Water Resources of Jackson and Independence Counties, Arkansas

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1839-G

Prepared in cooperation with the Arkansas Geological Commission

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By DONALD R. ALBIN, MARION S. HINES, *and* J. W. STEPHENS

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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WATER RESOURCES OF JACKSON AND INDEPENDENCE COUNTIES, ARKANSAS

By DONALD R. ALBIN, MARION S. HINES, and J. W. STEPHENS

ABSTRACT

The present (1965) water use in Jackson and Independence Counties is about 55.6 million gallons per day, and quantities sufficient for any foreseeable use are available. Supplies for the large-scale uses—municipal, industrial, and irrigation—can best be obtained from wells in the Coastal Plain and from streams in the highlands.

Wells in the Coastal Plain will yield 1,000–2,000 gallons of water per minute when screened at depths from 100 to 150 feet in alluvial sand and gravel of Quaternary age. The water will require treatment for the removal of iron and the reduction of hardness to be suitable for municipal and industrial uses. Wells in the highlands generally yield less than 50 gallons per minute of water that is of good quality, though hard.

The dependable flow of the White River at Newport is about 4.2 billion gallons per day. The dependable base flows of the small streams tributary to the White River in the Salem Plateau and Springfield Plateau sections range from 0.25 to 5 million gallons per day, and the dependable flow of Polk Bayou at Batesville is about 21 million gallons per day. These streams can be utilized for water supply with little or no artificial storage required. Streams in the Boston Mountains section and in the Arkansas Valley section recede to very low flow or to no flow during extended dry periods, but dependable supplies can be obtained from these streams by construction of storage facilities Water from all the highland streams is of excellent chemical quality except that it generally is hard.

INTRODUCTION

PURPOSE

The U.S. Geological Survey, in cooperation with the Arkansas Geological Commission, is conducting a statewide program of water resources investigations in Arkansas. As a part of this program, work was begun in Jackson and Independence Counties in July 1962 to (1) determine the availablity of water for municipal, industrial, irrigation, and domestic uses, (2) provide information with which to judge the feasibility of alternate solutions to water problems, and (3) provide information to guide the future development and management of the water resources of the two counties. This report outlines the results of that work.

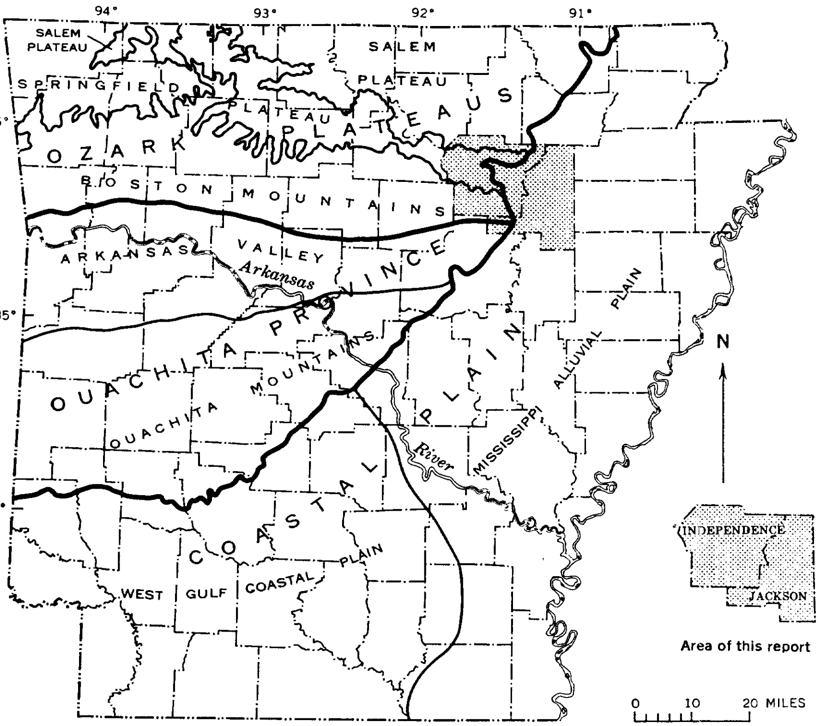
ACKNOWLEDGMENTS

The authors thank all those persons who supplied information during the course of this project—especially the members of the Arkansas Geological Commission, who gave freely of their time and knowledge during geologic discussions and fieldwork.

DESCRIPTION OF THE AREA

PHYSIOGRAPHY

Jackson and Independence Counties constitute an area of about 1,400 square miles in northeast Arkansas (fig. 1). Most of Jackson



EXPLANATION

Physiographic province boundary

Physiographic section boundary

FIGURE 1.—Location and physiography of Jackson and Independence Counties, Ark.

County and the valley of the White River from the vicinity of Batesville eastward are in the Mississippi Alluvial Plain section of the Coastal Plain province. This area is nearly flat; local relief seldom exceeds 20 feet. Land-surface altitudes generally range from 250 feet above sea level in the northern part of Jackson County and in the White River valley east of Batesville to 220 feet in southern Jackson County—a southward slope of about 1 foot per mile. Because of the flat terrain, streams in the area are sluggish and runoff is slow. However, the slow runoff aids recharge of the ground-water reservoir.

Most of Independence County, and a small part of southwestern Jackson County, is in the Ozark Plateaus province, which comprises the Boston Mountains, Springfield Plateau, and Salem Plateau sections. The southwest corner of Jackson County is in the Arkansas Valley section of the Ouachita province. The part of the report area in these provinces is hilly and is characterized by dissected plateau surfaces and steep-sided sinuous stream valleys. Land-surface altitudes generally are about 1,000 feet above sea level in the Boston Mountains, between 500 and 700 feet in the Springfield and Salem Plateaus, and less than 300 feet in the valley of the White River. The highest point in the report area, 1,128 feet above sea level, is in the Boston Mountains section on Round Mountain about 10 miles west-southwest of Batesville. Streams in this hilly area have gradients as high as 25 feet per mile in their upper courses, and runoff is fast. The White River descends about 2 feet per mile in Independence County, and its major tributaries have gradients of 5–10 feet per mile.

GEOLOGY

The characteristics of the rocks underlying an area greatly control the availability of water in that area. Where the surface rocks are permeable, some precipitation infiltrates to temporary storage in the ground. The stored water can be recovered from wells, springs, or streams. In areas where the surface rocks are of low permeability, the infiltration of precipitation is impeded, runoff is fast, and little recoverable water is stored in the rocks; therefore, well yields are small, and springs and streams cease to flow during dry spells. Dependable large-scale water supplies can be obtained in these areas only by construction of artificial storage reservoirs.

The rocks in Jackson and Independence Counties are of two general types—hard consolidated rocks of Paleozoic age that crop out in the Ozark Plateaus and Ouachita provinces, and unconsolidated deposits of Mesozoic and Cenozoic age that crop out in the Coastal Plain province. The rocks are described in table 1, and a generalized geologic map is shown in figure 2. The principal water-bearing formations are discussed in the next section of this report.

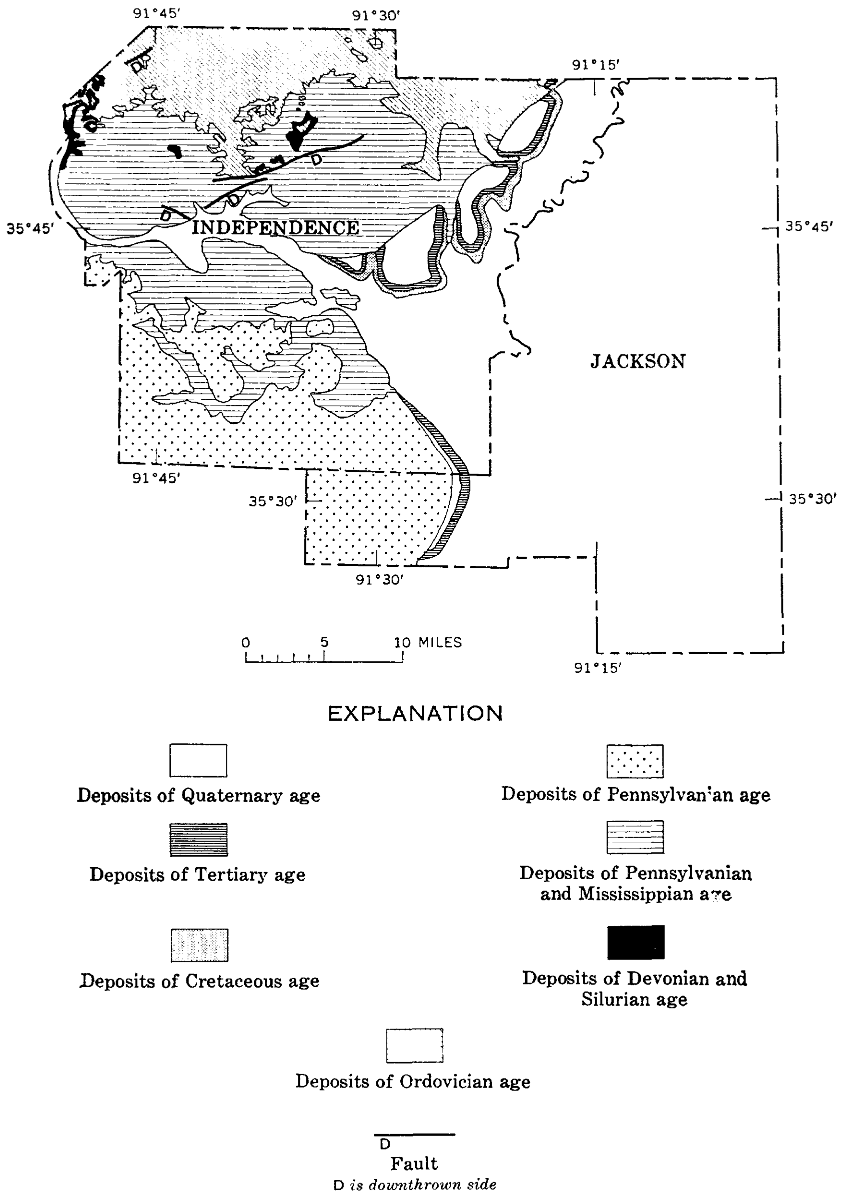


FIGURE 2.—Generalized geology of Jackson and Independence Counties, Ark. (Modified from Arkansas Geol. Survey, Geologic Map of Arkansas.)

TABLE 1.—*Geologic column of rocks in Jackson and Independence Counties, Ark.*

Era	System		Series	Geologic unit		Description
Cenozoic	Quaternary		Recent	Alluvium and terrace deposits		Sand, fine to very coarse, and gravel; contains much silt and clay near surface. Thickness 0–155 feet.
			—?———?— Pleistocene	Loess		Silt, light-tan to reddish-brown. Thickness 0–12 feet.
	Tertiary(?)		Pliocene(?)	Undifferentiated deposits		Sand and gravel to boulder size, cross-bedded, orange to red; contains some sandy clay. Thickness 0–25 feet.
	Tertiary		Eocene	Wilcox Group		Sand, silt, and clay, gray and greenish- to dark-brown; contains 1,400-foot sand of Memphis area. Does not appear at surface in area of this report. Thickness 0–350 feet.
			Paleocene	Midway Group	Porters Creek Clay	Clay, silty in part, black with some dark-gray and green. Thickness 0–350 feet.
					Clayton Formation	Limestone, sandy, fossiliferous. Grades to marl and clay in subsurface. Thickness 0–30 feet.
Mesozoic	Cretaceous		Upper	Arkadelphia Marl		Clay, silty and sandy in part, interbedded light- and dark-gray, lignitic in part; contains shell fragments. Does not appear at surface in area of this report. Thickness 0–30 feet.
				Nacatoch Sand		Sand, medium to coarse, clayey in part, glauconitic, phosphatic, maroon to brown, sometimes greenish; contains minor layers of reddish-brown clay. In subsurface formation consists of clay, silt, and "salt and pepper" sand. Thickness 0–300 feet.
				Saratoga Chalk(?)		Upper unit—Clay. Middle unit—Sand and clay, interbedded. Lower unit—Chalk. Does not appear at surface in area of this report. Thickness 0–117 feet.
Paleozoic	Carboniferous	Pennsylvanian	Atoka	Atoka Formation		Sandstone, medium-grained, light-brown; locally interbedded with black or brown shale; contains basal conglomerate in southern Independence County. Thickness 200–250 feet.
			Morrow	Rocks of Morrow age		Upper part—Shale, fissile, brown or dark-gray to black; contains beds of gray sandy limestone and sandstone. Probably equivalent to Bloyd Shale of northwest Arkansas. Thickness 34–164 feet. Middle part—Limestone, massive, bedded, fossiliferous, brownish-gray; contains some shaly layers Probably equivalent to Prairie Grove Member of Hale Formation. Thickness 38 feet. Lower part—Shale, fissile, brown to black; contains some sandy layers. Thickness 46 feet.

TABLE 1.—*Geologic column of rocks in Jackson and Independence Counties, Ark.*—Continued

Era	System		Series	Geologic unit	Description
Paleozoic—Continued	Carboniferous—Continued	Mississippian	Upper	Pitkin Limestone	Limestone, finely crystalline, compact, fossiliferous, bluish-gray to black; contains layers and lenses of brown to black shale. Some limestones of this formation have been quarried for "black marble." Thickness 240 feet.
				Fayetteville Shale	Upper member—Shale, platy to fissile, black; contains black fine-grained sandstone. Thickness 30–55 feet. Middle member—Limestone, fine- to coarse-grained, bedded, fossiliferous, brownish-gray to dark-gray. Thickness 30 feet. Lower member—Shale, fissile, dark-gray to black; contains beds of dark-gray to black dense fine-grained limestone which have been quarried for "black marble." Thickness 270 feet.
				Batesville Sandstone	Sandstone, medium-grained, calcareous, distinctly bedded, brown or buff to gray; contains lenses of limestone and dark-gray shale. Thickness 70 feet.
				Ruddell Shale	Shale, fissile, calcareous in part, dark-gray and green. Difficult to distinguish from underlying Moorefield Formation. Thickness 120–272 feet.
				Moorefield Formation	Shale, platy, calcareous, dark-gray to black, and dark siliceous limestone. North of Pfeiffer fault the formation reportedly is composed of even-bedded chert. Thickness 25–199 feet.
			Lower	Boone Formation and St. Joe Limestone Member	Chert, dense, brown and brownish-gray to dark-gray or black, and gray to white finely crystalline or cherty limestone; contains a basal pink to maroon crinoidal finely crystalline limestone. Thickness 132–295 feet.
	Devonian		Upper	Chattanooga Shale and Sylamore Sandstone Member	Shale, fissile, bituminous, black to brownish-black; contains a basal brown to white phosphatic fine- to coarse-grained sandstone. Thickness of shale 20 feet; sandstone, 5 feet.
			Lower or Middle	Penters Chert	Chert, light-gray to black; contains thin interbeds or lenses of gray crystalline limestone, and dolomite. Thickness 91 feet.
	Silurian		Middle	Lafferty Limestone	Limestone, earthy, thin-bedded; lower part mostly red, upper part gray. Thickness 85 feet.
				St. Clair Limestone	Limestone, pinkish-gray, finely crystalline; contains coarse-grained calcite crystals and fossil fragments. Thickness 100 feet.
	Ordovician		Upper	Cason Shale	Shale, platy to fissile, calcareous in part, black and gray to bluish-green; locally contains phosphatic sandstone and some limestone. Iron, phosphorus, and manganese minerals disseminated throughout formation give weathered exposures a characteristic "dirty red" color. Thickness 20 feet.
				Fernvale Limestone	Limestone, coarsely crystalline, massive, crossbedded, white to gray with pink tinge; contains calcite crystals and pink barrel-shaped crinoid stems. Thickness 125 feet.
			Middle	Kimmswick Limestone	Limestone, sacchoroidal to finely crystalline, even-bedded, fossiliferous, white to light-gray; contains some medium to coarse crystals. Thickness 60 feet.

TABLE 1.—*Geologic column of rocks in Jackson and Independence Counties, Ark.*—Continued

Era	System	Series	Geologic unit	Description
Paleozoic—Continued	Ordovician—Continued	Middle—Continued	Plattin Limestone	Limestone, dense, sublithographic, light-gray to bluish-gray; contains minute veins of calcite; conchoidal fracture. Thickness 250 feet.
			Joachim Dolomite	Dolomite, finely crystalline, slightly saccharoidal, silty in part, gray to brown; contains some calcareous sandstone. Thickness 150 feet.
			St. Peter Sandstone	Sandstone, fine- to coarse-grained but mostly medium grained; grains rounded and frosted; white to buff; contains some shale, clayey sand, and dolomite. Thickness 100–175 feet.
			Everton Formation	Dolomite, very finely crystalline, dense, slightly sandy, gray to brown, and dolomitic limestone; contains beds of fine- to coarse-grained sandstone throughout the formation that closely resemble those of the overlying St. Peter. Thickness 650 feet.
		Lower	Black Rock Formation	Limestone, dolomitic, slightly sandy, fossiliferous, dark-gray; contains much brown and tan translucent chert. Thickness 55–425 feet.

AVAILABILITY OF WATER

Quantities of water sufficient for any foreseeable use are available in Jackson and Independence Counties. Supplies for the various large-scale uses—municipal, industrial, and irrigation—generally can best be obtained from wells in the Coastal Plain and from streams in the highlands.

GROUND WATER

Ground water can be obtained from wells nearly everywhere in Jackson and Independence Counties. Ground-water supplies are abundant in the Coastal Plain, and generally are sufficient for household and nonirrigation farm use in the highlands.

COASTAL PLAIN PROVINCE

The alluvium of Quaternary age is the best aquifer (a formation that yields water to wells) in the area of this report. The alluvium generally is composed of silt and clay to a depth of about 30 feet below land surface, and of sand increasing in coarseness to gravel from 30 feet to a maximum depth of about 155 feet. The base of the alluvium generally is marked by coarse gravel. Plate 1 shows the depth to the base of the alluvium below land surface. Wells drilled in the Coastal Plain should not greatly exceed the depths shown on this map, because the geologic formations underlying the alluvium contain brackish or salty water.

The Coastal Plain extends up the White River to a few miles beyond Batesville. Data from test holes augered at the locations shown on plate 1 indicate that the general pattern of increasing coarseness of the alluvium with depth is maintained to the upstream boundary of the Coastal Plain. However, the thickness of the alluvium in the Batesville area probably does not exceed 50 feet.

Water levels were measured periodically in 16 wells (pl. 1) screened in the alluvium. The measurements show that water levels in these wells average about 20 feet below land surface and fluctuate about 10 feet. The fluctuations result primarily from changes in the rate at which water is released from or taken into storage in the aquifer. Plate 2 shows the configuration of the water table in spring 1964 and in spring 1965. Figures 3 and 4 are hydrographs of four wells screened in the alluvium, and figure 5 shows the relation of one of these wells to fluctuations of the White River and to precipitation at Newport.

The maps and hydrographs indicate that most of the recharge to the alluvial aquifer is in an area extending northward through central Jackson County. This area is a divide from which ground water moves southwestward toward the White River and southeastward toward discharge points outside the county. The water levels fluctuate in response to precipitation and irrigation pumpage, but do not decline continuously because of pumpage.

A pumping test was made of the alluvial aquifer in December 1964 using the public-supply well at the Newport Air Base. The well was pumped for 24 hours at a rate of 150 gpm (gallons per minute), and water-level drawdowns were measured in observation wells 157 and 203 feet from the pumping well. Results of the test show that the coefficients of transmissibility and storage of the aquifer in the Newport area are about 75,000 gpd per ft (gallons per day per foot) and 0.07, respectively. These values have been used to construct figure 6, which shows the amount of drawdown at various distances from a pumping well that will be caused by a steady pumping rate of 1,500 gpm, if there is no recharge. For instance, the drawdown 100 feet from a well pumping 1,500 gpm continuously for 10 days will be about 13.5 feet, and water levels as much as 1,200 feet away will be affected. Although yields of 1,500 gpm are within the capability of many wells screened in the alluvium, such high-yield wells should be at least 1,000 feet apart.

The spacing between irrigation or other high-yield wells depends greatly on the number of wells in a given area. In general, the greater the distance between wells the better. If there are only two or three wells per section (square mile), they can be spaced as closely as 1,000 feet, and additional wells can be drilled. Additional wells can be drilled in most of the Coastal Plain part of Jackson and Independence Counties without danger of dewatering the alluvium. However, if wells become so numerous that there are four or five per section in most of the sections in a township, spacing must be carefully considered and additional wells drilled only after thorough investigation of the possible interference effects. Areas where spacing should be carefully considered are as follows: The northwest and southwest corners of T. 11 N., R. 3 W.; the north half of T. 11 N., R. 2 W.; the southeast corner of T. 12 N., R. 2 W.; and the area east of State Highway 37 from Beedeville to Grubbs.

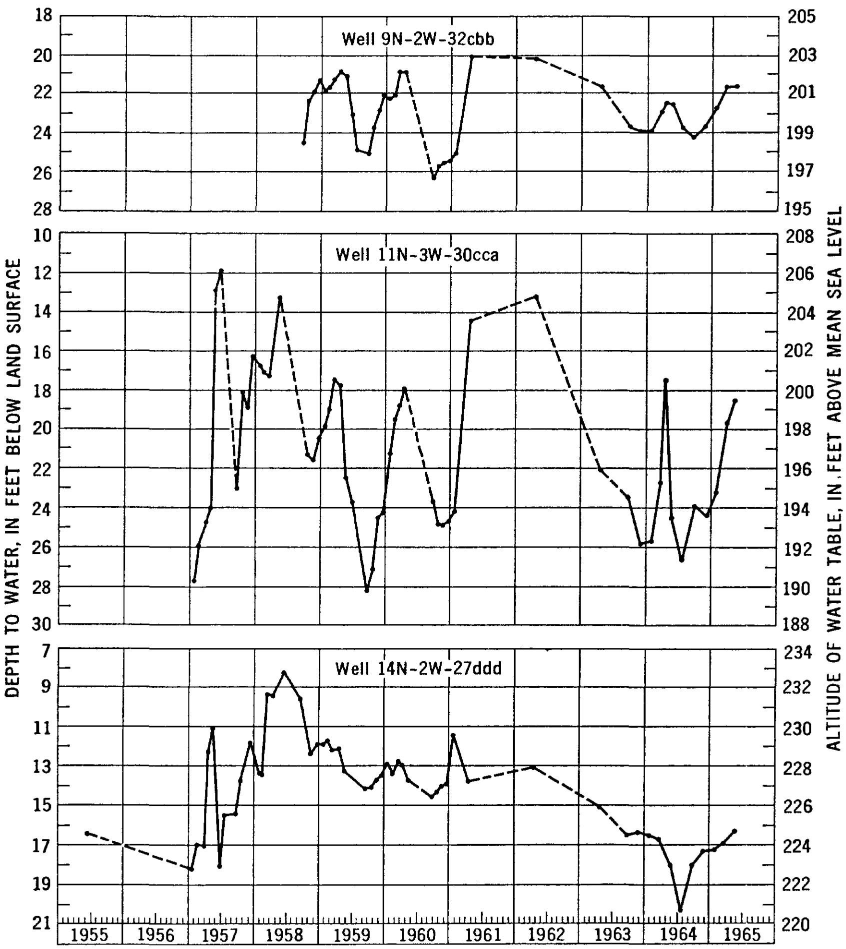


FIGURE 3.—Water levels in wells screened in deposits of Quaternary age, Jackson County, Ark.

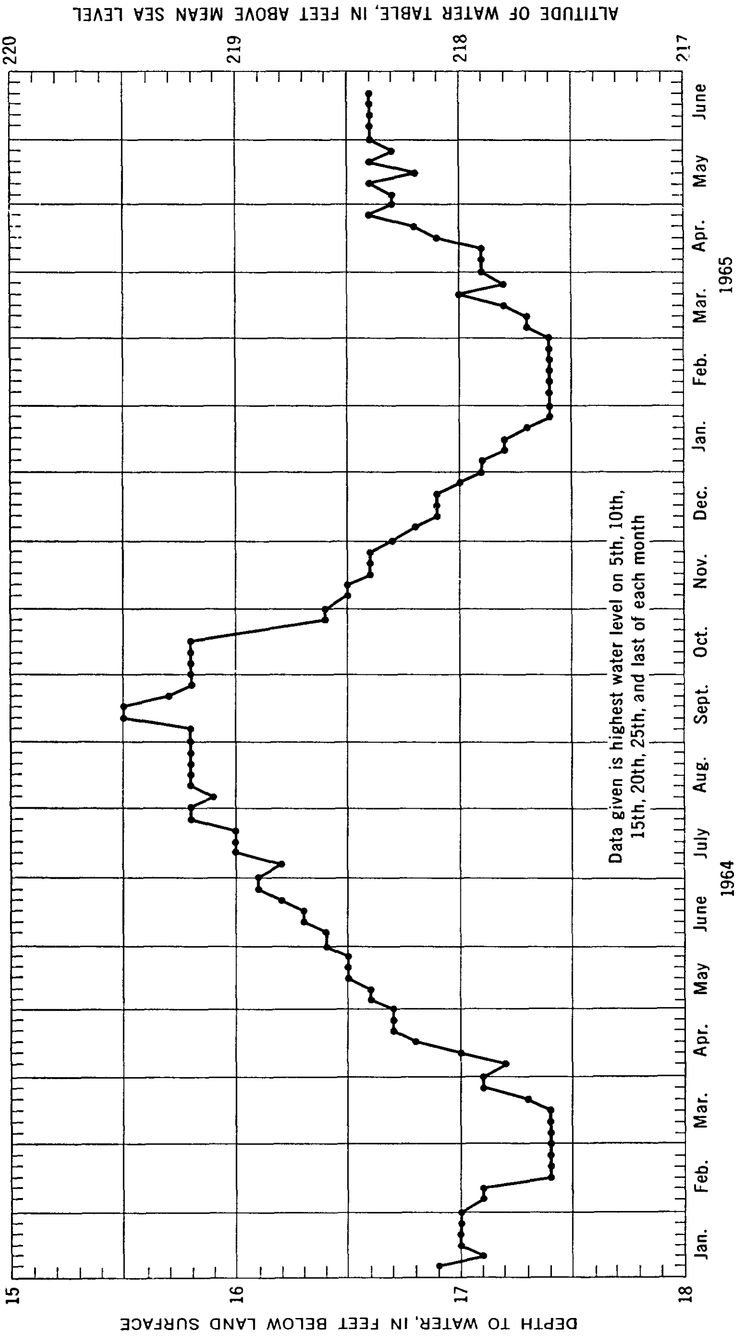


FIGURE 4.—Water levels in well screened in deposits of Quaternary age at the Newport Air Base, Jackson County, Ark

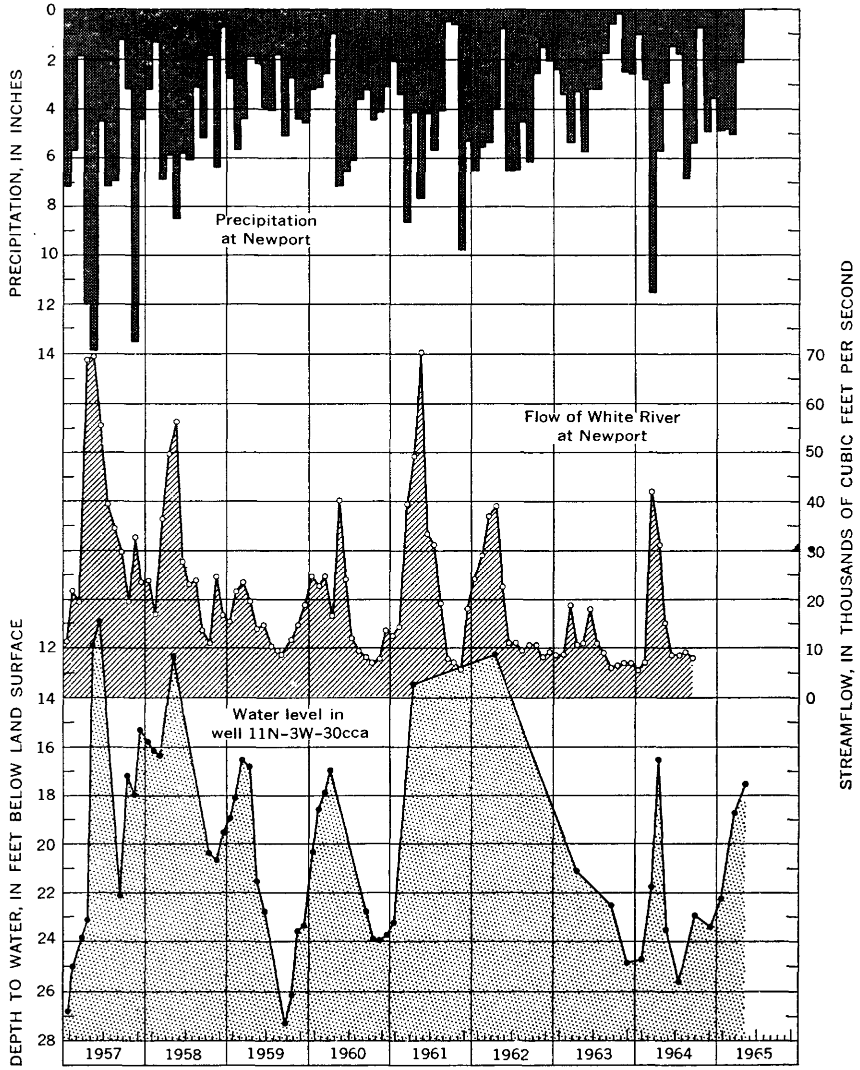


FIGURE 5.—Relation between water levels in the Quaternary aquifer, flow of the White River, and precipitation near Newport, Ark.

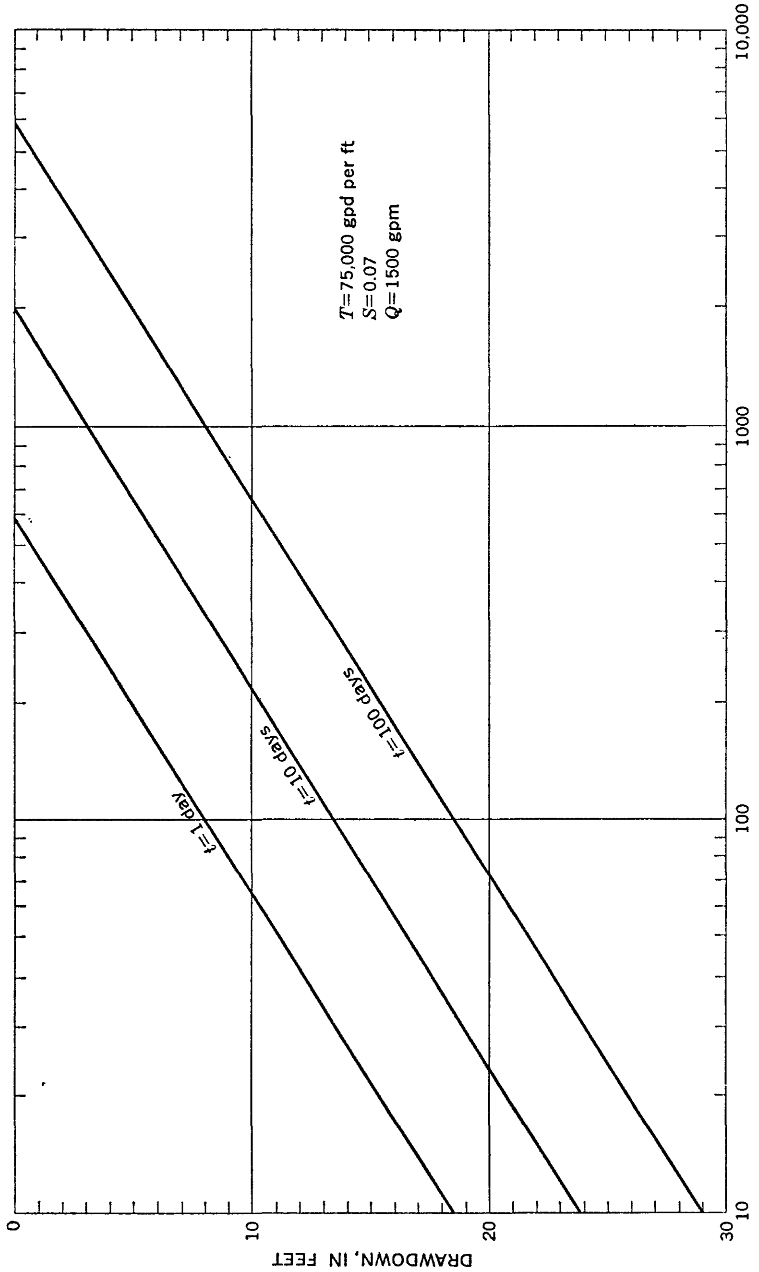


FIGURE 6.—Drawdown at various distances after various periods of pumping from a well of constant discharge. *T*, coefficient of transmissibility; *S*, coefficient of storage; *Q*, pumping rate.

The following table shows the yields of representative irrigation wells in Jackson County measured during May and July 1964. The wells range in diameter from 10 to 14 inches and are equipped with turbine pumps. The system of locating and numbering the wells is illustrated in figure 7.

Well	Discharge (gpm)	Well	Discharge (gpm)	Well	Discharge (gpm)
9N-1W- 3bab	1,830	11N-1W-12cbc	1,086	13N-1W-10aaa	889
9ddd	994	15ccc	1,675	20aaa	1,200
19ada	784	19ddc	1,120	20cdb	1,246
30baa	1,680	22ddc	1,000	21aaa	1,162
9N-2W-33bbb	1,661	28abc	1,050	32baa	1,386
36abb	915	32cad	1,324	33baa	1,308
10N-1W-20add	1,150	11N-2W-21bbb	1,300	33bbb	936
21bca	1,300	11N-3W- 6dab	1,680	34daa	460
21bcc	1,352	31bcc	1,528	14N-1W-13bbb	1,920
22dda	1,688	12N-1W-28aba	706	26bcb	495
27aad	1,320	36ccb	981	14N-2W-34aaa	1,226
29ddd	397	12N-2W-24abb	1,425	35aaa	1,203
10N-3W-20add	1,200	25baa	1,328		
20ddb	1,340				
34dab	1,600				

The Wilcox Group, which underlies the alluvium in Jackson County, contains an aquifer known as the 1,400-foot sand in most of northeastern Arkansas. This aquifer may underlie the extreme eastern part of Jackson County. However, interpretation of electric logs indicates that the aquifer, if present, is probably not more than about 25 feet thick. Because of its limited areal distribution and thickness, the 1,400-foot sand is not considered a potential source of water in Jackson County. Interpretation of electric logs also indicates that water in the lower part of the Wilcox Group is salty.

Deposits of Late Cretaceous age underlie the Midway Group in Jackson and Independence Counties and crop out as shown in figure 2. The deposits include the Nacatoch Sand, which, in the vicinity of Newport, is about 170 feet thick. Wells yielding 200–500 gpm probably could be screened in the Nacatoch Sand in Jackson County, but interpretation of electric logs indicates that the formation contains salty water.

OZARK PLATEAUS AND OUACHITA PROVINCES

Ground water is not as plentiful in the hard rocks of the highlands (Ozark Plateaus and Ouachita provinces) as it is in the Coastal Plain. Because the rocks are consolidated, the open spaces between the individual rock particles are not as large or as numerous as those in the unconsolidated alluvium. Most of the rocks are so dense that the only recoverable water in them is in secondary openings such as fractures, joints, solution cavities, and separations along bedding planes. Nevertheless, wells in the highlands generally yield sufficient water for household, small municipal, and nonirrigation farm use.

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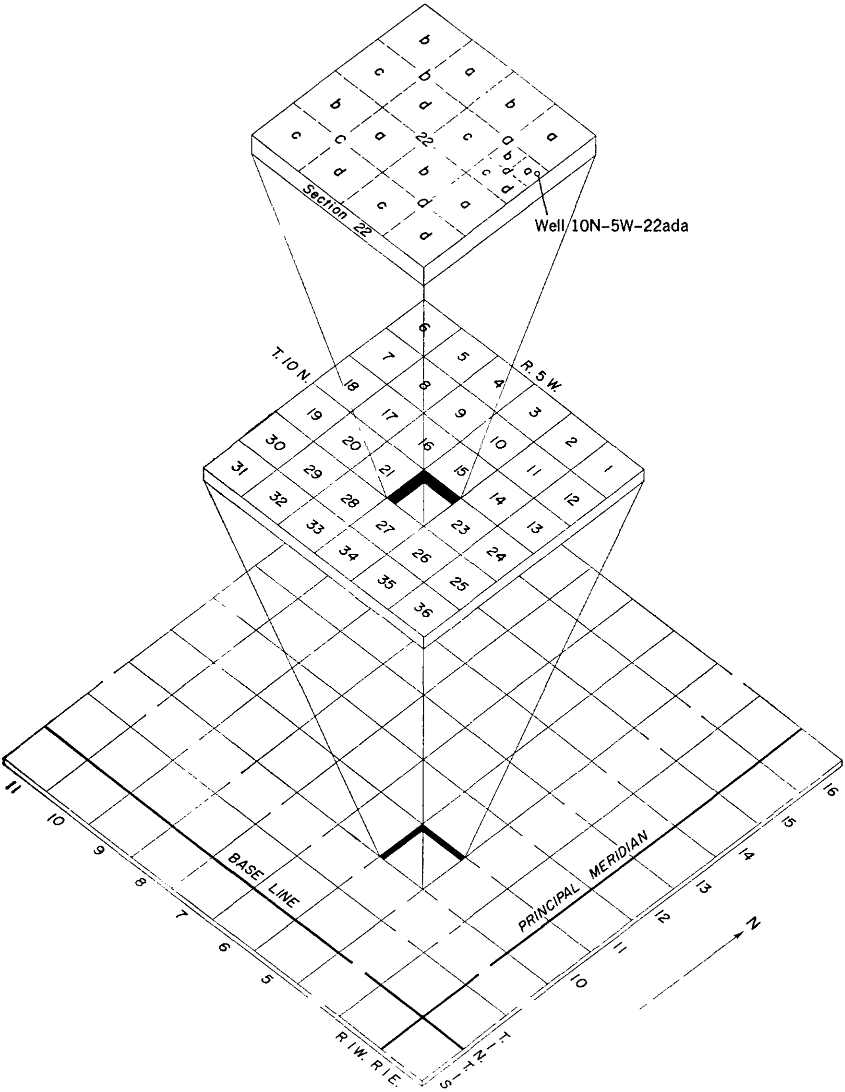

FIGURE 7.—Location-numbering system used in Arkansas

The limestone formations of Ordovician age are the principal source of ground water in the Salem Plateau area. The water occurs in joints and fractures that commonly have been enlarged by solution. The successful completion of a well in the area depends almost entirely on the number and size of these openings that are penetrated. A well drilled into a cave formed by solution and collapse beneath Cave City reportedly yields 50 gpm. A cave about 1 mile west of Cushman contains an "underground river" which issues forth near the mouth of the cave as a 200-gpm spring (measured in June 1965). Openings as large as these caves are rare, but wells commonly penetrate a sufficient number of smaller openings to yield as much as 10 gpm. If water is not obtained in a test hole within depths of about 250 feet, a new location generally will present a better chance of finding water than will further deepening of the hole.

Even though water is available from wells, many people in the Salem Plateau rely on cisterns. The ground water in the area, having been in contact with predominantly calcareous rocks, generally is hard.

Ground water is available nearly everywhere in the Springfield Plateau area of the counties from wells in the Boone Formation. The formation is jointed and fractured and is overlain by loose detrital chert. The insoluble chert rubble, left behind as the formation weathers, retards precipitation runoff and aids recharge to the water table. Many large solution channels have been formed in the limestone underlying the chert rubble, and slump features are common. Wells in the Boone Formation generally are less than 200 feet deep and yield about 10 gpm. Yields of 50 gpm or more probably are available from wells intersecting large solution channels. If the formation is penetrated without finding water, another location should be tried rather than attempting to obtain water from a deeper formation. However, near the northern limit of the Boone outcrop, about the latitude of Cushman, test holes should be drilled at least 250 feet deep on the chance of intersecting joints, fractures, and solution channels in limestone formations of Ordovician age.

Much of the water in the Boone Formation is discharged to springs. The springs are especially numerous along streams in the Springfield Plateau, and many of them have been developed for water supply. Big Spring, about 7 miles northwest of Batesville, has supplied water for a gristmill for many years. Measurements made in the creek just below the spring and mill indicate that the average flow is about 1,100 gpm.

The Batesville Sandstone also yields water to wells in those areas of the Springfield Plateau where the formation crops out. In the outcrop areas, the calcareous cement between the sand grains has been leached and the sandstone is porous. Many wells that obtain water from the formation extend into the underlying shales. Although some water may be derived from the shales, the borehole extending into them serves mainly as a sump. A well of this type at the Arkansas Highway Department District Headquarters south of Batesville is 250 feet deep and yields about 10 gpm.

In the Boston Mountains and Arkansas Valley sections of Jackson and Independence Counties, water generally can be obtained from wells in one or more of the sandstones of the Atoka and Morrow Series. Some of the sandstones of the Atoka Formation are porous and commonly yield 5–10 gpm to wells less than 300 feet deep. Wells flowing 5–10 gpm have been drilled in the extreme southwestern part of Jackson County. These flowing wells probably could be pumped at rates as high as 50 gpm, although tests are necessary to confirm this estimate. Ground water is difficult to obtain in an area from 2 to 5 miles west of Pleasant Plains. Wells in this area have very small yields, and a test hole drilled to a depth of 352 feet failed to obtain water although three sandstone layers were penetrated. This area is about 1 mile from the deep valley cut by Salado Creek, which may affect the storage of water in the Atoka Formation.

Drilled wells in the highlands seldom exceed 6 inches in diameter, and most are equipped with jet pumps having capacities of 5–10 gpm. Water levels measured periodically in 16 wells ranged from slightly below land surface to depths of about 50 feet. Some wells were observed to flow 5–10 gpm. Pumping lowered the water levels in some wells to nearly 84 feet below the land surface. Seasonal water-level fluctuations in the highland wells are about 10 feet, and drawdowns caused by pumping are as much as 45 feet.

CHEMICAL QUALITY OF GROUND WATER

Samples of ground water from 32 wells and 1 spring in Jackson and Independence Counties were collected for chemical analysis. The analyses were made by procedures described by Rainwater and Thatcher (1960) and showed that water from most of the geologic units is of the calcium bicarbonate or calcium-magnesium bicarbonate type. Representative analyses are listed in table 2.

Water from deposits of Quaternary age generally is hard, and the iron content is high. In most samples hardness exceeded 120 ppm (parts per million) and iron exceeded 0.3 ppm. Some of the samples contained significant concentrations of magnesium, sodium, sulfate, and chloride. Water from deposits of Quaternary age is suitable without treatment for many uses, and, when treated for the removal of iron and the reduction of hardness, it is suitable for municipal and most industrial uses.

Samples of water were not available from deposits of Tertiary or Cretaceous age. Interpretation of electric logs of oil-test wells indicates that good-quality water may be available from sands of the Wilcox Group in extreme eastern Jackson County. Interpretation of the logs also indicates that water from deposits of Cretaceous age is salty.

TABLE 2.—*Chemical analyses of water from representative wells in Jackson and Independence Counties, Ark.*

[Results in parts per million except as indicated]

Well	Geologic source	Date of collection (May 1964)	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Percent sodium	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate					
12N-3W-25adc	Quaternary deposits	26	62	37	6.6	1.6	34	8.3	6.0	2.4	143	0	11	3.0	0.2	0.0	180	119	2	9.6	0.2	262	7.4	2
10N-5W-22ada	Atoka Formation	19	60	12	.22	.01	1.7	.3	2.0	1.1	6	0	1.2	4.5	.0	1.3	27	5	0	41	.4	32	5.9	2
13N-7W-33add	Fayetteville Shale	19	60	24	.27	.00	76	23	53	1.5	446	0	24	10	.9	.0	432	284	0	29	1.4	727	7.5	1
12N-6W-3bbc	Batesville Sandstone	19	60	11	.10	.01	5.4	.3	176	.8	454	10	.2	7.5	.9	8.8	444	14	0	96	20	702	8.5	3
14N-5W-35dcd	Moorefield Formation	18	57	4.8	.02	.00	26	8.5	3.1	5.5	102	0	17	6.5	.1	1.8	124	100	16	5.7	.1	228	7.2	8
13N-7W-8acb	Boone Formation	18	62	11	.12	.00	94	4.0	8.4	1.0	289	0	10	9.0	.1	5.1	285	251	14	6.7	.2	471	7.6	5
14N-8W-14bab	Fernvale Limestone	18	59	9.1	.12	.00	40	4.4	3.4	16	151	0	8.8	3.0	.2	5.2	164	118	0	5.1	.1	278	7.5	3
15N-5W-31cca	Joachim Dolomite	18	-----	7.8	.19	.00	81	7.8	3.6	4.8	275	0	7.2	9.0	.0	2.0	258	234	8	3.2	.1	435	7.6	3
15N-7W-22daa	St. Peter Sandstone	18	63	4.9	.02	.04	17	.8	2.3	8.0	56	0	7.8	.5	.1	6.4	75	46	0	8.3	.1	127	7.3	10

Analyses of ground-water samples from wells in the Atoka Formation indicate that water from this formation generally is of excellent quality. The concentration of most chemical constituents is very low, but in a few areas the water is hard and the iron content is high.

The poorest quality ground water found in the counties is from well 12N-5W-16bdc, which is developed in the Fayetteville Shale. The sample collected from this well contained 9.1 ppm iron, 642 ppm sodium, 1,030 ppm sulfate, 268 ppm chloride, 2,440 ppm dissolved solids, and 551 ppm hardness as calcium carbonate. Such highly mineralized water is unsuitable for most uses.

Only one sample of ground water from the Batesville Sandstone was analyzed. This analysis indicates that water from the formation is of the sodium bicarbonate type. The water is suitable for most uses, but its sodium content limits its use for irrigation and, probably, would cause foaming if the water were used in steam boilers. However, the relatively limited quantity of water available from the formation nearly precludes its use for these purposes.

The analyses of samples from wells in the Moorefield and Boone Formations, Fernvale Limestone, Joachim Dolomite, and St. Peter Sandstone indicate that water from these formations generally is of the calcium bicarbonate type. Most of the waters are hard but otherwise are suitable for most uses.

SURFACE WATER

Jackson and Independence Counties are drained by the White River and its tributaries, principally Polk Bayou, Salado Creek, the Black River, Village Creek, Departee Creek, and the Cache River. The combined average flow of these streams is about 25,000 cfs (cubic feet per second); if storage facilities were constructed, large supplies of water would be available. In the highland area, streams generally are the best source of water for supplies of more than about 100,000 gpd. Streams in the Coastal Plain can furnish more water for irrigation than is now (1965) being used, but the development of municipal and industrial supplies is limited by the lack of reservoir sites.

The ability of a stream to supply water is determined by the variability of its flow which in turn is controlled greatly by the geology of the drainage basin. Streams draining areas underlain by rocks of low permeability often are "flashy"; that is, they rise quickly after precipitation and soon recede to a trickle or even go dry. Streams draining areas underlain by permeable rocks respond more slowly to precipitation and continue to flow during dry spells as water stored in the ground is discharged to the stream. In general, streams draining the Coastal Plain, the Salem Plateau, and the Springfield Plateau have dependable base flows and are suitable for water supply. Streams draining the Arkansas Valley and Boston Mountains sections are "flashy" and are therefore less dependable for water supply. Analyses of streamflow variations involve the consideration of (1) the frequency with which streamflow recedes to minimal amounts, (2) the amount of streamflow present for certain percentages of time, and (3) the magnitude and frequency of floods.

Estimates of streamflow characteristics are based on past experience. The accuracy of the estimates depends on the type and length of records collected. Daily discharge records are available for White River at Batesville from July 1937 to September 1958, and at Newport from September 1927 to September 1931 and from October 1937 to the present (1965). However, the records at Batesville and Newport used for this report are those collected since 1951, which represent the condition of the stream as regulated by Bull Shoals reservoir 161 miles upstream from Newport.

Daily discharge records are available for Black River at Black Rock (68.3 miles above the mouth near Jacksonport) from June 1929 to September 1931 and from October 1939 to September 1963. The flow of the Black River at Black Rock is not significantly affected by regulation; therefore the entire period of record was used for this report.

Low-flow partial-record stations have been operated on Polk Bayou at Batesville and on Village Creek near Newport since September 1957, and on Departee Creek near Coffeeville since October 1958. From fall 1963 through spring 1965, base-flow discharge measurements were made quarterly at nine miscellaneous sites (fig. 5) to aid in defining the areal distribution of low flows.

LOW-FLOW FREQUENCY

The flow of streams in Arkansas generally is lowest in the summer and fall which unfortunately is the time of greatest demand for water. Unless storage is provided, the amount of water needed during a period of low flow may exceed the amount available from the stream. Therefore, one of the major factors to consider in determining the ability of a stream to supply water is the frequency with which low flows occur.

Results of low-flow-frequency analyses of streams in Jackson and Independence Counties are shown in tables 3 and 4. More complete results were reported by Hines (1965). A low-flow-frequency analysis provides a statistical estimate, based on past experience, of how often the flow of a stream will recede below certain amounts. Data for Black River at Black Rock (mile 68.3) are included in table 3 because there are no gaging stations on the Black River in the report area. The data at Black Rock are representative of conditions in the report area except that the flow of Black River is about 10 percent greater at Jacksonport than at Black Rock. The estimates in table 4 were obtained by using data from gaging stations and from base-flow discharge measurements at partial-record sites.

TABLE 3.—*Frequency of low flows and duration of daily flows*

Station	Drainage area (sq mi)	Annual low flow (cfs), for indicated recurrence interval (years)					
		Period (days)	1.2	2	5	10	20
White River at Newport, Ark	19,812	7	8,700	6,500	5,440	4,520	3,520
		14	9,300	6,620	5,780	4,820	3,750
		30	10,300	7,000	6,020	5,010	4,000
		60	11,700	7,410	6,400	5,380	4,240
		120	14,000	8,100	6,520	5,620	4,500
Black River at Black Rock, Ark	7,323	7	3,200	2,280	1,800	1,680	1,620
		14	3,370	2,340	1,840	1,710	1,650
		30	3,650	2,500	1,950	1,800	1,740
		60	4,000	2,620	2,000	1,840	1,780
		120	4,640	2,840	2,130	1,950	1,890

Station	Daily mean flow (cfs), which was equaled or exceeded for indicated percentage of time								
	99	95	90	80	60	40	20	5	1
White River at Newport, Ark	4,000	5,200	6,100	7,600	10,900	16,300	29,000	52,000	76,000
Black River at Black Rock, Ark	1,930	2,200	2,440	2,930	4,350	6,750	11,500	24,300	45,400

Interpretation of the tables can be illustrated by using data for White River at Newport as an example. If hydrologic and climatic conditions do not change, the annual low flow of the White River at Newport probably will be less than 6,500 cfs (about 4.2 billion gpd) for a 7-day period at intervals averaging 2 years in length, and less than 5,010 cfs for a 30-day period at intervals averaging 10 years in length. The recurrence intervals are long-term averages and are not regular occurrences. Although the 7-day, 2-year low flow, which is considered the dependable flow without storage, may be expected 5 times in 10 years or 10 times in 20 years, it may occur in consecutive years during an extended drought.

These data can be used to estimate the adequacy of streamflow for a given demand. For instance, if a water supply of 4 cfs is needed and if an insufficient supply can be tolerated for a week once every 5 years (the 7-day, 5-year flow), inspection of the tables shows that the White River, the Black River, Polk Bayou, Curia Creek, and the Cache River have flows at the points where they were measured that will meet that demand.

TABLE 4.—*Low-flow characteristics of streams in Jackson and Independence Counties, Ark.*

[Type station: M, miscellaneous station; P, low-flow partial-record station]

Station	Type station	Estimated mean flow (cfs per sq mi)	Annual low flow (cfs) for indicated number of days and recurrence interval						Daily mean flow (cfs) which will be exceeded the indicated percentage of time		
			7-day			30-day					
			Recurrence interval			Recurrence interval					
			2-year	5-year	10-year	2-year	5-year	10-year	95	90	80
West Lafferty Creek near Cushman	M	1.18	3.6	3.0	2.5	4.1	3.4	3.0	3.8	4.3	5.0
East Lafferty Creek near Cushman	M	1.18	2.0	1.6	1.2	2.3	1.8	1.6	2.1	2.5	3.0
Spring Creek near Batesville	M	1.25	2.5	2.0	1.7	2.6	2.2	1.8	2.3	2.7	3.4
Polk Bayou at Batesville	P	1.18	33	30	29	35	31	30	34	38	45
Salado Creek near Pleasant Plains	M	1.33	.5	.2	.1	.8	.4	.2	.6	1.0	(1)
Caney Creek near Southside	M	1.25	.4	.3	.2	.4	.3	.3	.4	.4	.6
Curia Creek near Dowdy	P	1.18	5.0	4.5	4.2	5.5	4.7	4.5	5.4	6.2	7.8
Dota Creek near Newark	P	1.18	3.2	2.6	2.4	3.6	2.8	2.6	3.4	4.0	5.6
Black River at Jacksonport	M	1.18	2,500	2,000	1,870	2,770	2,100	2,000	2,430	2,680	3,250
Village Creek near Newport	P	1.25	3.6	1.6	[2] .5	4.9	2.3	1.5	3.0	4.7	9.8
Departee Creek near Coffeeville	P	1.33	0	0	0	.5	0	0	0	0	.3
Cache River near Newport	M	1.25	17	11	[2] 5.9	23	15	11	17	22	35

[1] Relation not defined in this range.
[2] Estimated.

FLOW DURATION

Another factor determining the suitability of a stream for water supply is the percentage of time certain flows will be exceeded. For example, table 3 shows that the flow of White River at Newport since 1951 has exceeded 5,200 cfs 95 percent of the time, 10,900 cfs 60 percent of the time, and 52,000 cfs 5 percent of the time. The flow exceeded 95 percent of the time (5,200 cfs, or 3.4 billion gpd) is sufficient for any foreseeable use. Inspection of tables 3 and 4 shows further that a water demand of 4 cfs can be satisfied more than 95 percent of the time by the White River, the Black River, Polk Bayou, Curia Creek, and the Cache River at the points where the streamflow was measured.

FLOODS

The suitability of a stream for water supply is greatly affected by the frequency with which the stream is in flood. High flows present both a problem of damage and an opportunity to store water that ordinarily would be unavailable or wasted. Comprehensive information on floods in Arkansas is contained in a report by Patterson (1964).

Floods are a serious problem in the Coastal Plain part of Jackson and Independence Counties. Many acres of the flat-lying Coastal Plain are inundated during floods, and the water recedes slowly. For instance, during spring 1957 the Cache River was above bankfull stage for 74 days. However, because runoff is slow, destruction from the force of the water is slight, and flood losses are generally limited to water damage and silt deposition. The storage of floodwaters in the Coastal Plain area is generally impractical because of the lack of suitable reservoir sites.

Floods of highland streams do not affect large areas because they are limited to relatively narrow stream valleys. However, the velocity of floodflows in the highlands is high enough to cause destruction from the force of the water. Because of the many narrow points in the stream valleys where dams could be constructed, there is great potential for storage of floodwaters in the highland part of Jackson and Independence Counties.

The magnitude of White River floods has been reduced considerably in the report area by the construction of Bull Shoals and other upstream reservoirs. Table 5 lists estimated flood-frequency information for the regulated condition of White River at Batesville. This information has been used to construct plate 3, which shows the approximate area flooded at average intervals of 10 years (10-year flood) and 50 years (50-year flood). The table and figure can be used in planning economic development of the floodplain near Batesville.

TABLE 5.—*Flood frequency of White River at Batesville, Ark.*

[Datum of gaging station on White River at Batesville is 237.72 ft above mean sea level, datum of 1929. Altitude of bankfull stage, 253.7 ft]

Number of occurrences per 100 years	Peak discharge (cfs)	Stage (feet above mean sea level)	Recurrence interval (years)
50	78, 000	253	2
20	120, 000	257	5
10	140, 000	260	10
4	180, 000	263	25
2	215, 000	265	50

CHEMICAL QUALITY OF SURFACE WATER

Water samples for chemical analysis were collected daily from the White River at Newport during the period October 1945–September 1961. Tables 6 and 7 list the analyses and the temperatures of samples collected during the 1960 water year (October 1959–September 1960), which was representative of the period of record. Samples also were collected during periods of low flow from the White River at Batesville and from eight of the tributary streams. The analyses of these samples are listed in table 8.

The analyses indicate that water in the streams of Jackson and Independence Counties is generally hard but is otherwise of excellent chemical quality. The waters are of the calcium bicarbonate or calcium-magnesium bicarbonate type and are chemically suitable for most uses if treated to reduce hardness. Although not determined for this report, the silt load of the smaller streams in the Coastal Plain may be a problem in developing the streams for water supply.

USE OF WATER

Water was used in Jackson and Independence Counties at a rate of about 55.6 mgd in 1963. Of this total, about 50.6 mgd was obtained from wells and about 5 mgd was obtained from streams and surface reservoirs. Table 9 shows the amount of ground and surface water used for various purposes in the report area. The use of ground water for irrigation averages nearly 47.5 mgd and accounts for more than 85 percent of all water used in the two counties. Although the irrigation pumpage is presented in the table as a daily average throughout an entire year, it is concentrated primarily in the period from mid-April through September. Therefore, during the irrigation season, ground water is pumped in the counties at a rate of nearly 107 mgd, and during the remainder of the year, at a rate only a little more than 3 mgd.

TABLE 6.—*Chemical analyses of daily samples from White River at Newport, Ark., 1960 water year*

Location: At gaging station at bridge on U.S. Highway 67 at Newport, Jackson County, 7.2 miles downstream from Black River.

Drainage area: 19,812 square miles.

Records available: chemical analyses, October 1945–September 1961 (discontinued); water temperatures, October 1945–September 1961 (discontinued).

Extremes, 1945–61: Dissolved solids: maximum, 388 ppm Jan. 20–21, 23, 30, 1954; minimum, 96 ppm Nov. 19–30, 1957. Hardness: maximum, 248 ppm Mar. 31, 1961; minimum, 51 ppm Jan. 25–31, 1949. Specific conductance: maximum daily, 695 micromhos Jan. 30, 1954; minimum daily, 103 micromhos Jan. 28, 1949. Water temperatures: maximum, 87°F Aug. 4, 9, 1947, Aug. 1, 1952; minimum, 34°F Feb. 2–4, 1951.

Remarks: Records of specific conductance of daily samples available in district office at Little Rock, Ark.

[Results in parts per million except as indicated]

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
1959																		
Oct. 1–5	8,360			38	16	2.9	1.1	190	4.4	3.0		1.6	178	161	6	291	8.1	3
6–10	17,160			33	12	2.1	1.1	156	4.6	2.5		2.2	151	132	4	246	8.0	3
11–20	12,430	2.3	0.00	35	15	2.2	1.3	180	4.2	2.5	0.2	.5	175	149	2	285	8.1	5
21–31	10,010			36	16	2.3	1.2	188	5.0	2.5		1.8	172	156	2	285	8.1	2
Nov. 1–4	11,640			36	17	2.8	1.1	188	5.0	3.5		1.7	182	160	6	292	8.0	1
5–8	30,450			27	8.8	2.0	1.9	120	5.0	2.5		2.9	133	104	5	201	7.7	7
9–12	15,320			33	14	2.1	1.3	162	5.0	2.5		1.6	158	140	7	253	7.9	3
13–20	12,380	1.8	.00	37	16	2.2	1.3	[1] 184	4.8	3.0	.1	.5	179	158	8	297	8.3	6
21–30	10,430			35	18	2.6	1.2	188	4.6	3.0		1.4	174	162	8	294	8.0	4
Dec. 1–10	8,812	2.7	.00	33	18	2.9	.9	188	4.2	2.5	.2	.2	150	156	2	298	8.2	6
11–20	20,800			29	13	2.9	1.3	148	6.0	3.0		1.9	155	126	4	239	7.7	7
21–31	25,910			30	12	2.5	1.1	148	5.4	2.0		1.8	155	124	3	238	7.8	5
1960																		
Jan. 1–10	25,090	7.8	.00	30	13	2.5	.9	148	9.0	2.8	.1	2.0	146	128	7	235	7.9	5
11–20	26,560			30	13	2.3	1.0	144	5.4	4.5		2.9	151	128	10	247	7.6	4
21–31	22,670			32	15	2.5	.9	166	4.8	3.0		2.0	158	142	6	259	7.8	3
Feb. 1–10	25,530	6.4	.00	32	12	2.8	.8	152	6.2	2.8	.3	1.8	142	130	5	248	7.9	5
11–20	22,740			32	15	2.5	1.1	166	5.8	2.5		1.7	162	142	6	268	7.7	2
21–29	19,220			30	17	2.6	.8	168	4.8	3.0		2.3	152	145	8	279	7.8	4
Mar. 1–10	19,680	5.7	.00	28	16	3.1	.8	158	5.2	3.0	.1	1.7	141	136	6	258	7.5	3
11–20	28,010			32	14	2.4	1.2	158	6.6	2.8		1.5	160	138	8	261	7.9	2

21–31	26,250			34	14	2.2	.8	166	6.0	2.8		1.4	162	142	6	261	7.9	4
Apr. 1–10	19,040	3.5	.00	32	15	2.7	.7	169	5.2	1.2	.1	2.0	150	142	3	267	8.2	5
11–20	15,550			34	16	2.5	1.2	176	5.0	3.0		1.3	171	151	7	274	8.1	4
21–30	15,260			34	16	3.4	1.2	176	6.6	2.8		2.3	159	151	7	254	8.0	8
May 1–10	25,340	6.6	.00	31	13	2.5	1.1	154	5.2	2.2	.1	2.2	151	131	5	248	8.1	8
11–20	39,630			33	13	2.8	1.4	160	5.4	2.8		2.3	148	136	5	246	7.7	5
21–31	53,770			30	11	2.6	1.3	136	7.4	2.5		2.2	133	120	8	220	7.5	10
June 1–10	39,020	5.6	.00	34	15	2.7	.9	170	5.2	2.5	.2	1.7	151	146	7	269	8.2	8
11–20	17,400			37	16	3.4	1.3	188	5.4	2.5		2.0	169	158	4	283	7.9	5
21–30	15,500			33	16	3.5	1.3	172	5.4	3.5		2.5	146	148	8	267	7.8	10
July 1–10	13,280	6.2	.00	35	16	3.2	.9	178	6.2	3.5	.1	2.2	163	154	8	284	8.1	5
11–20	10,170			36	19	4.0	1.5	198	5.4	4.5		2.6	173	168	6	304	7.4	5
21–31	12,240			36	17	3.4	1.3	188	4.8	3.2		2.1	156	160	6	291	7.7	5
Aug. 1–10	9,750	5.3		32	17	3.4	3.2	184	5.6	3.5	.2	.9	160	150	0	274	8.1	0
11–20	9,402			38	18	4.1	1.5	198	5.4	4.2		2.9	176	169	6	301	7.9	5
21–31	9,442			37	18	3.6	1.2	198	5.4	3.0		1.7	176	166	4	298	7.9	5
Sept. 1–10	8,778	7.8		33	18	3.2	1.1	188	5.6	3.0	.1	.8	167	156	2	281	8.1	0
11–20	7,541			36	19	3.7	1.6	196	8.8	3.8		2.1	173	168	8	296	7.9	5
21–30	7,508			37	19	3.7	1.4	200	8.4	3.5		1.8	182	170	6	303	8.0	5

[1] Includes equivalent of 4 ppm carbonate $(CO)_3$.

TABLE 7.—*Daily water temperature (°F) of White River at Newport, Ark., 1960 water year*

[Once-daily measurement]

Month	Day																															Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
October	70	71	72	72	73	70	71	71	69	68	68	65	64	60	60	60	59	61	58	56	58	60	62	59	57	58	57	56	56	58	58	63
November	59	59	59	62	61	54	53	52	50	50	51	51	50	51	48	48	44	45	45	44	45	48	48	48	47	49	46	46	45	44	----	50
December	42	44	42	43	43	43	43	44	44	47	47	49	52	50	49	49	49	48	46	48	48	46	46	47	47	49	49	46	49	47	44	46
January	46	47	46	44	44	42	43	42	42	44	46	47	49	49	49	50	48	46	44	44	40	41	39	39	40	40	42	43	43	42	44	44
February	43	43	44	45	46	47	49	47	50	48	44	47	43	46	43	42	42	39	41	43	44	42	42	43	40	43	41	42	41	----	----	44
March	41	39	38	38	38	40	41	41	41	40	39	41	42	42	41	41	41	41	41	43	43	44	45	47	46	47	47	51	49	53	52	43
April	53	55	55	57	56	56	56	57	58	58	57	58	59	60	61	63	63	62	63	63	65	65	66	68	68	69	67	64	65	63	----	61
May	63	62	62	64	63	67	64	62	62	63	61	58	58	58	58	56	59	61	61	63	62	62	65	67	67	68	67	68	68	68	68	63
June	67	63	61	63	64	64	63	61	62	63	65	65	68	69	69	69	68	69	70	73	74	76	76	77	74	74	72	69	67	----	----	68
July	----	----	----	----	----	----	----	----	----	78	79	79	81	79	76	77	81	78	78	80	78	78	78	76	79	78	78	79	78	77	78	----------
August	77	78	79	80	80	81	81	80	79	78	77	80	77	79	80	82	82	80	77	80	78	76	77	78	79	77	77	78	77	79	79	79
September	79	80	77	80	78	78	78	80	80	76	74	71	71	71	70	72	73	74	74	75	76	74	73	74	73	73	71	69	69	69	----	74

TABLE 8.—*Chemical analyses of water from selected streams in Jackson and Independence Counties, Ark.*

[Samples collected during periods of low flow. Results in parts per million except as indicated]

Streamflow station	Mean discharge (cfs)	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
West Lafferty Creek near Cushman	2.21	Oct. 8, 1963	70	6.1	0.10	0.09	31	14	1.9	0.7	169	0	4.0	3.0	0.0	0.1	144	135	0	0.4	266	6.8	3
East Lafferty Creek near Cushman	1.00	do	72	5.5	.07	.11	44	13	1.8	1.0	198	0	3.6	6.0	.1	.1	173	164	2	.3	316	6.6	3
Polk Bayou at Batesville	34.3	Aug. 12, 1963	78	7.2	----	----	40	14	2.4	.8	188	0	4.2	4.0	.0	.0	165	158	4	.5	306	7.7	3
White River at Batesville	7,200	May 9, 1956	----	.8	.28	.02	43	13	2.3	2.1	184	0	4.8	4.2	.1	2.2	176	161	10	.1	304	7.7	10
Caney Creek near Southside	.21	Oct. 8, 1963	64	12	.39	.06	23	1.7	4.0	1.2	82	0	2.0	6.0	.0	.2	91	64	0	1.1	153	6.3	5
Curia Creek near Dowdy	3.99	Oct. 10, 1963	69	7.2	.14	.09	43	14	2.4	.7	196	0	6.0	6.0	.1	.1	176	165	4	.4	322	6.6	5
Dota Creek near Newark	2.96	Oct. 9, 1963	68	9.0	.10	.12	39	3.2	2.8	1.1	129	0	9.2	3.0	.1	.1	131	111	5	.6	226	6.9	3
Black River near Jacksonport	2,250	Oct. 10, 1963	67	8.2	.28	.12	40	21	4.8	1.1	232	0	3.2	6.0	.0	.1	199	187	0	.9	364	6.8	3
Village Creek near Newport	16.1	Aug. 14, 1963	77	14	----	----	17	6.0	9.7	4.4	97	0	4.8	4.8	.3	.4	109	67	0	2.9	185	7.4	17

TABLE 9.—*Estimated use of water in Jackson and Independence Counties, Ark., 1963*

[Millions of gallons per day]

Water use	Independence County		Jackson County	
	Ground water	Surface water	Ground water	Surface water
Municipal	0.04	1.10	0.81	----------
Industrial	----------	----------	1.00	----------
Rural domestic	.44	----------	.48	----------
Irrigation				
Rice	1.24	----------	31.14	1.64
Cotton	.11	.17	.37	.07
Soybeans	.92	1.38	13.68	.13
Livestock				
Poultry	.17	----------	.03	----------
Cattle, hogs, and horses	.08	.44	.10	.15
Total	3.00	3.09	47.61	1.99

Ground water is being used in a manner uncommon in Arkansas at the Victor Metal Products plant north of Newport. About 1 mgd of water from the alluvial aquifer is used at the plant, primarily for cooling purposes. The unusual feature of the operation is that the cooling system is a closed cycle in which water is pumped from either or both of two wells through the cooling system and back into the aquifer through an injection (or recharge) well. Except for temperature, the chemical and physical characteristics of the ground water apparently are unchanged by the cooling cycle. The amount of temperature rise and the area of aquifer affected are unknown, but the temperature of water from wells less than 1 mile from the Victor plant is not higher than that from wells elsewhere in the county. The system has been in successful operation since 1951 and is an excellent example of the conservation of a natural resource by industry.

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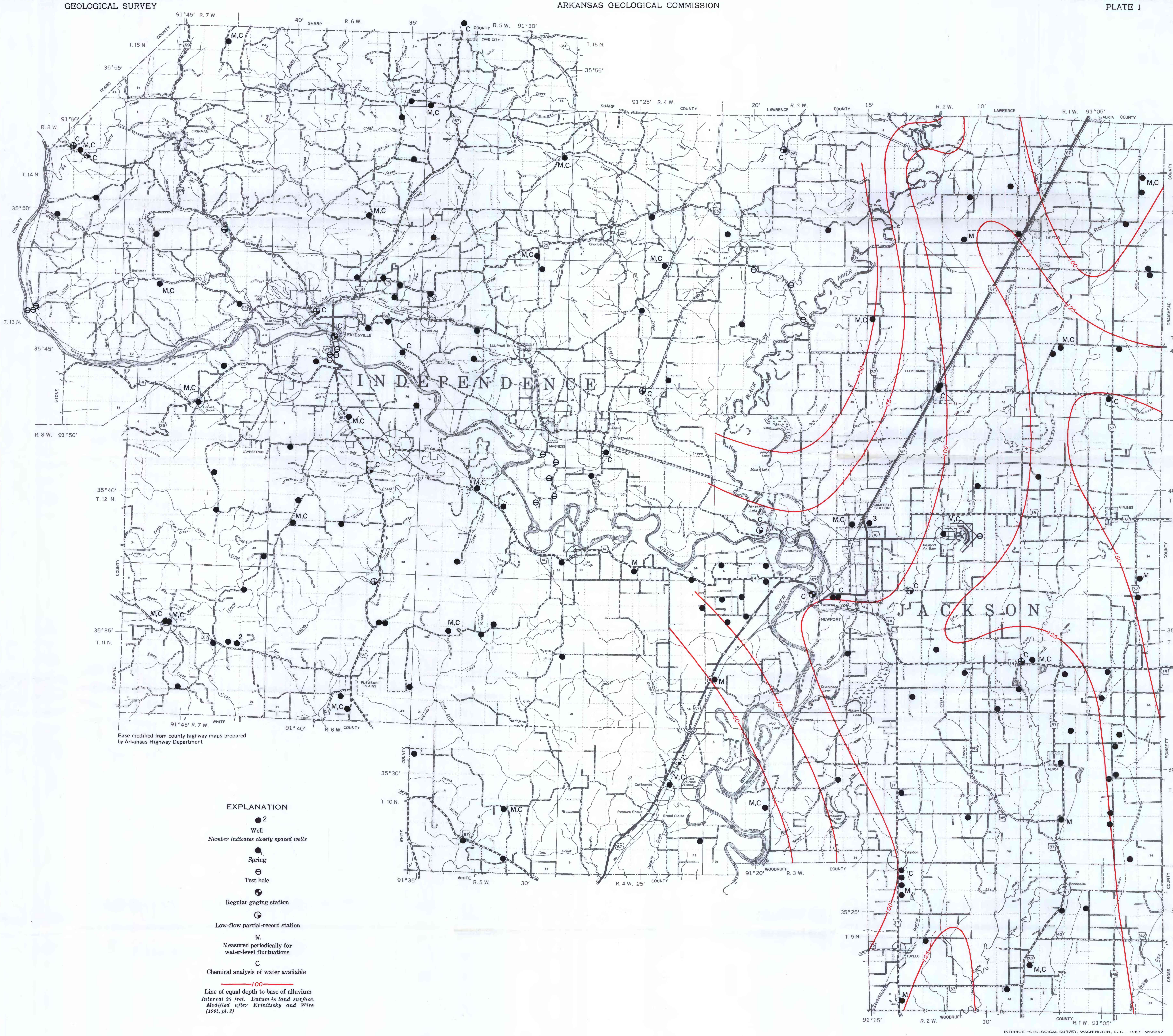


MAP SHOWING LOCATION OF DATA-COLLECTION POINTS, AND DEPTH TO BASE OF ALLUVIUM IN JACKSON AND INDEPENDENCE COUNTIES, ARKANSAS

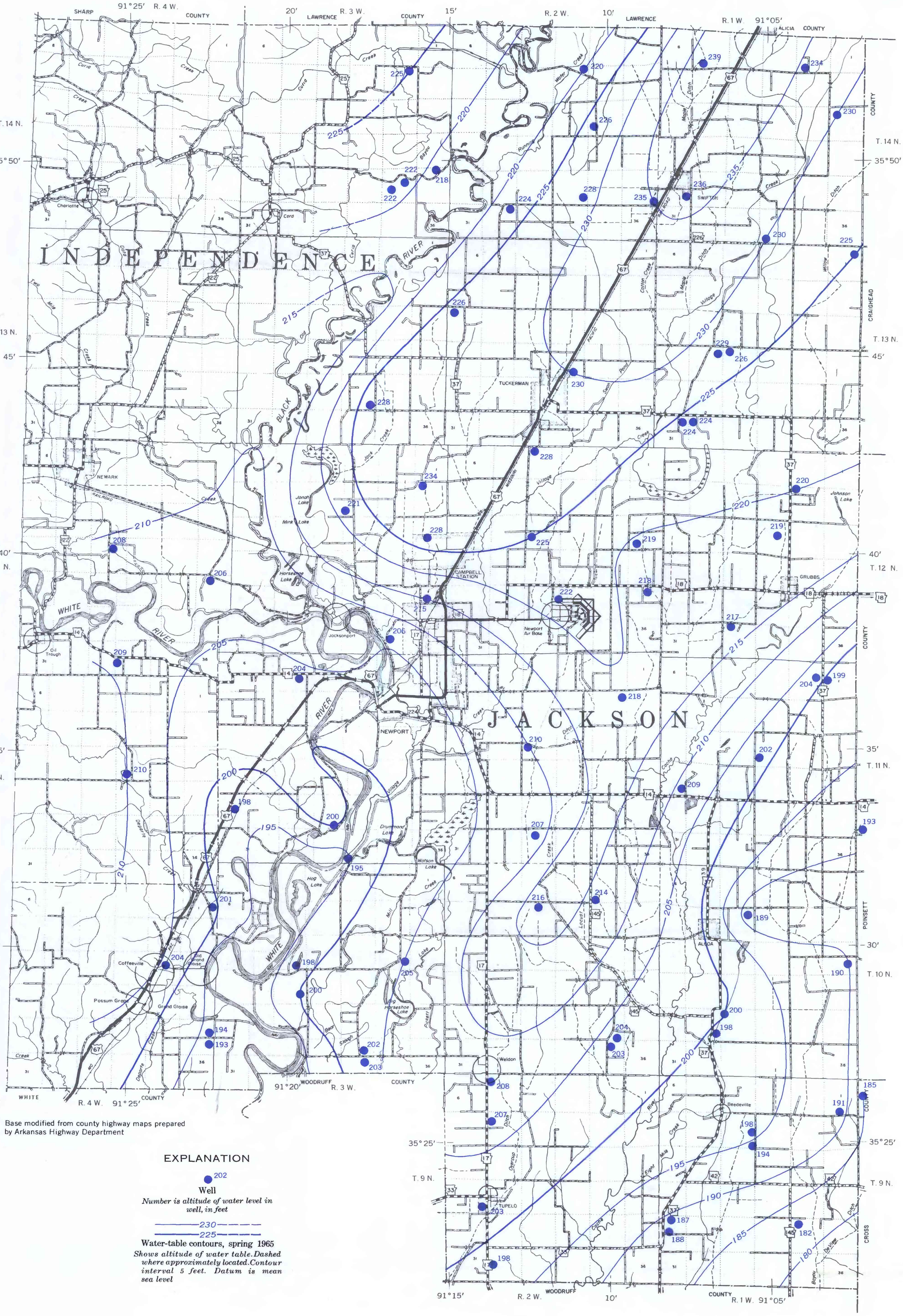
SCALE 1:125 000

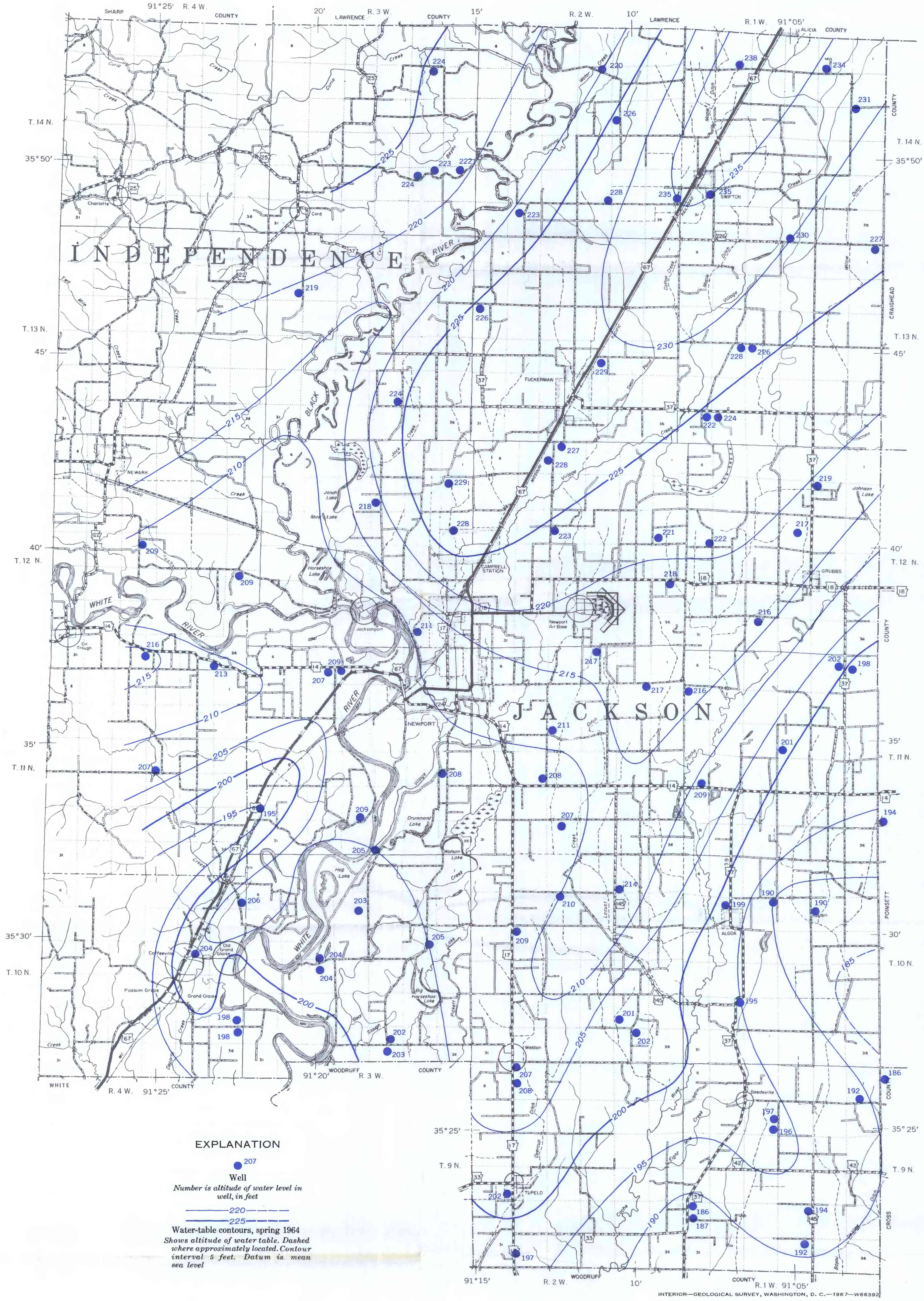
2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETERS

APPROXIMATE MEAN DECLINATION, 1967

PREPARED IN COOPERATION WITH THE
ARKANSAS GEOLOGICAL COMMISSION





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MAPS SHOWING WATER-TABLE CONTOURS IN QUATERNARY DEPOSITS, JACKSON AND PART OF INDEPENDENCE COUNTIES, ARKANSAS

APPROXIMATE MEAN DECLINATION, 1967

SCALE 1:125 000

2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETERS

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
ARKANSAS GEOLOGICAL COMMISSION

WATER-SUPPLY PAPER 1839-G
PLATE 3

MAP SHOWING APPROXIMATE AREA INUNDATED BY 10-YEAR AND 50-YEAR FLOODS AT BATESVILLE, ARKANSAS

SCALE 1:24 000

1 MILE

1 KILOMETER

APPROXIMATE MEAN DECLINATION, 1967