STATE OF ARKANSAS

Geological and Conservation Commission

Norman F. Williams, Geologist-Director

WATER RESOURCES CIRCULAR No. 1

ARKANSAS' GROUND-WATER RESOURCES

By R. C. Baker

U. S. Geological Survey

Published by agreement with U. S. Geological Survey.

Little Rock, Ark.

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By R. C. BAKER

INTRODUCTION

Topography and Geology

The State of Arkansas is nearly square and covers an area of about 53,100 square miles. On the basis of the land surface and differences in the underlying rocks, the State is divided into two areas of nearly equal size. The northwestern half is part of a physiographic division known as the Interior Highlands, and the southeastern half is part of the Gulf Coastal Plain. These areas are shown on figure 1.

The land surface in the Interior Highlands is hilly to mountainous. The altitude ranges from about 250 to 2,800 feet above sea level, averaging about 1,400 feet. The valley of the Arkansas River crosses the Highlands in a general southeasterly direction.

The bedrock in the Interior Highlands consists of interbedded shale, sandstone, and limestone. The rocks are relatively old geologically, and they have been compacted and cemented. North of the Arkansas River the formations generally are nearly flat lying and show little faulting or folding. South of the River they have been extensively folded, faulted, and jointed.

In the valley of the Arkansas River the present river flood plain is underlain by alluvium which consists of unconsolidated clay, silt, and sand and a minor amount of gravel. The maximum thickness of the alluvium is about 65 feet. The flood plains of the smaller streams are underlain by lesser thicknesses of alluvium.

In the part of Arkansas lying in the Gulf Coastal Plain, the land surface is nearly flat or consists of low hills. The altitude ranges from about 100 to 600 feet above sea level.

The deposits underlying the Gulf Coastal Plain consist generally of clay, silt, and sand and some calcareous material. At some places the different kinds of material are intricately interbedded. The deposits of the Gulf Coastal Plain are relatively young geologically. Generally they have been only slightly compacted or cemented. Only minor folding and faulting of the deposits has occurred. The deposits range in thickness from a feather edge at the boundary with the Interior Highlands to about 4,500 feet at the southeastern corner of the State.

Climate

The average annual temperature in the State ranges from about 58°F in the northwestern part to about 65° in the southeastern part. At Little Rock, which is nearly centrally located in the State, the average annual temperature is 61.4°. The average temperature at Little Rock by months is shown in the following table.

Average monthly temperature at Little Rock based on 73 years of records of the U. S. Weather Bureau (degrees Fahrenheit).

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
41.8	45.6	52.8	62.5	69.8	78.5	81.9	81.7	74.8	64.1	51.5	43.9

The normal annual precipitation ranges from 39 to 56 inches, being greatest in the southern and eastern parts of the State. At Little Rock the normal annual precipitation is 47.38 inches. The normal monthly precipitation at Little Rock is shown below. The precipitation is fairly well distributed throughout the year, but the spring months tend to be wettest and the early fall months driest.

Normal monthly precipitation at Little Rock based on 73 years of records of the U. S. Weather Bureau (inches).

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.12	4.06	4.85	5.16	4.85	3.43	3.10	3.15	2.85	2.81	3.92	4.08

Because of the large amount of water that falls on every part of Arkansas, some of the major water problems are concerned with floods and drainage. However, poor distribution of rainfall and lack of storage of water create periodic shortages of water despite an abundance of precipitation. Protracted droughts, covering large areas, generally are not common, but local droughts are common.

OCCURRENCE OF GROUND WATER IN ARKANSAS

The differences in topography between the Interior Highlands and the Gulf Coastal Plain are caused in a large part by differences of earth materials underlying the areas. The geologic formations also control, to a large extent, the occurrence and availability of ground water in the two regions. Figure 1 shows the approximate productive areas of the most important water-bearing deposits in Arkansas. Figure 2 shows, by patterns, the approximate yields to be expected from wells at different places in Arkansas and also the approximate

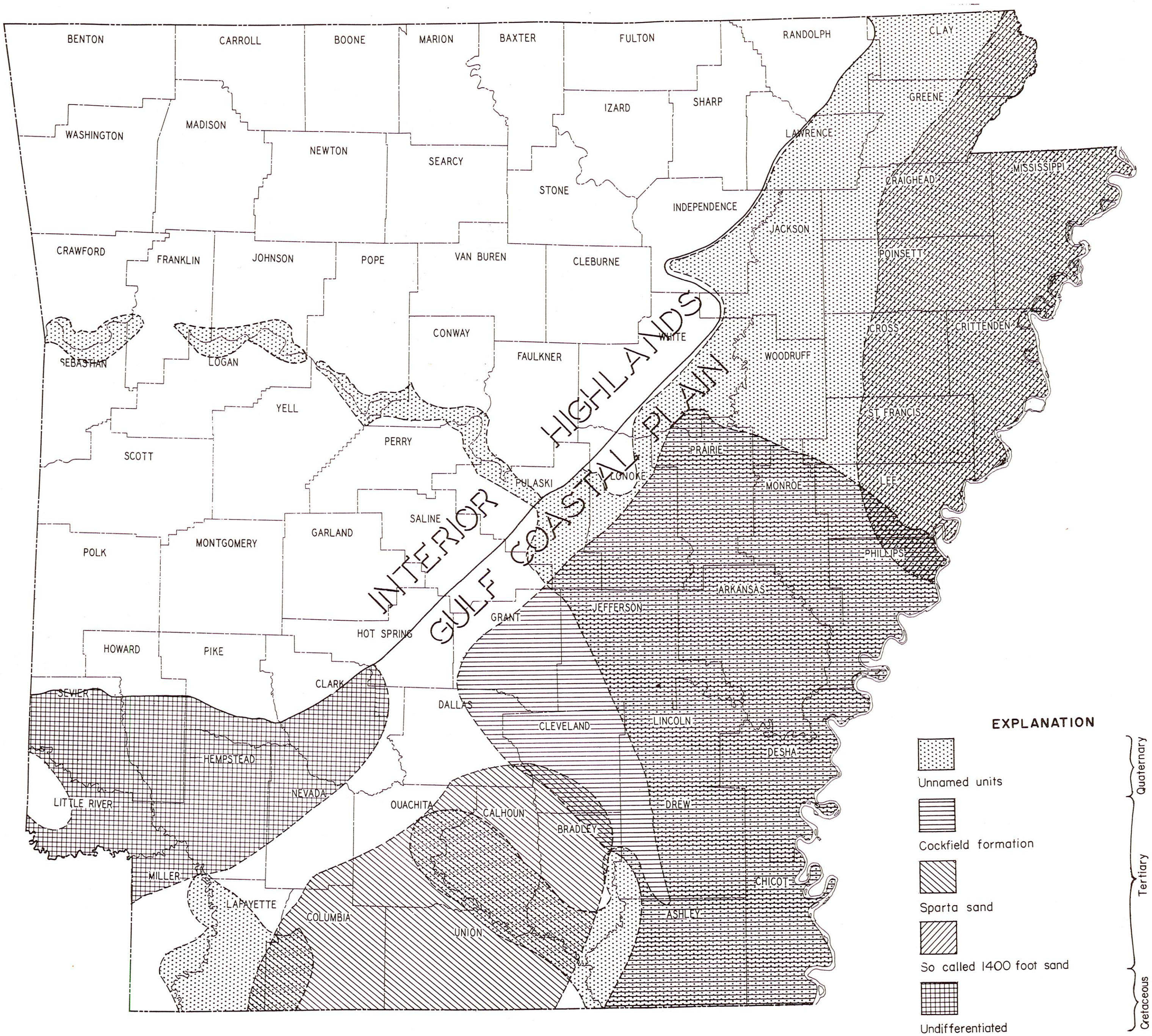

Figure 1. Approximate productive areas of the most important water-bearing deposits in Arkansas.

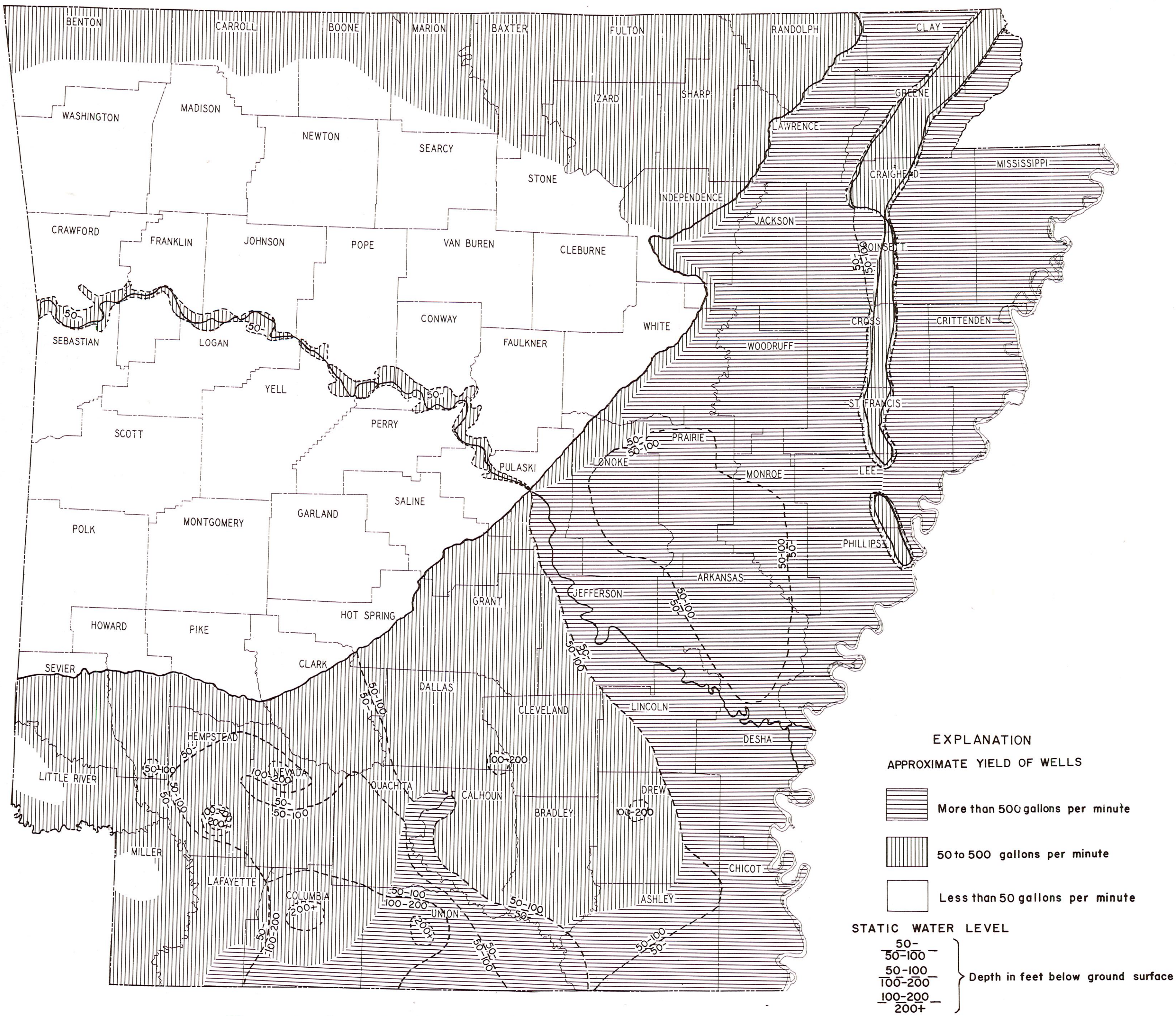

Figure 2. Approximate yields to be expected from wells and the approximate depth to the static water level in Arkansas.

depth below the land surface to the static (nonpumping) water levels in wells.

Interior Highlands

Nearly everywhere in the Interior Highlands region, wells will yield a few gallons of water per minute, and good water is available for domestic use. However, in most of the region wells will not yield as much as 50 gallons per minute, except as indicated below.

Water-Bearing Formations in Northern Arkansas

In the Interior Highlands area of northwestern Arkansas there are several formations which, at places where conditions are favorable, may yield between 50 and 500 gallons per minute to wells. At present only very general statements can be made about these formations, either because at present they are tapped by only a few wells or because information about wells is not available. The formations are in ascending order (oldest to youngest) the Gasconade dolomite, the Roubidoux formation, the Cotter dolomite, the St. Peter sandstone, the Boone formation, the Batesville sandstone, and the Hale formation.

The Gasconade and Roubidoux formations are tapped by several wells in northwestern Arkansas. The maximum reported yield of any well is 450 gpm. These wells range in depth from 1,000 to more than 2,000 feet. These formations do not crop out in Arkansas, but they underlie a large area in north-central and northwestern Arkansas. They are relatively undeveloped but may be the most important potential source of ground water in the area where they occur.

The Cotter dolomite and the Boone formation are the surface rock over a large area in north-central and northwestern Arkansas, respectively. They are the source of water for numerous springs. There is a wide range in the yields of wells tapping these formations, depending on the local thickness of the formation, the height of the locality above streams, and particularly the number and effective size of fractures and solution channels penetrated by the well. A mantle of chert debris formed by the weathering of these formations is important in much of the area; because it tends to check and hold the runoff from precipitation, and wells obtain water directly from the mantle or from the fractures and solution channels which it feeds.

The St. Peter sandstone, the Batesville sandstone, and the Hale formation crop out in irregular, relatively narrow, east-trending bands. They yield water to wells at places where they have been fractured and where they have not been cemented or where the calcareous cement has been leached out, leaving a porous sandstone.

Alluvium of the Arkansas Valley

The deposits of alluvium in the valley of the Arkansas River are a potentially important source of ground water. At present this source has not been extensively used. Existing records show that at some places wells can be developed with yields of 500 gallons per minute or more. Elsewhere in the alluvium, the maximum yields are considerably less. The quality of the water from the alluvium is generally suitable for most uses. However, there may be a considerable difference in the quality of the water from place to place.

Gulf Coastal Plain

Nearly all the Gulf Coastal Plain region is underlain by one or more deposits that will yield fairly large amounts of good-quality water to wells.

Cretaceous Formations

Formations of Cretaceous age crop out in southwestern Arkansas in a general east-trending band. They dip in a general southerly direction. Some of these formations will yield good water in sufficient quantity for domestic and small industrial or municipal supplies. The yields of all of the known wells are less than 500 gallons per minute. The water is of acceptable quality in and near the outcrop areas of the water-bearing formations, but a few miles down dip to the south it is mineralized and is unsuitable for most uses.

So-Called 1,400-Foot Sand

In northeastern Arkansas there is an important water-bearing deposit of Tertiary age, which is known locally at Memphis, Tenn., as the "1,400-foot" sand. The sand occurs at a depth of about 1,000 feet in northeastern Arkansas and reaches a depth of 1,900 feet in the east-central part of the State. Water from the sand is of good quality, and it is used extensively for municipal supplies in northeastern Arkansas. The so-called 1,400-foot sand extends into western Tennessee, and it is tapped by numerous wells in the vicinity of Memphis.

The water is under artesian pressure and originally it flowed from the wells. As the number of wells tapping the sand was increased and there was an increase in the amount of water used, the artesian pressure declined so that it is now necessary to use pumps to get water from most of the wells.

Sparta Sand

The Sparta sand underlies a large area in southern Arkansas. It is the most important source of ground water in south-central Arkansas, where it is used extensively for industrial and municipal supplies and in the oil fields. Important centers of pumping are in the vicinity of El Dorado and Magnolia. The Sparta sand is present, at greater depth, in southeastern Arkansas, but the water tends to be mineralized and is not suitable for most uses.

The Sparta sand extends into northern Louisiana and western Mississippi. A large amount of water is taken from it in these States, particularly in northern Louisiana.

Cockfield Formation

The Cockfield formation underlies a large area in east-central and southeastern Arkansas. The formation is an important source of water for industrial use in the vicinity of Pine Bluff and for municipal supplies in most of the area in which it occurs. Water from the Cockfield formation is pumped for irrigation from about 20 or 30 wells in east-central Arkansas, chiefly in the Grand Prairie region.

Deposits of Quaternary Age

Deposits of Quaternary age occur in a large part of the Gulf Coastal Plain in eastern Arkansas and in the valleys of the Saline, Ouachita, Red, and Arkansas Rivers. They are relatively young and are everywhere exposed at the surface. They are generally less than 200 feet thick. The upper part consists of silt and clay and is relatively impermeable, and the lower part consists of sand and gravel and generally yields water to wells.

These deposits are by far the most important sources of ground water in Arkansas with respect to both presently developed supplies and undeveloped reserves. The largest use of water from these deposits is for the irrigation of rice and other crops.

There is considerable difference in the quality of the water from these deposits from place to place. In general, the water tends to be relatively hard and high in iron.

USE OF GROUND WATER IN ARKANSAS

In 1945 the average daily rate of use of ground water in Arkansas was about 525 million gallons. At that time, Arkansas ranked ninth among the States in the rate of use of ground water. In 1952 ground water was used in Arkansas at an estimated daily rate of 865 million gallons—60 percent above 1945.

In 1952 the estimated average daily rate of use of ground water in millions of gallons was: for irrigation 720, industry 70, municipalities 40, and rural domestic and stock-water supplies 35.

About 90 percent of the ground water used in Arkansas comes from the Gulf Coastal Plain. Roughly 75 percent of the total amount is taken from the deposits of Quaternary age.

GROUND-WATER CONDITIONS IN SELECTED AREAS

Magnolia

At Magnolia, in Columbia County, the Sparta sand is the principal source of ground water. In 1950, in the vicinity of Magnolia, the rate of pumping from the Sparta was about 2.7 million gallons per day.

At Magnolia in 1928 the water level in the Sparta sand was about 165 feet above sea level. This was about 200 feet above the top of the Sparta, which is here at an altitude of about 35 feet below sea level. In 1950 the water level was about 90 feet above sea level. Thus, the water level declined about 75 feet from 1928 to 1950. Figure 3 shows that there was not an appreciable change in the water level at Magnolia from 1950 to 1954.

The available information shows that at Magnolia the present rate of pumping does not exceed the maximum rate that can be maintained over a long period of time. However, it appears that any large increase in the rate of pumping in the vicinity of Magnolia would result in a large additional decline in water levels.

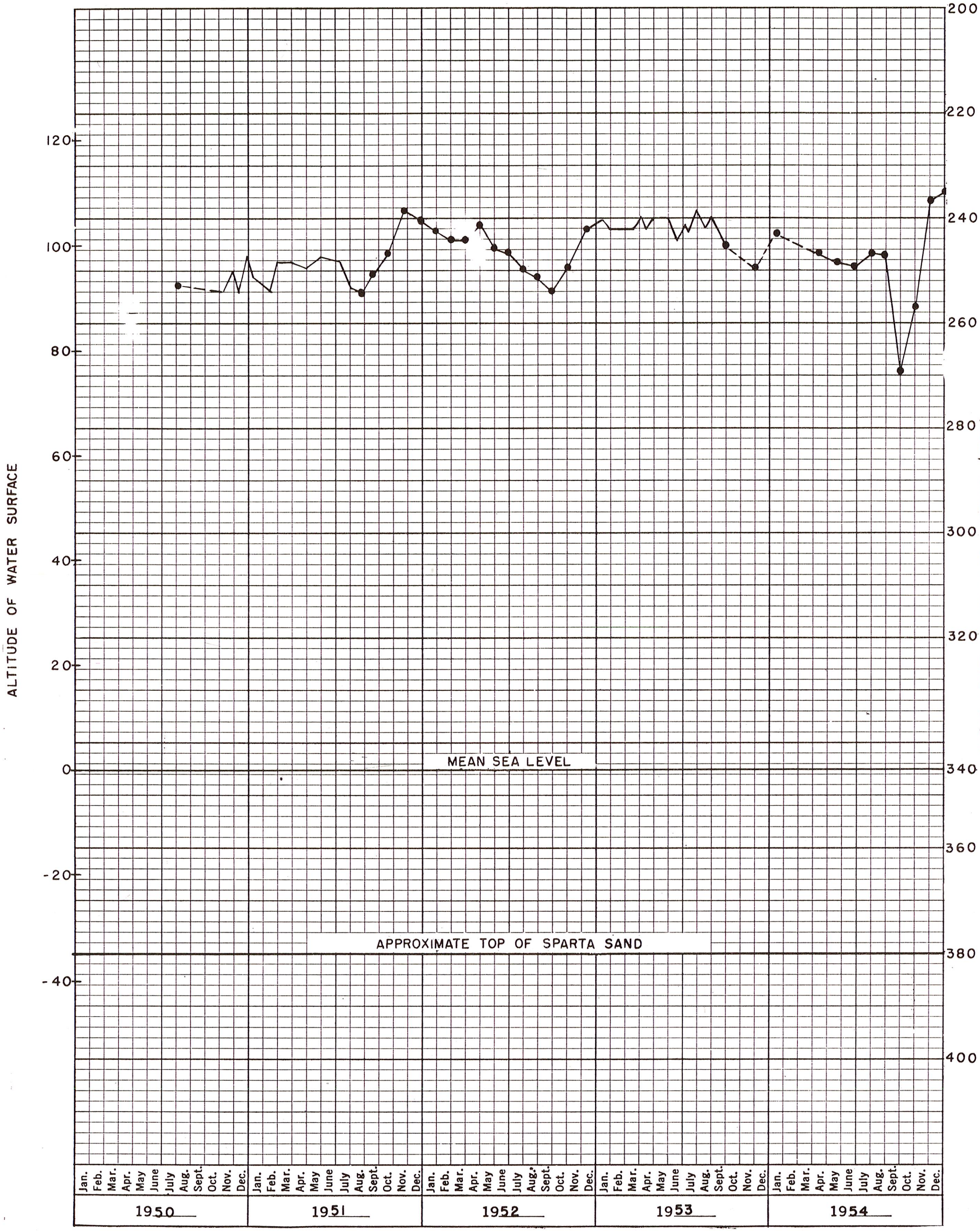

Figure 3. Changes in water level in a well at Southern State College, Magnolia, Ark.

El Dorado

In the vicinity of El Dorado, in Union County, the rate of pumping from the Sparta sand increased from less than 1 million gallons per day in 1921 to about 10.6 million gallons per day in 1947. The rate of pumping since 1947 has increased and was roughly 15 million gallons per day in 1953.

At El Dorado in 1922 the water level in the Sparta sand was about 40 feet above sea level. In 1947 it was about 30 feet below sea level and in 1953 was about 100 feet below sea level. (See fig. 4.) Thus, at El Dorado the water level in the Sparta sand declined 240 feet from 1922 to 1953.

The available information suggests that the rate of pumping from the Sparta sand in the vicinity of El Dorado could be increased by a few million gallons per day without exceeding the perennial rate of recharge to the area. No larger increase would be safe, however.

Pine Bluff

In the vicinity of Pine Bluff, in Jefferson County, the average daily rate of pumping from the Cockfield formation in 1949 was about 10 million gallons. The original water level in the formation was about 30 feet below the ground surface; in 1949 it was about 80 feet below the ground surface.

The maximum perennial yield of the Cockfield formation in the vicinity of Pine Bluff is not known; however, the present information indicates that it is considerably in excess of the present rate of pumping.

Grand Prairie Region

The Grand Prairie region consists of an area of about 1,000 square miles in east-central Arkansas. Rice has been grown in this region since 1904. There is about 450,000 acres of developed riceland in the area. Since 1915 the rice acreage has averaged more than 135,000 and has not been below 100,000.

The principal source of water in the region is the sand and gravel in the lower part of the deposits of Quaternary age. In addition, about 20 or 30 irrigation wells tap the Cockfield formation.

The water level in the deposits of Quaternary age has declined throughout the area. In part of the area the decline has been more than 60 feet. Figure 5 shows the approximate decline of water level in these deposits in the region from before 1915 to 1953. This is based on an unpublished map by T. J. Fricke showing the approximate water levels before 1915 and on water-level measurements made in 1953. Figure 6 shows the changes in water level that have occurred from 1928 to 1954 in the Hederich observation well, which is near the center of the region. At some places in the region, the decline in water level has been accompanied by an appreciable reduction in the yield of wells. This is a definite indication that there is over-pumping in part of the region.

In most of the Grand Prairie region the blanket of silt and clay in the upper part of the deposits of Quaternary age tends to prevent the movement of water from the land surface downward into the permeable sand and gravel in the lower part of the deposits. The average annual precipitation at Stuttgart is about 50 inches; and at times, particularly in the winter and spring months, there is an excess of surface water. If this excess water could be stored and made available when it is needed, there would not be a shortage of water in the area. The possibility of storing this excess water, or other water from surface sources, by artificial recharge into the permeable deposits of Quaternary age is being investigated.

Changes in Water Levels in a Part of Eastern Arkansas, 1938 to 1953

Deposits of Quaternary age, of which those in the Grand Prairie region are a part, extend continuously over a large area in eastern Arkansas, southeastern Missouri, and northeastern Louisiana. In most of this area they are used extensively as a source of ground water.

Figure 7 shows by patterns the changes in water levels that have occurred in the deposits of Quaternary age in a part of eastern Arkansas from 1938 to 1953. There has been a lowering of the water levels in 89 percent of the area covered. The water levels have declined from 0 to 10 feet in 73 percent of the area, from 10 to 20 feet in 13 percent of the area, and more than 20 feet in 3 percent of the area. A slight rise of the water level has occurred in about 11 percent of the area.

The changes in water levels are caused by differences in natural recharge and natural discharge and withdrawals of water from wells. The decline in water levels that has occurred in most of the area was caused largely by pumping. Ground water was pumped in the area in

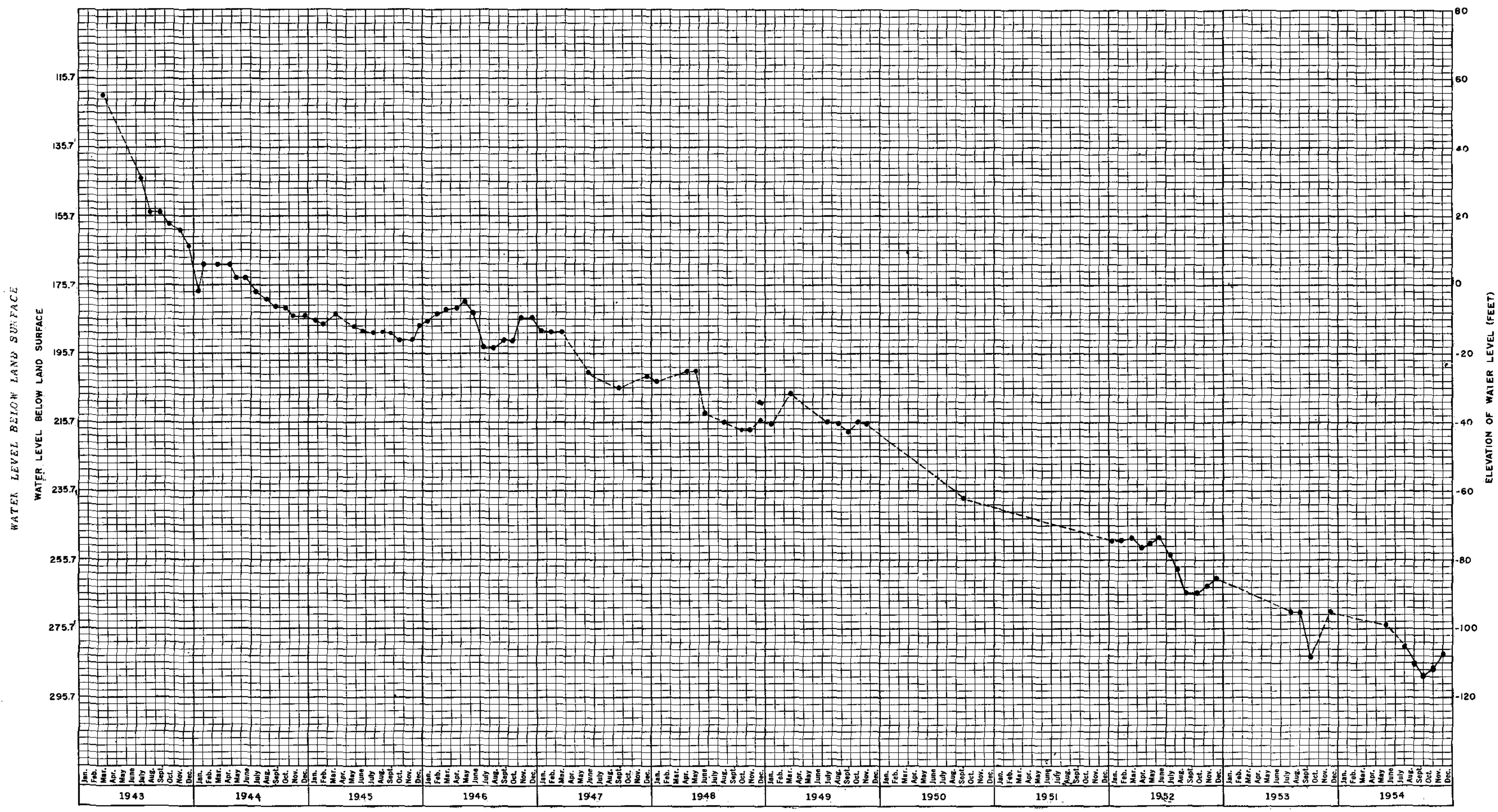

Figure 4. Changes in water level at Lion Oil Co. Chemical Plant well 8-B near El Dorado, 1943 to 1953.

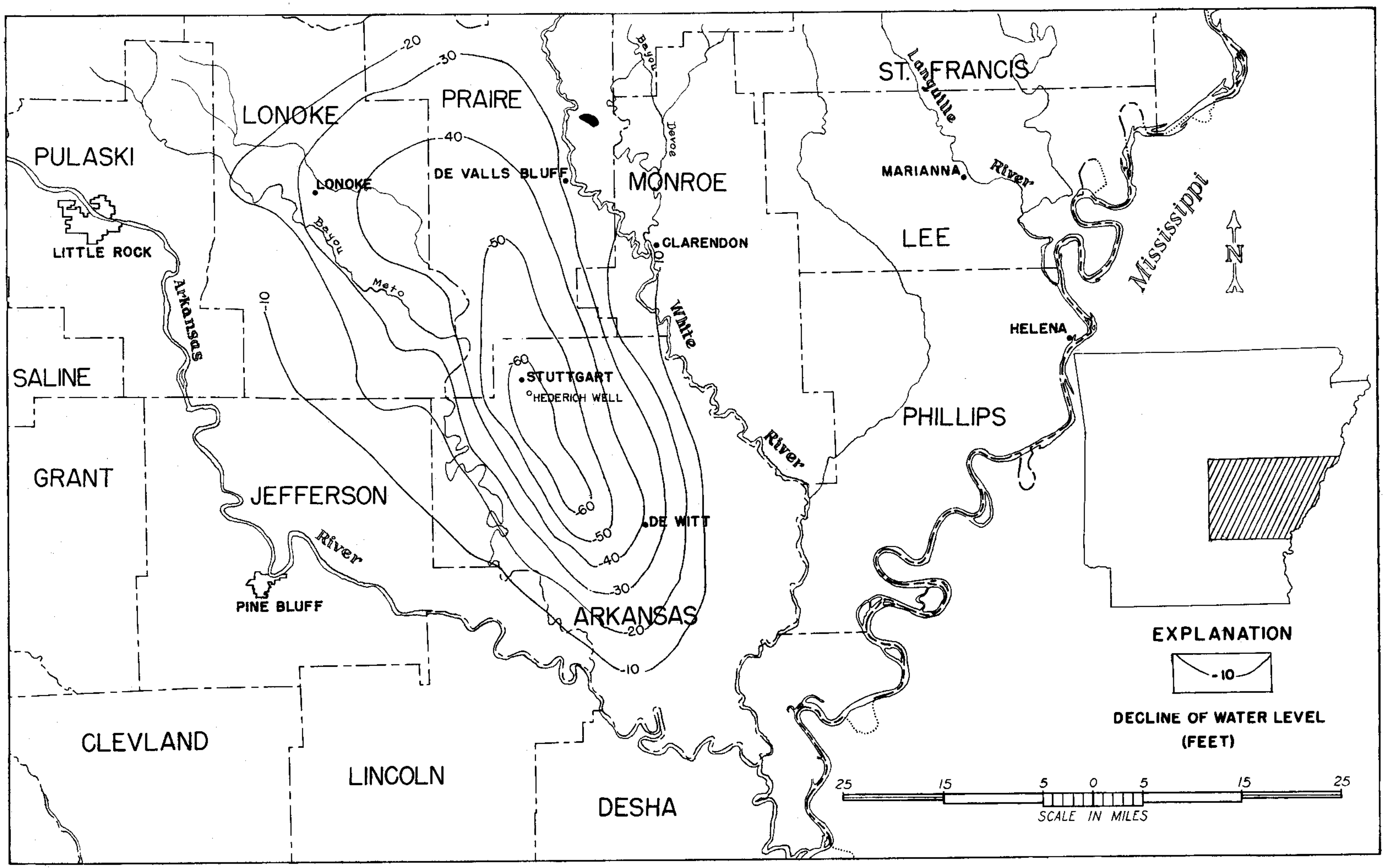

Figure 5. Decline in water levels in the Grand Prairie region from before 1915 to 1953.

Figure 6. Changes in water level in the Hederich well in the Grand Prairie region, 1928 to 1954.

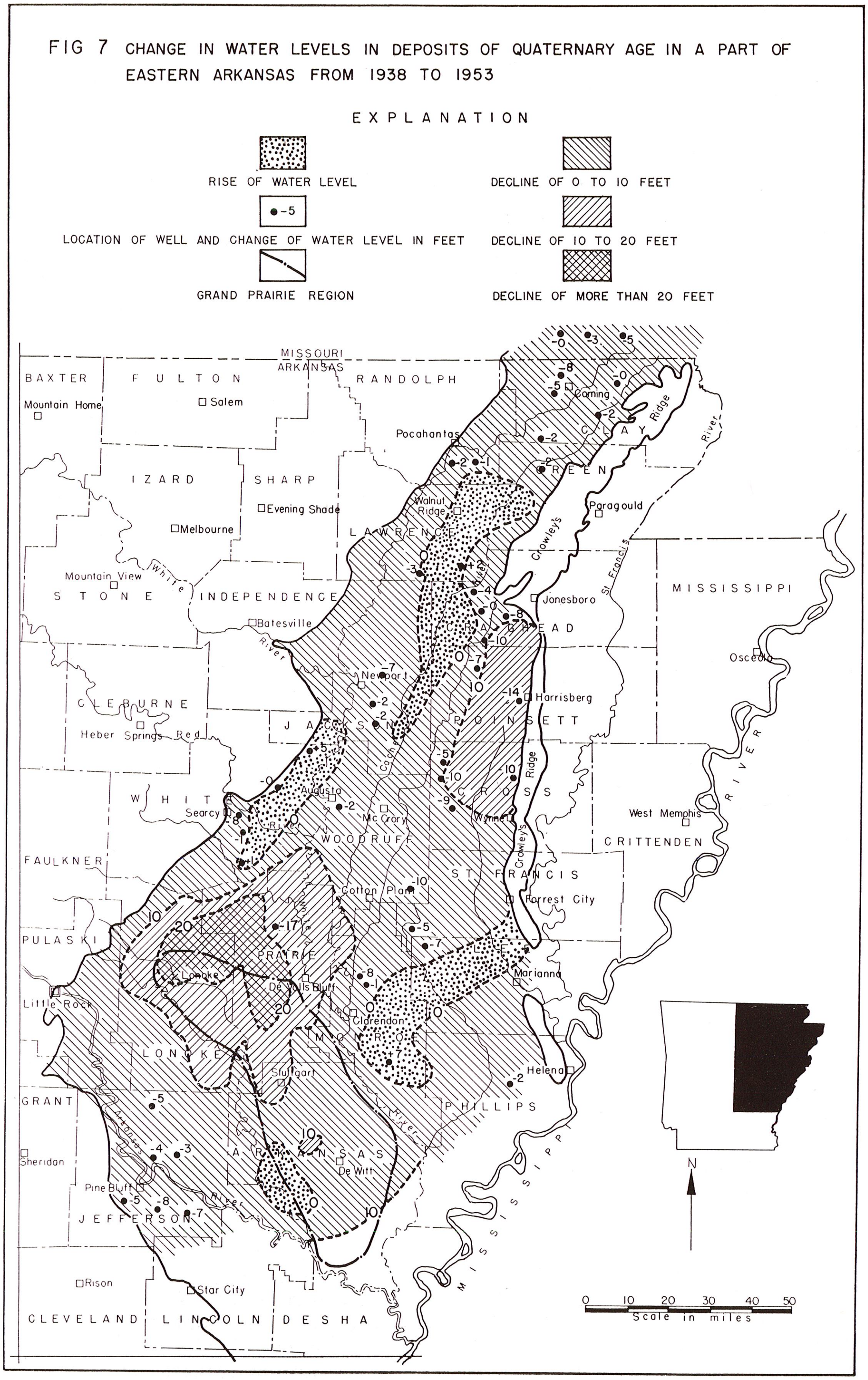

Figure 7. Map showing changes in water levels in deposits of Quaternary age in a part of eastern Arkansas from 1938 to 1953.

1938 at a rate of roughly 320 million gallons per day. In 1952 it was pumped at an estimated rate of 685 million gallons per day.

The rises in water levels are probably due to natural recharge, which occurs locally, chiefly in areas along the margins of the prairies.

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APPENDIX I

GENERAL PRINCIPLES OF GROUND-WATER OCCURRENCE

When water falls on the earth's surface, a part runs into streams or lakes or other surface bodies of water. This water on the earth's surface is known as surface water. Another part of the precipitation is returned to the air by evaporation. Still another part filters into the ground; some of this is returned to the atmosphere by transpiration from plants, and some of it percolates downward to a zone where the interstices in the earth are saturated with water under hydrostatic pressure. The water in this saturated zone is known as ground water. Ground water moves under the influence of gravity to places of discharge at lower elevations. The discharge of ground water maintains the flow of streams at times when there is no direct runoff from precipitation.

Owing to frictional resistance, the rate of movement of water in the ground is very slow compared to the rate of flow of streams. It is only a few hundred feet per year in most places. The capacity of rocks to transmit water by gravity is known as permeability.

Consolidated rocks generally are rather impermeable. Most of the ground water in these rocks moves through joints and openings along bedding planes. Actual underground streams exist but are quite rare, because large open spaces in rocks, such as fissures or caverns, are uncommon.

In most unconsolidated deposits the amount of pore space is comparatively large. Deposits of sand and gravel generally have high permeability, because the pore spaces are large enough to permit water to move readily. Most large-capacity wells yield water from deposits of sand and gravel. Fine-grained deposits, such as silt and clay, are relatively impermeable. These materials contain a large number of pore spaces, but they are so small that water cannot move readily through them. Silt and clay will not yield large amounts of water to wells. At some places deposits of these materials may act as barriers tending to impede the movement of water into or from more permeable deposits.

The amount of water in the ground, slowly moving from places of recharge to places of discharge, is very large. This water, which is in effect in storage, may support pumping for a considerable length of time. However, assuming that there is little or no recharge to the permeable deposits, if water is pumped from them for a long period the water in storage will be largely removed and the rate of pumping must then decrease until it does not exceed the rate of recharge. This means that the rate of pumping from a water-bearing deposit that can be maintained indefinitely cannot be larger than the rate of recharge of water to the deposit, minus the remaining natural discharge from the deposit that cannot be salvaged. At some places where the rate of natural recharge to a deposit is the factor that tends to limit the ultimate yield of ground water from the deposit, artificial recharging of water might increase the yield.

When water is withdrawn from a well the water level in the well is lowered, and water levels around the well are lowered, taking the form of an inverted cone. If the rate of discharge from the well is constant, the decline in water level is rapid at first but gradually decreases. The cone of depression slowly spreads and the water level is lowered at distances farther and farther from the well. The lowering of the water level in response to pumping is a natural and necessary condition. Hydrologically the lowering of the water level caused by pumping is serious only if it causes water of less desirable quality to move into the deposit or if it lowers the water level to the extent that the yields of wells tapping the deposit decrease or the pumping lift becomes uneconomical.

APPENDIX II

QUESTIONS MOST FREQUENTLY ASKED ABOUT THE RECOVERY OF WATER FROM WELLS

In this appendix an attempt is made to answer the questions most frequently asked about ground water. Some of the questions most frequently appearing in letters to our offices are given below, with answers and references to the text and illustrations where information on each subject appears.

Q. How deep is it to water where I wish to drill my well?

A. The answer to this question involves two aspects: (1) how deep is it to a water-bearing formation, and (2) what will be the static water level in the well? Where the water-bearing bed is not confined, the two depths will be essentially the same. Where the water-bearing bed is overlain by a confining bed, the water level may rise considerably above the depth where water is struck. Depths to static water levels in wells are shown in a general way on the map, figure 2. For depths to the water-bearing formation (how deep will I have to drill my well?) the map, figure 1, showing the geographic distribution of water-bearing formations, furnishes a part of the answer. In general, wells in the Quaternary are between 50 and 150 feet deep; in the Cockfield, between 100 and 600 feet; in the Sparta, between 100 and 800 feet; and in the Wilcox in northeastern Arkansas, between 1,000 and 1,900 feet. These are highly generalized figures and may not apply to your area. For more detailed information, consult publications on your area (see reference on p. 13), or, if there is no report on your area, consult or write for open-file records in the office of the U. S. Geological Survey, 515 East Second Street, Little Rock, Ark.

Q. How much water can I get out of my well?

A. If the well is properly constructed and developed, the quantity of water that can be obtained from it will depend largely upon the permeability of the aquifer (capacity to transmit water) and the drawdown that can be tolerated at the well site. Because the permeability may change rapidly within the aquifer from place to place, only the approximate average yields of wells can be shown on a map such as figure 2. Closer approximations can be made from quantitative studies and records of wells nearest the proposed site. Records contained in publications on your area (see references on p. 13) will be useful. If there is no report on your area, call at or write to the office of the U. S. Geological Survey, 515 East Second Street, Little Rock, Ark.

Q. Will I get more water out of my well if I dig (or drill) it deeper?

A. For shallow wells, such as those most commonly used in Arkansas for domestic supplies and stock watering, the answer is generally yes. A deeper well provides more storage and a margin of safety for declining water levels during periods of dry weather. However, if the bottom of the water-bearing bed has already been reached in digging or drilling, further deepening will have little effect on the amount of water coming into the well, but a few feet of added depth may provide the drawdown necessary to get maximum production from the well. In some places, other water-bearing beds may occur at a greater depth. It is necessary to know the local geology at the well to determine definitely whether more water can be obtained by deepening the well.

Q. Where does the water in my well or spring come from?

A. The source of our water supply—whether from lakes and streams or from wells and springs—is precipitation from clouds whose water vapor was obtained largely by evaporation from the oceans. Most of the precipitation runs off as streamflow or is evaporated or used by plants, and only a small percentage reaches the water table and is temporarily stored in the small openings between grains of sand and gravel. Except for some deep water-bearing beds in northern Arkansas which crop out and are recharged in Missouri, the water gets underground from rainfall penetration and seepage from streams and lakes within the State.

Q. Does the water level in my well "draw down" when it is pumped?

A. Yes, there is drawdown in all wells when they are pumped; otherwise the water would not flow into the well. The drawdown is the difference between the static water level and the pumping water level in a well. Even a flowing well has a drawdown; it is the difference between the height to which the water would rise in a standpipe and the height of the point of discharge. The larger the amount of water discharged from a well, the greater the drawdown. (See fig. 8.)

Q. What is the relationship of drawdown to yield of a well?

A. In general, for rough estimates of yield, a direct proportion can be used. If a 10-foot drawdown gives 200 gpm then it can usually be assumed that a 20-foot drawdown will give about 400 gpm. The specific capacity of a well is the yield in gpm divided by the drawdown. If the above figures are used, the specific capacity of the well would be 400 gpm divided by 20 feet, or 20 gpm per foot of drawdown.

Q. What is the effect on its yield of increasing the diameter of a well?

A. Assuming that the drawdown is kept the same, an increase in diameter results in only a small increase in yield. However, although increasing the diameter of the bore has little theoretical effect on discharge, it does decrease the velocity with which water passes through the formation adjacent to the well screen and through the screen itself. Where fine sand is present, this is an important consideration. Doubling the diameter will decrease the velocity by half, thus reducing the possibility of carrying excess quantities of sand into the well.

Q. What is the effect of lowering of water levels on pumping costs?

A. As a rule of the thumb, for each 1,000 gpm pumped, a drop in water level of 1 foot will increase the power required by about a quarter of a horsepower. If you had a well pumping 2,000 gpm and it required 50 horsepower, a drop of 2 feet in water level would increase the horsepower required to pump 2,000 gpm to 51.

Q. What is meant by interference between wells?

A. When a well is pumped, the water level in the well, and for some distance from the well, declines and takes a form similar to that of an inverted cone, called the cone of depression or cone of influence. In a given formation, the greater the pumping rate of a well the greater the drawdown and the larger the cone of depression. When wells are close enough together, the cones of depression of the wells overlap and the yields of the wells decrease. This is called well interference. In other words, each well takes some water that would normally flow into another, therefore creating interference. (See fig. 8.)

Q. Are ground-water supplies inexhaustible?

A. No. There is no place where the ground-water supplies are inexhaustible, just as there is no place where the amount of streamflow is unlimited. In general, the ground-water and surface-water supplies of an area are replenishable resources; that is, the amount added each year, or each several years, balances the amount taken out. Ground water in many ways is like water stored in surface reservoirs. We draw on it in time of need, and it is replenished by the penetration of rainfall or by seepage from streams. Some ground-water reservoirs are small, some are large, but all of them can be over-developed if sufficient water is pumped out of them.

Q. What is meant by over-development of ground water?

A. Where water is taken out of the ground faster than it gets back in, water levels in wells continue to decline and yields of wells are greatly reduced and some will ultimately fail to produce any water. Such a situation of over-development is generally local, being caused by wells too close together pumping too much water. Sometimes there is too little precipitation and streamflow to provide the water for recharge, but this is not the case in Arkansas. In the Grand Prairie region, which is the only large area in the State that is now overdeveloped, little water can travel directly downward because of the clay cap that overlies the water-bearing sand and gravel. Water movement from the recharge areas at the margin of the prairie is slow because of the low gradients. Thus, the water is being taken out faster than it can move in.

Q. Is it possible to hit underground streams in drilling or digging a well?

A. In most parts of Arkansas the ground water occurs in the small spaces between sand grains and other rock particles or in cracks in hard rocks. The water-bearing materials are generally beds having considerable lateral extent. The idea that water occurs underground in extensive "veins" or streams is generally not correct. However, the size of the openings in which water occurs varies from place to place; wells of large yields can be obtained where the openings are large, and only small yields may be obtained where the openings are small.

Q. How shall I construct and develop my well?

A. The answer to this question depends upon your water needs and the geologic and hydrologic conditions at the well site. Your local well driller will generally be able to advise you from his experience. All the common types of wells—dug, driven, bored, and drilled—are used in Arkansas. A few commonly asked questions are given below.

Q. What are the advantages and limitations of driven wells?

A. The drive-point well is probably the most easily constructed and least expensive type of well. Because these wells are pumped with some type of suction pump, the water level must be close to the surface, the maximum lift being approximately 20 feet. They cannot be put down in hard rock or in very coarse gravel or boulders. Because of these limitations, driven wells are most common in alluvial deposits of the Coastal Plain and the Arkansas River Valley.

Q. Can drive-point wells be used for irrigation?

A. Yes, they can be and are used in Arkansas for irrigation. A battery of several 2-inch driven wells are connected with one centrifugal pump, and quantities of water sufficient for irrigation are thereby produced. For this type of operation to be successful, the water table generally must be within 15 feet of the surface and the water-bearing materials must be very permeable so that drawdowns are not large.

Q. How can I guard against bacterial pollution of my well?

A. This question is best referred to the Arkansas State Board of Health, Bureau of Sanitary Engineering. Its bulletin No. 12 shows how to protect all types of wells, springs, and cisterns against pollution. Where the water supply is to be used for domestic purposes, protection against bacterial pollution is very important.

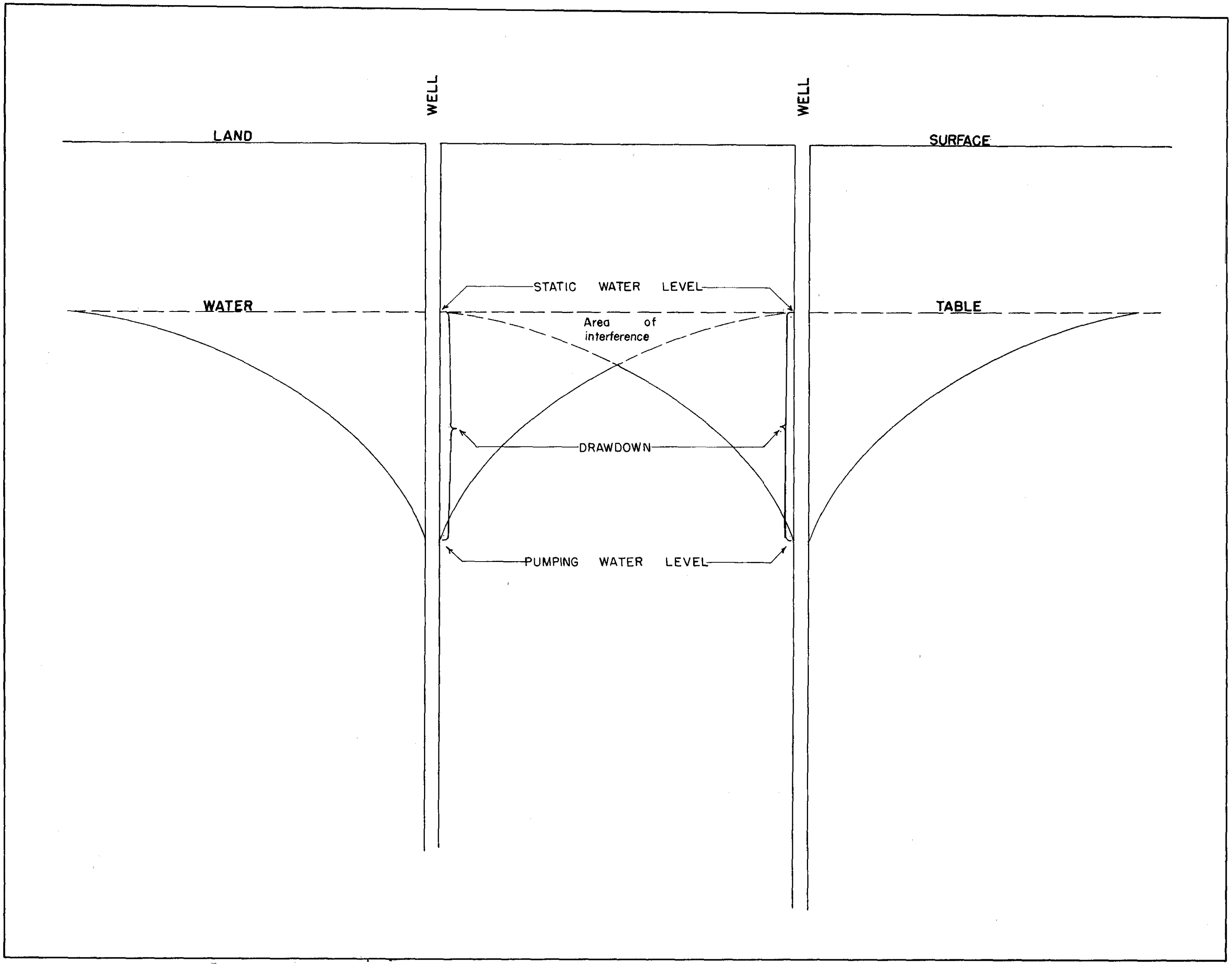

Figure 8. **Diagram showing the relationship between static water-level, pumping water-level, drawdown, hydraulic gradient, and interference in water-table wells.**