496	8.6	Upper sand
170	-22aaa1	Joe Wilson	400±	7-9-51		.14[1]	14	245	18	47	1.2	3	0	593	8.6	Upper sand
171	-29acc1	Ed Fontaine	475	7-9-51		.06[1]	20	370	4	78	1.3	7	0	871	8.6	Upper sand

TABLE 12. CHEMICAL ANALYSES OF WATER FROM WELLS IN SOUTHWESTERN, ARKANSAS — Continued

Map number	Location number	Owner	Depth (feet)	Date of collection	Temperature °F	Iron (Fe)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-Carbonate	Specific Conductance (Micromhos)	pH	Remarks
		Tokio formation — Continued														
172	11S27W-29ddb1	Gilbert Smith	500±	7-9-51		.35	26	385	3	28	1.9	7	0	899	8.8	Upper sand
173	-30caa1	Ideal Cement Company	503	7-7-51	73	.15	0	400	12	65	1.1	17	0	804	8.2	
178	-32dac1	Joe Fontaine	800±	7-9-51		.08[1]	18	475	1	175	5.4	8	0	1,300	8.4	Middle sand
179	11S28W-2ddd1	School and Church	240	6-27-51	69	.23	28	342	133	12	1.7	6	0	902	8.9	Middle sand
180	-7bbb1	Ortho Johnson	120	7-11-51	66	.04[1]	10	178	244	44	1.4	13	0	960	8.6	
181	-14cad1	W. H. Toland	260	6-27-51	70	.19	10	269	24	11	.8	6	0	513	8.6	Upper sand
182	-30bcc1	Ideal Cement Company	300±	7-11-51		.08[1]	40	704	60	105	.5	8	0	1,580	8.5	
183	-30cdb1	Ideal Cement Company	300±	7-11-51		.02[1]	15	587	2	855	1.5	26	0	3,570	8.3	
184	11S29W-2baa1	O. A. Mitchell	150±	7-11-51		1.1	0	180	123	22	4.4	198	0	578	8.0	
185	-6baa1	Guy McCullough	150±	8-16-51	66	11	0	72	19	16	2.3	28	0	253	7.0	
186	-7baa1	Lewis Walk		8-16-51	67	.06	0	194	40	17	.3	23	0	411	8.3	
187	-7bbd1	Edwin Polk	200±	8-16-51	66	.15	12	192	42	23	1.1	10	0	462	8.6	
188	-7dce1	J. K. Polk		8-16-51	67	.06[1]	8	182	78	25	.5	4	0	535	8.5	
189	-8cad1	J. W. Roberts	379	8-16-51		.16	0	162	66	14	1.0	6	0	410	7.9	
190	-11cab1	Milton Garrison	387	7-7-51		1.2	98	178	90	20	2.8	98	0	548	7.2	
191	-11dcb1	Loyd Garrison	307	7-11-51		.06[1]	0	203	127	26	1.0	18	0	666	7.9	
192	-14dbc1	Dave Holt	391	7-11-51		1.8	9	217	99	20	3.6	2	0	621	8.8	
193	-14ddc1	Ben Savage	380	7-11-51		.08[1]	16	390	202	117	3.5	13	0	1,410	8.4	
194	-17adc1	J. C. Walker	250±	8-16-51	68	.11	0	189	80	53	1.0	6	0	600	8.3	
195	-17dbb1	Mrs. W. C. Sutton	250±	8-16-51		.14	14	259	61	18	1.4	10	0	628	8.7	
196	-18aba1	C. I. Brewer	250±	8-16-51	67	.18	0	374	64	20	.8	14	0	695	8.0	
197	-18bdb1	Vaughn		7-20-51		.04	18	196	95	38	.4	3	0	677	8.8	
198	-18cbb1	Dierks Lumber Company	300±	8-15-51		39	28	454	1.0	1,020	4.2	40	0	3,760	8.6	
199	-20abd1	Ralph Penny	200±	8-16-51	65	.08	14	341	84	28	1.8	7	0	706	8.8	
200	-24bab1	Frank Moore	347	7-11-51		.06[1]	20	352	114	13	1.2	4	0	851	8.7	
201	-30bbb1	C. E. Ashley	380	7-20-51	68	.04[1]	22	318	63	281	1.7	6	0	1,550	8.7	
202	11S30W-1dad1	Mrs. Rhyne	360±	7-20-51		.10[1]	16	236	12	858	2.3	46	0	3,100	8.5	
203	-12daa1	Bob Grady		8-16-51	66	.41	8	190	45	24	.3	6	0	495	8.6	
204	-12aaa1	Roland Oglesby	22	7-24-51		.17	0	75	23	102	130	92	30	675	7.4	
205	12S23W-3acd3	Ark. Louisiana Gas Company	1,217	8-30-50	89	.25	18	405	189	335	.8	17	0	2,040	8.6	
207	12S24W-5bdd1	Hope Light and Water Co.	1,202	12-28-49	87	.14	11	268	54	114	1.6	18	0	878	8.5	
208	-28cdc2	Hope Light and Water Co.	1,480	10-26-45	100	.16	28	517	44	292	.2	14	0	1,880	8.2	
209	-28cdd1	Hope Light and Water Co.	1,500	3-27-51	98	.07	10	549	44	320	3.6	10	0	1,920	8.4	
210	12S27W-4bbc1	Saratoga School	870	3-29-51	69	.07	60	636	37	36	.9	12	0	1,210	9.0	
211	-23bda1	T. M. Bemis	800±	3-29-51		.39	8	704	1	422	.5	23	0	2,310	8.4	
		Brownstown marl														
213	7S20W-31cbb1	W. H. Ross	330	9-14-50	69	.16		284	347	142	1.9	39	0	1,600	8.1	
		Ozan formation														
215	7S20W-22bbb1	Charles B. Welch	306	10-12-50	65	.32	14	272	400	70	.1	396	150	1,480	8.7	
216	-28cbc1	W. R. Burrow	462	9-14-50	67	.26	6	184	311	32	1.9	98	0	1,040	8.4	
217	-30dcb1	D. H. Ryan	220-230	9-14-50	68	.14		173	517	98	2.1	67	0	1,690	9.3	
218	8S21W-1acd1	Buck Arnold		9-14-50	67	.25	10	250	430	288	5.3	67	0	2,160	8.5	
219	-2cdd1	R. W. Kelly	196	9-14-50	69	.32		140	260	1,880	8.4	321	206	6,280	7.9	
220	-3ddd1	J. B. Hank	165	9-14-50	65	.61	6	406	230	2,040	.8	262	0	7,030	8.3	
221	-9dda1	V. W. Hardin		9-14-50	65	.40		542	230	1,340	1.7	112	0	5,170	8.1	
222	-15abc1	R. N. McIlhannon	150	9-14-50	65	.76		420	273	2,100	.9	232	0	7,200	8.0	
223	-18aac1	Baswell Farms	163	9-13-50	.65	.21	16	410	180	670	.4	64	0	2,940	8.6	
224	-18aac2	Baswell Farms	163	9-13-50	67	.12	30	450	178	915	3.2	83	0	3,700	8.6	
225	10S26W-24abc1	T. J. Draper	27	3-29-51		.14	0	203	99	169	4	336	170	957	8.4	
226	11S29W-30bbb2	C. E. Ashley	180	7-20-51	67	.03	24	559	4.9	1,100	2.1	24	0	4,100	8.2	
		Nacatoch sand														
227	8S19W-7aba1	Earl Manning	100	10-12-50	65	3.5	0	116	120	39	.6	246	151	497	8.0	
230	8S20W-11abc1	N. W. Crawford	85	10-12-50	64	1.8	0	16	5	10	.3	12	0	68.7	7.3	
231	-19ccc1	Henry Crawford	98	10-12-50	65	3.5	7	208	20	8.5	.6	133	0	386	8.6	
232	-23dda1	Ro Vern Court	150	10-12-50	65	1.6	5	165	22	9.5	.2	122	0	311	8.4	
233	-25cdd1	Lonnie Mitchell	175	10-12-50	66	.44	10	241	34	20	1.4	160	0	489	8.5	
234	-25dbd1	Grover Wells		10-12-50	65	.55	6	202	30	12	1.0	140	0	366	8.5	
239	-35caa1	R. H. Herron	120	9-15-50	68	.22	12	240	34	16	1.6	45	0	494	8.6	
242	-36bdd2	Thomas Lumber Company	160	10-12-50	66	.09	13	237	8	14	1.9	56	0	486	8.5	
245	9S20W-10aaa1		140	9-14-50	67	.14	30	392	3	535	2.7	33	0	2,260	8.6	
246	-21dcc1	W. C. Wray	220	10-11-50	67	.04	21	295	24	24	1.9	13	0	590	8.5	
247	-22abd1	R. E. Allen		9-15-50	67	.24	16	406	14	275	1.5	34	0	1,500	8.5	
248	-27bcc1	Arkansas Power & Light Co.	200	9-15-50	68	.22	25	428	1	310	1.2	17	0	1,660	8.6	
249	-32dcc1	Gurdon Lumber Company	220	9-15-50	71	.12	32	374	40	55	1.1	6	0	848	8.7	
250	-33bbc1	City of Gurdon	245	7-26-46		.03[1]	30	350	49	158	0	11	0	1,820	8.9	
253	-33ddb1	F. E. Knight	300	9-14-50	69	.40	35	372	3	402	1.1	18	0	1,820	8.8	
254	-34abc1	Marvin Anderson	360	10-11-50	65	.18	26	380	1	562	2.6	47	0	2,310	8.7	
255	-34dab1	Conrad Nelson	360	10-11-50	69	.46	22	348	40	490	1.0	33	0	2,040	8.7	
256	-35caa1	William Wells	420	10-11-50	70	.11	28	358	6	1,080	4.2	72	0	3,910	8.7	
257	10S20W-3acb1	Earl Frizzell	330	9-14-50	71	.14	21	367	1	445	.5	19	0	1,950	8.6	
258	-9aaa1	Melvin Gates	340	9-14-50	69	.16	26	364	1	505	3.4	22	0	2,130	8.7	
259	-22cdd1	Barringer Lumber Company	480-500	9-14-50	67	.14		374	1	1,100	.6	42	0	3,800	8.2	
260	-35bcb1	McKinney Lumber Company	568	9-13-54	70	3.4	10	408	3	8.2	1.1	30	0	3,200	8.5	
261	10S21W-12bba1	Gurdon Lumber Company	265	9-13-50	68	.21		246	36	29	.7	9	0	585	8.0	
263	-12bdd1	Gurdon Lumber Company	200-250±	4-24-50	66	.08	6	244	33	22	.8	10	0	535	8.5	
264	10S22W-23dcb1	Baptist Church	45	4-19-51	63	1.9	0	202	6	5.5	.7	148	0	340	7.5	

TABLE 12. CHEMICAL ANALYSES OF WATER FROM WELLS IN SOUTHWESTERN, ARKANSAS — Continued

Map number	Location number	Owner	Depth (feet)	Date of collection	Temperature °F	Iron (Fe)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-Carbonate	Specific Conductance (Micromhos)	pH	Remarks
		Nacatoch sand — Continued														
265	10S22W-27caa1	T. Formby	65±	4-19-51	60	7.8	0	207	7	9.0	.5	156	0	351	8.0	
268	-9dcd1	Mrs. G. Dewoody	525	4-18-51	...	.17	15	356	8	372	.5	14	0	1,750	8.6	
269	-16acd1	P. H. Gullick	565±	4-18-51	71	.17	0	353	9	680	1.0	24	0	2,630	8.3	
270	-22baa1	R. L. Cunningham	565±	4-18-51	75	.05	9	361	4.9	680	.4	8	0	2,680	8.4	
273	-22dbd1	Ella Shell	750	6-17-53	78	.07	24	312	22	648	0.5	23	0	2,530	8.7	
274	11S21W-14cac1	Mr. Barns	500-600	6-17-53	74	.07	13	294	28	222	1.4	10	0	1,210	8.6	
275	-18baa1	Ed Clark	300-400	4-17-51	...	.19	14	271	38	38	1.9	10	0	629	8.7	
276	11S22W-8bbd1	Southern Ice Company	200	8-30-50	68	.47	0	262	18	12	.5	188	0	461	7.5	
280	-8ddb2	City of Prescott	250	2-18-46	...	.22	0	266	19	18	1	174	0	489	7.4	
281	-8ddb3	City of Prescott	325	8-30-50	70	.13	0	265	26	14	.7	144	0	456	8.3	
282	11S23W-3dcd1	C. L. Miller	135	4-18-51	...	.46	0	259	7	7.5	.8	212	0	435	7.5	
283	-12abb1	Dennis Ledbetter	300±	4-19-51	...	1.7	0	240	7	7.2	.7	196	0	446	7.9	
284	-18acd1	B. J. Ellis	60	3-22-51	...	.14	0	188	22	3.0	3.1	171	17	334	8.0	
285	-31ccd1	J. D. Allen	185	3-22-51	...	.12	0	251	24	8.0	.9	195	0	449	7.9	
286	-34abc1	Boyd Brothers	240±	4-17-51	66	.13	0	211	33	41	1.5	18	0	521	8.5	
287	-34abd1	Mrs. Cliff Arnold	240±	4-17-51	66	.11	0	211	35	44	.7	16	0	541	8.2	
288	11S24W-8bdb1	H. E. Sutton	32	3-30-51	...	.21	0	2	1	18	26	22	20	152	4.7	
289	-21add1	Roy B. Roberts	50	3-30-51	...	.35	0	13	1	7.2	18	18	7	83.2	7.2	
290	-34cbc1	Sidney Cash	31	3-30-51	...	.72	10	246	60	32	.5	282	64	558	8.5	
291	11S25W-22ccb1	W. M. Frazier	105	3-28-51	...	2.5	14	222	1	3.8	3.1	74	0	381	8.7	
292	11S26W-27bdd1	Hempstead County	32	3-20-51	...	.44	0	179	37	28	.5	136	0	400	8.0	
295	12S22W-10bcb1	Layward Dickson	265	6-17-53	71	.08	22	265	32	92	0	8	0	816	8.9	
296	-10cdd1	Mrs. Reva Wren	500±	6-17-53	...	.14	16	266	28	126	0	6	0	927	8.7	
297	-15bab1	Mrs. W. K. Martin	500±	6-17-53	...	.06	16	264	36	128	1.6	6	0	909	8.8	
299	12S23W-3acd1	Ark. Louisiana Gas Company	301	8-30-50	70	.63	...	214	34	43	.3	18	0	532	8.0	
302	-3cbd1	M. Grumby	268	9-6-50	...	.68		208	40	31	1.6	21	0	490	8.3	
305	12S24W-4add1	W. T. Schooley	160	3-30-51	...	.50	6	261	100	8.5	1.1	262	38	586	8.4	
307	-14bac2	Ark. Agri. Experiment Station	220	3-16-51	...	.18	8	220	48	22	.3	68	0	486	8.5	
308	-27cbc1	Hope Brick Company	597	3-22-51	...	.10	0	256	46	30	1.4	47	0	546	7.9	
309	-28cdc1	Hope Light & Water Company	620	10-26-45	...	.25	0	264	43	31	0	69	0	593	8.1	City No. 4
311	-28cdd2	Hope Light & Water Company	620	10-26-45	...	.11	0	260	52	41	0	52	0	635	8.1	
312	-28cdd3	Hope Light & Water Company	620	10-26-45	...	.51	0	267	46	36	.6	66	0	622	8.3	City No.3
313	-28dca1	Southern Ice Company	520	3-22-51	...	.37	0	54	44	31	.2	50	6	563	8.2	
315	-33bcd1	Hope Basket Company	512	3-22-51	...	.29	10	239	51	44	1.7	55	0	607	8.6	
316	-36aaa1	Earnest McWilliams	600±	3-22-51	...	.21	16	212	49	36	1.7	15	0	565	8.9	
317	12S25W-7abb1	Mrs. P. M. Gilbert	100±	3-29-51		1.5	0	10	1	4.5	4.9	7	0	38.2	7.1	
318	-7abd1	H. B. Gilbert	42	3-29-51	58	.08	0	39	1	7.0	4.4	28	0	99.7	7.6	
319	-11add1	Hope Air Field	207	12-28-49	66	.19	0	267	18	5.5	1.0	198	0	448	8.1	
320	-15dbc1	R. E. Long	202	3-21-51	...	1.1	5	204	12	5.8	2.8	140	0	373	8.4	
321	-33ddc1	Guernsey Public School	300	3-20-51	...	.11	6	208	46	18	2.0	30	0	489	8.4	
322	12S26W-21aac1	M. E. Patrick	300	3-20-51	...	.62	0	222	119	17	2.2	50	0	648	8.2	
323	12S26W-21aac1	Lee Cheetam	60	3-29-51	...	.22	0	17	1	5.8	21	21	7	90.2	7.4	
324	-24abc1	E. R. Calhoun	108	3-29-51	...	.31	0	227	5	4	.7	155	0	348	8.4	
326	-24cca1	T. E. Edwards	125	3-21-51	...	.23	6	230	5	7.8	1.0	108	0	382	8.4	
327	12S27W-4ddc1	W. M. Dillard	55	3-29-51	64	.21	0	19	1	3.8	9.6	20	4	75.6	7.3	
328	13S24W-2ada1	A. S. Williams	635	3-22-51	...	.16	11	234	65	40	3.1	10	0	634	8.6	
330	-9bda1	Grayden Anthony Lumber Co.	637	3-21-54	...	.54	18	251	48	46	.4	8	0	690	8.9	
331	-9bdc1	Grayden Anthony Lumber Co.	400±	3-21-50	...	.09	16	255	42	47	2.0	10	0	701	8.8	
332	13S25W-5abd1	N. B. Coleman	300±	3-20-51	...	.30	13	222	21	18	2.8	15	0	476	8.6	
333	-18aab1	Roy Woods	335	3-22-51	...	.09	24	260	15	16	2.1	28	0	528	9.0	
334	-25ccb1	Spring Hill School District	850	3-21-51	...	.05	12	297	35	225	.7	10	0	1,240	8.7	
335	13S26W-16dda1	Hope School District	225	3-21-51	...	.16	0	250	18	6	1.4	93	0	417	8.2	
336	-20add1	Missouri Pacific Railroad	465	3-21-51		.54	9	245	16	5.5	1.7	38	0	431	8.6	
338	-35bcc1	Jessie Smith	384	3-19-51	55	.13	22	253	24	78	1.7	8	0	800	8.9	
340	13S27W-28bbd1	H. H. Horton, Jr.	165	8-10-51	66	.25	15	241	1.0	117	1.5	48	0	755	8.6	
341	-31acd1	J. B. Davis	100±	7-20-51	66	.06'	18	248	2	151	1.2	55	0	902	8.6	
342	-35ddd1	R. G. Reed	450	8-15-51	...	.28	11	267	30	116	1.1	20	0	835	8.6	
343	12S28W-31cdb1	J. B. Davis	270	7-27-51	...	1.4	5	404	8	13	.6	316	0	621	8.3	
344	-34adb1	Temple Brothers	165	8-10-51	69	.09	0	273	7.4	41	.9	116	0	578	7.6	
345	-35cba1	J. B. Davis	100±	8-10-51	...	.19	21	251	5.0	64	.9	51	0	628	8.8	
346	-36dca1	E. E. Paxton	100±	8-10-51	...	.36	0	228	1.0	395	6.5	66	0	1,560	8.2	
347	14S25W-7bbc1	Mary Jefferson	700±	3-19-51	...	.36	21	288	32	210	1.0	9	0	1,220	8.8	
348	14S26W-7cca1	R. G. Reed	390	8-15-51	...	.03	8	296	46	158	1.3	32	0	1,070	8.5	
349	14S27W-1aaa1	R. G. Reed	390	8-15-51	...	.36	18	290	34	67	2.1	40	0	747	8.7	
351	14S27W-1aad1	R. G. Reed	350	8-15-51	...	.09	18	267	30	62	2.0	13	0	711	8.7	
352	-1bbb1	R. G. Reed	400	8-15-51	...	.06	16	260	40	76	1.7	16	0	718	8.8	
353	-2aaa1	R. G. Reed	425	8-9-51	...	.08	20	302	34	76	1.9	27	0	785	8.7	
354	-2aab1	R. G. Reed	390	8-15-51	...	.27	0	278	45	85	3.6	25	0	776	8.3	
355	-2add1	R. G. Reed	450	8-15-51	...	.16	11	273	40	108	2.0	42	0	821	8.5	
356	-7cbc1	A. P. Cox	364	8-9-51	72	.20	11	202	1.0	452	3.6	28	0	1,740	8.6	
357	-12aab1	R. G. Reed	375	8-15-51	...	2.1	22	395	20	59	2.0	203	0	805	8.7	
358	14S28W-7cca1	J. D. Harris	426	8-8-51	...	.09	22	303	4	205	2.3	8	0	1,140	8.8	

TABLE 12. CHEMICAL ANALYSES OF WATER FROM WELLS IN SOUTHWESTERN, ARKANSAS — Continued

Map number	Location number	Owner	Depth (feet)	Date of collection	Temperature °F	Iron (Fe)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-Carbonate	Specific Conductance (Micromhos)	pH	Remarks
					Nacatoch sand — Continued											
359	14S28W-14cbd1	Walter Clement	400	8-8-51	......	.10	0	216	2	1,200	.6	61	0	3,750	7.7	
360	-14cbd1	E. J. Miller	400±	8-9-51	......	.17	0	156	3	1,410	.3	78	0	4,190	8.4	
361	-16dac1	Texarkana Const. Co.	400±	8-9-51	70	.13	30	338	3	355	8.6	13	0	1,680	8.8	
362	-17bbc1	T. L. Winham	360	8-9-51	......	.10	25	301	2	186	2.1	12	0	1,080	8.9	
363	-17cba1	M. A. Parker	300-400	8-9-51	......	.04	54	352	1.0	128	2.1	12	0	1,040	8.8	
364	-18aac1	Mrs. Wallace Dunn	500	8-8-51	......	.10	25	288	3	218	4.8	12	0	1,190	8.8	
365	-21aaa1	D. L. Thompson	450±	8-9-51	......	.27	14	316	2	565	1.9	22	0	2,210	8.5	
366	-22bda1	H. C. Shuffield	600±	8-8-51	......	.17	0	218	2	1,670	2.0	100	0	5,320	7.7	
367	-30aca1	Mrs. Dan Gillham	500	8-8-51	......	.19	32	368	2	602	1.9	24	0	2,400	8.8	
368	-32dcb1	Chester Stanley	600	7-26-51	74	.12	14	245	2	1,480	1.0	70	0	4,900	8.6	
370	14S30W-1daa1	Kelly Budd	375	8-8-51	68	1.5	0	566	14	57	1.7	353	0	941	7.4	
371	15S28W-10aab1	Roy Steuber	800	7-27-51	74	.04[1]	8	170	1	3,850	1.7	306	153	11,200	8.2	
372	-18acc1	Mildred Pencantet	950	7-26-51	......	1.9	13	469	2	955	1.2	46	0	3,650	8.5	
373	East. Bowie Co., Tex.	J. B. Richardson	700	8-8-51	......	.08	0	498	2.1	680	.6	24	0	2,720	8.1	
374	East. Bowie Co., Tex.	Walter Clement	800	8-8-51	......	.18	26	444	2	482	3.5	19	0	2,180	8.6	
375	East. Bowie Co., Tex.	Ed McKee	500	8-8-51	......	.07	34	452	3	260	.8	11	0	150	8.8	
376	East. Bowie Co., Tex.	H. T. Ham	360	8-8-51	65	.10	20	306	3	290	4.1	36	0	1,390	8.7	
					Wilcox formation											
377	13S21W-21cda1	Town of Rosston	......	1-24-46	......	.06[1]	0	148	26	4.8	1.2	110	0	290	8.1	
378	15S28W-10aab2	Roy Steuber	30	7-26-51	......	1.8	0	8	2	45	86	32	25	274	6.6	
379	-27aba1	Miss Osteen Phillips	270	7-28-51	......	5.7	0	111	2.0	7.5	.3	35	0	205	6.6	
380	-32cab1	W. K. Elliot	150	7-25-51	......	7.5	0	95	2	5.5	.8	39	0	152	7.4	
					Deposits of Quarternary age											
381	11S32W-2ccc1	W. D. Carson	30	7-24-51	......	.09	0	11	17	136	560	400	391	1,540	5.5	
382	12S29W-6ccc1	Ada Mills	35	7-26-51	......	.02[1]	7	316	7	167	3.9	455	185	1,270	8.1	
386	-32cab4	Ashdown Water Works	90	8-7-51	66	.06	0	234	13	34	7.7	207	15	477	7.1	
387	12S30W-3bab1	S. M. Beck	50	7-25-51	......	11	0	578	13	610	1.0	790	316	2,680	7.4	
388	-12aaa1	Ada Mills	65	7-26-51	......	.14	0	371	11	104	6.1	357	53	905	7.5	
389	12S31W-36bcc1	Lloyd Wright	55-60	7-25-51	......	.02[1]	0	134	2	124	212	351	241	1,020	7.0	
390	12S32W-15dbb1	Town of Foreman	......	7-11-46	......	.03[1]	0	4.0	3.3	59	66	66	63	317	5.1	
392	-26bca1	Magnolia Pipe Line Co.	22	7-25-51	......	.02[1]	0	276	5	33	3.8	243	17	550	7.8	
393	13S27W-22cab1	Smith Place	30±	......	......	5.2	0	270	22	19	1.0	225	4	488	8.2	
394	13S28W-14cbd2	E. J. Miller	40±	8-9-51	......	.30	0	328	30	7.2	9.6	349	80	714	8.1	
395	15S26W-26dcc1	Luther Lowe	50?	6-16-53	65	3.1	0	418	328	226	0	654	0	1,840	7.9	
396	-35aab1	Shelly Frank	50?	6-16-53	65	4.0	0	480	387	300	0	......	......	2,130	7.9	
397	15S28W-19ddd1	Texarkana Water & Sewage Co.	40-50	7-25-51	71	.26	0	24	4.9	36	4.9	36	16	249	6.8	Composite of 22 wells

[1] Iron in solution at time of analysis.