

# POTENTIOMETRIC SURFACE AND SPECIFIC CONDUCTANCE OF THE SPARTA AND MEMPHIS AQUIFERS IN EASTERN ARKANSAS, 1995

*by Gregory P. Stanton*

---

**U.S. GEOLOGICAL SURVEY  
Water-Resources Investigations Report 97-4119**

**Prepared in cooperation with the  
ARKANSAS GEOLOGICAL COMMISSION and the  
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION**

Little Rock, Arkansas  
1997



**U.S. DEPARTMENT OF THE INTERIOR**  
**BRUCE BABBITT, *Secretary***

**U.S. GEOLOGICAL SURVEY**  
**Gordon P. Eaton, *Director***

---

**For additional information  
write to:**

**District Chief  
U.S. Geological Survey, WRD  
401 Hardin Road  
Little Rock, Arkansas 72211**

**Copies of this report can be  
purchased from:**

**U.S. Geological Survey  
Branch of Information Services  
Box 25286  
Denver Federal Center  
Denver, Colorado 80225**

# CONTENTS

Abstract.....	1
Introduction .....	1
Description of Aquifers .....	2
Potentiometric-Surface Map.....	3
Long-Term Hydrographs .....	3
Specific Conductance Map .....	3
Summary.....	15
Selected References.....	16

## PLATES

Plate 1. Map showing potentiometric surface.....	In pocket
2. Map showing specific conductance .....	In pocket

## ILLUSTRATIONS

Figure 1. Map showing location of study area .....	2
2. Water-level hydrographs for selected wells completed in the Sparta and Memphis aquifers .....	8

## TABLES

Table 1. Information pertaining to measured wells completed in the Sparta and Memphis aquifers.....	4
2. Specific conductance measurements in wells completed in the Sparta and Memphis aquifers.....	12



# POTENTIOMETRIC SURFACE AND SPECIFIC CONDUCTANCE OF THE SPARTA AND MEMPHIS AQUIFERS IN EASTERN AND SOUTH-CENTRAL ARKANSAS, 1995

By Gregory P. Stanton

## ABSTRACT

The Sparta and Memphis aquifers in eastern and south-central Arkansas are a major source of water for industrial, public supply, and agricultural uses. An estimated 240 million gallons per day was withdrawn from the Sparta and Memphis aquifers in 1995, an increase of about 17 million gallons per day from 1990. During the spring and early summer of 1995, the water level in the Sparta and Memphis aquifers was measured in 145 wells, the specific conductance of 101 ground-water samples collected from those aquifers was measured. Maps of areal distribution of potentiometric surface and specific conductance generated from these data reveal spatial trends in these parameters across the eastern and south-central Arkansas study area. The altitude of the potentiometric surface ranged from about 206 feet below sea level in Union County to about 307 feet above sea level in Saline County.

The potentiometric surface of the Sparta and Memphis aquifers contains cones of depression descending below sea level in the central and southern portions of the study area, and a potentiometric high along the western study area boundary. Major recharge areas exhibit potentiometric highs greater than 200 feet above sea level and specific conductance values less than 200 microsiemens per centimeter, and generally are located in the outcrop/subcrop areas on the southern one-third of the western boundary and the northern portion of the study area. The regional direction of ground-water flow is from the north and west to the south and east, away from the outcrop and subcrop and northern regions, except near areas

affected by intense ground-water withdrawals; such areas are manifested by large cones of depression centered in Columbia, Jefferson, and Union Counties. The cones of depression in adjoining Columbia and Union Counties are coalescing at or near sea level. The lowest water level measured was about 206 feet below sea level in Union County. Increased specific conductance values were measured in the areas of the cones of depression in Columbia and Union Counties.

The cone of depression centered in Jefferson County coincides with an elongate area where ground water in the aquifer has low specific conductance. This area extends eastward from the outcrop/subcrop region of recharge. This extension of ground water with low specific conductance possibly indicates increased ground-water movement to the east-southeast from the outcrop/subcrop area induced by ground-water withdrawals in Jefferson County. Specific conductance increases markedly to the northeast and gradually to the south of this area.

Long-term hydrographs of eight wells in the study area, during the period 1970-1995, reveal water-level declines ranging from less than 0.5 foot per year in Phillips County to more than 2.0 feet per year in Union County. Water-level declines of greater than 1.5 feet per year generally are associated with the cones of depression centered in Columbia, Jefferson, and Union Counties.

## INTRODUCTION

The Sparta and Memphis aquifers are a major source of water for much of eastern and south-central Arkansas. Major withdrawals occur from the aquifers

for industrial and public supply, with lesser but locally significant withdrawals for agricultural uses. During 1995, an estimated 240 million gallons per day (Mgal/d) of water was withdrawn from the Sparta and Memphis aquifers, up from about 222.50 Mgal/d in 1990. The two aquifers are the second most productive source of ground water in Arkansas (Holland, 1993).

The study area (fig. 1) includes most of the Coastal Plain physiographic province in Arkansas. The area is bounded on the north by the Missouri State line, on the south by the Louisiana State line, and on the east by the Tennessee and Mississippi State lines. The western boundary is defined as the western extent of the outcrop and subcrop (Hosman, 1982) of the Sparta Sand and the Memphis Sand.

The U.S. Geological Survey (USGS) in cooperation with the Arkansas Geological Commission and the Arkansas Soil and Water Conservation Commission has monitored water levels in the Sparta and Memphis aquifers since 1928. During March through July 1995, 145 water-level measurements and 101 specific conductance measurements were made in wells completed in these aquifers. The purpose of these measurements was to provide information describing the potentiometric surface and specific conductance of ground water in the Sparta and Memphis aquifers. This

report presents results as maps and as updated water-level hydrographs.

## DESCRIPTION OF AQUIFERS

The Sparta Sand and Memphis Sand of Eocene age are part of the Claiborne Group and mainly consist of fine- to medium-grain sand. In the central and southern parts of the study area, the Sparta Sand is underlain by the marine clay of the Cane River Formation, which serves as a lower confining unit. In the northern part of the study area (north of about 35 degrees latitude), the Cane River Formation is predominantly composed of sand (Hosman and others, 1968), and the aquifer is thicker and more homogeneous. In this northern area, the Claiborne Group is not subdivided into the Sparta Sand, Cane River Formation, and Carrizo Sand, but the equivalent section is a single formation known as the "Memphis Sand." The Memphis Sand is underlain by a thick layer of clay that is part of the Wilcox Group. Some silt, clay, and lignite occur in the upper portion of the Sparta and Memphis Sands. Both the Sparta and Memphis Sand are overlain by the Cook Mountain Formation, which serves as an upper confining unit. The

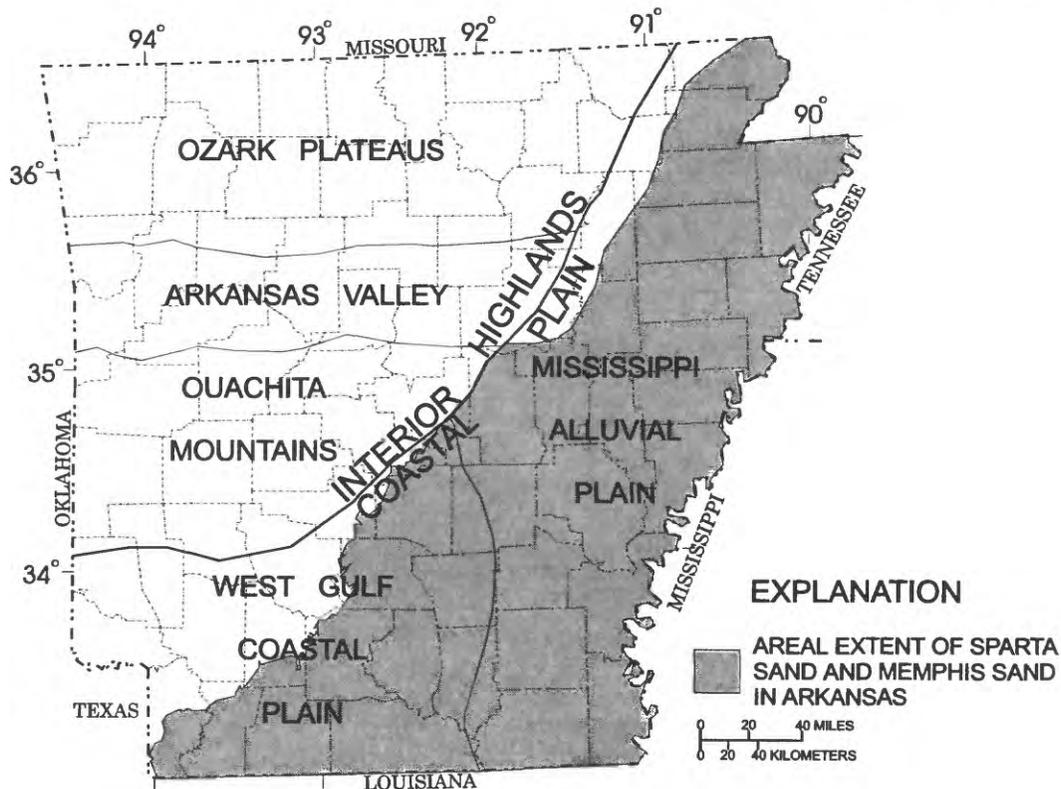


Figure 1. Location of study area.

permeable units of the Sparta Sand and the Memphis Sand comprise the respective aquifers. Water levels in the Sparta aquifer generally correlate with those in the Memphis aquifer; therefore, the water-bearing formations are considered to be one hydrologic unit.

Water in the Sparta and Memphis aquifers is generally confined except in the outcrop/subcrop areas (plate 1). Recharge to the aquifers chiefly occurs from infiltration of precipitation on the outcrop areas and from downward movement of water from the overlying alluvium in subcrop areas (Petersen and others, 1985). Minor amounts of recharge probably also occur from leakage of water through the upper and lower confining beds where a positive gradient exists between overlying or underlying aquifers and the Sparta or Memphis aquifer (Edds and Fitzpatrick, 1989). Lateral flow occurs from the Memphis Sand south to the Sparta Sand at the zone of lithofacies transition (plate 1) near 35° latitude (Petersen and others, 1985). Discharge from the Sparta and Memphis aquifers occurs by withdrawal from wells, discharge to confining beds above or below, and subsurface flow to the south. A more detailed description of the Sparta and Memphis aquifers is given in Hosman and others (1968) and Petersen and others (1985).

## POTENTIOMETRIC-SURFACE MAP

The potentiometric-surface map shows the altitude to which water would have risen in tightly cased wells screened in the aquifers (plate 1). The map is based on 145 water-level measurements made during March through July 1995 (table 1). The surface is mapped by determining the altitude of the water levels measured in the wells and is represented on the map by contours that connect points of equal value. The general direction of ground-water flow in the Sparta and Memphis aquifers is perpendicular to the contours in the direction of downward hydraulic gradient.

The highest water-level altitude measured was about 307 feet (ft) above sea level, located in Saline County near the edge of the outcrop/subcrop region. The regional direction of ground-water flow is generally to the south to southwest in the northern half of the study area and to the east and south in the southern half, away from the outcrop and subcrop region except where affected by intense ground-water withdrawals. Three cones of depression centered in Columbia, Jefferson, and Union Counties are a result of large withdrawals of water for industrial and public supplies. The cone of depression centered in Jefferson County has an

elliptical shape because of withdrawals for irrigation in Arkansas and Prairie Counties. The cones of depression in Columbia and Union Counties are elongate to the southeast and northwest, respectively, and coalesce at or near sea level. The lowest point measured was about 206 ft below sea level in central Union County.

## LONG-TERM HYDROGRAPHS

Twenty-five years of water-level data from each of eight selected wells completed in the Sparta and Memphis aquifers were plotted as hydrographs to illustrate the history of water-levels in Arkansas, Bradley, Columbia, Desha, Jefferson, Phillips, Poinsett, and Union Counties (fig. 2). Water levels have declined during the period of 1970 to 1995, generally more than 2 feet per year (ft/yr) in Union County; between 1.5 - 2.0 ft/yr in Arkansas, Columbia, Desha, and Jefferson Counties; between 1.0 and 1.5 ft/yr in Bradley and Poinsett Counties; and less than 0.5 ft/yr in Phillips County. Water-level declines of greater than 1.5 ft/yr generally are associated with the cones of depression centered in Columbia, Jefferson, and Union Counties. The hydrograph in Phillips County, indicating draw-down of less than 0.5 ft/yr, is from a well in an area unaffected by a cone of depression.

## SPECIFIC CONDUCTANCE MAP

The specific conductance of water is proportional to the concentration of dissolved solids in solution. In ground-water samples collected from wells in Union County (Broom and others, 1984), total dissolved solids (in milligrams per liter) averaged about 60 percent of the specific conductance value in microsiemens per centimeter. The specific conductance map (plate 2) shows lines of equal specific electrical conductance of ground water in the Sparta and Memphis aquifers in microsiemens per centimeter at 25 degrees Celsius ( $\mu\text{S}/\text{cm}$ ). The map is based on 101 specific conductance measurements made during the period April through July 1995 from wells that are open to only the Sparta or Memphis aquifers (table 2). Wells were pumped until temperature stabilized before a specific conductance sample was collected.

**Table 1.** Information pertaining to measured wells completed in the Sparta and Memphis aquifers

Latitude	Longitude	Local well number	Water level altitude (feet above sea level)	Depth to water level (feet below land-surface datum)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
<b>Arkansas County</b>							
340116	911131	08S02W01CBA1	88	77.26	165	4/26/95	Sparta
340124	912039	08S03WT2307	84	92.07	176	4/25/95	Sparta
340135	912152	08S03WT2299	77	98.39	175	4/25/95	Sparta
340340	911410	07S02W28ABA1	92	89.22	181	4/26/95	Sparta
340711	912248	07S03W06ABC1	71	114.00	185	4/25/95	Sparta
341228	911622	06S02W06ABB1	77	103.93	181	4/25/95	Sparta
341247	912946	05S05W36DAA1	55	124.89	180	4/25/95	Sparta
341734	912006	05S03W04ADB1	65	122.34	187	4/25/95	Sparta
341752	913004	04S05W36DCC1	51	145.06	196	5/01/95	Sparta
341929	910739	04S01W28BAA1	93	96.66	190	4/27/95	Sparta
342004	912514	04S04W22DAA1	61	134.39	195	5/02/95	Sparta
342005	912926	04S04W19CBB1	53	141.73	195	5/01/95	Sparta
342155	912503	04S04W11BCC1	54	144.20	198	5/01/95	Sparta
342416	912437	03S04W26CDA1	62	141.44	203	5/01/95	Sparta
342416	912645	03S04W33BAA1	58	142.85	201	5/01/95	Sparta
342515	914210	03S06W30BBD1	50	141.34	191	5/02/95	Sparta
342554	913925	03S06W21ACC1	55	139.95	195	5/02/95	Sparta
342632	913005	03S05W13BDC1	45	165.50	210	4/28/95	Sparta
342633	913523	03S05W18CAB1	52	143.82	196	5/02/95	Sparta
342747	912457	03S04W02CCB1	67	134.90	202	4/28/95	Sparta
342839	913032	03S05W02AAB1	54	155.71	210	4/28/95	Sparta
342924	912700	02S04W33BBB1	64	141.22	205	4/29/95	Sparta
343044	912349	02S04W23DAA1	90	117.81	208	4/28/95	Sparta
343312	912849	02S04W06CDB1	69	142.96	212	4/28/95	Sparta
<b>Ashley County</b>							
332117	915103	15S07W32CDD1	38	152.37	190	4/18/95	Sparta
<b>Bradley County</b>							
331836	922052	16S12W21CAA1	29	70.57	100	4/19/95	Sparta
333453	921607	13S11W17BCD1	57	192.51	250	4/19/95	Sparta
<b>Calhoun County</b>							
333040	922403	14S13W12CCB1	38	166.79	205	4/26/95	Sparta
333226	922741	13S13W32CDA1	35	172.82	208	4/26/95	Sparta
<b>Cleveland County</b>							
334543	921422	11S11W16AAB1	94	208.53	303	4/20/95	Sparta
334917	920019	10S09W23CDC1	58	162.19	220	6/16/95	Sparta
335133	921749	10S12W12BDD1	108	112.00	220	4/20/95	Sparta
335728	921133	09S11W01DCA1	45	184.81	230	4/20/95	Sparta
335729	921120	09S11W01DDA2	61	204.79	266	4/20/95	Sparta
<b>Columbia County</b>							
330517	931725	19S21W16DBB1	110	174.42	284	5/24/95	Sparta
330555	931128	19S20W09CAC1	74	257.97	332	5/25/95	Sparta
330557	931146	19S20W08DAD1	71	248.77	320	5/24/95	Sparta

**Table 1.** Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

Latitude	Longitude	Local well number	Water level altitude (feet above sea level)	Depth to water level (feet below land-surface datum)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
330609	932743	19S23W11CDA2	193	55.11	248	5/24/95	Sparta
331142	931248	18S20W06DDC1	-17	317.38	300	5/24/95	Sparta
331406	930650	17S19W30ABB1	31	217.50	248	5/31/95	Sparta
331519	931159	17S20W17CDA1	9	316.12	325	5/30/95	Sparta
331537	930328	17S19W15ABD1	50	274.98	325	5/31/95	Sparta
331609	931449	17S21W11DCC2	-20	323.09	303	6/02/95	Sparta
331753	931513	16S21W35CCD1	-23	297.66	275	6/02/95	Sparta
331948	932222	16S22W22CCD1	205	134.78	340	5/25/95	Sparta
332049	931516	16S21W14CBB1	64	217.01	281	5/25/95	Sparta
332052	931237	16S20W18ACD1	55	282.16	337	5/25/95	Sparta
332453	931215	15S20W20CCB1	155	216.84	372	6/02/95	Sparta
<b>Craighead County</b>							
354641	904114	13N04E05DCC1	205	135.35	340	3/22/95	Memphis
354836	903953	14N04E28DBD1	197	56.62	254	6/22/95	Memphis
354929	903922	14N04E22CBD1	204	51.53	256	6/22/95	Memphis
<b>Crittenden County</b>							
350344	901300	05N08E11CCA2	188	22.96	211	3/22/95	Memphis
350958	901738	06N07E01DAD2	188	20.60	209	3/22/95	Memphis
<b>Cross County</b>							
351018	904231	06N04E06ACA1	162	196.26	358	3/22/95	Memphis
351537	903329	07N05E04ADD1	177	32.27	209	3/21/95	Memphis
352231	904215	09N04E30DCA1	174	254.85	429	3/21/95	Memphis
352359	904514	09N03E22AAD1	160	118.14	278	3/23/95	Memphis
352403	905949	09N01E16CAC1	158	76.40	234	3/23/95	Memphis
<b>Dallas County</b>							
334832	922455	10S13W34ACA2	126	145.59	272	4/24/95	Sparta
335304	922413	09S13W35CCD1	133	66.67	200	4/24/95	Sparta
335935	924307	08S16W27DDD1	240	31.64	272	4/24/95	Sparta
<b>Desha County</b>							
333636	912304	12S03W34DAD1	69	78.19	147	5/03/95	Sparta
334223	911421	11S01W31BBB1	50	90.93	141	5/03/95	Sparta
334605	911705	11S02W03CCA1	82	56.72	139	5/03/95	Sparta
334748	911618	10S02W26CCC2	84	64.35	148	5/09/95	Sparta
335304	913005	09S04W28DDD1SP	58	107.31	165	5/09/95	Sparta
335341	911522	09S02W26AAC1	87	66.42	153	5/09/95	Sparta
<b>Drew County</b>							
332418	912726	15S04W12DDA1	69	56.15	125	4/19/95	Sparta
333154	913404	13S05W36ACB1	81	88.13	169	4/19/95	Sparta
333649	914400	12S06W32DAD1	53	158.77	212	4/19/95	Sparta
334248	912708	11S04W25DAA1	69	78.69	148	4/19/95	Sparta
<b>Grant County</b>							
341024	923545	06S15W26ACA1	213	66.53	280	4/24/95	Sparta
341341	921414	06S11W05ACA1	83	196.79	280	4/21/95	Sparta
341841	923320	05S14W06DCC1	205	87.93	293	4/24/95	Sparta
341845	922359	05S13W03DBC1	161	98.61	260	4/21/95	Sparta

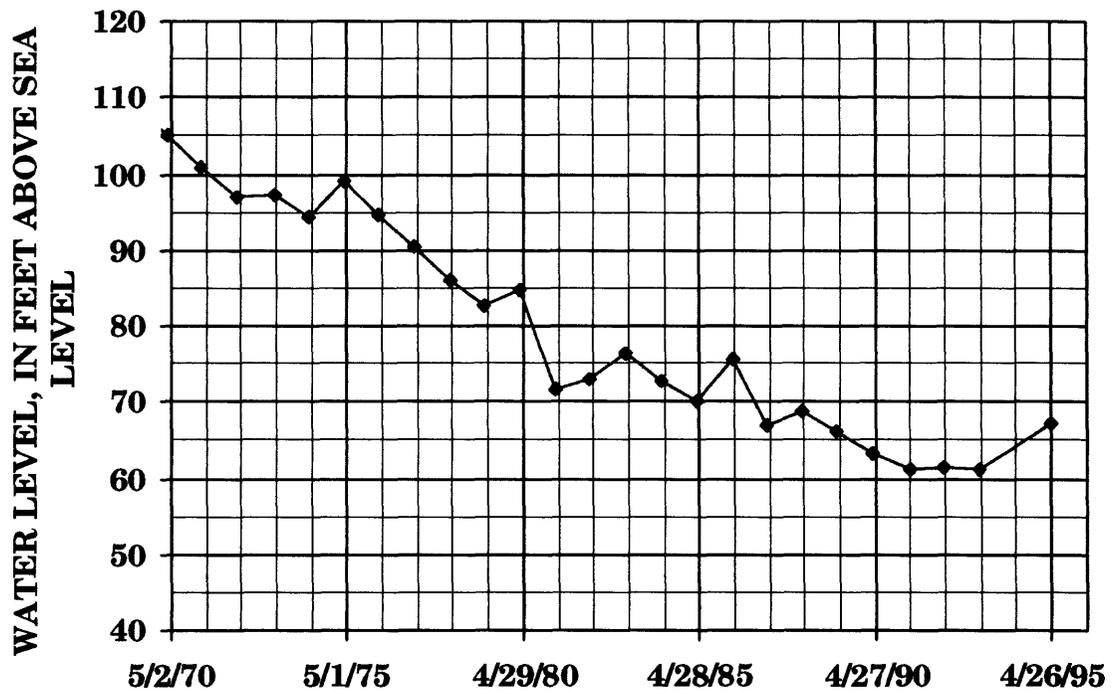
**Table 1.** Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

Latitude	Longitude	Local well number	Water level altitude (feet above sea level)	Depth to water level (feet below land-surface datum)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
342445	922845	03S14W35DCA1	251	68.81	320	4/21/95	Sparta
342846	922106	03S13W12AAA1	234	126.51	361	4/24/95	Sparta
<b>Jefferson County</b>							
340401	915917	07S09W35CCB1	35	234.76	270	5/17/95	Sparta
340547	920420	07S10W24CAC1	35	276.38	311	5/17/95	Sparta
340631	914520	07S07W24BAB1	36	152.27	188	5/18/95	Sparta
340947	914040	06S06W20CAA1	42	151.48	193	5/18/95	Sparta
341026	915116	06S08W25ADC1	-4	207.52	203	5/16/95	Sparta
341117	920504	06S10W23ACD1	3	228.82	232	5/17/95	Sparta
341138	915516	06S08W16CCC1	-38	240.07	202	5/16/95	Sparta
341249	915355	06S08W10CAC1	-42	244.45	203	5/16/95	Sparta
341427	915652	05S09W35AAB1	-68	272.62	205	5/23/95	Sparta
341446	915526	05S08W30CBA1	-71	278.17	207	5/16/95	Sparta
342107	920440	04S10W22BDD1	57	187.18	244	5/23/95	Sparta
342140	914741	04S07W17BCC1	40	160.48	200	5/18/95	Sparta
342627	915502	03S08W19BBD1	61	153.84	215	5/18/95	Sparta
342644	921055	03S11W22ABC1	144	166.42	310	5/16/95	Sparta
<b>Lafayette County</b>							
330223	933033	20S23W05ADB1	204	38.42	242	4/25/95	Sparta
330546	933916	19S25W13CAB1	221	33.54	255	4/25/95	Sparta
330911	933038	18S23W29ACC1	242	13.38	255	4/25/95	Sparta
332026	933728	16S24W19DBC1	216	48.78	265	4/25/95	Sparta
<b>Lincoln County</b>							
335229	913758	10S05W05ADB1	60	110.86	171	5/03/95	Sparta
335907	913333	08S05W35ACC1	59	105.63	165	5/09/95	Sparta
340345	913446	08S05W03BAA2	53	127.30	180	5/09/95	Sparta
340444	915042	07S07W30CDC1	42	165.87	208	5/02/95	Sparta
<b>Lonoke County</b>							
343227	915227	02S08W16BDA1	107	109.21	216	5/02/95	Sparta
344425	914503	01N07W03BCC1	108	115.30	223	4/27/95	Sparta
344536	915703	02N09W35BBC1	156	78.34	234	5/02/95	Sparta
344652	914419	02N07W22DBA1	111	115.71	227	4/27/95	Sparta
<b>Monroe County</b>							
344145	911756	01N03W14CCB1	114	57.58	172	6/07/95	Sparta
345313	911014	03N02W12CBC1	158	28.00	186	6/09/95	Sparta
345535	911221	04N02W28DDD4	165	26.93	192	6/09/95	Sparta
<b>Nevada County</b>							
332818	931740	14S21W32DCC1	258	111.81	370	4/25/95	Sparta
333324	930708	13S20W36DCC1	244	105.98	350	4/25/95	Sparta
<b>Ouachita County</b>							
332618	930318	15S19W10DCC1	140	69.93	210	4/27/95	Sparta
332942	930513	14S19W29ABB1	195	84.89	280	4/27/95	Sparta
333234	925252	14S17W05CAD1	121	35.69	157	4/27/95	Sparta
334018	925948	12S18W19CDC1	203	32.28	235	4/27/95	Sparta

**Table 1.** Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

Latitude	Longitude	Local well number	Water level altitude (feet above sea level)	Depth to water level (feet below land-surface datum)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
334342	924835	11S17W36CCA1	128	5.29	133	4/26/95	Sparta
<b>Phillips County</b>							
341822	905124	04S02E25CCC1	129	36.57	166	6/08/95	Sparta
342403	904914	03S03E30DAA1	138	33.76	172	6/08/95	Sparta
342856	903636	02S05E29CCC1	157	21.80	179	6/08/95	Sparta
343110	903525	02S05E16BCB1	156	33.70	190	6/08/95	Sparta
343242	903902	02S04E02DBA1	132	118.04	250	6/08/95	Sparta
343324	905446	01S02E32DDC1	139	72.21	211	6/09/95	Sparta
<b>Poinsett County</b>							
352930	905825	10N01E15DBB1	148	84.02	232	3/21/95	Memphis
353225	904316	11N03E25ACC1	162	111.37	273	6/20/95	Memphis
<b>Prairie County</b>							
343748	913654	01S06W11DBD1	83	142.97	226	4/27/95	Sparta
344113	913504	01N05W19CDC1	92	119.74	212	4/27/95	Sparta
344644	913828	02N06W21DAD1	123	109.18	232	4/27/95	Sparta
344649	912801	02N04W19ACB1	127	83.91	211	4/27/95	Sparta
344653	913800	02N06W22BDD1	120	112.98	233	4/27/95	Sparta
<b>Saline County</b>							
342904	923222	03S14W05CCC1	307	8.45	315	4/21/95	Sparta
<b>Union County</b>							
330110	924321	19S16W35DDC1	-45	219.77	175	6/29/95	Sparta
330631	923708	18S15W35DAC1	-106	306.73	201	7/06/95	Sparta
330652	922119	18S12W33BBB1	-11	122.58	112	4/20/95	Sparta
330657	923859	18S15W33ADA1	-108	361.02	253	7/06/95	Sparta
330807	924613	18S16W28BBB1	-125	350.44	225	6/29/95	Sparta
331006	921443	18S11W09ABC1	47	88.35	135	4/20/95	Sparta
331011	924317	18S16W11DAB1	-157	426.59	270	6/30/95	Sparta
331024	924229	18S16W12ACB1	-182	485.23	303	6/29/95	Sparta
331042	924021	18S15W08ABB1	-174	379.34	205	7/06/95	Sparta
331142	924118	17S15W31DCA1	-201	472.58	272	6/29/95	Sparta
331203	922218	17S12W32BBC1	-5	235.26	230	4/20/95	Sparta
331205	922916	17S13W31BAC1	-66	281.59	216	7/07/95	Sparta
331228	924038	17S15W29CDC1	-206	425.57	220	7/06/95	Sparta
331300	925356	17S17W30DCD1	-24	304.38	280	7/05/95	Sparta
331900	923956	16S15W20DAA1	-77	266.79	190	6/28/95	Sparta
331944	923217	16S14W15CAB1	-56	149.66	94	6/27/95	Sparta
332205	924330	16S16W02ABC1	-56	172.35	116	6/28/95	Sparta
<b>Woodruff County</b>							
350026	911454	05N02W31DCB3	181	11.70	193	6/07/95	Memphis

### A. ARKANSAS COUNTY 03S04W02CCB1



### B. BRADLEY COUNTY 16S20W18CAA1

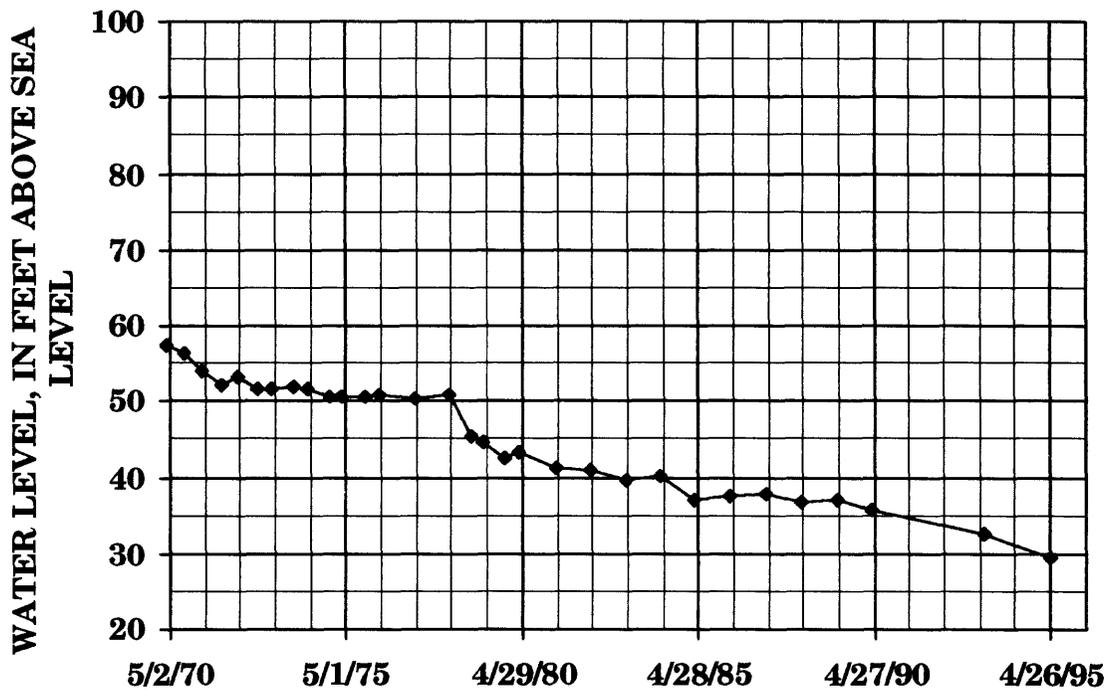
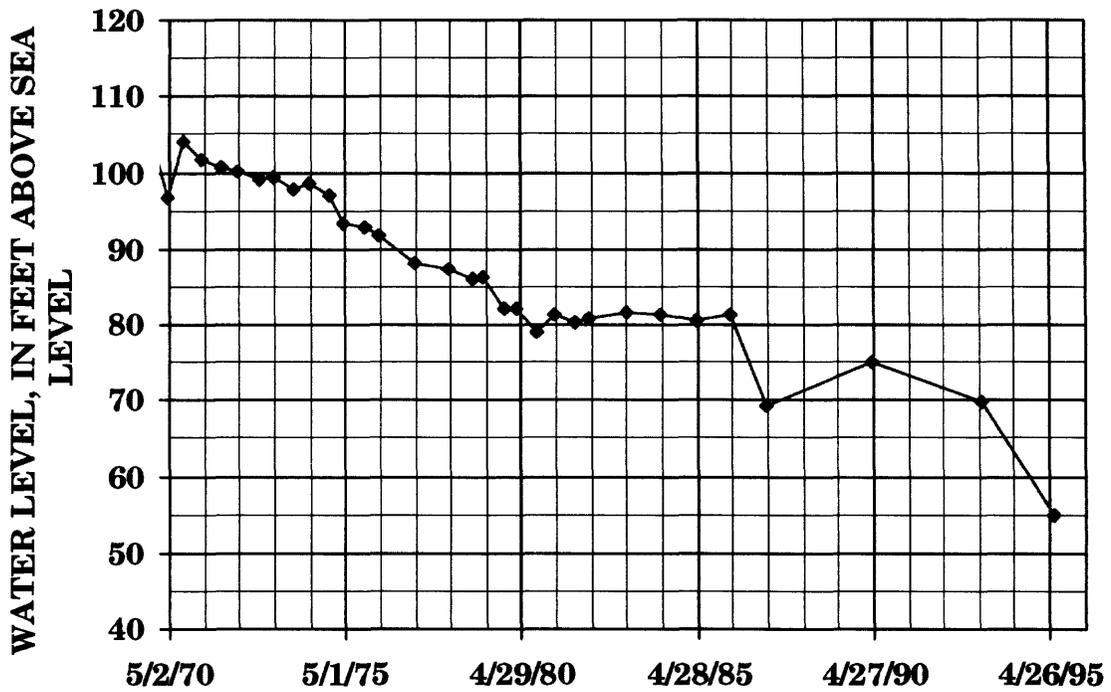


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 1 of 4).

### C. COLUMBIA COUNTY 16S20W18ACD1



### D. DESHA COUNTY 09S04W28DDD1SP

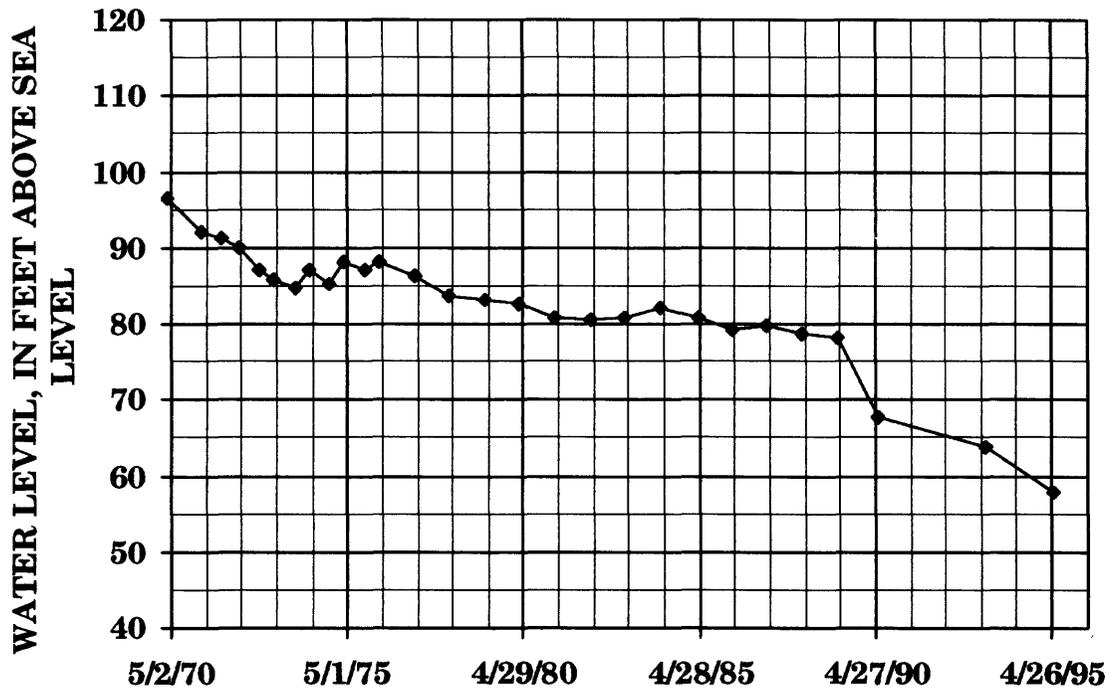
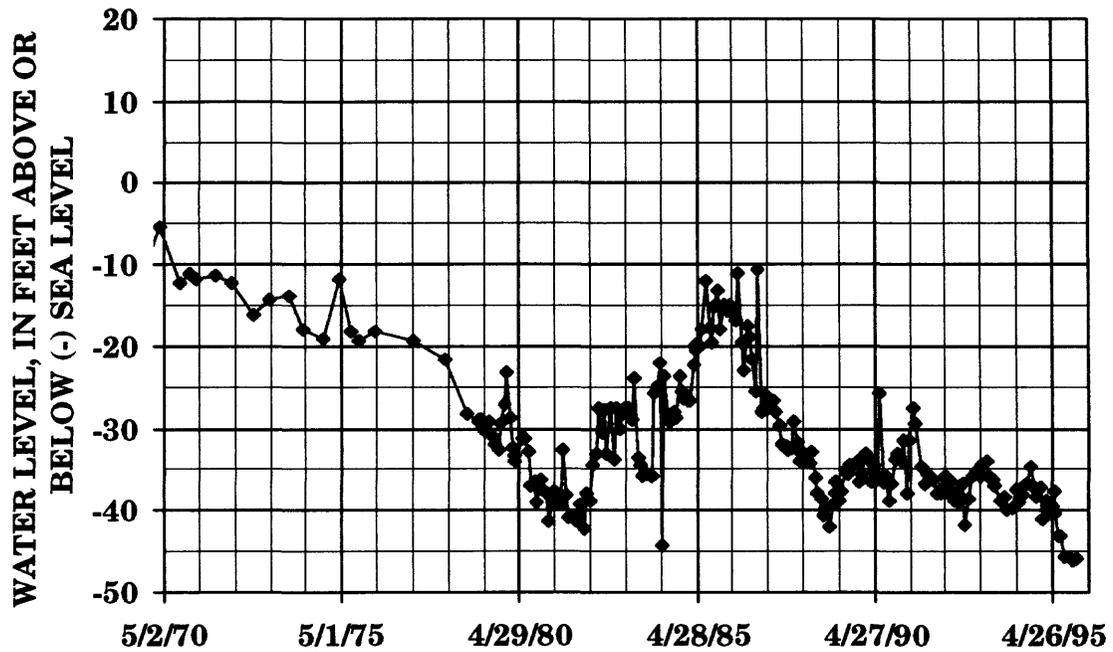


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 2 of 4).

### E. JEFFERSON COUNTY 06S08W16CCC1



### F. PHILLIPS COUNTY 01S02E32DDC1

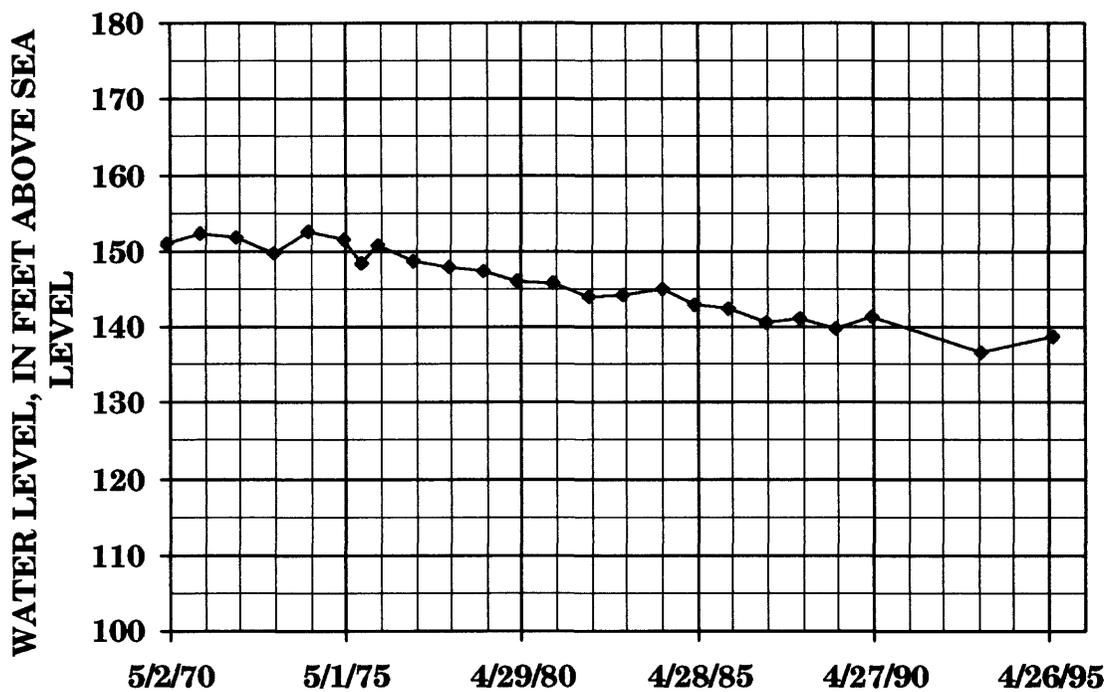
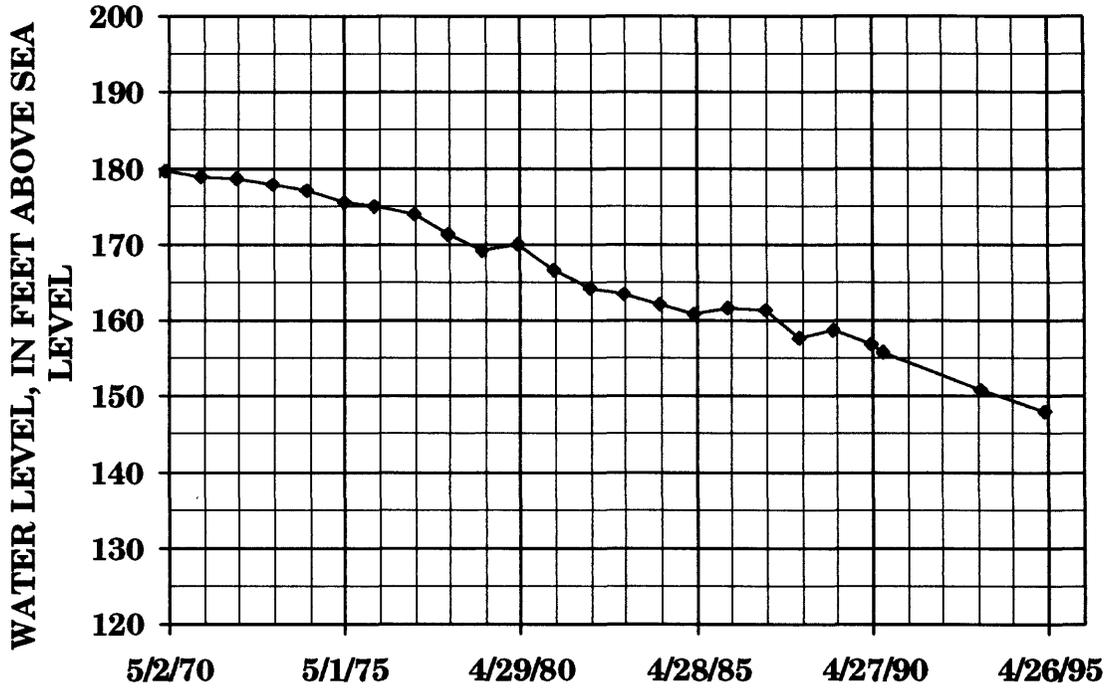


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 3 of 4).

### G. POINSETT COUNTY 10N01E15DBB1



### H. UNION COUNTY 17S15W31DCA1

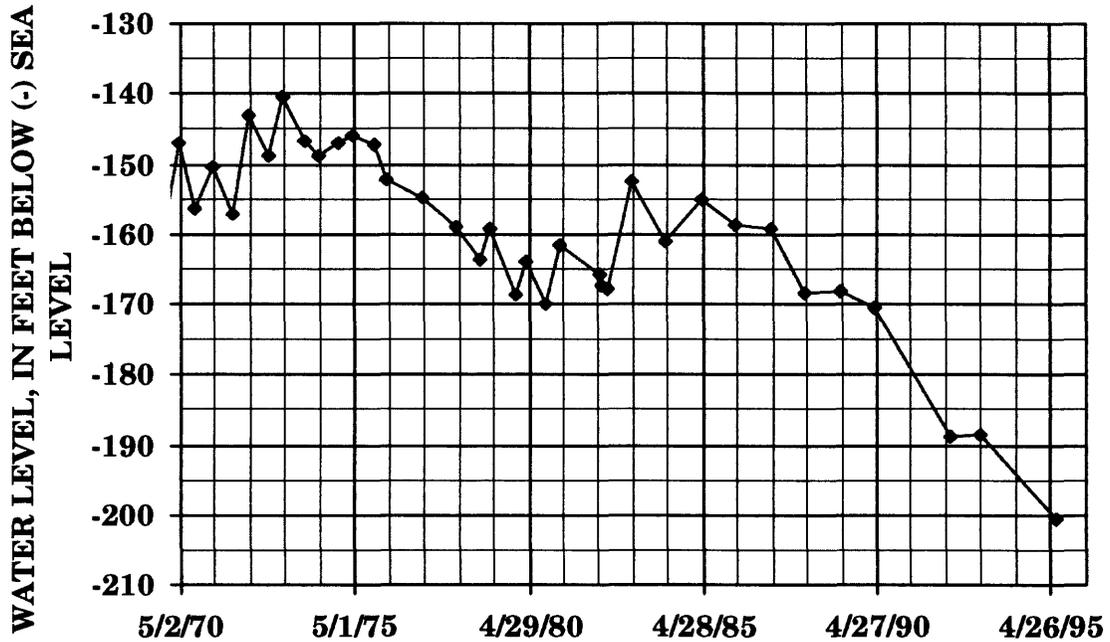


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 4 of 4).

**Table 2.** Specific conductance measurements in wells completed in the Sparta and Memphis aquifers[--, no data;  $\mu\text{S/cm}$ , microsiemens per centimeter at 25 degrees Celsius]

Latitude	Longitude	Specific conductance ( $\mu\text{S/cm}$ )	Well depth (feet)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
<b>Arkansas County</b>						
340135	912152	236	654	175	4/26/95	Sparta
340340	911410	294	690	181	6/22/95	Sparta
340711	912248	195	720	185	4/25/95	Sparta
341734	912006	395	802	187	4/25/95	Sparta
341752	913004	207	880	196	6/21/95	Sparta
342004	912514	352	800	195	6/21/95	Sparta
342005	912926	307	1,048	195	6/21/95	Sparta
342155	912503	409	836	198	6/21/95	Sparta
342321	912955	328	929	196	6/21/95	Sparta
342416	912437	440	666	203	5/01/95	Sparta
342515	914210	347	870	191	5/02/95	Sparta
342632	913005	353	910	210	6/21/95	Sparta
342633	913523	358	819	196	6/20/95	Sparta
342740	913050	398	--	--	6/29/95	Sparta
342829	912632	434	746	202	6/22/95	Sparta
342839	913032	439	801	210	6/21/95	Sparta
343018	912350	486	795	205	6/21/95	Sparta
343028	913230	503	818	210	6/29/95	Sparta
343041	912354	1,080	840	--	6/20/95	Sparta
343312	912849	452	840	212	6/20/95	Sparta
<b>Ashley County</b>						
332117	915103	879	1,000	190	4/19/95	Sparta
<b>Bradley County</b>						
331836	922052	651	457	100	4/19/95	Sparta
<b>Calhoun County</b>						
334633	922928	219	650	310	4/26/95	Sparta
<b>Cleveland County</b>						
334543	921422	374	815	303	4/20/95	Sparta
335728	921133	279	558	230	4/20/95	Sparta
335729	921120	282	550	266	4/20/95	Sparta
<b>Columbia County</b>						
330555	931128	234	623	332	5/24/95	Sparta
330609	932743	343	385	248	5/24/95	Sparta
331142	931248	313	502	300	5/24/95	Sparta
331518	930657	448	--	315	7/28/95	Sparta
331519	931159	395	495	325	6/01/95	Sparta
331533	930803	419	--	340	7/28/95	Sparta
331537	930328	447	516	325	5/31/95	Sparta
331537	930538	459	--	305	7/28/95	Sparta
<b>Craighead County</b>						
354929	903922	144	240	256	6/22/95	Memphis

**Table 2.** Specific conductance measurements in wells completed in the Sparta and Memphis aquifers (Continued)[--, no data;  $\mu\text{S}/\text{cm}$ , microsiemens per centimeter at 25 degrees Celsius]

Latitude	Longitude	Specific conductance ( $\mu\text{S}/\text{cm}$ )	Well depth (feet)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
<b>Cross County</b>						
352231	904215	530	1,148	429	6/21/95	Memphis
352359	904514	370	367	278	6/21/95	Memphis
352403	905949	529	400	234	6/20/95	Memphis
<b>Desha County</b>						
333624	911242	325	520	136	5/03/95	Sparta
333636	912304	335	796	147	5/03/95	Sparta
334223	911421	263	753	141	5/03/95	Sparta
335341	911522	260	626	153	5/09/95	Sparta
<b>Drew County</b>						
332539	913044	722	980	125	4/19/95	Sparta
333154	913404	324	692	169	4/19/95	Sparta
333534	914852	302	830	265	4/20/95	Sparta
334248	912708	318	622	148	4/19/95	Sparta
<b>Grant County</b>						
341024	923545	47	172	280	4/24/95	Sparta
341341	921414	126	1,081	280	4/21/95	Sparta
341839	922402	69	539	281	4/21/95	Sparta
341841	923320	92	370	293	4/24/95	Sparta
<b>Jefferson County</b>						
341117	920504	168	--	232	5/17/95	Sparta
341447	915606	158	--	--	5/02/95	Sparta
341453	915441	165	753	221	5/18/95	Sparta
342140	914741	147	756	200	5/19/95	Sparta
342218	920957	85	854	400	5/16/95	Sparta
342432	920617	155	520	226	5/23/95	Sparta
342627	915502	262	789	215	5/19/95	Sparta
342649	921056	101	--	--	5/16/95	Sparta
<b>Lafayette County</b>						
330223	933033	280	231	242	4/25/95	Sparta
<b>Lincoln County</b>						
335229	913758	274	693	171	5/03/95	Sparta
335631	915121	207	1,052	300	5/02/95	Sparta
340444	915042	210	1,350	208	5/02/95	Sparta
<b>Lonoke County</b>						
343227	915227	594	542	216	5/02/95	Sparta
344606	915442	403	255	243	6/19/95	Sparta
345624	915837	42	--	--	5/02/95	Sparta
<b>Ouachita County</b>						
332618	930318	194	375	210	4/27/95	Sparta
333252	924926	640	278	120	4/27/95	Sparta
<b>Phillips County</b>						
341822	905124	1,230	930	166	6/08/95	Sparta
343324	905446	857	689	211	6/09/95	Sparta

**Table 2.** Specific conductance measurements in wells completed in the Sparta and Memphis aquifers (Continued)[--, no data;  $\mu\text{S}/\text{cm}$ , microsiemens per centimeter at 25 degrees Celsius]

Latitude	Longitude	Specific conductance ( $\mu\text{S}/\text{cm}$ )	Well depth (feet)	Land-surface datum altitude (feet above sea level)	Date of measurement	Aquifer
<b>Poinsett County</b>						
352930	905825	533	302	232	6/20/95	Memphis
353225	904316	528	250	273	6/20/95	Memphis
<b>Prairie County</b>						
343705	913317	689	606	215	6/22/95	Sparta
343748	913654	675	618	226	6/20/95	Sparta
343902	913531	707	616	220	6/20/95	Sparta
344113	913504	586	522	212	6/20/95	Sparta
344644	913828	505	314	232	6/20/95	Sparta
344653	913800	572	451	233	6/20/95	Sparta
344708	914033	371	--	--	6/20/95	Sparta
345554	913347	303	300	208	6/23/95	Sparta
<b>Union County</b>						
330057	924327	406	529	185	6/29/95	Sparta
330059	924306	406	--	--	6/29/95	Sparta
330219	921112	1,150	529	135	7/06/95	Sparta
330531	923642	325	318	182	7/07/95	Sparta
330607	922121	514	290	135	7/07/95	Sparta
330631	923708	729	685	201	7/06/95	Sparta
330657	923859	654	752	253	7/06/95	Sparta
330807	924613	547	636	225	6/29/95	Sparta
330809	924611	547	--	--	6/29/95	Sparta
330918	924207	572	--	310	6/29/95	Sparta
331011	924317	533	767	270	6/30/95	Sparta
331024	924229	571	797	303	6/29/95	Sparta
331203	922218	808	822	230	4/20/95	Sparta
331205	922219	812	--	--	4/20/95	Sparta
331205	922916	686	772	216	7/07/95	Sparta
331237	923921	455	754	285	7/06/95	Sparta
331300	925356	331	690	280	7/05/95	Sparta
331351	925727	331	--	--	7/05/95	Sparta
331805	925709	340	465	248	7/05/95	Sparta
331900	923956	505	603	190	6/28/95	Sparta
331944	923217	591	466	94	6/27/95	Sparta
332206	924324	418	--	--	6/28/95	Sparta

Specific conductance data indicate regionally diverse zones of mineralization within the aquifers across the study area. Specific conductance ranged from 47  $\mu\text{S}/\text{cm}$  in Grant County to 1,230  $\mu\text{S}/\text{cm}$  in Phillips County. Along the western border of the southern two-thirds of the study area (near the outcrop/subcrop region) ground water in the Sparta aquifer has low specific conductance indicating low dissolved solids. This is indicative of a recharge area. These data are consistent with interpretation of the potentiometric map, which indicates water-level highs and recharge areas near the western edge of the study area. An area where the ground water has low specific conductance extends from the central portion of the western edge of the study area across Jefferson County. This feature may result from the large ground-water withdrawals and resulting cone of depression centered in Jefferson County, producing movement of less mineralized water from the recharge area toward the east-southeast. Specific conductance increases markedly to the northeast and gradually to the south of Jefferson County. This gradual increase of specific conductance to the south continues to the Louisiana State line with a greater increase apparently corresponding to the cones of depression in Union and Columbia Counties. A possible explanation for this increase in specific conductance is leakage of water with greater conductance from an underlying aquifer. A previous study (Broom and others, 1984) documented specific conductance values greater than 2,000  $\mu\text{S}/\text{cm}$  for ground water from the Sparta aquifer in Union County in 1984.

Elevated levels of specific conductance also occur in Phillips and Arkansas Counties where values increase to greater than 1,000  $\mu\text{S}/\text{cm}$ . "Historic" data recorded anomalous highs in specific conductance ranging from 1,500 to 4,000  $\mu\text{S}/\text{cm}$  near Brinkley, Arkansas, in Monroe County (Morris and Bush, 1986). Morris and Bush (1986) cited leakage of saltwater from the Nacatoch aquifer into the Sparta aquifer via a fault or abandoned oil and gas wells as possible explanations for these anomalies.

## SUMMARY

During the period of March through July 1995, 145 water-level measurements and 101 specific-conductance measurements were made by the U.S. Geological Survey in cooperation with the Arkansas Geological Commission and the Arkansas Soil and Water Conservation Commission in wells completed in the Sparta and Memphis aquifers in Arkansas. Potenti-

ometric-surface and specific-conductance maps generated from these data reveal spatial trends of these parameters across the study area. An estimated 240 Mgal/d was withdrawn from the Sparta and Memphis aquifers in 1995, an increase of about 17 Mgal/d from 1990.

Spatial trends in the potentiometric surface reflect the distribution of recharge and pumpage in the aquifer. A linearly trending potentiometric high along the western study area boundary coincides with a major recharge area. These areas exhibit potentiometric highs greater than 200 ft above sea level and specific conductance values less than 200  $\mu\text{S}/\text{cm}$ , and generally are located in the outcrop/subcrop areas on the southern one-third of the western boundary and the northern portion of the study area. The regional direction of ground-water flow is from the north and west towards the south and east, away from the outcrop and subcrop and northern regions except where affected by intense ground-water withdrawals in the central and southern portions of the study area; such areas are manifested by large cones of depression centered in Columbia, Jefferson, and Union Counties descending below sea level. The lowest water level measured was about 206 ft below sea level in Union County. Increased specific conductance values in Columbia and Union Counties coincide with cones of depressions.

Long-term hydrographs of eight wells indicate trends of water-level decline over a 25-year history. During the period 1970-1995, water-level declines ranged from less than 0.5 ft/yr in Phillips County more than 2.0 ft/yr in Union County. Water-level declines of greater than 1.5 ft/yr generally are associated with the cones of depression centered in Columbia, Jefferson and Union Counties.

## SELECTED REFERENCES

- Broom, M.E., Kraemer, T.F., and Bush, W.V., 1984, A reconnaissance study of saltwater contamination in the El Dorado aquifer, Union County, Arkansas: U.S. Geological Survey Water-Resources Investigations Report 84-4012, 47 p.
- Edds, Joe, and Fitzpatrick, D.J., 1989, Altitude of the potentiometric surface and changes in water levels in the Sparta-Memphis aquifer in eastern and southern Arkansas, spring 1986: U.S. Geological Survey Water-Resources Investigations Report 88-4042, 1 sheet.
- Hem, J.D., 1992, Study and interpretation of the chemical characteristics of natural water, U.S. Geological Survey Water-Supply Paper 2254, 263 p.
- Holland, T.W., 1993, Use of water in Arkansas, 1990: U.S. Geological Survey Open-File Report 93-48, pamphlet.
- Hosman, R.L., 1982, Outcropping Tertiary units in southern Arkansas: U.S. Geological Survey Miscellaneous Investigations Series I-1405, 1 sheet.
- Hosman, R.L., Long, A.T., Lambert, T.W., and others, 1968, Tertiary aquifers in the Mississippi Embayment: U.S. Geological Survey Professional Paper 448-D, 29 p.
- Morris, E.E., and Bush, W.V., 1986, Extent and sources of saltwater intrusion into the alluvial aquifer near Brinkley, Arkansas, 1984: U.S. Geological Survey Water-Resources Investigations Report 85-4322, 123 p.
- Petersen, J.C., Broom, M.E., and Bush, W.V., 1985, Geohydrologic units of the Gulf Coastal Plain in Arkansas: U.S. Geological Survey Water-Resources Investigations Report 85-4116, 20 p.