ENVIRONMENTAL ASSESSMENT

Alton to Gale Organized Levee Districts, Illinois and Missouri (Continuing, Deficiency Corrections) Letter Report

APPENDIX E

Water Quality Data

Additional Information

To ensure that tap water is safe to drink, EPA prescribes limits on the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791). The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

(A) Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
(B) Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban storm runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
(C) Pesticides and herbicides, which may come from a variety of sources such as agriculture, storm water runoff, and residential uses.
(D) Organic chemical contaminants, including synthetic and volatile organics, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems.
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Some people may be more vulnerable to contaminants in drinking water than is the general population. Immuno-compromised persons such as those with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium are available from the Safe Drinking Water Hotline (800-426-4791).

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CITY OF CAPE GIRARDEAU
Public Works-Water Division
P. O. Box 1809
Cape Girardeau, MO 63702-1809

City of Cape Girardeau

PUBLIC WORKS DEPARTMENT
WATER DIVISION

Water Quality Report 2007

Dear Customer,

We are pleased to present a summary of the water quality provided to you during the past year. The Safe Drinking Water Act (SDWA) requires that water systems issue an annual "Consumer Confidence" report to customers in addition to other notices that may be required by law. This report details where our water comes from, what it contains, and the risks our water testing and treatment are designed to prevent. The City of Cape Girardeau is committed to providing you with the safest and most reliable water supply possible. Informed consumers are our best allies in maintaining safe drinking water. Call us for information about the next opportunity for public participation in decisions about our drinking water. Consult our Web site at www.cityofcapegirardeau.org and, for further information, see the U.S. Environmental Protection Agency (EPA) water information at www.epa.gov/safewater/. Water produced at the City of Cape Girardeau's drinking water treatment facilities meets or surpasses all federal and state drinking water standards.

Concerning Lead in Our Water

Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water Hotline (800-426-4791).

Source of Supply

The City of Cape Girardeau utilizes both the Mississippi River with intake facilities at Mile 54 and alluvial well water as source water for the Cape Rock Treatment Plant. Source water is pumped to the treatment facility where lime softening, clarification, disinfection and filtration takes place. Source water from alluvial wells is pumped to the Ramsey Branch Treatment Facility for iron removal, disinfection and filtration. After treatment, the water from both treatment facilities is pumped to a common distribution system where mixing of treated water from both sources take place. The Department of Natural Resources conducted an assessment of our source water to determine its susceptibility to contamination. All surface water sources are vulnerable to land use activities within their watershed. This is why all surface water in Missouri must be treated in dual treatment trains with barriers in place for potential microbiological and chemical contaminants. The assessment is a delienation of our watershed(s) and an inventory of the potential contaminants found within the watershed(s). The assessment of ground water sources is a three-step process of identifying an area around our wellhead(s), inventorying potential sources of contaminants within that area (a one-half mile radius around the wellhead(s)) and a look at the adequacy of well construction. The ground water assessment can be used to develop a wellhead protection program to protect this valuable resource.

The City of Cape Girardeau utilizes state and private laboratories to perform analysis for 188 pollutants and microbiological contamination. In addition, the laboratories at the city's water plants perform process monitoring and quality control analysis 24 hours per day. Of the 188 contaminants tested for, traces of only 15 were detected. All were below the allowed level illustrated in the following table.

How to Read This Table

The chart in this report provides representative analytical results of water samples, collected in 2007 from our system. *Range represents historical high/low readings from multiple years.Please note the following definitions: Maximum Contaminant Level or MCL: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology. Maximum Contaminant Level Goal or MCLG: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Key To Table

AL=Action Level
MCL=Maximum Contaminant Levl
MCLG=Maximum Contaminant Level Goal
MFL=million fibers per liter
mrem/year-millirems per year (a measure of radiation absorbed by the body)
NTU=Nephelometric Turbidity Units
nd=not detectable at testing limits
pCi/L=picocuries per liter (a measure of radioactivity)
ppm=parts per million, or milligrams per liter (mg/l)
ppb=parts per billion, or micrograms per liter (ug/l)
ppt=parts per trillion, or nanograms per liter
ppq=parts per quadrillioin or picograms per liter
TT=Treatment Technique

Contaminant	Date Tested	Unit	MCL	MCLG	Highest Value	Range	Major Sources	Violation
Inorganic Contaminants								
Arsenic	2007	ppb	10	n/a	1.33	nd-1.33	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes.	No
Atrazine	2007	ppb	3	3	0.68	nd-0.68	Runoff from herbicide used on row crops	No
Barium	2007	ppm	2	2	0.258	0.0524-0.258	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes.	No
Carbon,Total Organic	2007	ppm			6.22	0.76-6.22	Naturally present in the environment.	No
Chromium	2007	ppb	100	100	1.6	1.07-1.6	Discharge from steel and pulp mills	No
Fluoride	2007	ppm	4	4	1.2	0.67-1.2	Erosion of natural deposits; Water additive which promotes strong teeth; Discharge from fertilizer and aluminum factories.	No
Nitrate+Nitrite as N	2007	ppm	10	10	2.82	0.13-2.82	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.	No
Combined Radium Level RA226 and RA228								
Gross Alpha Particle	2006*	pCi/l	15	0	1.3	1.3	Erosion of natural deposits	No
Radium	2006*	pCi/l	5	10	0.2	0.1-0.2	Erosion of natural deposits	No
Radium-226	2006*	pCi/l	5	0	0.2	0.1-0.2	Erosion of natural deposits	No
Volatile Organic Contaminants								
TTHM's	2007	ppb	80	na	49.394	33.8-116	By-product of drinking water chlorination	No
HAA5	2007	ppb	60	na	32.203	29.2-92.2	By-product of drinking water disinfection	No
Microbiological Contaminants								
Turbidity (April)	2007	NTU	.5	na	0.16	0.01-0.16	Soil Runoff	No

	Collected	Unit	MCL	MCLG	90th Percentile	Range	Sites Over AL	Sources
Copper	2005-2007	ppm	AL=1.3	AL=1.3	0.129	0.00296-0.172	0	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives.
Lead	2005-2007	ppb	15	0	1.9	1.03-16.8	0	Corrosion of household plumbing systems; Erosion of natural deposits

Violations and Health Effects Information

There were no MCL, Monitoring, or treatment technique violations for this report.

Other monitoring

In addition to testing we are required to perform, our water system voluntarily tests for hundreds of additional substances and microscopic organisms to make certain our water is safe and of high quality. If you are interested in a more detailed report, contact System Manager Kevin Priester at 573-651-6280 or Production Superintendent William Pecord at 573-334-6747.

Additional Information

To ensure that tap water is safe to drink, EPA prescribes limits on the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water.
Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791). The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

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(D) Organic chemical contaminants, including synthetic and volatile organics, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems.

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CITY OF CAPE GIRARDEAU
Public Works-Water Division
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CITY OF CAPE GIRARDEAU

PUBLIC WORKS DEPARTMENT
WATER DIVISION

WATER QUALITY REPORT 2008

Dear Customer,

We are pleased to present a summary of the water quality provided to you during the past year. The Safe Drinking Water Act (SDWA) requires that water systems issue an annual "Consumer Confidence" report to customers in addition to other notices that may be required by law. This report details where our water comes from, what it contains, and the risks our water testing and treatment are designed to prevent. The City of Cape Girardeau is committed to providing you with the safest and most reliable water supply possible. Informed consumers are our best allies in maintaining safe drinking water. Call us for information about the next opportunity for public participation in decisions about our drinking water. Consult our Web site at www.cityofcapegirardeau.org and, for further information, see the U.S. Environmental Protection Agency (EPA) water information at www.epa.gov/safewater/. Water produced at the City of Cape Girardeau's drinking water treatment facilities meets or surpasses all federal and state drinking water standards.

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Source of Supply

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The City of Cape Girardeau utilizes state and private laboratories to perform analysis for 188 pollutants and microbiological contamination. In addition, the laboratories at the city's water plants perform process monitoring and quality control analysis 24 hours per day. Of the 188 contaminants tested for, traces of only 13 were detected. All were below the allowed level illustrated in the following table.

How to Read This Table

The chart in this report provides representative analytical results of water samples, collected in 2008 from our system. *Range represents historical high/low readings from multiple years. .Please note the following definitions: Maximum Contaminant Level or MCL: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology. Maximum Contaminant Level Goal or MCLG: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

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Contaminant	Date Tested	Unit	MCL	MCLG	Highest Value	Range	Major Sources	Violation
Inorganic Contaminants								
Atrazine	2008	ppb	3	3	0.6	nd-0.6	Runoff from herbicide used on row crops	No
Barium	2008	ppm	2	2	0.231	0.0518-0.231	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes.	No
Carbon, Total Organic	2008	ppm			6.63	0.9-6.63	Naturally present in the environment.	No
Fluoride	2008	ppm	4	4	0.83	0.73-0.83	Erosion of natural deposits; Water additive which promotes strong teeth; Discharge from fertilizer and aluminum factories.	No
Nitrate+Nitrite as N	2008	ppm	10	10	1.68	0.18-1.68	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.	No
Combined Radium Level RA226 and RA228								
Gross Alpha Particle	2006*	pCi/l	15	0	1.3	1.3	Erosion of natural deposits	No
Radium	2006*	pCi/L	5	10	0.2	0.1-0.2	Erosion of natural deposits	No
Radium-226	2006*	PIC/L	5	0	0.2	0.1-0.2	Erosion of natural deposits	No
Volatile Organic Contaminants								
TTHM's	2008	ppb	80	na	52.84829	3.89-135	By-product of drinking water chlorination	No
HAA5	2008	ppb	60	na	35.32664	8.3-90.5	By-product of drinking water disinfection	No
Microbiological Contaminants								
Turbidity (Oct.)	2008	NTU	.5	na	0.16	0.01-0.16	Soil Runoff	No

Date Collected		Unit	MCL	MCLG	90th Percentile	Range	Sites Over AL	Sources
Copper	2005-2007*	ppm	AL=1.3	AL=1.3	0.129	0.00296-0.172	0	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives.
Lead	2005-2007*	ppb	15	0	1.9	1.03-16.8	0	Corrosion of household plumbing systems; Erosion of natural deposits

Violations and Health Effects Information

There were no MCL, Monitoring, or treatment technique violations for this report.

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CITY OF CAPE GIRARDEAU

PUBLIC WORKS DEPARTMENT
WATER DIVISION

CAPE GIRARDEAU
Where the river turns a thousand tales
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WATER QUALITY REPORT 2009

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Barium	2009	ppm	2	2	0.247	0.0549-0.247	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes.	No
Carbon, Total Organic	2009	ppm			6.58	2.54-6.58	Naturally present in the environment.	No
Fluoride	2009	ppm	4	4	1.1	0.82-1.1	Erosion of natural deposits; Water additive which promotes strong teeth; Discharge from fertilizer and aluminum factories.	No
Nitrate+Nitrite as N	2009	ppm	10	10	1.96	0.26-1.96	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.	No
Combined Radium Level RA226 and RA228								
Gross Alpha Particle	2006*	pCi/l	15	0	1.3	1.3	Erosion of natural deposits	No
Radium	2006*	pCi/L	5	10	0.2	0.1-0.2	Erosion of natural deposits	No
Radium-226	2006*	PIC/L	5	0	0.2	0.1-0.2	Erosion of natural deposits	No
Volatile Organic Contaminants								
TTHM's	2009	ppb	80	na	56.89557	4.75-127	By-product of drinking water chlorination	No
HAA5	2009	ppb	60	na	49.34118	27.8-126	By-product of drinking water disinfection	No
Microbiological Contaminants								
Turbidity (Dec.)	2009	NTU	.5	na	0.14	0.01-0.14	Soil Runoff	No

	Date Collected	Unit	MCL	MCLG	90th Percentile	Range	Sites Over AL	Sources
Copper	2008-2010	ppm	AL=1.3	AL=1.3	0.226	0.00347-0.313	0	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives.
Lead	2008-2010	ppb	15	0	2.69	1.04-51.3	0	Corrosion of household plumbing systems; Erosion of natural deposits

Violations and Health Effects Information

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Other monitoring

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This report is intended to provide you with important information about your drinking water and the efforts made to provide safe drinking water.

Attencion!

Este informe contiene información muy importante. Tradúscalo o prequntele a alguien que lo entienda bien.
[translated: This report contains very important information. Translate or ask someone who understands this very well.]

What is the source of my water?

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and groundwater wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pickup substances resulting from the presence of animals or from human activity.

Our water comes from the following source(s):

Source Name	Type
OLD POL STA W3	Ground Water
OLD CITYHALL W1	Ground Water
DRUETTA W2	Ground Water
PARK W4	Ground Water
WELL # 5	Ground Water
WELL # 7	Ground Water
WELL # 6	Ground Water

Why are there contaminants in my water?

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Is our water system meeting other rules that govern our operations?

The Missouri Department of Natural Resources regulates our water system and requires us to test our water on a regular basis to ensure it's safety. Our system has been assigned the identification number MO4010726 for the purposes of tracking our test results. Last year, we tested for a variety of contaminants. The detectable results of these tests are on the following pages of this report. Any violations of state requirements or standards will be further explained later in this report.

How might I become actively involved?

If you would like to observe the decision-making process that affect drinking water quality or if you have any further questions about your drinking water report, please call us at 573-264-2157 to inquire about scheduled meetings or contact persons.

Do I need to take any special precautions?

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ trans-plants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

Contaminants Report

Definitions:

MCLG: Maximum Contaminant Level Goal, or the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
MCL: Maximum Contaminant Level, or the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

AL: Action Level, or the concentration of a contaminant which, when exceeded, triggers treatment or other requirements which a water system must follow..
TT: Treatment Technique, or a required process intended to reduce the level of a contaminant in drinking water.
90th percentile: For lead and Copper testing. 10% of test results are above this level and 90% are below this level.
Level Found: is the average of all test results for a particular contaminant.
Range of Detections: Shows the lowest and highest levels found during a testing period, if only one sample was taken, then this number equals the Level Found.
MRLDG: Maximum Residual Disinfectant Level Goal, or the level of a drinking water disinfectant below which there is no known or expected risk to health.
MRDL: Maximum Residual Disinfectant Level, or the highest level of a disinfectant allowed in drinking water.

Abbreviations:

PPB: parts per billion or micrograms per liter.

ppm: parts per million or milligrams per liter.

n/a: not applicable.

NTU: Nephelometric Turbidity Unit, used to measure cloudiness in drinking water.

MFL: million fibers per liter, used to measure asbestos concentration.

nd: not detectable at testing limits.

The state has reduced monitoring requirements for certain contaminants to less often than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year. Records with a sample year more than one year old are still considered representative.

Regulated Contaminants

Regulated Contaminants	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
BARIUM	9/8/2006	0.476	0.476	ppm	2	2	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits
FLUORIDE	5/15/2007	1.7	0.95 - 1.7	ppm	4.0	4	Natural deposits; Water additive which promotes strong teeth.

Disinfection By Products	Monitoring Period	RAA	Range	Unit	MCL	MCLG	Typical Source
No Detected Results were Found in the Calendar Year of 2007							

Lead and Copper	Date	90TH Percentile	Range	Unit	AL	Sites Over AL	Typical Source
COPPER	2005 - 2007	0.316	0.0175 - 0.586	ppm	1.3	0	Corrosion of household plumbing systems
LEAD	2005 - 2007	3.5	1.02 - 25.8	ppb	15	1	Corrosion of household plumbing systems

Microbiological	Result	MCL	MCLG	Typical Source
No Detected Results were Found in the Calendar Year of 2007				

Radionuclides	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
GROSS ALPHA PARTICLE ACTIVITY, TOTAL	5/9/2006	1.9	1.9	pCi/l	15		Erosion of natural deposits
RADIUM, COMBINED (226, 228)	5/9/2006	0.3	0.3	pCi/l	5		Erosion of natural deposits
RADIUM-226	5/9/2006	0.3	0.3	pCi/l	5	0	

Violations and Health Effects Information

During the 2007 calendar year, we had the below noted violation(s) of drinking water regulations.

Type	Category	Analyte	Compliance Period
No Violations Occurred in the Calendar Year of 2007			

Any Additional Required Health Effects Language or Violation Notices
Additional Required Health Effects Language:

Infants and children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water Hotline (800-426-4761).
There are no additional required health effects violation notices.

Optional Monitoring (not required by EPA)

Optional Contaminants

Monitoring is not required for optional contaminants.

Secondary Contaminants	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
ALKALINITY, TOTAL	9/8/2006	284	284	MG/L			
CALCIUM	9/8/2006	82.2	82.2	MG/L			
CHLORIDE	9/8/2006	32.7	32.7	MG/L	250		
HARDNESS, CARBONATE	9/8/2006	307	307	MG/L			
MAGNESIUM	9/8/2006	24.8	24.8	MG/L			
MANGANESE	9/8/2006	0.00897	0.00897	MG/L	0.05		
NICKEL	9/8/2006	0.00134	0.00134	MG/L	0.1	0.1	
PH	9/8/2006	7.62	7.62	PH	8.5		
POTASSIUM	9/8/2006	2.03	2.03	MG/L			
SODIUM	9/8/2006	31.6	31.6	MG/L		20	
SOLIDS, TOTAL DISSOLVED (TDS)	9/8/2006	388	388	MG/L	500		
SULFATE	9/8/2006	34.8	34.8	MG/L	250		
ZINC	9/8/2006	0.0203	0.0203	MG/L	5		

This report is intended to provide you with important information about your drinking water and the efforts made to provide safe drinking water.

Attencion!

Este informe contiene información muy importante. Tradúscalo o prequntele a alguien que lo entienda bien.
[translated: This report contains very important information. Translate or ask someone who understands this very well.]

What is the source of my water?

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and groundwater wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pickup substances resulting from the presence of animals or from human activity.

Our water comes from the following source(s):

Source Name	Type
WELL # 7	GROUND WATER
WELL # 6	GROUND WATER

Source Water Assessment:

The Department of Natural Resources conducted a source water assessment to determine the susceptibility of our water source to potential contaminants. This process involved the establishment of source water area delineations for each well or surface water intake and then a contaminant inventory was performed within those delineated areas to assess potential threats to each source. Assessment maps and summary information sheets are available on the internet at http://maproom.missouri.edu/swipmaps/pwssid.htm. To access the maps for your water system you will need the State-assigned identification code, which is printed at the top of this report. The Source Water Inventory Project maps and information sheets provide a foundation upon which a more comprehensive source water protection plan can be developed.

Why are there contaminants in my water?

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).
Contaminants that may be present in source water include:
A. Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
B. Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial, or domestic wastewater discharges, oil and gas production, mining, or farming.
C. Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
D. Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
E. Radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.
In order to ensure that tap water is safe to drink, the Department of Natural Resources prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Department of Health regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Is our water system meeting other rules that govern our operations?

The Missouri Department of Natural Resources regulates our water system and requires us to test our water on a regular basis to ensure it's safety. Our system has been assigned the identification number MO4010726 for the purposes of tracking our test results. Last year, we tested for a variety of contaminants. The detectable results of these tests are on the following pages of this report. Any violations of state requirements or standards will be further explained later in this report.

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Contaminants Report

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MCL: Maximum Contaminant Level, or the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

AL: Action Level, or the concentration of a contaminant which, when exceeded, triggers treatment or other requirements which a water system must follow..
TT: Treatment Technique, or a required process intended to reduce the level of a contaminant in drinking water.
90th percentile: For lead and Copper testing. 10% of test results are above this level and 90% are below this level.
Level Found: is the average of all test results for a particular contaminant.
Range of Detections: Shows the lowest and highest levels found during a testing period, if only one sample was taken, then this number equals the Level Found.
MRLDG: Maximum Residual Disinfectant Level Goal, or the level of a drinking water disinfectant below which there is no known or expected risk to health.
MRDL: Maximum Residual Disinfectant Level, or the highest level of a disinfectant allowed in drinking water.
RAA: Running Annual Average, or the average of sample analytical results for samples taken during the previous four calendar quarters.

Abbreviations:

PPB: parts per billion or micrograms per liter.

ppm: parts per million or milligrams per liter.

n/a: not applicable.

NTU: Nephelometric Turbidity Unit, used to measure cloudiness in drinking water.

MFL: million fibers per liter, used to measure asbestos concentration.

nd: not detectable at testing limits.

The state has reduced monitoring requirements for certain contaminants to less often than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year. Records with a sample year more than one year old are still considered representative.

Regulated Contaminants

Regulated Contaminants	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
BARIUM	9/14/2009	0.369	0.369	ppm	2	2	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits
CHROMIUM	9/14/2009	1.87	1.87	ppb	100	100	Discharge from steel and pulp mills
FLUORIDE	9/14/2009	1.11	1.11	ppm	4	4	Natural deposits; Water additive which promotes strong teeth.

Disinfection By Products	Monitoring Period	RAA	Range	Unit	MCL	MCLG	Typical Source
TTHM	2005 - 2007	7.22	7.22	ppb	80	0	By-product of drinking water chlorination

Lead and Copper	Date	90TH Percentile	Range	Unit	AL	Sites Over AL	Typical Source
COPPER	2005 - 2007	0.316	0.0175 - 0.586	ppm	1.3	0	Corrosion of household plumbing systems
LEAD	2005 - 2007	3.5	1.02 - 25.8	ppb	15	1	Corrosion of household plumbing systems

Microbiological	Result	MCL	MCLG	Typical Source
COLIFORM (TCR)	In the month of March, 1 sample(s) returned as positive	MCL: Systems that Collect Less Than 40 Samples per Month - No more than 1 positive monthly sample	0	Naturally present in the environment

Radionuclides	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
RADIUM-228	4/16/2009	0.6	0.6	pCi/l	5	0	

Violations and Health Effects Information

During the 2009 calendar year, we had the below noted violation(s) of drinking water regulations.

Type	Category	Analyte	Compliance Period
MONITORING (TCR), ROUTINE MAJOR	Failure to Monitor	COLIFORM (TCR)	02/01/2009 - 02/28/2009

Any Additional Required Health Effects Language or Violation Notices
Additional Required Health Effects Language:

Infants and children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water Hotline (800-426-4761).
There are no additional required health effects violation notices.

Optional Monitoring (not required by EPA)

Optional Contaminants

Monitoring is not required for optional contaminants.

Secondary Contaminants	Collection Date	Highest Value	Range	Unit	MCL	MCLG	Typical Source
ALKALINITY, CACO3 STABILITY	9/14/2009	283	283	MG/L			
ALKALINITY, TOTAL	9/8/2006	284	284	MG/L			
CALCIUM	9/14/2009	70.2	70.2	MG/L			
CHLORIDE	9/8/2006	32.7	32.7	MG/L	250		
HARDNESS, CARBONATE	9/14/2009	268	268	MG/L			
IRON	9/14/2009	0.00225	0.00225	MG/L	0.3		
MAGNESIUM	9/14/2009	22.5	22.5	MG/L			
PH	9/14/2009	7.36	7.36	PH	8.5		
POTASSIUM	9/14/2009	1.96	1.96	MG/L			
SODIUM	9/14/2009	27.1	27.1	MG/L		20	
SULFATE	9/14/2009	36.5	36.5	MG/L	250		
TDS	9/14/2009	404	404	MG/L	500		
ZINC	9/14/2009	0.00419	0.00419	MG/L	5		

West Memphis Utility
2009 Annual Drinking Water Quality Report

We're pleased to present to you this year's Annual Drinking Water Quality Report. This report is designed to inform you about the quality water and services we deliver to you every day. Our constant goal is to provide you with a safe and dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, can pick up substances resulting from the presence of animals or from human activity. Our sources of water are five wells that pump from the Wilcox Group Aquifer.

Contaminants that may be present in source water include: Microbial contaminants such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife; Inorganic contaminants such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming; Pesticides and herbicides which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses; Organic chemical contaminants including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems; Radioactive contaminants which can be naturally occurring or be the result of oil and gas production and mining activities.

The Arkansas Department of Health has completed a Source Water Vulnerability Assessment for West Memphis Utility. The assessment summarizes the potential for contamination of our sources of drinking water and can be used as a basis for developing a source water protection plan. Based on the various criteria of the assessment, our water sources have been determined to have a medium susceptibility to contamination. You may request a summary of the Source Water Vulnerability Assessment from our office.

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

In order to assure tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. West Memphis Utility is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

If you have any questions about this report or concerning your water utility, please contact Josh Grabowski, Water Superintendent, at 870-702-5102. We want our valued customers to be informed about their water utility. If you want to learn more, please attend any of our regularly scheduled meetings. They are held on the second Thursday of each month at 8:30 AM at 604 East Cooper in West Memphis.

West Memphis Utility routinely monitors for constituents in your drinking water according to Federal and State laws. The test results table shows the results of our monitoring for the period of January 1st to December 31st, 2009. In the table you might find terms and abbreviations you are not familiar with. To help you better understand these terms we've provided the following definitions:

Action Level - the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.
Maximum Contaminant Level (MCL) - the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
Maximum Contaminant Level Goal (MCLG) – unenforceable public health goal; the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
Maximum Residual Disinfectant Level (MRDL) - the highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
Maximum Residual Disinfectant Level Goal (MRDLG) - the level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
NA – Not applicable
Parts per billion (ppb) - a unit of measurement for detected levels of contaminants in drinking water. One part per billion corresponds to one minute in 2,000 years, or a single penny in $10,000,000.
Parts per million (ppm) – a unit of measurement for detected levels of contaminants in drinking water. One part per million corresponds to one minute in two years or a single penny in $10,000.

TEST RESULTS

MICROBIOLOGICAL CONTAMINANTS

Contaminant	Violation Y/N	Level Detected	Unit	MCLG (Public Health Goal)	MCL (Allowable Level)	Major Sources in Drinking Water
Total Coliform Bacteria	N	1 positive in December	Present	0	1 positive sample per month	Naturally present in the environment

INORGANIC CONTAMINANTS

Contaminant	Violation Y/N	Level Detected	Unit	MCLG (Public Health Goal)	MCL (Allowable Level)	Major Sources in Drinking Water
Fluoride	N	Average: 0.58 Range: 0.39 – 0.81	ppm	4	4	Erosion of natural deposits; water additive which promotes strong teeth

LEAD AND COPPER TAP MONITORING

Contaminant	Number of Sites over Action Level	90th Percentile Result	Unit	Action Level	Major Sources in Drinking Water
Lead	0	0.005	ppm	0.015	Corrosion from household plumbing systems; erosion of natural deposits
Copper	0	0.39	ppm	1.3	

- West Memphis Utility is on a reduced monitoring schedule and required to sample once every three years for lead and copper at the customers' taps. The above data is from our last monitoring period in 2008. Our next required monitoring period is 2011.

REGULATED DISINFECTANTS

Disinfectant	Violation Y/N	Level Detected	Unit	MRDLG (Public Health Goal)	MRDL (Allowable Level)	Major Sources in Drinking Water
Chlorine	N	Average: 0.50 Range: 0.007 – 1.26	ppm	4	4	Water additive used to control microbes

BY-PRODUCTS OF DRINKING WATER DISINFECTION

Contaminant	Violation Y/N	Level Detected	Unit	MCLG (Public Health Goal)	MCL (Allowable Level)
HAA5 [Haloacetic Acids]	N	3.3	ppb	0	60
TTHM [Total Trihalomethanes]	N	12.6	ppb	NA	80

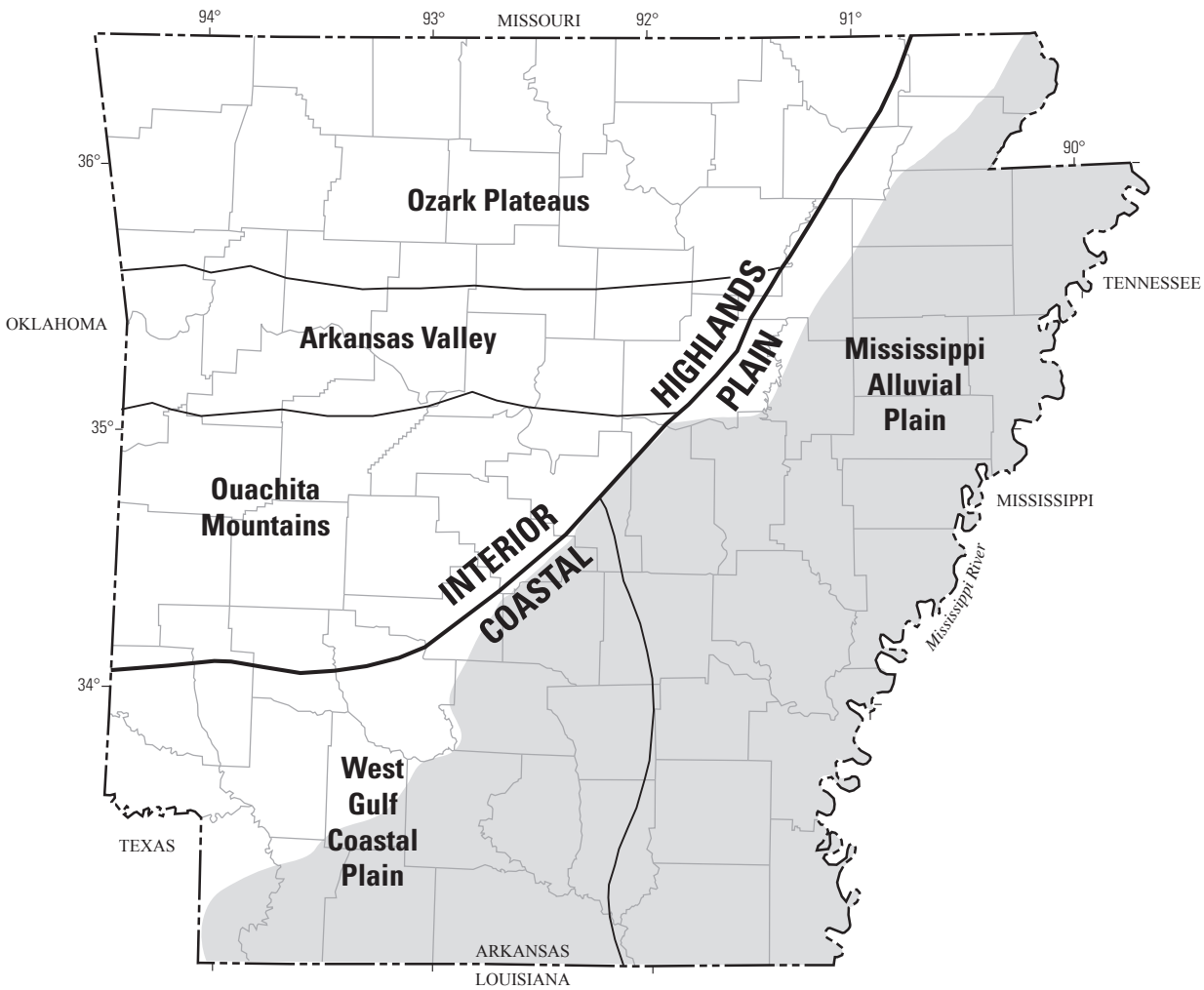
Test	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
Hardness as CACO3 by SM 2340B	**4.80**	**mg/L**	**0.012**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Silver	< 0.006	mg/L	0.006	1	07/28/08 17:56	JTR	200.7
Aluminum	< 0.125	mg/L	0.125	1	07/28/08 17:56	JTR	200.7
Arsenic	< 0.012	mg/L	0.012	1	07/28/08 17:56	JTR	200.7
Barium	**0.026**	**mg/L**	**0.012**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Calcium	**1.16**	**mg/L**	**0.125**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Cadmium	< 0.002	mg/L	0.002	1	07/28/08 17:56	JTR	200.7
Chromium	< 0.006	mg/L	0.006	1	07/28/08 17:56	JTR	200.7
Copper	**0.065**	**mg/L**	**0.006**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Iron	**0.226**	**mg/L**	**0.125**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Potassium	**1.35**	**mg/L**	**0.125**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Magnesium	**0.461**	**mg/L**	**0.125**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Manganese	**0.016**	**mg/L**	**0.012**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Sodium	**45.0**	**mg/L**	**0.625**	**1**	**07/28/08 17:56**	**JTR**	**200.7**
Lead	< 0.008	mg/L	0.008	1	07/28/08 17:56	JTR	200.7
Selenium	< 0.012	mg/L	0.012	1	07/28/08 17:56	JTR	200.7
Zinc	< 0.012	mg/L	0.012	1	07/28/08 17:56	JTR	200.7
Mercury	< 0.00020	mg/L	0.00020	1	07/24/08 15:30	TJ	245.1
Chloride	**2.73**	**mg/L**	**1.00**	**1**	**07/23/08 15:54**	**KS**	**300.0**
Fluoride	**0.588**	**mg/L**	**0.100**	**1**	**07/23/08 15:54**	**KS**	**300.0**
Nitrate Nitrogen	< 0.100	mg/L	0.100	1	07/23/08 15:54	KS	300.0
Nitrite Nitrogen	< 0.100	mg/L	0.100	1	07/23/08 15:54	KS	300.0
Nitrate/Nitrite Nitrogen	< 0.100	mg/L	0.100	1	07/23/08 15:54	KS	300.0
Sulfate	**3.02**	**mg/L**	**1.00**	**1**	**07/23/08 15:54**	**KS**	**300.0**
Alkalinity as CACO3	**100**	**mg/L CaCO3**		**1**	**07/31/08 15:40**	**GD**	**2320 B**
pH	**7.3**	**SU**		**1**	**07/23/08 15:30**	**JK**	**4500H-B**
Phosphorus, Total (As P)	**0.185**	**mg/L**	**0.025**	**1**	**07/24/08 9:05**	**TCB**	**4500PB5**
Silica	**9.80**	**mg/L**	**0.10**	**1**	**08/04/07 15:15**	**GD**	**4500-E**
Total Dissolved Solids	**119**	**mg/L**	**2**	**1**	**07/23/08 13:45**	**GD**	**2540C**

Qualifiers/ Definitions

*	Surrogate Recovery outside accepted limits	* I	Recoveries affected by interferences or high background
B	Analyte detected in the associated Method Blank	DF	Dilution Factor
E	Value exceeds method calibration range	H	Prepped / Analyzed out of holding time.
J	Estimated Value Analyte below reported detection limit	M	Minimum value
MDL	Method Dection Limit (unadjusted)	MQL	Method Quantitation Limit (adjusted)
MRL	Method Reporting Limit	N	Refer to attached Non-Compliance Report
Q	RPD >40% between primary and confirmation columns	SQL	Sample Quantitation Limit (adjusted MDL)

Prepared in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey

Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer (Middle Claiborne Aquifer) in Arkansas, Spring-Summer 2007



Scientific Investigations Report 2009–5207

U.S. Department of the Interior
U.S. Geological Survey

Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer (Middle Claiborne Aquifer) in Arkansas, Spring–Summer 2007

By T.P. Schrader

Prepared in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey

Scientific Investigations Report 2009–5207

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2009

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Conversion Factors and Datums

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Flow rate	
million gallons per day (Mgal/d)	0.04381	cubic meters per second (m^3/s)
foot per year (ft/yr)	0.3048	meter per year (m/yr)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F=(1.8×°C)+32

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C=(°F-32)/1.8

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 1983).

Altitude as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer (Middle Claiborne Aquifer) in Arkansas, Spring-Summer 2007

By T.P. Schrader

Abstract

The U.S. Geological Survey in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey has monitored water levels in the Sparta Sand of Claiborne Group and Memphis Sand of Claiborne Group (herein referred to as the Sparta Sand and the Memphis Sand, respectively), since the 1920s. Groundwater withdrawals have increased while water levels have declined since monitoring was initiated. Herein, aquifers in the Sparta Sand and Memphis Sand will be referred to as the Sparta-Memphis aquifer throughout Arkansas. During the spring of 2007, 309 water levels were measured in wells completed in the Sparta-Memphis aquifer. During the summer of 2007, 129 water-quality samples were collected and measured for temperature and specific conductance and 102 were collected and analyzed for chloride from wells completed in the Sparta-Memphis aquifer.

Water-level measurements collected in wells screened in the Sparta-Memphis aquifer were used to produce a regional potentiometric-surface map. The regional direction of ground-water flow in the Sparta-Memphis aquifer is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large ground-water withdrawals. The highest water-level altitude measured in the Sparta-Memphis aquifer was 326 feet above National Geodetic Vertical Datum of 1929, located in Grant County in the outcrop at the western boundary of the study area; the lowest water-level altitude was 161 feet below National Geodetic Vertical Datum of 1929 in Union County near the southern boundary of the study area.

Eight cones of depression (generally represented by closed contours) are located in the following counties: Bradley, Drew, and Ashley; Calhoun; Cleveland; Columbia; Crittenden; Arkansas, Jefferson, and Lincoln; Cross and Poinsett; and Union. Two large depressions are shown on the 2007 potentiometric-surface map, centered in Jefferson and Union Counties, as a result of large withdrawals for industrial and public supplies. The depression centered in Jefferson County deepened and expanded in recent years into Arkansas and Prairie Counties as a result of large withdrawals for irrigation and public supply. The area enclosed within the 40-foot contour has expanded on the 2007 potentiometric-surface map when compared with the 2005 potentiometric-surface map. In 2003, the depression in Union County was elongated east and west and beginning to coalesce with the depression in Columbia County. The deepest measurement during 2007 in the center of the depression in Union County has risen 38 feet since 2003. The area enclosed by the deepest contour, 160 feet below National Geodetic Vertical Datum of 1929, on the 2007 potentiometric-surface map is less than 10 percent of the area on the 2005 potentiometric-surface map. A broad depression in western Poinsett and Cross Counties was first shown in the 1995 potentiometric-surface map caused by withdrawals for irrigation extending north to the Poinsett-Craighead County line, and south into Cross County.

A water-level difference map was constructed using the difference between water-level measurements made during 2003 and 2007 from 283 wells. The difference in water level between 2003 and 2007 ranged from -49.8 to 60.0 feet. Areas with a general rise in water levels are shown in northern Arkansas, Columbia, southern Jefferson, and most of Union Counties. In the area around west-central Union County, water levels rose as much as 60.0 feet with water levels in 15 wells rising 20 feet or more, which is an average annual rise of 5 feet or more. Water levels generally declined throughout most of the rest of Arkansas.

Hydrographs from 157 wells were constructed with a minimum of 25 years of water-level measurements. During the period 1983-2007, the county mean annual water level rose in Calhoun, Columbia, Hot Spring, and Lafayette Counties. Mean annual declines between 0.0 and 2.1 feet per year occurred in all other counties. In western Arkansas County, a hydrograph shows a 60-foot seasonal change in water level for the 2 years shown. The period of the 60-foot decline in water level coincides with the spring-summer irrigation season.

Specific conductance ranged from 35 microsiemens per centimeter at 25 degrees Celsius (µS/cm) in Ouachita County to 1,280 µS/cm at two wells in Monroe County. The mean

specific conductance was 398 µS/cm and the median specific conductance was 334 µS/cm. Dissolved chloride concentrations ranged from 1.2 milligrams per liter (mg/L) in Lincoln County to 308 mg/L in Monroe County. The mean dissolved chloride concentration was 28.6 mg/L and the median dissolved chloride concentration was 8.7 mg/L. Although there is a regional increase in specific conductance to the east and south, anomalous increases occur in some parts of the study area. Large specific conductance values (greater than 700 µS/cm and less than 1,300 µS/cm) occur in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties.

Introduction

The U.S. Geological Survey (USGS) in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey has monitored water levels in the Sparta Sand of Claiborne Group and Memphis Sand of Claiborne Group (herein referred to as the Sparta Sand and the Memphis Sand, respectively), since the 1920s. Groundwater withdrawals have increased while water levels have declined since monitoring was initiated. The USGS has produced reports, at various periodic schedules, discussing the groundwater conditions of the Sparta Sand and Memphis Sand aquifers in Arkansas from a continuing project that includes the groundwater networks and basic data collection for Arkansas to provide information for the management of this valuable resource.

This report presents a status of water levels and water-quality conditions in the aquifers in the Sparta Sand and the Memphis Sand in Arkansas. Herein, aquifers in the Sparta Sand and Memphis Sand will be referred to as the Sparta-Memphis aquifer throughout Arkansas. During the spring of 2007, water levels were measured in 309 wells completed in the Sparta-Memphis aquifer. These measurements were used to describe the potentiometric surface of the Sparta-Memphis aquifer. During the summer of 2007, 129 water-quality samples were collected and measured for temperature and specific conductance, and 102 were collected and analyzed for chloride. This report presents a potentiometric-surface map, a water-level difference map comparing water levels from 2003 to 2007, selected water-level hydrographs, a specific-conductance map, and water-level and water-quality data tables.

The study area (fig. 1) in Arkansas is bounded on the north by the Missouri State line, on the east by the Tennessee and Mississippi State lines, and on the south by the Louisiana State line. The western boundary is defined as the western extent of the outcrop and subcrop (Hosman, 1982) of the Sparta Sand and the Memphis Sand. Water levels in the aquifer in the Sparta Sand generally correlate with those in the aquifer in the Memphis Sand; therefore, the water-bearing formations are considered to be one hydrologic unit (Stanton, 1997).

Water Use

Water use in the Sparta-Memphis aquifer in Arkansas generally has increased from 1965 to 2000 (fig. 2). In 1965, water use in the Sparta-Memphis aquifer was about 112 million gallons per day (Mgal/d), increasing to 142 Mgal/d in 1970, 144 Mgal/d in 1975, and 185 Mgal/d in 1980 (Halberg, and Stephens, 1966; Halberg, 1972, Halberg, 1977, Holland and Ludwig, 1981). In 1985, water use declined to about 157 Mgal/d (Holland, 1987). Water use in the Sparta-Memphis aquifer was about 223 Mgal/d in 1990 and 284 Mgal/d in 1995 (Holland, 1993, 1999). In 2000, water use in the Sparta-Memphis aquifer was about 287 Mgal/d (Holland, 2004), an increase of about 156 percent from 1965. In 2005, water use in the Sparta-Memphis aquifer declined to about 170 Mgal/d (Holland, 2007).

Water use from the Sparta-Memphis aquifer in 2005 was divided into three primary categories— irrigation, public supply, and industrial. Irrigation used about 61.0 Mgal/d (35.9 percent), public supply used about 58.9 Mgal/d (34.6 percent), and industrial used about 48.0 Mgal/d (28.2 percent). Agriculture and power generation each accounted for less than 1 percent of the water use in the Sparta-Memphis aquifer in Arkansas in 2005. Major pumping centers that use the Sparta-Memphis aquifer for public supply and industry occur in Columbia, Jefferson, and Union Counties. Arkansas, Craighead, Cross, Desha, Lonoke, Monroe, Phillips, and Prairie Counties accounted for the majority of the water withdrawn for irrigation from the Sparta-Memphis aquifer in 2005 (Holland, 2007).

Well-Numbering System

The well-numbering system used in this report is based upon the location of the wells according to the Federal land survey used in Arkansas. The component parts of a well number are the township designation; the range designation; the section number; three-letter designation that indicates, respectively, the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section in which the well is located; and the sequence number of the well in the quarter-quarter-quarter section. The letters are assigned counterclockwise, beginning with “A” in the northeast quarter or quarter-quarter or quarter-quarter-quarter section in which the well is located. For example, well 01S03W04BBD16 (fig. 3) is located in Township 1 South, Range 3 West, in the southeast quarter of the northwest quarter of the northwest quarter of section 4. This well is the 16th well in this quarter-quarter-quarter section of section 4 from which data were collected.

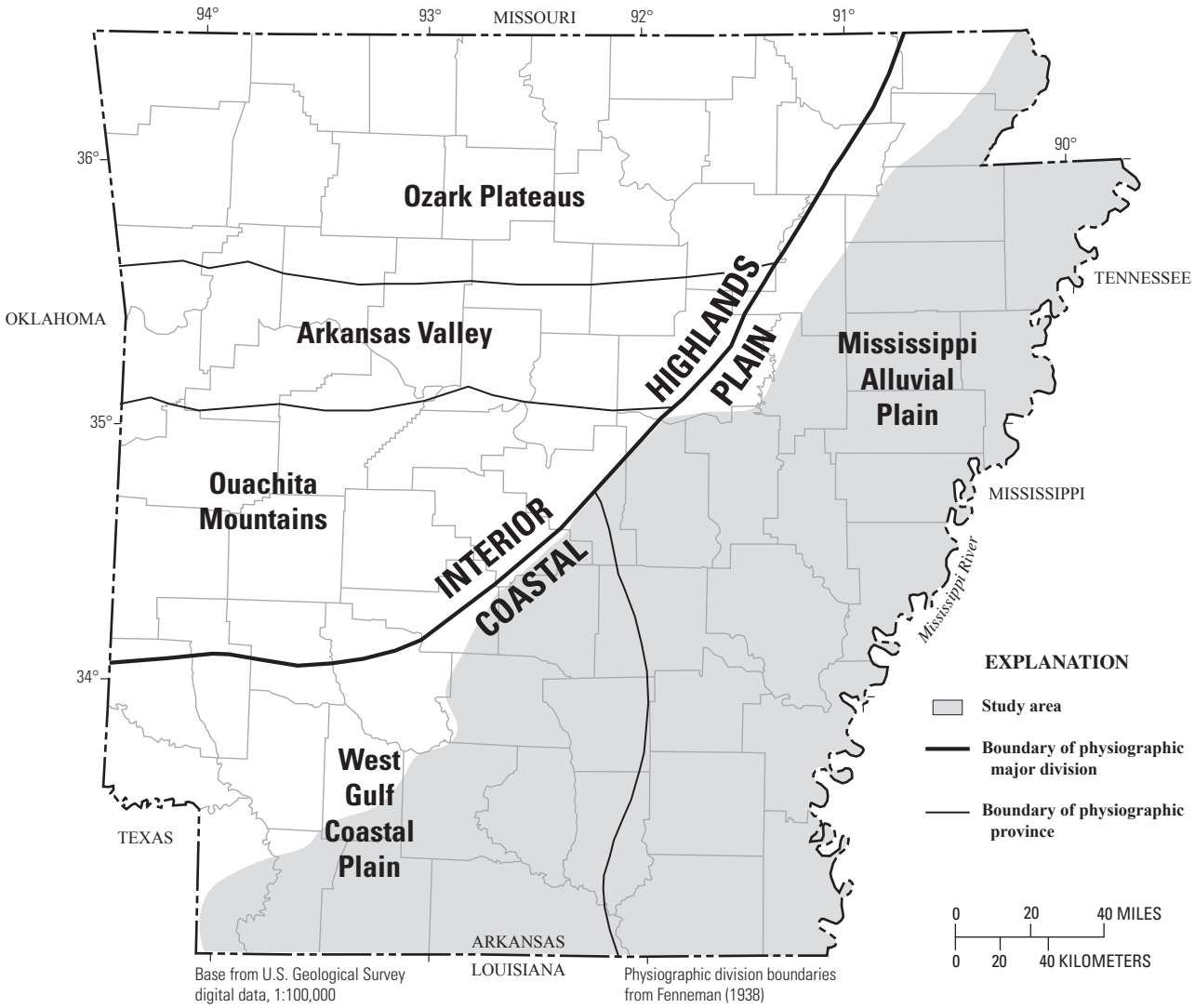

Figure 1. Location of study area.

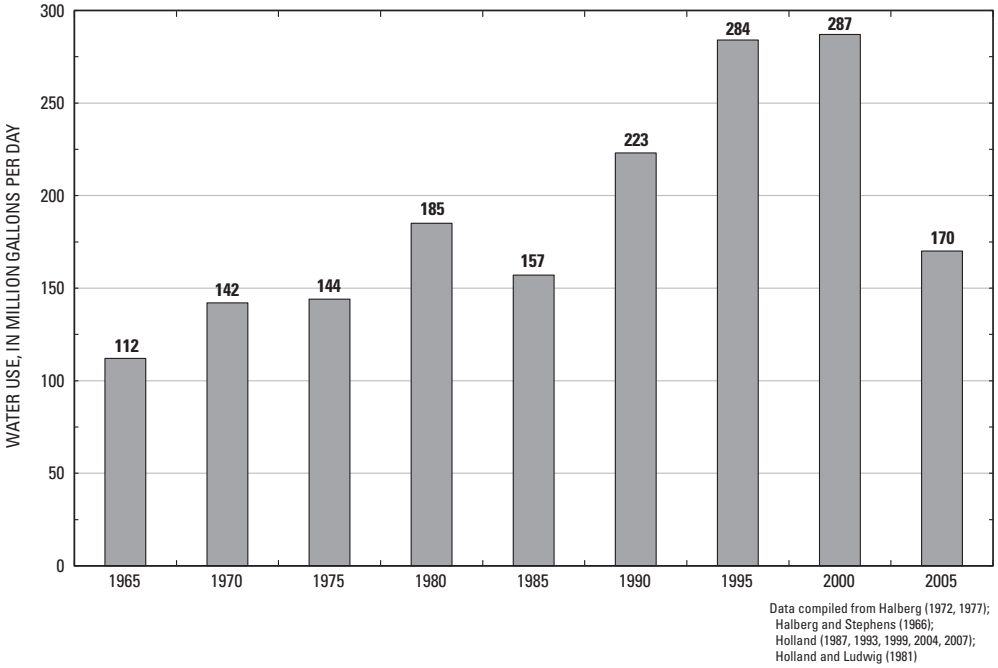

Figure 2. Water use in the Sparta-Memphis aquifer in Arkansas, 1965-2005.

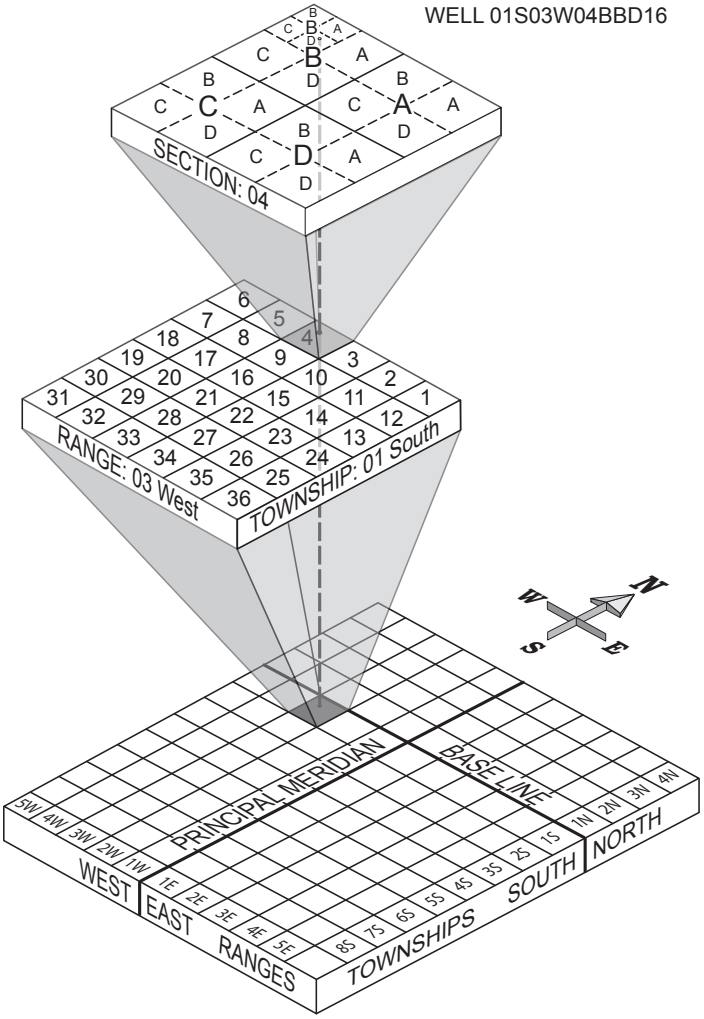

Figure 3. Well-numbering system.

Methods

USGS personnel measured water levels from February 2007 to April 2007 from wells completed in the Sparta-Memphis aquifer. Measurements were made using steel or electric tapes graduated in hundredths of a foot. The steel and electric tapes were calibrated prior to collecting water-level measurements. Calibration was performed by comparing the steel or electric tapes to a standardized steel tape used only for calibration.

Well locations were verified using Global Positioning System (GPS) receivers to acquire the horizontal-coordinate information, latitude and longitude, based on the North American Datum of 1983. The latitude and longitude of the wells in Arkansas were recorded from a GPS receiver accurate to one-tenth of a second of latitude and longitude (approximately 10-20 feet (ft)). The latitude and longitude of the well location were transferred to a topographic map and the altitude of the well (National Geodetic Vertical Datum of 1929) was determined from the topographic contours at the location on the map. Altitude is accurate to about one-half of the contour interval (2.5 to 5 ft) of the topographic map.

Two methods for calculating the annual rise or decline of water levels are used. One method is to take the difference between the final and initial water levels and divide by the period of time. This method uses two measurements and calculated values are dependent solely on the final and initial water levels. A second method uses the linear regression of water levels and time of measurement to calculate the annual rise or decline in water level. Linear regression is more robust because it includes all the measurements to determine the trend line, resulting in a value that is dependent on all water levels during the period of record. The slope, β, of the line is the annual rise or decline in water level. The intercept, β_0, would be the water level in the year 1900, the origin for the graph. This requires the assumption that the pumping rate was constant throughout the period of pumping. This condition is not commonly met or the data are not available to demonstrate this has occurred. The predevelopment water level will not be discussed as this condition can not be demonstrated. The R^2 term is the coefficient of determination, correlation coefficient, or the fraction of variance explained by the regression. The R^2 value gives the proportions of the total variability that can be accounted by the independent variable (Helsel and Hirsch, 1992). Values of R^2 can range from 0.00 to 1.00. A large value of R^2 can indicate a linear change in water level. A low value of R^2 can indicate a sporadic change in water level.

Five assumptions are associated with linear regression: (1) Y is linearly related to X, (2) data used to fit the linear regression are representative of data of interest, (3) variance of the residuals is constant and does not depend on X or on anything else, (4) the residuals are independent, and (5) the residuals are normally distributed. The assumption of a normal distribution is involved only when testing hypotheses, requiring the residuals from the regression equation to be normally distributed (Helsel and Hirsch, 1992).

Water-quality samples were collected for specific-conductance, temperature, and chloride analysis using the procedures described in the “National Field Manual for the Collection of Water-Quality Data” (U.S. Geological Survey, variously dated). Wells were purged a minimum of three-casing volumes. During the well purge, specific conductance and temperature were monitored until measurements stabilized. If the specific conductance and temperature were fluctuating after three volumes, the well purge continued until specific-conductance and temperature values stabilized to ensure a representative sample. Chloride samples were analyzed by the USGS National Water Quality Laboratory. The analytical method was an ion-exchange chromatography, lab schedule 1571, method code IC022 (Fishman and Friedman, 1989).

Specific-conductance data were measured from selected wells using specific-conductance meters with temperature compensation. Specific-conductance meters were calibrated twice daily by comparing the measurement of two specific conductance calibration standards. Specific conductance is a measure of the electrical conductance of a solution. As the dissolved-solids concentration in groundwater increases, specific conductance increases. Most of the wells sampled were public supply and industrial wells.

Sparta-Memphis Aquifer

The Sparta-Memphis aquifer is a hydrologic unit within the Mississippi Embayment aquifer system that covers parts of seven states. Water use from the aquifer is large in four states: Arkansas, Louisiana, Mississippi, and Tennessee. Three states, Alabama, Kentucky, and Missouri, withdraw smaller amounts of water from the aquifer. Within the Mississippi Embayment the name for the Sparta-Memphis aquifer can vary depending on the location, which may include the Sparta Sand, Memphis Sand, 500-foot Sand, and the Lisbon Formation. The name used in the Mississippi Embayment aquifer system is the middle Claiborne aquifer (Hart and others, 2008).

The Sparta Sand and Memphis Sand (table 1) of Eocene age mainly consist of fine to medium sand in Arkansas. Some silt, clay, and lignite occur in the upper part of the Sparta Sand and Memphis Sand. Sands in the Sparta Sand were deposited by shifting streams on a deltaic-fluvial flood plain (Payne, 1968). These sands mostly are interconnected, but separately identifiable sands can be traced for short distances (Snider and others, 1972). The Cook Mountain Formation of Claiborne Group overlies the Sparta Sand and Memphis Sand and serves as an upper confining unit (table 1). The permeable units of the Sparta Sand and the Memphis Sand compose the Sparta and Memphis aquifers. In this report, the aquifers are referred to as the Sparta-Memphis aquifer throughout the study area.

Table 1. Stratigraphic correlation of the northern and southern parts of Arkansas for the study area.

[Modified from Hosman and Weiss, 1991]

Epoch	Group	Formations in the southern part of Arkansas	Formations in the northeastern part of Arkansas
Eocene	Jackson	Undifferentiated	Undifferentiated
	Claiborne	Cockfield Formation	Cockfield Formation
		Cook Mountain Formation	Cook Mountain Formation
		Sparta Sand	Memphis Sand
		Cane River Formation	
		Carrizo Sand	
Upper Paleocene	Wilcox	Undifferentiated	Flour Island Formation
			Fort Pillow Sand
			Old Breastworks Formation

The Sparta Sand is composed of a sequence of alternating sand and clay beds between the massive clays of the overlying Cook Mountain Formation of Claiborne Group and the underlying Cane River Formation of Claiborne Group confining units (Hosman and others, 1968) shown in table 1. The Sparta Sand is in the southern part of the study area (south of about 35 degrees latitude, plate 1) where the Cane River Formation of Claiborne Group is composed predominantly of clay. The Memphis Sand is in the northern part of the study area (north of about 35 degrees latitude), and the Cane River Formation of Claiborne Group or equivalent facies is composed predominantly of sand. Moving south to north in the area, the Cane River Formation undergoes a facies change northward at about 35 degrees latitude, and the marine clays become sand. The transitional zone of interfingering sands and clays is narrow. The northern sand facies of the Cane River Formation is the middle part of the Memphis Sand (Hosman and others, 1968). In the southern area, the Claiborne Group is subdivided into the Carrizo Sand, Cane River Formation, Sparta Sand, Cook Mountain Formation, and the Cockfield Formation (table 1). The equivalent section in the northern area is subdivided into the Memphis Sand, the Cook Mountain Formation, and the Cockfield Formation. The Memphis Sand in the northern area is equivalent to the Carrizo Sand, the Cane River Formation, and the Sparta Sand in the southern area. The Memphis Sand is underlain by a thick layer of clay in the upper part of the Wilcox Group (Hosman and others, 1968).

The Sparta Sand and Memphis Sand generally thicken and groundwater increases in salinity as depth increases to the southeast. The Sparta Sand is 50 to 200 ft thick within the outcrop area (along the western limit) and thickens easterly to nearly 900 ft. The Sparta Sand contains freshwater throughout most of its extent in Arkansas. However, saltwater is present in the extreme southeastern part of the State in parts of Ashley, Chicot, and Union Counties (Payne, 1968).

Water Levels

Water-level measurements in wells screened in the Sparta-Memphis aquifer (appendix 1) were used to produce a regional potentiometric-surface map (plate 1), water-level difference map (plate 2), and hydrographs (fig. 4). Water levels measured during the spring of 2007 were subtracted from water levels measured during the spring of 2003 at selected Sparta-Memphis aquifer wells (appendix 2) and were used to create the water-level difference map. Data from 157 wells that have water-level measurements with a minimum 25-year period of record were used to produce hydrographs compiled by county; hydrographs for 24 of the wells are shown in figure 4.The water levels shown in the hydrographs indicate long-term changes in hydrologic conditions. Long term water-level declines shown in the hydrographs reflect the development of the depressions on the potentiometric surface.

Potentiometric-Surface Map

A potentiometric-surface map was constructed using 309 water-level measurements from wells completed in the Sparta-Memphis aquifer. Hydrologic principles, water-use data, and historical information were interpreted with the water-level data to delineate the potentiometric-surface contours. The number and location of wells used to construct potentiometric-surface maps differ from year to year. The combined information will result in variations and similarities in potentiometric contours that define the surface depicted on the maps produced in different years.

The potentiometric-surface map of the Sparta-Memphis aquifer shows the altitude of which water would have stood in tightly cased wells completed in the aquifer (plate 1). The map is based upon water-level data collected in 309 wells (appendix 1) in the Sparta-Memphis aquifer during the spring of 2007. 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 water-level altitude. The general direction of groundwater flow in the Sparta-Memphis aquifer is perpendicular to the contours in the direction of decreasing hydraulic gradient.

The natural direction of flow, which historically was eastward and then southward, in the Sparta-Memphis aquifer is altered in areas by large groundwater withdrawals. The regional direction of groundwater flow in the Sparta-Memphis aquifer in 2007 is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large groundwater withdrawals. The highest water-level altitude measured in Sparta-Memphis aquifer was 326 ft above NGVD of 1929, located in Grant County in the outcrop at the western boundary of the study area; the lowest water-level altitude was 161 ft below NGVD of 1929 in Union County (appendix 1) near the southern boundary of the study area. The water level at this well in Union County was 14 ft higher than in 2005 (Schrader, 2006).

Eight cones of depression (generally represented by closed contours) are located in the following counties: Bradley, Drew, and Ashley; Calhoun; Cleveland; Columbia; Crittenden; Arkansas, Jefferson, and Lincoln; Cross and Poinsett; and Union. Cones of depression usually are caused by withdrawals rates that exceed the recharge rates within the aquifer over an extended period of time. When a well is pumped, the water level in and around the well declines, creating a depression in the potentiometric surface. Groundwater flows toward the depression at a rate that is proportional to the slope of the depression and the transmissivity of the aquifer; if withdrawal rates exceed the recharge rates to the aquifer, the area of the declining water level expands to form a cone of depression.

Two large cones of depression, centered in Jefferson and Union Counties, are the result of large withdrawals for industrial and public supplies. The cone of depression centered in Jefferson County has deepened and expanded in recent years into Arkansas and Prairie Counties as a result of large withdrawals for irrigation and public supply. This depression is approximately 5 ft shallower in 2007 than in 2005 (Schrader and Jones, 2007). The area enclosed within the 40-ft contour on the 2007 potentiometric-surface map has expanded when compared with the 2005 potentiometric-surface map. The 40-ft contour has extended further east into Arkansas County and further south into Lincoln County. The depression in Union County is roughly circular within the -60-ft contour. In 2003, this depression was elongated east and west and beginning to coalesce with the depression in Columbia County. Decreasing withdrawals in Columbia and Union Counties have resulted in a separation of these two depressions.

The deepest measured water level in the center of the depression in Union County during 2007 has risen 38 feet since 2003. The location of the deepest water level can vary through time. Changes in pumping rates and well efficiency can affect the location of the deepest water level. The deepest measurement in 2007 is from a different well than the deepest measurement in 2003. On the 2005 potentiometric-surface map, the area enclosed by the deepest contour, 180 ft below NGVD of 1929, is not evident on the 2007 potentiometric-surface map. The area enclosed by the deepest contour, 160 ft below NGVD of 1929, on the 2007 potentiometric-surface map is less than 10 percent of the area on the 2005 potentiometric-surface map (Schrader and Jones, 2007). The depression in Union County has receded from Union Parish, Louisiana. The -100-ft contour had extended into Union Parish on the 2001 potentiometric-surface map (Schrader, 2004). The -60-ft contour on the 2007 potentiometric-surface map is near the Arkansas-Louisiana State border.

A broad depression in western Poinsett and Cross Counties was first shown in the 1995 potentiometric-surface map (Stanton, 1997) and has been variable in size since 1995. The depression expanded in area in 1997 and 1999, and then decreased in area in 2003 and 2005. In 1995, this depression was enclosed within the 150-foot contour in the southwestern corner of Poinsett County. In 1997, the depression covered most of the western half of Poinsett County (Joseph, 1998). In 1999 and 2001, the depression extended from Poinsett County through Cross County into St. Francis County (Joseph, 2000; Schrader, 2004). In 2003, the depression covered most of the western half of Poinsett County (Schrader, 2006). In the 2005 potentiometric-surface map, the depression covers part of western Poinsett County and extends into northwestern Cross County. In the 2007 potentiometric-surface map, the 140-ft contour has expanded to the largest area, extending north to the Poinsett-Craighead County line, further east, and the farthest extent south into Cross County.

Unlike other depressions, the depression in Poinsett and Cross Counties is caused by withdrawals for irrigation, instead of withdrawals for public supply and industrial uses. The Mississippi Embayment Regional Aquifer Study project has identified an area near Poinsett and Cross Counties where the Sparta-Memphis aquifer and the Mississippi River Valley alluvial aquifer (herein referred to as the alluvial aquifer) are hydrologically connected. Borehole geophysical logs show

that the Jackson Formation, the unit that underlies the alluvial aquifer; the Cockfield Formation of Claiborne Group; and the Cook Mountain Formation of Claiborne Group, the unit that confines the Sparta-Memphis aquifer are absent in this area (Rheannon M. Hart, U.S. Geological Survey, written commun., 2007). Irrigation withdrawals from the alluvial aquifer have resulted in water-level declines in the Sparta-Memphis aquifer (Schrader, 2008).

Five other depressions are shown on the 2007 potentiometric surface. The depression in Columbia County was first shown on the 1996-97 potentiometric-surface map (Joseph, 1998). An initial perception of this depression on the 2007 potentiometric-surface map is that the area has greatly decreased, with water levels rising about 21 ft since 2005 in the well with the deepest measurement. Further investigation revealed that fewer data points were collected in 2007 in this area. The two sites that historically had the deepest water levels were not measured in 2007; therefore, the apparent changes in this depression may be the result of the distribution and number of data points in 2007. The depression in Calhoun County was first shown on the 1999 potentiometric-surface map (Joseph, 2000). The area and depth remained reasonably consistent from 2001 to 2005 (Schrader, 2004, 2006; Schrader and Jones, 2007). This depression has expanded and deepened on the 2007 potentiometric-surface map. The depression in Bradley, Drew, and Ashley Counties was not evident on previous potentiometric-surface maps. The depression shown in eastern Crittenden County is the western edge of the cone of depression in western Tennessee (Schrader, 2008). The depression in Cleveland County was first shown on the 2003 potentiometric-surface map (Schrader, 2006). This depression has deepened from 24 to 18 ft above NGVD of 1929 from 2003 to 2007. The area enclosed by the 40-ft contour has remained reasonably consistent from 2003 to 2007.

Water-Level Difference from 2003 to 2007

A water-level difference map (plate 2) was constructed using the difference between water-level measurements made during 2003 and 2007 from 283 wells (appendix 2). The difference in water level was calculated by subtracting the 2007 depth-to-water level from the 2003 depth-to-water level. Negative values indicate a decline and positive values indicate a rise in water level. Rises in the water level are indicated on plate 2 with blue triangles pointing upward; declines in the water level are indicated with red triangles pointing downward. Triangles are scaled to the relative value of the rise or decline. Water-level differences do not necessarily indicate a long-term water-level trend, but are intended to show where water levels have increased or decreased from 2003 to 2007.

The difference in water level between 2003 and 2007 ranged from -49.8 to 60.0 ft. The largest measured rise (60.0 ft) in water level was in Union County. The largest measured decline (-49.8 ft) in water level was in Lincoln County. Areas with a general rise in water levels occur in northern Arkansas County, central Columbia County, southern Jefferson County, and most of Union County (plate 2). The inset area on plate 2 shows a more detailed view of part of Union County. In the area around west-central Union County (plate 2), water levels in 15 wells rose 20 ft or more, which is an average annual rise of 5 ft or more. The rising water level around west-central Union County coincides with water conservation measures initiated in 1999 and the conversion of large industrial groundwater users to surface water from the Ouachita River beginning in December 2004 (Freiwald and Johnson, 2008). Water levels generally declined throughout most of the Sparta-Memphis aquifer.

Long-Term Hydrographs

Hydrographs from 157 wells were constructed with a minimum of 25 years of water-level measurements. Selected hydrographs are shown in figure 4 with locations indicated on plate 1. The minimum 25-year period of record is used to evaluate long-term trends not dominated by variations in climate and localized pumping rates on water levels in a single well. A trend line using linear regression was calculated for the period from 1983 to 2007 to determine the slope in feet per year (ft/yr) for water levels in each well. The slope of the trend line represents the typical annual decline or rise in water level during the 25-year period. A statistical summary of the number of wells, the range of the annual rise or decline in water level for the county, the mean, the median, and the range of the R2 values for each county are listed in table 2. Negative values denote a decline in water level.

During the period 1983-2007, county mean annual water levels generally declined. The county mean annual water level rose in Calhoun, Columbia, Hot Spring, and Lafayette Counties (table 2). Mean annual declines were between 0.5 ft/yr and 0.0 ft/yr in Crittenden, Dallas, Grant, Monroe, Ouachita, Phillips, and Woodruff Counties. Mean annual declines were between 1.0 ft/yr and 0.5 ft/yr in Craighead, Cross, Desha, Drew, and Union Counties. Mean annual declines were between 1.5 ft/yr and 1.0 ft/yr in Arkansas, Bradley, Cleveland, Jefferson, Poinsett, and Prairie Counties. The mean annual decline for Lincoln County was 2.11 ft/yr. The data set for Lincoln County wells was skewed by a single well having an annual decline of 4.38 ft/yr. The median annual decline for Lincoln County was 1.48 ft/yr.

Water levels in the Sparta-Memphis aquifer may change substantially throughout the year. In western Arkansas County, hydrograph B (fig. 4, plate 1) shows a 2-year period of daily water levels. In September 2006, a transducer was installed at this site to collect hourly water levels. These data are transmitted four times a day for display on the USGS water data web site (http://waterdata.usgs.gov). The hydrograph shows about a 60-ft seasonal change in water level for both years shown. The period of the 60-ft decline in water level coincides with the spring-summer irrigation season.

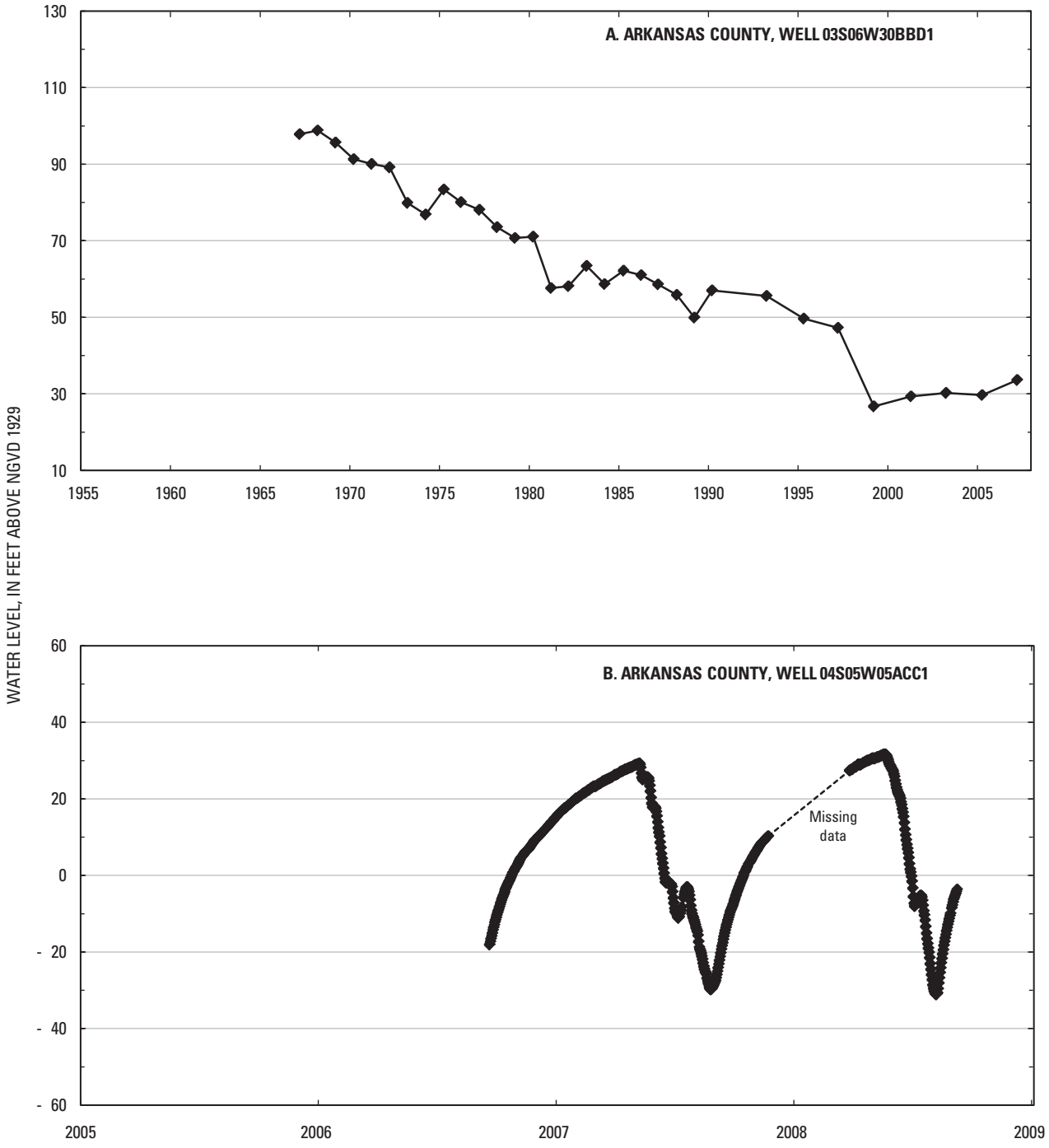

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.

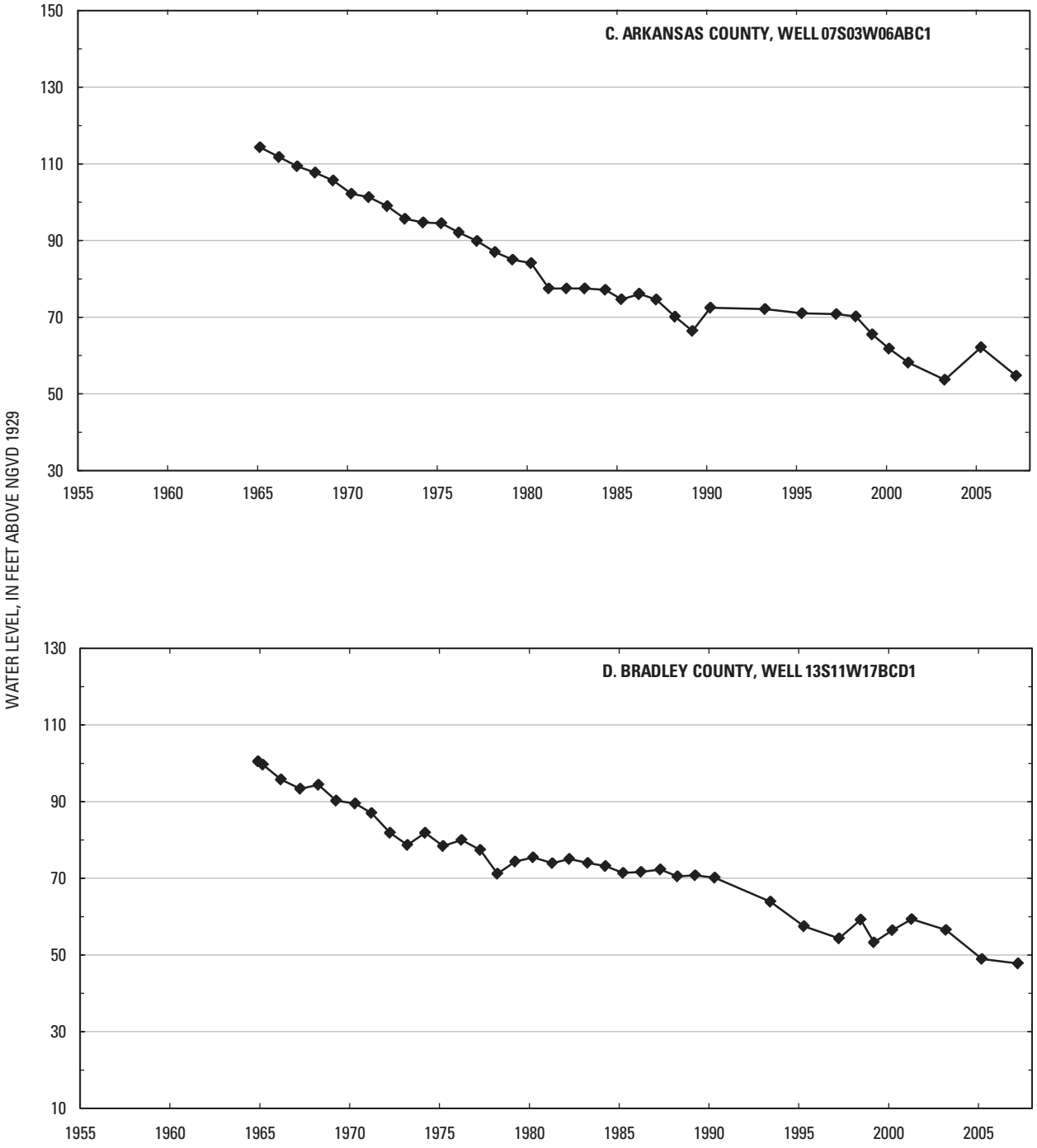

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

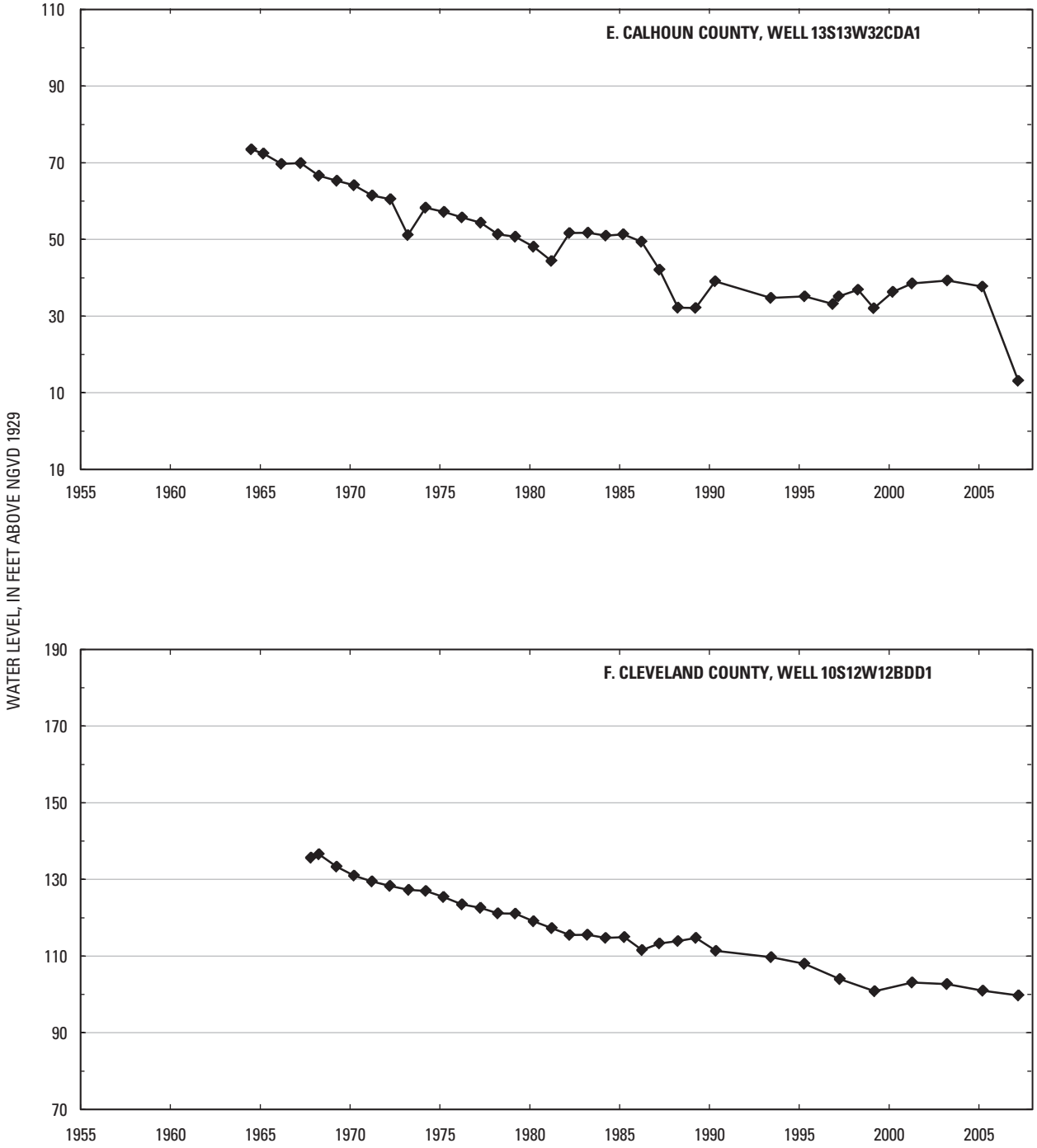

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

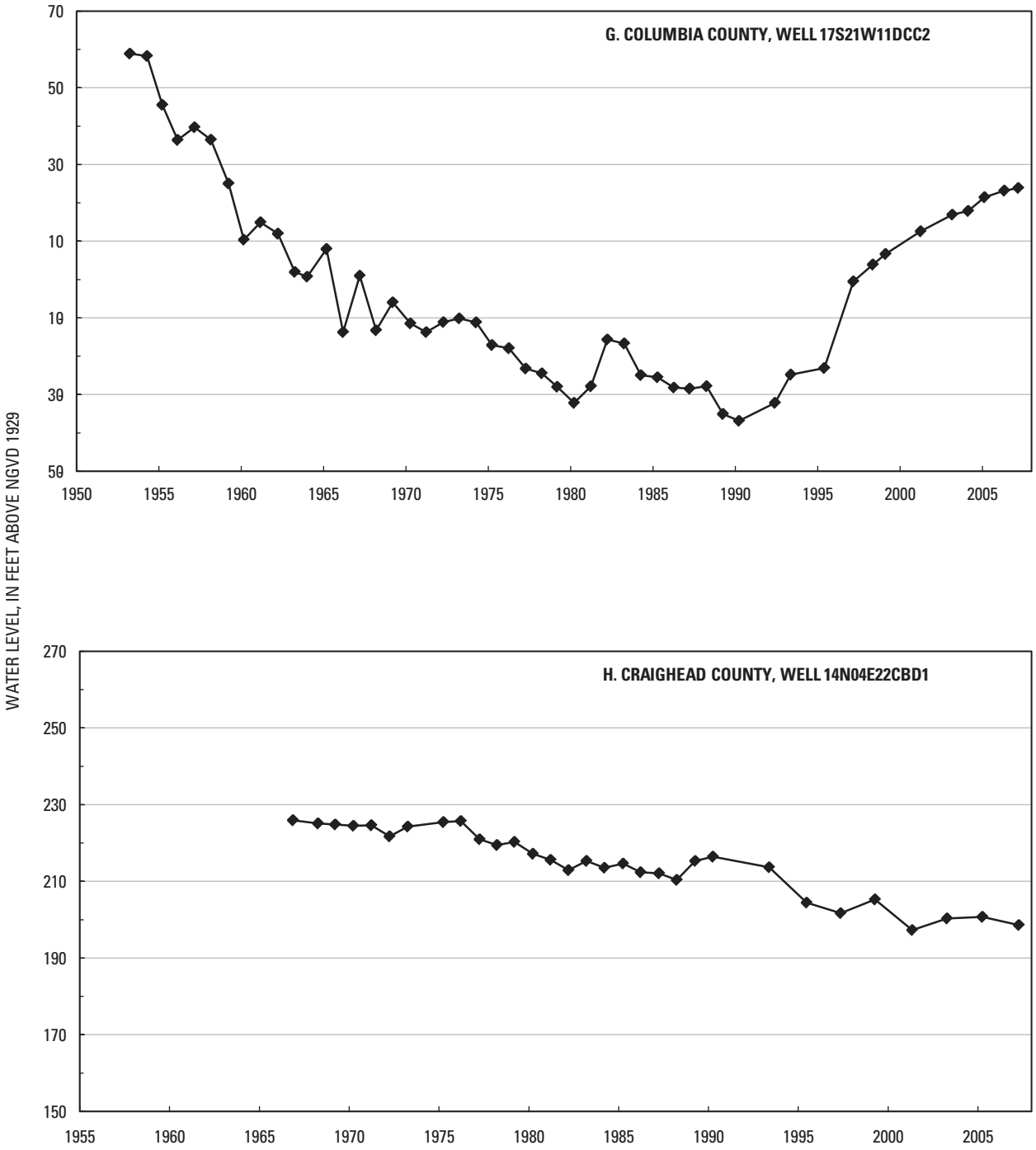

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

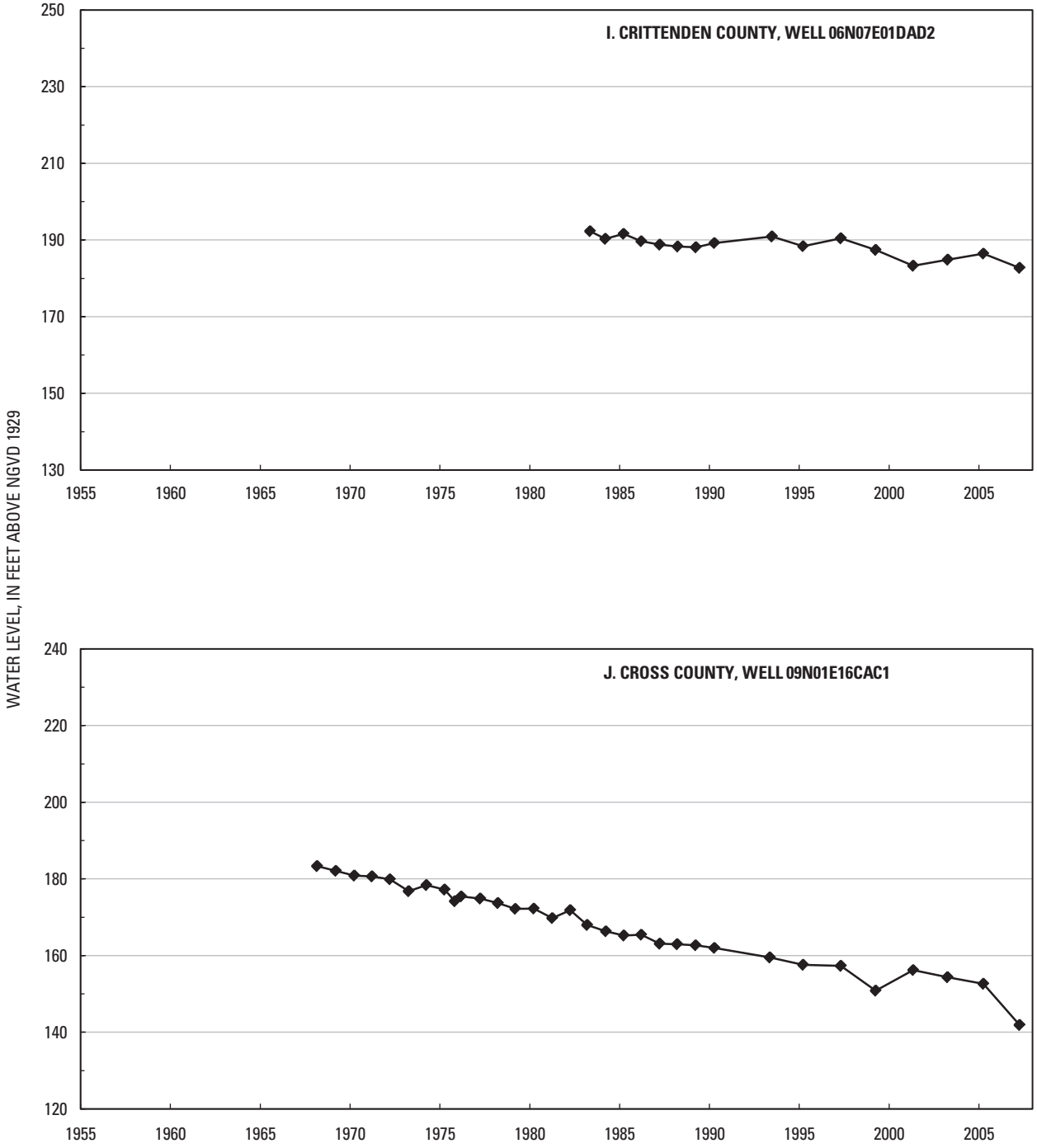

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

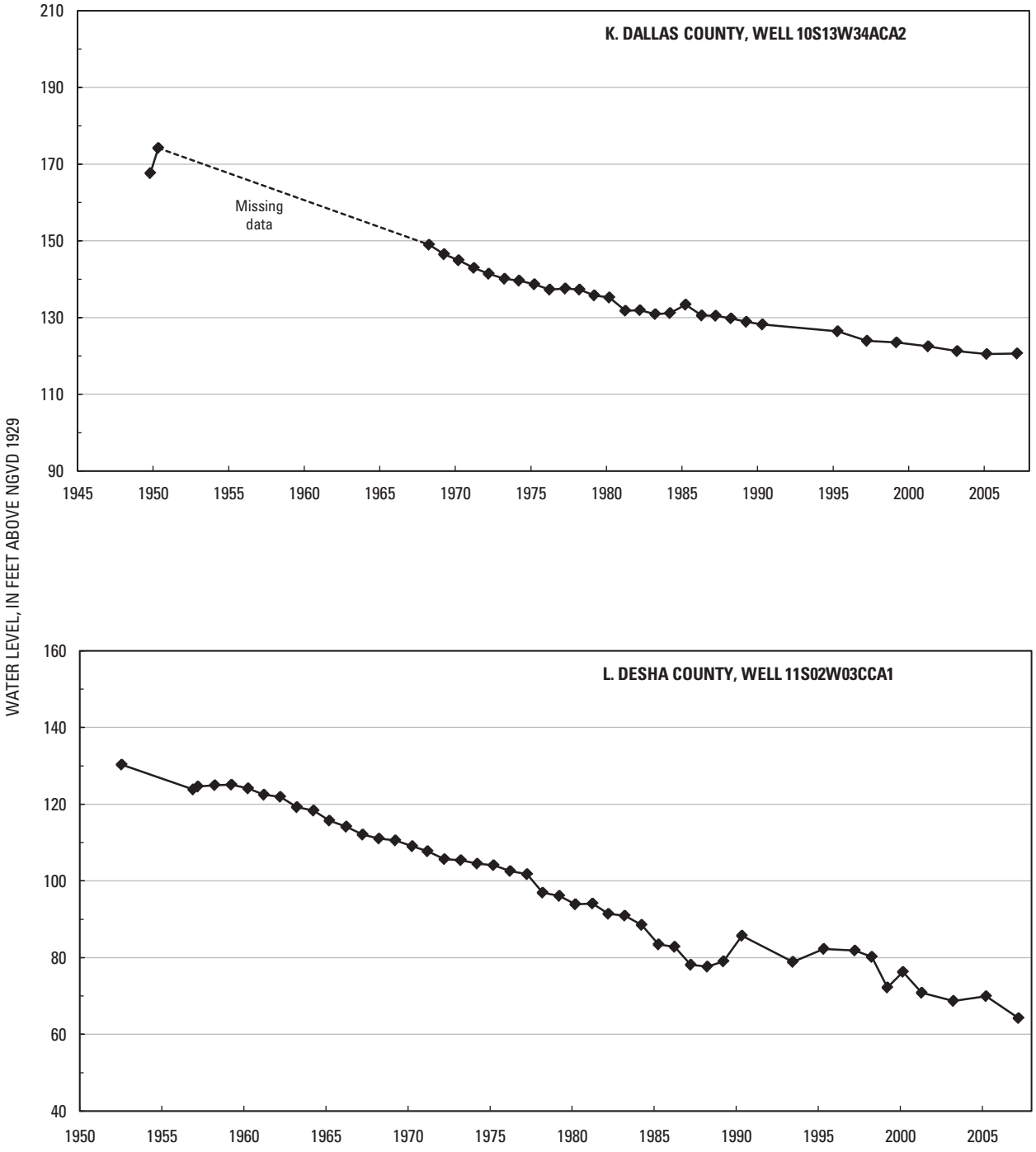

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

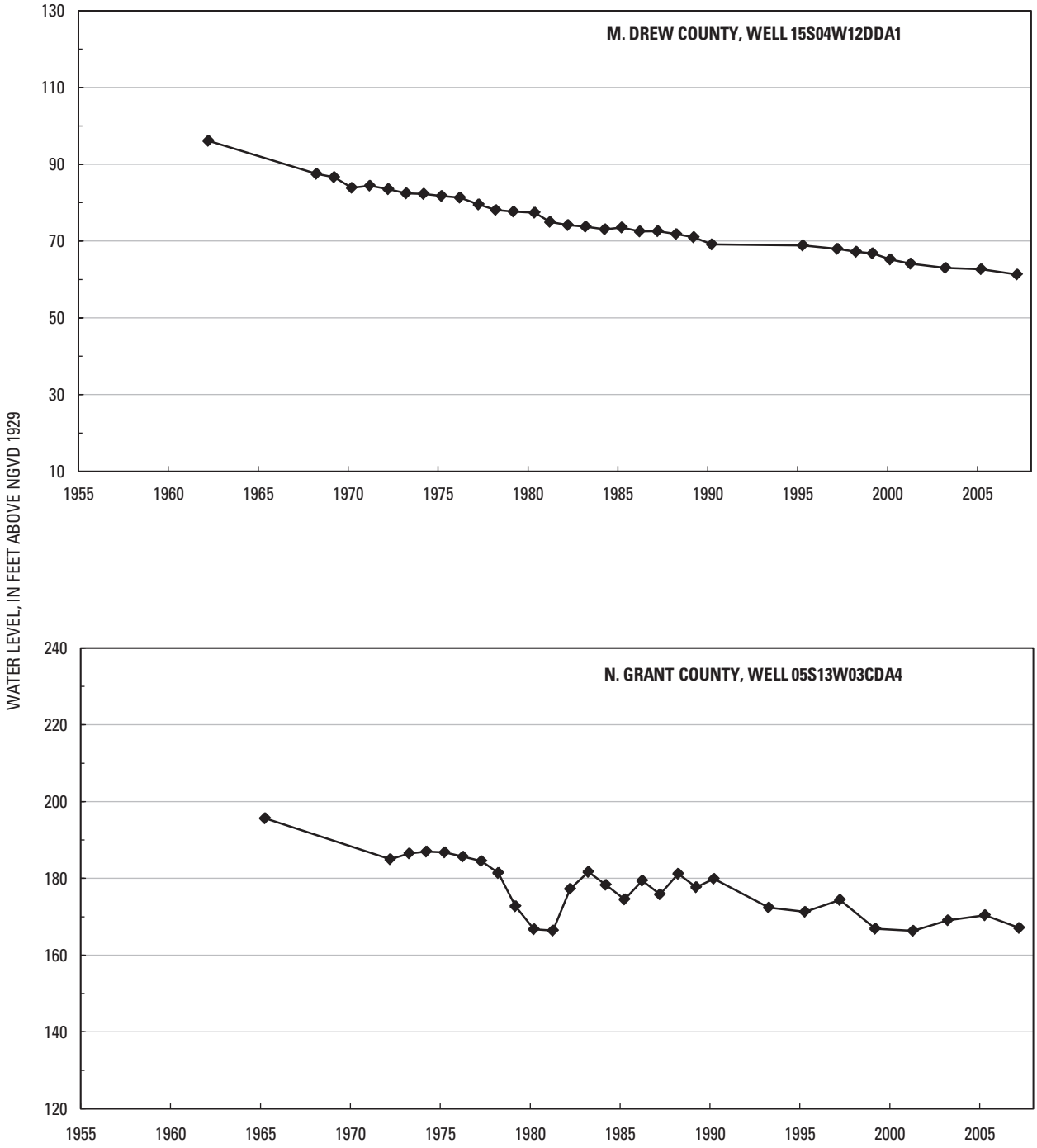

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

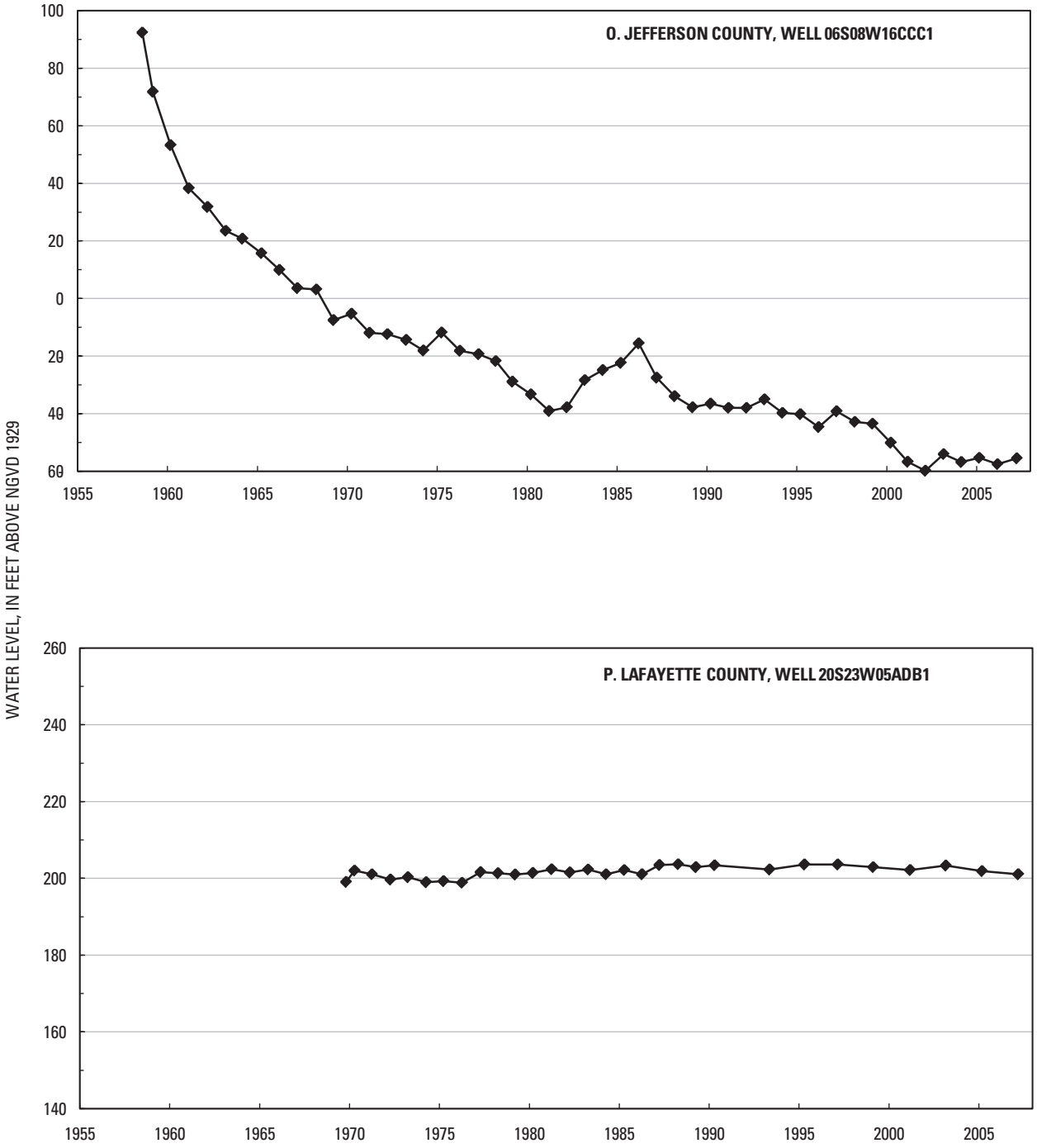

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

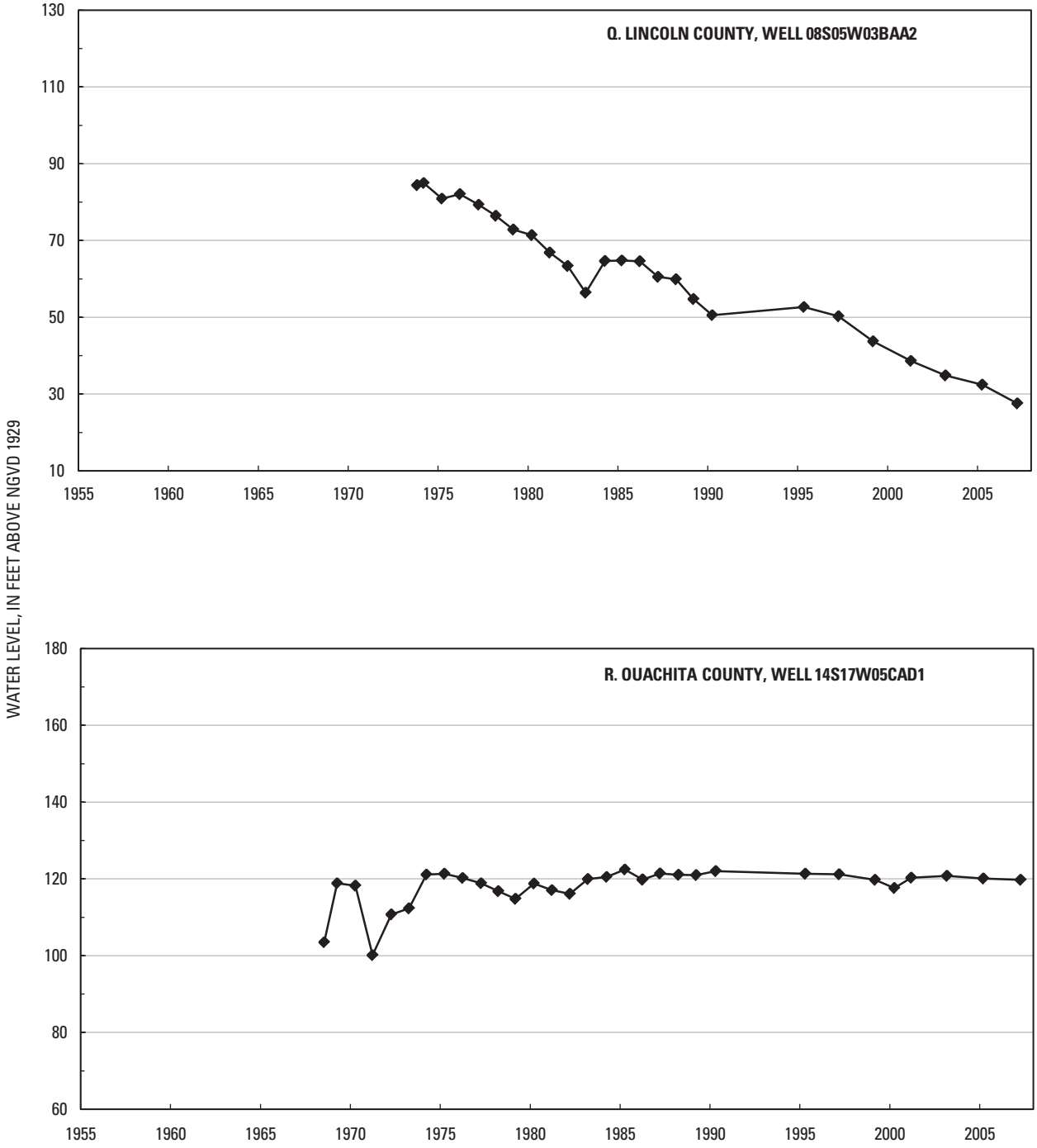

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

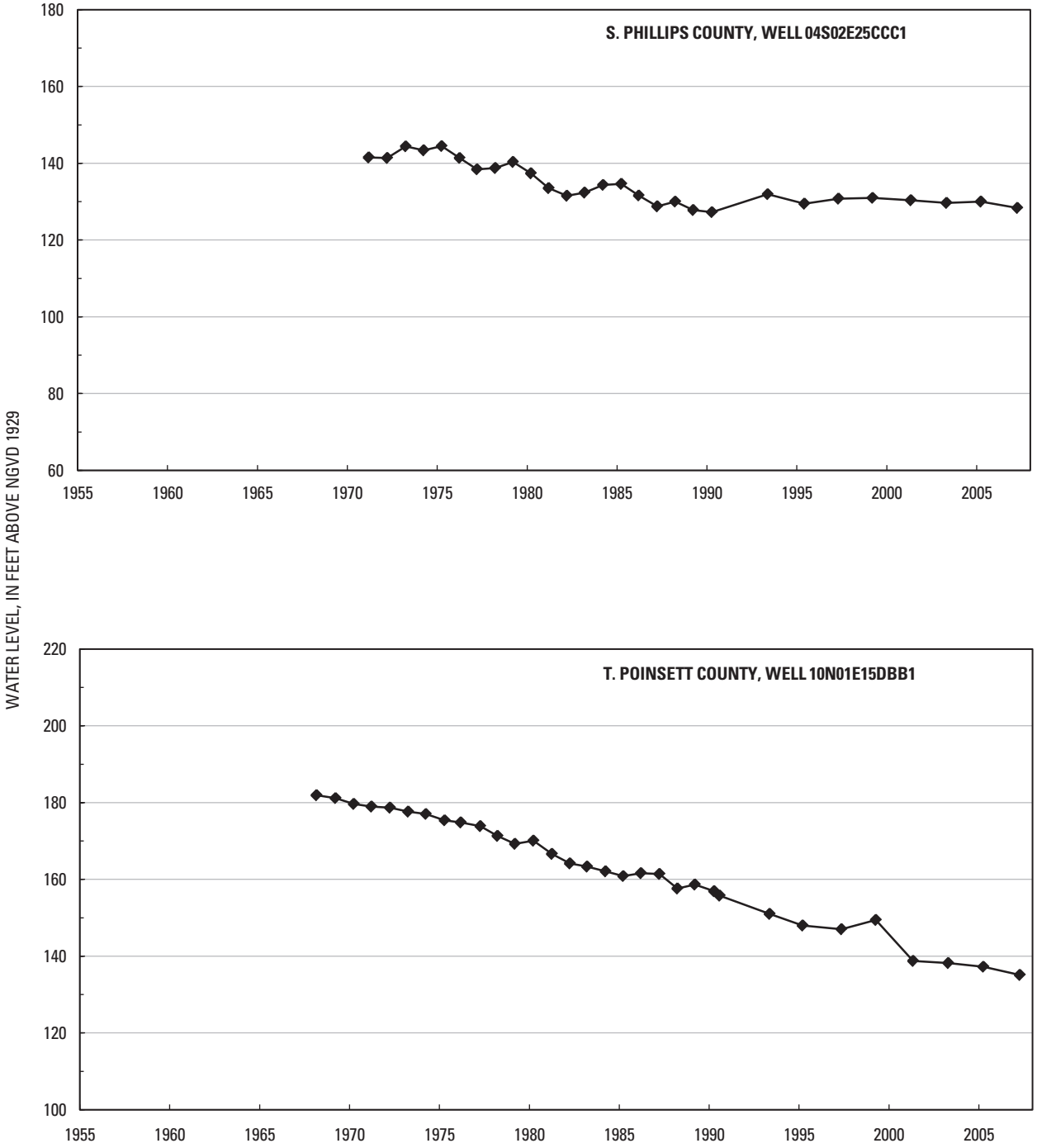

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

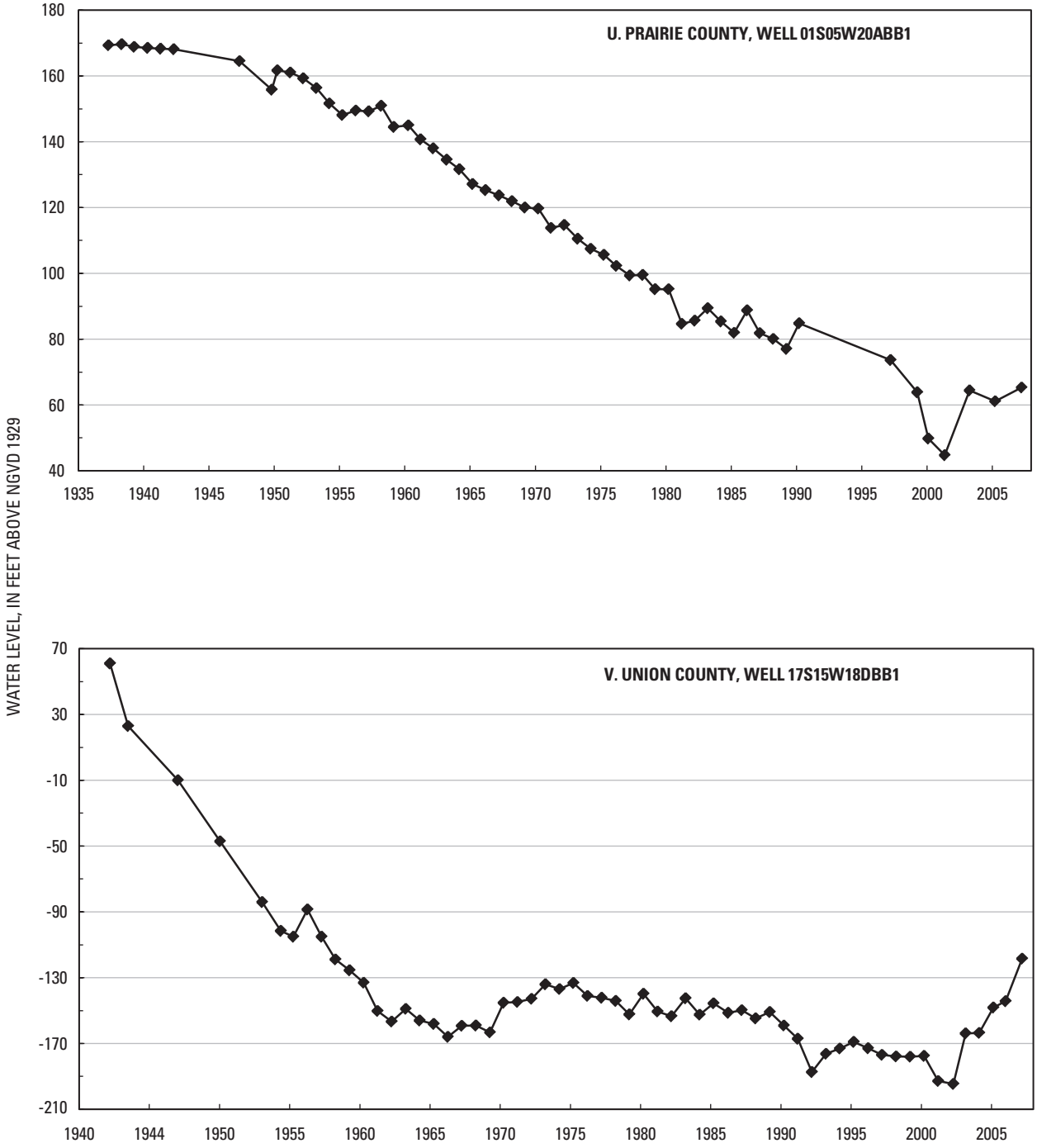

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

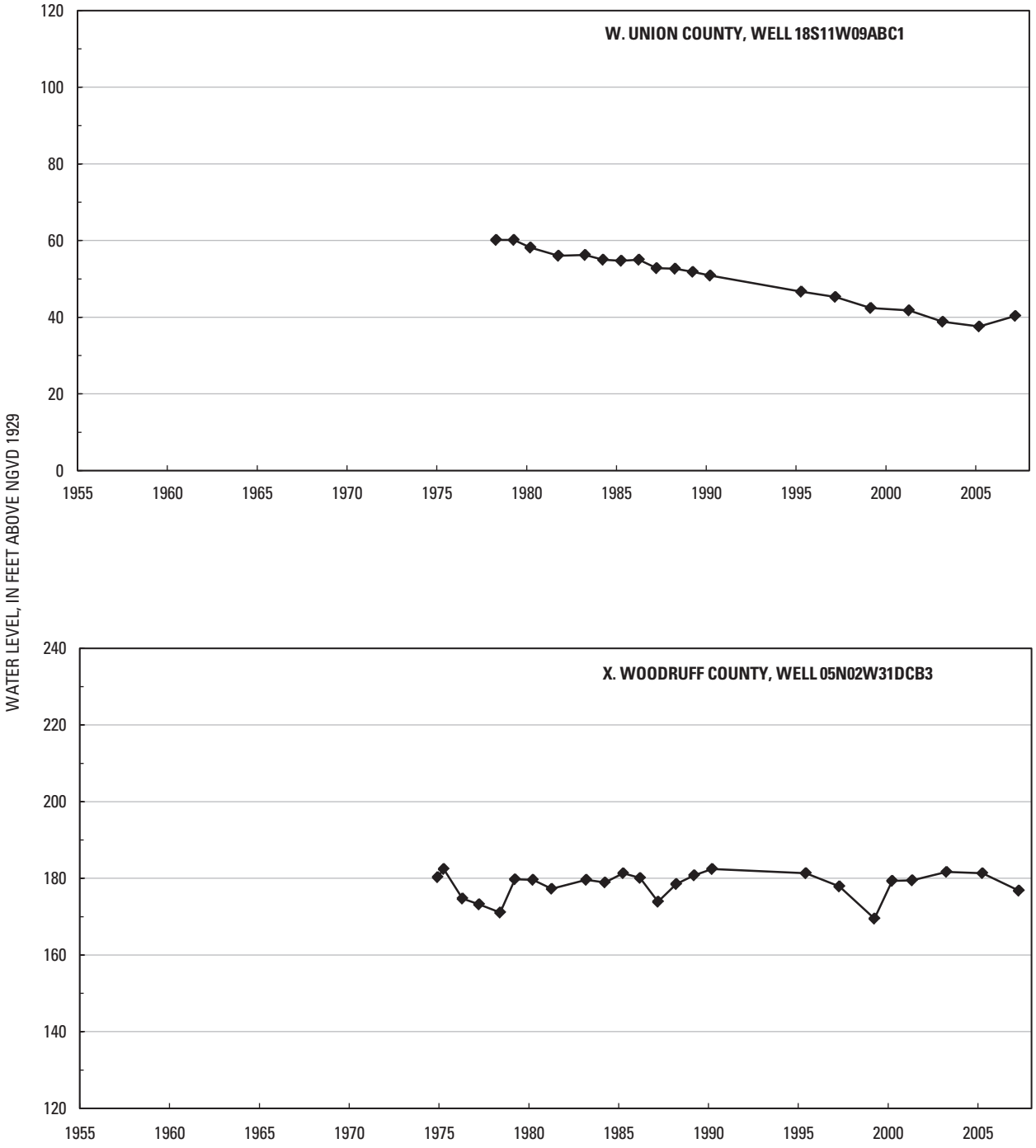

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas. Well location listed in appendix 1.—Continued

Table 2. Statistical summary of annual rise-decline in water level by county for wells in the Sparta-Memphis aquiifer, 1983-2007.

[Annual rise or decline in water level for each well is calculated using linear regression; negative value indicates decline; positive value indicates rise]

County	Number of wells	Range of annual rise-decline in water level (feet/year)	Mean annual rise-decline in water level (feet/year)	Median annual rise-decline in water level (feet/year)	Range of R^2 values for trend line
Arkansas	23	-2.25 to 0.18	-1.15	-1.28	0.50 to 0.88
Bradley	4	-1.61 to -0.77	-1.26	-1.33	0.38 to 0.97
Calhoun	2	-0.84 to -0.80	0.82	0.82	0.48 to 0.77
Cleveland	3	-1.79 to -0.73	-1.11	-0.80	0.90 to 0.92
Columbia	8	-0.58 to 2.52	0.24	-0.18	0.11 to 0.80
Craighead	3	-0.80 to -0.03	-0.53	-0.77	0.73 to 0.81
Crittenden	4	-0.29 to 0.07	-0.16	-0.20	0.11 to 0.66
Cross	4	-1.28 to -0.69	-1.00	-1.00	0.68 to 0.94
Dallas	7	-0.51 to 0.15	-0.23	-0.22	0.14 to 0.97
Desha	5	-1.61 to -0.69	-0.91	-0.73	0.37 to 0.92
Drew	5	-0.91 to -0.37	-0.62	-0.51	0.83 to 0.98
Grant	6	-1.46 to -0.07	-0.50	-0.38	0.18 to 0.93
Hot Spring	1	0.15	0.15	0.15	0.41
Jefferson	14	-2.15 to -0.47	-1.27	-1.26	0.37 to 0.89
Lafayette	2	0.00 to 0.07	0.04	0.04	0.04
Lincoln	6	-4.38 to -1.13	-2.11	-1.48	0.42 to 0.94
Monroe	3	-0.95 to 0.80	-0.11	-0.18	0.20 to 0.87
Ouachita	9	-1.06 to 0.84	-0.06	-0.01	0.12 to 0.92
Phillips	6	-0.73 to 0.47	-0.29	-0.44	0.18 to 0.95
Poinsett	2	-1.24 to -0.88	-1.02	-1.02	0.68 to 0.95
Prairie	9	-1.61 to -0.29	-1.23	-1.31	0.11 to 0.97
Union	30	-1.57 to 2.52	-0.66	-0.84	0.12 to 0.97
Woodruff	1	-0.04	-0.04	-0.04	0.71

Water-Quality Conditions

Water samples were collected in the summer of 2007 from 129 Sparta-Memphis wells and measured onsite for specific conductance and temperature. Samples were collected from 102 wells for dissolved chloride analysis at the USGS National Water Quality Laboratory (appendix 3).

Specific-conductance data indicate regionally diverse zones of mineralized water across the study area (plate 3). Specific conductance ranged from 35 microsiemens per centimeter at 25 degrees Celsius (µS/cm) in Ouachita County to 1,280 µS/cm at two wells in Monroe County. The mean specific conductance was 398 µS/cm and the median specific conductance was 334 µS/cm. Dissolved chloride concentrations ranged from 1.2 milligrams per liter (mg/L) in Lincoln County to 308 mg/L in Monroe County. The mean chloride concentration was 28.6 mg/L and the median chloride concentration was 8.7 mg/L. Along the western border of the Sparta-Memphis aquifer near the outcrop area, specific conductance is low—generally less than 200 µS/cm. Specific conductance generally increases to the east and south. Recharge occurs within the outcrop, subcrop, and from infiltration of overlying or underlying formations into the Sparta-Memphis aquifer. As water flows through the Sparta-Memphis aquifer, chemical interactions (mineralization) occur with the sediment of the aquifer. The chemical interactions may cause changes in water quality. The residence time of the water within the aquifer will increase along the flow direction from the recharge area causing increased specific conductance and chloride concentrations. This gradual increase of specific conductance continues south to the Louisiana State line.

Although there is a regional increase in specific conductance to the east and south, anomalous increases occur in some parts of the study area. Relatively large specific conductance values (greater than 700 µS/cm and less than 1,300 µS/cm) occur in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties. Morris and Bush (1986) and Broom and others (1984) cited upward leakage of saltwater from the Nacatoch aquifer of Cretaceous age into the Sparta aquifer through a fault or abandoned oil and gas wells as possible explanations for these anomalies. Large specific conductance values occur near the water-level cone of depression (plate 1) in Union County and increase eastward toward Ashley County. This increase in specific conductance may be because of leakage of water with greater conductance from an underlying aquifer. A previous study documented several specific-conductance values greater than 2,000 □S/cm for groundwater from the Sparta aquifer in Union County (Broom and others, 1984).

Summary

The U.S. Geological Survey in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey has monitored water levels since the 1920's. Groundwater withdrawals have increased while water levels have declined since monitoring was initiated. During the spring of 2007, 309 water levels were measured in wells completed in the Sparta-Memphis aquifer. During the summer of 2007, 129 water-quality samples were collected and measured for temperature and specific conductance and 102 were collected and analyzed for chloride from wells completed in the Sparta-Memphis aquifer.

Water use in the Sparta-Memphis aquifer in Arkansas generally increased from 1965 to 2000. In 2000, water use in the Sparta-Memphis aquifer was about 287 Mgal/d, an increase of about 156 percent from 1965. In 2005, water use in the Sparta-Memphis aquifer declined to about 170 Mgal/d.

The Sparta Sand is composed of a sequence of alternating sand and clay beds between the massive clays of the overlying Cook Mountain Formation of Claiborne Group and the underlying Cane River Formation of Claiborne Group confining units. The Sparta Sand is in the southern part of the study area (south of about 35 degrees latitude). The Memphis Sand is in the northern part of the study area (north of about 35 degrees latitude). The Memphis Sand is underlain by a thick layer of clay in the upper part of the Wilcox Group.

The regional direction of groundwater flow in the Sparta-Memphis aquifer is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large groundwater withdrawals. The highest water-level altitude measured in the Sparta-Memphis aquifer was 326 ft above NGVD of 1929 in the outcrop at the western boundary of the study area; the lowest water-level altitude was 161 ft below NGVD of 1929 in Union County.

Eight cones of depression (generally represented by closed contours) are located in the study area. Two large cones of depression, centered in Jefferson and Union Counties, are the result of large withdrawals for industrial and public supplies. The depression centered in Jefferson County has deepened and expanded in recent years into Arkansas and Prairie Counties are the result of large withdrawals for irrigation and public supply. The area enclosed within the 40-ft contour on the 2007 potentiometric-surface map has expanded when compared with the 2005 potentiometric-surface map. In 2003, the depression in Union County was elongated east and west and beginning to coalesce with the depression in Columbia County. The deepest measurement during 2007 in the center of the depression in Union County has risen 38 ft since 2003. The area enclosed by the deepest contour, 160 ft below NGVD of 1929, on the 2007 potentiometric-surface map is less than 10 percent of the area on the 2005 potentiometric-surface map. A broad depression in western Poinsett and Cross Counties was first shown in the 1995 potentiometric-surface map caused by withdrawals for irrigation extending north to the Poinsett-Craighead County line, and south into Cross County.

A water-level difference map was constructed using the difference between water-level measurements made during 2003 and 2007 from 283 wells. The difference in water level

between 2003 and 2007 ranged from -49.8 to 60.0 ft. Areas with a general rise in water levels are shown in northern Arkansas, central Columbia, southern Jefferson, and most of Union Counties. In the area around west-central Union County, water levels rose as much as 60.0 ft, with water levels in 15 wells rising 20 ft or more, which is an average annual rise of 5 ft or more. Water levels generally declined throughout most of the rest of Arkansas.

Hydrographs from 157 wells were constructed with a minimum of 25 years of water-level measurements. During the period 1983-2007, the county mean annual water level rose in Calhoun, Columbia, Hot Spring, and Lafayette Counties. Mean annual declines between 0.0 ft/yr and 2.1 ft/yr occurred in all the other counties. In western Arkansas County, a hydrograph shows a 60-ft seasonal change in water level for both years shown. The period of the 60-ft decline in water level coincides with the spring-summer irrigation season.

Specific-conductance data indicate regionally diverse zones of mineralized water within the aquifers across the study area. Specific conductance ranged from 35 µS/cm in Ouachita County to 1,280 µS/cm at two wells in Monroe County. The mean specific conductance was 398 µS/cm and the median specific conductance was 334 µS/cm. Dissolved chloride concentrations ranged from 1.2 mg/L in Lincoln County to 308 mg/L in Monroe County. The mean dissolved chloride concentration was 28.6 mg/L and the median dissolved chloride concentration was 8.7 mg/Ľ Although there is a regional increase in specific conductance to the east and south, anomalous increases occur in some parts of the study area. Relatively large specific conductance values (greater than 700 µS/cm and less than 1,300 µS/cm) occur in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties.

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APPENDIXES 1–3

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
			Arkansas County			
02S04W06CDB1	343312	912849	53	159.24	212	03/29/07
02S04W23DAA1	343044	912355	63	144.91	208	03/29/07
02S04W33BBB1	342922	912703	36	168.78	205	03/29/07
02S05W16CBB1	343144	913319	40	172.95	213	03/29/07
02S05W27BBB1	343028	913230	37	178.79	216	03/29/07
02S05W34BDA1	342925	913148	36	180.13	216	03/29/07
02S05W35AAB1	342930	913035	41	174.89	216	03/29/07
03S04W02CCB1	342748	912458	49	153.40	202	03/29/07
03S04W26CDA1	342421	912438	55	147.52	203	03/27/07
03S05W02AAB1	342842	913034	37	173.32	210	03/29/07
03S05W13BDC1	342631	913005	27	183.01	210	03/28/07
03S05W15CBB1	342633	913229	27	179.22	206	03/28/07
03S05W28DAB1	342447	913240	31	172.86	204	03/28/07
03S06W30BBD1	342516	914216	34	157.40	191	03/28/07
04S01W04CBD1	342225	910808	83	113.42	196	03/27/07
04S01W28BAA1	341927	910748	83	106.52	190	03/27/07
04S04W11BCC1	342157	912502	43	155.10	198	03/27/07
04S04W19CBB1	342004	912929	31	163.58	195	03/28/07
04S04W22DAA1	342007	912515	36	159.48	195	03/27/07
04S05W01BAA1	342322	912956	39	156.85	196	03/28/07
04S05W05ACC1	342303	913413	27	159.40	186	03/26/07
04S05W15AAA1	342132	913133	33	167.55	201	03/28/07
04S05W36DCC1	341752	913004	30	166.15	196	03/26/07
05S01W17BAA1	341551	910745	83	93.46	176	03/27/07
05S03W04ADB1	341734	912007	48	140.31	188	03/27/07
05S04W26ACA1	341358	912434	48	140.06	188	03/26/07
05S05W36DAA1	341245	912947	35	145.24	180	03/26/07
06S02W06ABB1	341228	911620	66	115.17	181	03/27/07
06S02W17ADA1	341023	911453	73	115.11	188	03/27/07
06S02W22CDB1	340904	911331	74	112.18	186	03/27/07
06S03W27BAA1	340859	912009	61	119.92	181	03/27/07
07S02W28ABA1	340340	911411	75	106.08	181	03/27/07
07S03W06ABC1	340702	912248	55	130.28	185	03/26/07
08S02W09BCC1	340031	911448	73	100.92	174	03/27/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Ashley County						
15S07W32CDD1	332118	915101	42	148.25	190	03/20/07
17S09W15ACC1	331334	920116	82	17.59	100	03/20/07
Bradley County						
12S09W31CCB1	333711	920444	36	194.72	231	03/19/07
13S09W06ACA1	333648	920437	15	220.18	235	04/25/07
13S09W06ACB2	333647	920417	29	179.00	208	03/19/07
13S11W17BCD1	333454	921607	48	202.22	250	03/19/07
16S12W21CAA1	331839	922052	21	79.02	100	03/19/07
Calhoun County						
11S14W12CAC3	334630	922928	175	138.00	313	03/29/07
13S13W32CDA1	333227	922742	13	194.83	208	03/16/07
13S15W36CBD1	333227	923532	76	82.47	158	03/20/07
14S13W03CAB1	333145	922551	34	167.59	202	03/20/07
14S13W05BBD1	333207	922802	32	156.80	189	03/20/07
14S13W12CCB1	333040	922404	33	171.60	205	03/20/07
15S13W20BDC1	332411	922807	85	24.42	109	03/20/07
Chicot County						
13S03W22DAD1	333312	912308	65	70.10	135	03/19/07
15S03W07BCC1	332445	912723	64	65.11	129	03/20/07
Cleveland County						
09S09W04BBD1	335820	920237	85	223.20	308	03/21/07
09S11W01DCA1	335729	921134	18	206.97	225	03/21/07
09S11W11CDB1	335623	921251	70	162.62	233	03/21/07
10S09W23CDC1	334918	920021	56	164.12	220	03/21/07
10S09W35ACD1	334758	915957	63	156.42	219	03/21/07
10S12W12BDD1	335133	921743	100	120.26	220	03/21/07
11S11W16AAB1	334543	921423	99	204.31	303	03/21/07
Columbia County						
16S20W08DCC1	332114	931141	83	319.33	402	03/16/07
16S20W18ACD1	332053	931237	73	263.82	337	03/16/07
17S19W15AAB1	331546	930318	42	265.73	318	03/16/07
17S19W19BCA1	331433	930705	32	268.97	301	03/21/07
17S20W17CDA1	331520	931201	11	313.96	325.1	03/21/07
17S20W36ABC1	331307	930755	42	292.66	335	03/21/07
17S21W11DCC2	331609	931449	24	276.11	300	03/14/07
17S21W11DCC3	331609	931449	20	277.89	298	03/21/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Columbia County—Continued						
18S21W17ACD1	331034	931759	85	230.38	315	03/21/07
19S20W09CBD1	330555	931129	69	263.22	332	03/21/07
19S21W16DBB1	330517	931724	109	175.30	284	03/15/07
19S23W10ABD1	330644	932833	196	45.57	242	03/15/07
19S23W11CDA2	330609	932744	195	53.07	248	03/15/07
19S23W11DDB1	330605	932722	192	53.82	246	03/15/07
19S23W14BAB2	330555	932752	191	52.58	244	03/15/07
20S22W03DCC1	330138	932236	161	52.85	214	03/15/07
20S22W11ACD1	330109	932133	163	108.04	271	03/15/07
Craighead County						
13N03E23CDD1	354404	904433	159	88.76	248	04/18/07
14N04E22CBD1	354929	903921	199	57.38	256	04/18/07
14N04E28DBD1	354837	903953	192	62.48	254	04/18/07
14N05E36CBC1	354751	903100	208	12.40	220	04/18/07
15N05E29DBB1	355360	903433	234	23.89	258	04/18/07
15N06E18ACA1	355544	902858	213	17.26	230	04/18/07
Crittenden County						
05N08E11CCA2	350345	901300	183	27.91	211	04/12/07
06N07E01DAD2	350958	901738	183	26.28	209	04/12/07
06N09E23AAB1	350745	900553	167	54.51	222	04/12/07
07N09E14BAC1	351348	900628	185	32.26	217	04/12/07
09N07E21BBB1	352341	902131	191	24.87	216	04/12/07
Ar:C-001	350958	901738	185	26.60	212	03/29/07
Ar:H-002	350344	901300	183	28.08	211	03/29/07
Cross County						
06N04E06ACA1	351004	904238	152	206.34	358	04/13/07
07N05E04ADD1	351538	903330	173	35.51	209	04/19/07
09N01E16CAC1	352405	905951	142	92.09	234	04/13/07
09N01E25AAD1	352244	905554	138	89.48	227	04/13/07
09N03E22AAB2	352404	904518	149	127.98	277	04/17/07
09N03E22AAD1	352403	904512	145	133.06	278	04/17/07
09N04E30DCA1	352232	904218	158	271.73	429.32	04/19/07
Dallas County						
07S14W30DCC1	340431	923360	215	120.35	335	03/13/07
07S14W31AAA1	340425	923334	219	111.07	330	03/13/07
07S16W20CAB1	340555	924545	294	28.46	322	03/13/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Dallas County—Continued						
08S15W34BDC1	335859	923730	213	26.67	240	03/13/07
08S16W18ACC1	340152	924639	235	16.86	252	03/13/07
08S16W27DDD1	335937	924307	241	33.66	275	03/13/07
09S13W35CCD1	335309	922413	128	71.62	200	03/13/07
09S14W01BDC1	335754	922919	182	82.92	265	03/13/07
09S16W19CAA1	335605	924701	253	7.31	260	03/14/07
10S13W34ACA2	334829	922458	121	151.38	272	03/13/07
10S14W27CDB1	334908	923138	237	33.44	270	03/13/07
10S15W18BCC1	335120	924120	249	79.05	328	03/14/07
Desha County						
09S02W26AAC1	335346	911521	80	72.64	153	03/19/07
09S04W28DDD1	335310	913007	50	115.48	165	03/19/07
10S02W26CCC2	334750	911624	72	75.97	148	03/19/07
10S04W11CBC1	335034	912905	55	105.61	161	03/19/07
11S02W03CCA1	334616	911711	64	74.73	139	03/19/07
12S03W26CBB1	333749	912259	43	100.29	143	03/19/07
12S03W34DAD1	333643	912305	65	82.21	147	03/19/07
Drew County						
11S04W02ACA2	334632	912827	57	96.09	153	03/20/07
11S04W25CB2	334249	912707	60	88.18	148	03/20/07
11S06W11DBC1	334607	914122	52	150.59	203	03/20/07
12S06W30BBD1	333807	914543	44	226.62	271	03/20/07
12S06W32DAD1	333649	914402	38	177.16	215	03/20/07
13S05W36ACB1	333151	913408	77	92.23	169	03/20/07
15S04W12DDA1	332429	912724	61	63.68	125	03/20/07
Grant County						
03S13W12AAA1	342846	922106	229	132.41	361	03/22/07
03S15W26DAA1	342601	923447	326	11.02	337	03/22/07
04S14W14CCC1	342201	922932	219	83.59	303	03/22/07
05S13W03CAA1	341844	922400	172	88.26	260	03/22/07
05S13W03CDA4	341838	922402	167	113.93	281	03/22/07
05S13W07ADB1	341810	922650	188	81.75	270	03/22/07
05S13W30AAA1	341550	922650	201	129.14	330	03/22/07
05S14W06DCC1	341843	923327	205	87.64	293	03/22/07
05S15W05ABD1	341924	923827	222	14.29	236	03/22/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Grant County—Continued						
06S11W05ACD1	341341	921413	53	216.06	269	03/22/07
06S15W26ACA1	341022	923538	207	72.77	280	03/22/07
07S12W21BDB1	340558	921953	219	4.12	223	03/22/07
Hot Spring County						
05S16W35ACA1	341460	924151	307	34.78	342	03/13/07
Jefferson County						
03S08W19BAD1	342624	915444	43	173.95	217	03/27/07
03S08W19BBD1	342628	915505	34	181.23	215	03/27/07
03S08W19BDB1	342619	915455	37	177.88	215	03/27/07
03S09W23BBD1	342627	915713	37	186.85	224	03/27/07
03S10W14CAD1	342659	920330	100	120.60	221	03/27/07
03S10W27AAD1	342502	920434	85	136.63	222	03/27/07
03S11W22ABC1	342651	921058	134	176.45	310	03/27/07
04S07W17BCC1	342140	914742	-5	205.35	200	04/03/07
04S08W35BBD1	341909	915056	-16	215.50	200	03/27/07
04S10W17BDA1	342212	920646	59	205.51	265	03/29/07
04S11W14BAD1	342220	921000	86	313.67	400	03/29/07
05S08W30ADB1	341452	915440	-78	298.66	221	04/03/07
05S09W19BAA3	341609	920131	-48	273.60	226	03/29/07
05S09W24DBD1	341530	915556	-71	279.23	208.17	04/03/07
05S09W31DDC1	341337	920109	-48	274.55	227	03/28/07
05S10W11ACA1	341741	920322	9	225.57	235	03/29/07
05S10W16BAD1	341700	920549	31	246.27	277	03/29/07
05S10W16DBB1	341635	920543	3	312.25	315	03/29/07
05S10W16DBD1	341635	920534	-9	311.38	302	03/29/07
06S08W16CCC1	341143	915517	-53	255.56	202.42	04/03/07
06S08W25ADC1	341025	915116	-22	225.35	203.48	04/03/07
06S09W17CAD1	341159	920207	-31	263.78	233	03/28/07
06S09W17CCA1	341152	920221	-23	257.38	234.34	03/28/07
06S10W23ACD1	341116	920508	8	230.84	239	03/28/07
06S10W23DBA1	341105	920506	4	248.12	252	03/28/07
07S07W24BAB1	340633	914523	17	170.85	188	03/28/07
07S10W24CAC1	340549	920421	52	258.80	311	03/28/07
Lafayette County						
16S23W12CAD1	332143	932609	244	77.88	322	03/14/07
16S24W26AAC1	331950	933303	209	57.61	267	03/14/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Lafayette County—Continued						
17S23W19ACC1	331520	933128	237	53.95	291	03/14/07
17S24W23BBD1	331526	933403	226	35.42	261	03/14/07
18S23W29ACC1	330911	933039	242	13.26	255	03/15/07
19S23W29BDB1	330352	933103	207	43.16	250	03/15/07
19S25W13CAB1	330555	933922	215	40.23	255	03/15/07
20S23W05ADA1	330223	933026	207	34.97	242	03/15/07
20S23W05ADB1	330223	933036	201	40.96	242	03/15/07
Lee County						
01N04E09CDD1	344210	904119	146	62.21	208	04/09/07
02N01E10CAD1	344743	905925	147	54.44	201	04/09/07
Lincoln County						
07S07W30CDC1	340444	915043	18	190.05	208	03/26/07
08S05W03BAA2	340310	913454	28	152.46	180	03/26/07
08S05W35ACC1	335907	913337	14	152.15	166	03/26/07
08S08W35DBB1	335858	915222	21	228.88	250	03/26/07
08S08W35DCB1	335851	915217	10	260.17	270	03/26/07
09S07W07DAD1	335634	915128	16	279.86	296	03/26/07
09S07W08BCC	335644	915118	33	259.39	292	03/26/07
Lonoke County						
01N07W03BCC1	344425	914503	92	131.22	223	04/02/07
01S08W02DBD1	343855	914960	112	98.31	210	04/03/07
02N07W06ACD1	344939	914737	115	125.85	241	04/04/07
02N07W09AAA1	344906	914500	131	101.45	232	04/04/07
02N07W22DBA1	344651	914426	95	131.71	227	04/02/07
02N07W24DAC1	344650	914209	81	149.65	231	04/02/07
02S07W08DCC1	343235	914700	59	143.40	202	04/04/07
02S09W15BBB2	343247	915825	144	81.97	226	04/03/07
03N07W03CAA1	345445	914426	155	79.98	235	04/04/07
03N08W11ACD1	345403	914935	154	93.65	248	05/22/07
03N08W22DAD1	345205	915024	136	97.42	233	05/22/07
03N08W22DAD2	345205	915024	133	99.53	233	05/22/07
03N08W22DDD2	345152	915025	133	101.98	235	05/23/07
Miller County						
17S25W18CDB1	331605	934402	213	7.04	220	03/15/07
19S27W10BBA1	330719	935345	319	1.48	320	03/15/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Mississippi County						
11N09E26AAD3	353302	900523	214	25.96	240	04/18/07
Monroe County						
11N09E26ABA2	353304	900539	211	24.88	236	04/18/07
01N03W14CCB1	344144	911801	96	75.96	172	04/04/07
03N02W26DAB1	345042	911026	143	49.02	192	04/09/07
04N02W28DDD4	345535	911221	159	32.68	192	04/09/07
04N02W30BAC1	345617	911504	170	11.80	182	04/09/07
04N02W30BAD1	345617	911515	161	15.07	176	04/09/07
Ouachita County						
11S15W27ABD1	334441	923726	131	69.34	200	03/22/07
11S17W14CAC1	334631	924927	124	22.32	146	03/22/07
11S17W36CCA1	334341	924834	124	9.43	133	04/26/07
12S15W09BBA1	334223	923922	160	52.90	213	03/22/07
12S16W25BDC1	333929	924211	108	32.42	140	03/21/07
12S16W26ABD1	333946	924304	102	34.63	137	03/21/07
12S18W19CDC1	334014	925951	204	30.63	235	03/26/07
12S18W25CAB1	333937	925442	108	78.56	187	04/30/07
12S19W14AAA1	334143	930105	230	7.45	237	03/26/07
12S19W35BDD1	333901	930146	190	160.25	350	03/26/07
13S16W28ADD1	333416	924451	73	33.28	106	03/21/07
13S18W31BDD1	333343	925956	171	71.18	242	03/15/07
13S19W28BCD1	333434	930418	192	38.21	230	03/26/07
14S17W02ABB1	333253	924927	114	16.80	131	04/26/07
14S17W05CAD1	333238	925255	120	37.24	157	04/17/07
14S17W32CAD1	332803	925251	141	79.06	220	03/21/07
14S19W29ABB1	332941	930513	192	88.16	280	03/15/07
15S15W32DBB2	332234	924027	-50	169.42	119	03/15/07
15S16W23DAC1	332417	924314	44	126.15	170	04/26/07
15S18W36ADD1	332311	925436	66	94.40	160	03/21/07
15S19W10DCC1	332618	930318	140	69.86	210	04/26/07
15S19W21CDD2	332438	930432	73	198.82	272	04/17/07
Phillips County						
01S02E32DDC1	343324	905455	127	84.17	211	04/10/07
02S02E01ADC1	343323	905056	141	35.17	176	04/10/07
02S04E02DAA1	343243	903844	126	132.52	259	04/10/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Phillips County—Continued						
02S04E02DBA1	343243	903907	121	129.19	250	04/10/07
02S05E16BCB1	343108	903526	155	35.11	190	04/10/07
02S05E29CCC1	342851	903635	155	23.56	179	04/10/07
03S03E30DAA1	342403	904915	137	35.05	172	04/11/07
04S02E25CCC1	341824	905121	128	37.67	166	04/10/07
Poinsett County						
10N01E12BDC1	353026	905630	134	100.38	234	04/18/07
10N01E15DBB1	352931	905825	135	96.92	232	04/18/07
10N01E33ABA1	352725	905924	142	79.50	221	04/18/07
10N03E02BCD1	353139	904447	139	111.68	251	04/18/07
10N03E23CAC1	352850	904432	145	113.12	258	04/18/07
11N02E16CCC1	353448	905321	134	108.69	243	04/18/07
11N03E25BDD	353328	904323	150	126.96	277	04/18/07
11N03E25BDD1	353325	904323	148	121.45	269	04/17/07
12N03E12BBB1	354137	904340	134	112.28	246	04/18/07
12N03E35BCC1	353745	904456	143	100.53	244	04/18/07
12N03E35DDA1	353727	904353	144	102.95	247	04/18/07
Prairie County						
01N05W19CDC1	344113	913505	67	145.15	212	04/12/07
01N06W02ABB1	344442	913701	93	128.34	221	04/12/07
01N06W34CBB1	343943	913846	56	169.70	226	04/12/07
01S05W06BCB1	343904	913532	43	177.20	220	04/12/07
01S05W20ABB1	343640	913352	65	154.65	220	04/06/07
01S06W11DBD1	343749	913654	48	177.82	226	04/12/07
02N04W19ACB1	344649	912802	145	66.13	211	04/11/07
02N06W04DBB1	344928	913852	129	106.45	235	04/19/07
02N06W19AAB1	344718	914050	85	150.58	236	04/11/07
02N06W20BCB1	344707	914033	89	147.18	236	04/11/07
02N06W21DAD1	344644	913829	99	132.92	232	04/11/07
02N06W22BDD1	344654	913801	105	127.90	233	04/11/07
03N05W03ADA2	345452	913043	145	59.90	205	04/06/07
03N05W20CCC1	345145	913356	141	71.89	213	04/06/07
03N06W20CDD1	345140	914004	139	85.88	225	04/06/07
St Francis County						
04N04E18BAB1	345743	904319	155	65.29	220	04/19/07
03N01W33CDD1	345446	910635	139	71.24	210	04/04/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
			Union County			
16S14W15CAB1	331944	923218	-56	149.70	94	03/08/07
16S15W20DAA1	331860	923958	-65	254.70	190	02/23/07
16S15W31ACC1	331717	924129	-98	265.72	168	03/15/07
16S16W02ABC1	332206	924329	-47	162.53	116	03/14/07
16S18W34ABC2	331806	925709	41	209.53	251	02/23/07
17S12W31DDD1	331206	922226	-8	228.07	220	03/22/07
17S12W32BBC1	331202	922219	-11	241.54	231	02/23/07
17S13W31BAC1	331200	922916	-93	309.04	216	03/08/07
17S14W22BAB1	331354	923224	-97	297.61	201	03/14/07
17S15W08CDD1	331505	924027	-115	289.65	174.92	03/22/07
17S15W18DBB1	331439	924129	-118	301.33	182.93	03/14/07
17S15W28DBA1	331246	923910	-116	345.83	230	03/14/07
17S15W28DCC1	331233	923924	-138	422.88	285	03/22/07
17S15W29CDC1	331229	924039	-142	361.79	220	03/22/07
17S15W31DCA1	331145	924117	-125	396.61	272	03/07/07
17S15W31DDA1	331144	924105	-122	383.42	261	03/14/07
17S16W01BAA1	331649	924233	-83	271.73	188.84	03/21/07
17S16W02CCC1	331559	924403	-134	316.37	182	03/22/07
17S16W02DCD1	331602	924326	-154	375.78	222	03/22/07
17S16W12CDD1	331506	924232	-161	382.38	221.58	03/22/07
17S16W24BDB1	331357	924248	-139	343.85	205	03/09/07
17S17W25DBA2	331256	924838	-86	336.42	250	03/14/07
17S17W30DCD1	331257	925356	-44	323.53	280	03/21/07
18S11W09ABC1	331012	921443	40	94.64	135	03/22/07
18S12W33BBB1	330651	922120	-28	139.56	112	02/23/07
18S14W06CCD1	331039	923531	-111	342.80	232	02/23/07
18S15W03DAB1	331104	923802	-106	346.05	240	03/14/07
18S15W07BAC2	331035	924139	-92	344.62	253	03/21/07
18S15W33ADA1	330659	923858	-107	359.87	253	03/21/07
18S15W35DAC1	330636	923707	-83	283.78	201	03/21/07
18S16W10CDD1	331000	924445	-133	314.68	182	03/21/07
18S16W11AAB1	331041	924314	-112	337.30	225	03/14/07
18S16W11DAC1	331011	924316	-141	412.75	272	03/21/07
18S16W12ACB1	331029	924232	-131	433.04	302	03/07/07
18S16W28BBB1	330809	924611	-94	319.20	225	03/07/07
18S17W22BDD1	330856	925056	-56	340.69	285	03/14/07

Appendix 1. Water-level data collected during spring 2007 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[NGVD of 1929, National Geodetic Vertical Datum; Horizontal datum is North American Datum of 1983]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD of 1929)	Date of measurement
Union County—Continued						
18S18W11ACD2	331051	925615	-28	267.28	239	03/21/07
19S10W16CBC1	330329	920904	-6	88.33	82	02/23/07
19S11W23ACA1	330255	921229	-10	152.44	142	02/23/07
19S11W25AAA1	330218	921113	-16	151.20	135	02/23/07
19S12W13AAA1	330411	921717	49	142.37	191	02/23/07
19S16W35DDC1	330109	924326	-60	235.15	175	03/07/07
19S18W14ADA1	330452	925608	50	192.57	243	02/20/07
Woodruff County						
05N01W11ABA1	350426	910407	151	60.00	211	04/19/07
05N01W17DBB1	350311	910727	163	47.36	210	04/17/07
05N02W31DCB3	350027	911456	177	16.24	193	04/17/07
06N01W13ABA1	350852	910254	144	68.46	212	04/17/07
06N01W13ADC1	350827	910247	144	68.38	212	04/17/07
07N01W12BCB1	351442	910326	154	67.94	222	04/17/07
08N01W12CDA1	351934	910311	150	74.86	225	04/17/07
08N02W26ADC1	351726	911004	178	33.83	212	04/17/07

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Arkansas County					
02S04W06CDB1	343312	912849	160.87	159.24	1.6
02S04W23DAA1	343044	912355	149.72	144.91	4.8
02S04W33BBB1	342922	912703	171.01	168.78	2.2
02S05W16CBB1	343144	913319	178.88	172.95	5.9
02S05W27BBB1	343028	913230	180.27	178.79	1.5
02S05W34BDA1	342925	913148	179.8	180.13	-0.3
02S05W35AAB1	342930	913035	174.85	174.89	0.0
03S04W02CCB1	342748	912458	162.24	153.4	8.8
03S04W26CDA1	342421	912438	137.3	147.52	-10.2
03S05W02AAB1	342842	913034	173.43	173.32	0.1
03S05W13BDC1	342631	913005	178.86	183.01	-4.1
03S05W15CBB1	342633	913229	171.95	179.22	-7.3
03S05W28DAB1	342447	913240	172.62	172.86	-0.2
03S06W30BBD1	342516	914216	160.74	157.4	3.3
04S01W04CBD1	342225	910808	113.14	113.42	-0.3
04S01W28BAA1	341927	910748	106.16	106.52	-0.4
04S04W11BCC1	342157	912502	155.5	155.1	0.4
04S04W19CBB1	342004	912929	162.72	163.58	-0.9
04S04W22DAA1	342007	912515	159.99	159.48	0.5
04S05W05ACC1	342303	913413	157.42	159.4	-2.0
04S05W15AAA1	342132	913133	166.7	167.55	-0.9
04S05W36DCC1	341752	913004	163.18	166.15	-3.0
05S01W17BAA1	341551	910745	93.49	93.46	0.0
05S03W04ADB1	341734	912007	160.84	140.31	20.5
05S04W26ACA1	341358	912434	128.98	140.06	-11.1
06S02W06ABB1	341228	911620	114.76	115.17	-0.4
06S02W17ADA1	341023	911453	114.77	115.11	-0.3
06S02W22CDB1	340904	911331	105.86	112.18	-6.3
06S03W27BAA1	340859	912009	119.62	119.92	-0.3
07S02W28ABA1	340340	911411	105.64	106.08	-0.4
07S03W06ABC1	340702	912248	131.33	130.28	1.1
08S02W09BCC1	340031	911448	100.22	100.92	-0.7
Ashley County					
15S07W32CDD1	332118	915101	137.84	148.25	-10.4

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Bradley County					
12S09W31CCB1	333711	920444	183.54	194.72	-11.2
13S09W06ACA1	333648	920437	183.67	220.18	-36.5
13S09W06ACB2	333647	920417	157.75	179	-21.3
13S11W17BCD1	333454	921607	193.43	202.22	-8.8
16S12W21CAA1	331839	922052	75.29	79.02	-3.7
Calhoun County					
11S14W12CAC3	334630	922928	146	138	8.0
13S13W32CDA1	333227	922742	168.68	194.83	-26.2
13S15W36CBD1	333227	923532	80.51	82.47	-2.0
14S13W05BBD1	333207	922802	154.13	156.8	-2.7
14S13W12CCB1	333040	922404	168.45	171.6	-3.2
15S13W20BDC1	332411	922807	34.11	24.42	9.7
Chicot County					
13S03W22DAD1	333312	912308	67.03	70.1	-3.1
Cleveland County					
09S11W01DCA1	335729	921134	206.18	206.97	-0.8
10S09W23CDC1	334918	920021	161.88	164.12	-2.2
10S09W35ACD1	334758	915957	154.2	156.42	-2.2
10S12W12BDD1	335133	921743	117.29	120.26	-3.0
11S11W16AAB1	334543	921423	205.99	204.31	1.7
Columbia County					
16S20W08DCC1	332114	931141	315.1	319.33	-4.2
16S20W18ACD1	332053	931237	263.2	263.82	-0.6
17S19W15AAB1	331546	930318	272.37	275.73	-3.4
17S19W19BCA1	331433	930705	274.59	268.97	5.6
17S20W17CDA1	331520	931201	303.03	313.96	-10.9
17S20W36ABC1	331307	930755	297	292.66	4.3
17S21W11DCC2	331609	931449	283.08	275.09	8.0
17S21W11DCC3	331609	931449	280.97	277.89	3.1
18S21W17ACD1	331034	931759	236.4	230.38	6.0
19S20W09CBD1	330555	931129	266.01	263.22	2.8
19S21W16DBB1	330517	931724	174.42	175.3	-0.9
19S23W10ABD1	330644	932833	45.22	45.57	-0.4
19S23W11CDA2	330609	932744	52.65	53.07	-0.4
19S23W11DDB1	330605	932722	53.76	53.82	-0.1
19S23W14BAB2	330555	932752	49.99	52.58	-2.6

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Columbia County—Continued					
20S22W11ACD1	330109	932133	107.17	108.04	-0.9
Craighead County					
13N03E23CDD1	354404	904433	86.89	88.76	-1.9
14N04E22CBD1	354929	903921	55.7	57.38	-1.7
14N04E28DBD1	354837	903953	61.17	62.48	-1.3
14N05E36CBC1	354751	903100	12.1	12.4	-0.3
15N05E29DBB1	355360	903433	23.47	23.89	-0.4
15N06E18ACA1	355544	902858	18.36	17.26	1.1
Crittenden County					
05N08E11CCA2	350345	901300	25.97	27.91	-1.9
06N07E01DAD2	350958	901738	24.16	26.28	-2.1
06N09E23AAB1	350745	900553	64.36	54.51	9.9
07N09E14BAC1	351348	900628	37.33	32.26	5.1
Cross County					
06N04E06ACA1	351004	904238	201.88	206.34	-4.5
07N05E04ADD1	351538	903330	35.26	35.51	-0.3
09N01E16CAC1	352405	905951	79.65	92.09	-12.4
09N01E25AAD1	352244	905554	84.32	89.48	-5.2
09N03E22AAB2	352404	904518	122.52	127.98	-5.5
09N03E22AAD1	352403	904512	134.5	133.06	1.4
09N04E30DCA1	352232	904218	263.74	271.73	-8.0
Dallas County					
07S14W30DCC1	340431	923360	119.75	120.35	-0.6
07S14W31AAA1	340425	923334	109.46	111.07	-1.6
07S16W20CAB1	340555	924545	24.37	28.46	-4.1
08S15W34BDC1	335859	923730	25.74	26.67	-0.9
08S16W18ACC1	340152	924639	15.78	16.86	-1.1
08S16W27DDD1	335937	924307	32.93	33.66	-0.7
09S13W35CCD1	335309	922413	71.61	71.62	0.0
09S14W01BDC1	335754	922919	78.8	82.92	-4.1
09S16W19CAA1	335605	924701	6.51	7.31	-0.8
10S13W34ACA2	334829	922458	150.74	151.38	-0.6
10S14W27CDB1	334908	923138	35.03	33.44	1.6
10S15W18BCC1	335120	924120	75.39	79.05	-3.7
Desha County					
09S02W26AAC1	335346	911521	69.98	72.64	-2.7

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Desha County—Continued					
09S04W28DDD1	335310	913007	112.42	115.48	-3.1
10S02W26CCC2	334750	911624	72.14	75.97	-3.8
10S04W11CBC1	335034	912905	102.45	105.61	-3.2
11S02W03CCA1	334616	911711	70.32	74.73	-4.4
12S03W26CBB1	333749	912259	96.12	100.29	-4.2
12S03W34DAD1	333643	912305	78.45	82.21	-3.8
Drew County					
11S04W02ACA2	334632	912827	92.38	96.09	-3.7
11S04W25CB2	334249	912707	84.28	88.18	-3.9
11S06W11DBC1	334607	914122	149.95	150.59	-0.6
12S06W30BBD1	333807	914543	222.63	226.62	-4.0
12S06W32DAD1	333649	914402	168.02	177.16	-9.1
13S05W36ACB1	333151	913408	89.13	92.23	-3.1
15S04W12DDA1	332429	912724	62.02	63.68	-1.7
Grant County					
03S13W12AAA1	342846	922106	131.45	132.41	-1.0
03S15W26DAA1	342601	923447	10.45	11.02	-0.6
04S14W14CCC1	342201	922932	83.05	83.59	-0.5
05S13W03CAA1	341844	922400	84.77	88.26	-3.5
05S13W03CDA4	341838	922402	111.9	113.93	-2.0
05S13W07ADB1	341810	922650	60.22	81.75	-21.5
05S13W30AAA1	341550	922650	120.65	129.14	-8.5
05S14W06DCC1	341843	923327	87.62	87.64	0.0
05S15W05ABD1	341924	923827	19.03	14.29	4.7
06S11W05ACD1	341341	921413	210.47	216.06	-5.6
06S15W26ACA1	341022	923538	66.34	72.77	-6.4
07S12W21BDB1	340558	921953	2.17	4.12	-2.0
Hot Spring County					
05S16W35ACA1	341460	924151	35.67	34.78	0.9
Jefferson County					
03S08W19BAD1	342624	915444	169.65	173.95	-4.3
03S08W19BBD1	342628	915505	167.52	181.23	-13.7
03S08W19BDB1	342619	915455	167.55	177.88	-10.3
03S09W23BBD1	342627	915713	178.27	186.85	-8.6
03S10W14CAD1	342659	920330	116.83	120.6	-3.8
03S10W27AAD1	342502	920434	125.96	136.63	-10.7

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Jefferson County—Continued					
03S11W22ABC1	342651	921058	175.34	176.45	-1.1
04S07W17BCC1	342140	914742	171.33	205.35	-34.0
04S08W35BBD1	341909	915056	211.75	215.5	-3.8
04S10W17BDA1	342212	920646	191.57	205.51	-13.9
04S11W14BAD1	342220	921000	308.55	313.67	-5.1
05S08W30ADB1	341452	915440	295.19	298.66	-3.5
05S09W19BAA3	341609	920131	255.57	273.6	-18.0
05S09W24DBD1	341530	915556	272.52	279.23	-6.7
05S09W31DDC1	341337	920109	286.14	274.55	11.6
05S10W11ACA1	341741	920322	195.96	225.57	-29.6
05S10W16BAD1	341700	920549	244.92	246.27	-1.4
05S10W16DBB1	341635	920543	292.4	312.25	-19.9
05S10W16DBD1	341635	920534	279.75	311.38	-31.6
06S08W16CCC1	341143	915517	256.4	255.56	0.8
06S08W25ADC1	341025	915116	217.39	225.35	-8.0
06S09W17CAD1	341159	920207	280.07	263.78	16.3
06S09W17CCA1	341152	920221	269.28	257.38	11.9
06S10W23ACD1	341116	920508	226.16	230.84	-4.7
06S10W23DBA1	341105	920506	239.96	248.12	-8.2
07S07W24BAB1	340633	914523	161.69	170.85	-9.2
07S10W24CAC1	340549	920421	302.05	258.8	43.3
Lafayette County					
16S23W12CAD1	332143	932609	73.11	77.88	-4.8
16S24W26AAC1	331950	933303	53.85	57.61	-3.8
17S23W19ACC1	331520	933128	51.12	53.95	-2.8
17S24W23BBD1	331526	933403	31.59	35.42	-3.8
18S23W29ACC1	330911	933039	12.57	13.26	-0.7
19S23W29BDB1	330352	933103	40.9	43.16	-2.3
19S25W13CAB1	330555	933922	37.1	40.23	-3.1
20S23W05ADA1	330223	933026	33.18	34.97	-1.8
20S23W05ADB1	330223	933036	38.69	40.96	-2.3
Lee County					
01N04E09CDD1	344210	904119	59.28	62.21	-2.9
02N01E10CAD1	344743	905925	51.1	54.44	-3.3
Lincoln County					
07S07W30CDC1	340444	915043	179.23	190.05	-10.8

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Lincoln County—Continued					
08S05W03BAA2	340310	913454	145.14	152.46	-7.3
08S05W35ACC1	335907	913337	136.92	152.15	-15.2
08S08W35DBB1	335858	915222	201.56	228.88	-27.3
08S08W35DCB1	335851	915217	210.41	260.17	-49.8
09S07W07DAD1	335634	915128	268.2	279.86	-11.7
Lonoke County					
01N07W03BCC1	344425	914503	127.59	131.22	-3.6
01S08W02DBD1	343855	914960	96.65	98.31	-1.7
02N07W06ACD1	344939	914737	122.12	125.85	-3.7
02N07W09AAA1	344906	914500	98.64	101.45	-2.8
02N07W22DBA1	344651	914426	126.17	131.71	-5.5
02N07W24DAC1	344650	914209	143.96	149.65	-5.7
02S09W15BBB2	343247	915825	72.99	81.97	-9.0
03N07W03CAA1	345445	914426	79.11	79.98	-0.9
03N08W11ACD1	345403	914935	88.65	93.65	-5.0
03N08W22DAD1	345205	915024	86.56	97.42	-10.9
03N08W22DAD2	345205	915024	93.37	99.53	-6.2
03N08W22DDD2	345152	915025	95	101.98	-7.0
Mississippi County					
11N09E26AAD3	353302	900523	21.75	25.96	-4.2
11N09E26ABA2	353304	900539	17.73	24.88	-7.2
Monroe County					
01N03W14CCB1	344144	911801	71.29	75.96	-4.7
03N02W26DAB1	345042	911026	46.87	49.02	-2.2
04N02W28DDD4	345535	911221	30.06	32.68	-2.6
04N02W30BAC1	345617	911504	15.16	11.8	3.4
04N02W30BAD1	345617	911515	9.09	15.07	-6.0
Ouachita County					
11S15W27ABD1	334441	923726	67.03	69.34	-2.3
11S17W14CAC1	334631	924927	19.59	22.32	-2.7
11S17W36CCA1	334341	924834	7.43	9.43	-2.0
12S15W09BBA1	334223	923922	68.75	52.9	15.9
12S16W25BDC1	333929	924211	33.1	32.42	0.7
12S16W26ABD1	333946	924304	42.32	34.63	7.7
12S18W25CAB1	333937	925442	77.29	78.56	-1.3

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Ouachita County—Continued					
12S19W14AAA1	334143	930105	4.36	7.45	-3.1
12S19W35BDD1	333901	930146	154.95	160.25	-5.3
13S16W28ADD1	333416	924451	24.35	33.28	-8.9
13S19W28BCD1	333434	930418	33.19	38.21	-5.0
14S17W05CAD1	333238	925255	36.25	37.24	-1.0
14S17W32CAD1	332803	925251	82.3	79.06	3.2
14S19W29ABB1	332941	930513	85.73	88.16	-2.4
15S15W32DBB2	332234	924027	174.58	169.42	5.2
15S18W36ADD1	332311	925436	95.1	94.4	0.7
15S19W10DCC1	332618	930318	70.85	69.86	1.0
15S19W21CDD2	332438	930432	194.69	198.82	-4.1
Phillips County					
01S02E32DDC1	343324	905455	80.73	84.17	-3.4
02S02E01ADC1	343323	905056	37.88	35.17	2.7
02S04E02DBA1	343243	903907	113.3	129.19	-15.9
02S05E16BCB1	343108	903526	32.02	35.11	-3.1
02S05E29CCC1	342851	903635	33.81	23.56	10.3
03S03E30DAA1	342403	904915	44.69	35.05	9.6
04S02E25CCC1	341824	905121	36.37	37.67	-1.3
Poinsett County					
10N01E12BDC1	353026	905630	94.51	100.38	-5.9
10N01E15DBB1	352931	905825	93.82	96.92	-3.1
10N01E33ABA1	352725	905924	74.66	79.5	-4.8
10N03E02BCD1	353139	904447	109.75	111.68	-1.9
10N03E23CAC1	352850	904432	111.13	113.12	-2.0
11N02E16CCC1	353448	905321	104.24	108.69	-4.5
11N03E25BDD1	353325	904323	119.68	121.45	-1.8
12N03E12BBB1	354137	904340	93.76	112.28	-18.5
12N03E35BCC1	353745	904456	98.58	100.53	-2.0
12N03E35DDA1	353727	904353	108.5	102.95	5.6
Prairie County					
01N05W19CDC1	344113	913505	141	145.15	-4.2
01N06W02ABB1	344442	913701	117.54	128.34	-10.8
01N06W34CBB1	343943	913846	157.19	169.7	-12.5
01S05W06BCB1	343904	913532	153.77	177.2	-23.4
01S05W20ABB1	343640	913352	155.61	154.65	1.0

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Prairie County—Continued					
01S06W11DBD1	343749	913654	169.4	177.82	-8.4
02N04W19ACB1	344649	912802	89.77	66.13	23.6
02N06W19AAB1	344718	914050	142.97	150.58	-7.6
02N06W20BCB1	344707	914033	139.81	147.18	-7.4
02N06W21DAD1	344644	913829	121.02	132.92	-11.9
02N06W22BDD1	344654	913801	127.91	127.9	0.0
03N05W03ADA2	345452	913043	59.14	59.9	-0.8
03N05W20CCC1	345145	913356	70.1	71.89	-1.8
03N06W20CDD1	345140	914004	84.2	85.88	-1.7
St. Francis County					
04N04E18BAB1	345743	904319	64.25	65.29	-1.0
03N01W33CDD1	345446	910635	67.51	71.24	-3.7
Union County					
16S14W15CAB1	331944	923218	153.21	149.7	3.5
16S15W20DAA1	331860	923958	275.89	254.7	21.2
16S15W31ACC1	331717	924129	301.68	265.72	36.0
16S16W02ABC1	332206	924329	170.9	162.53	8.4
16S18W34ABC2	331806	925709	206.35	209.53	-3.2
17S12W31DDD1	331206	922226	236.9	228.07	8.8
17S12W32BBC1	331202	922219	249.08	241.54	7.5
17S13W31BAC1	331200	922916	299.97	309.04	-9.1
17S15W08CDD1	331505	924027	333.65	289.65	44.0
17S15W18DBB1	331439	924129	346.83	301.33	45.5
17S15W28DBA1	331246	923910	393.19	345.83	47.4
17S15W28DCC1	331233	923924	445.2	422.88	22.3
17S15W29CDC1	331229	924039	380.4	361.79	18.6
17S15W31DCA1	331145	924117	436.69	396.61	40.1
17S15W31DDA1	331144	924105	426.27	383.42	42.9
17S16W01BAA1	331649	924233	313.1	271.73	41.4
17S16W02CCC1	331559	924403	339.93	316.37	23.6
17S16W02DCD1	331602	924326	391.78	375.78	16.0
17S16W12CDD1	331506	924232	399.07	382.38	16.7
17S16W24BDB1	331357	924248	403.82	343.85	60.0
17S17W30DCD1	331257	925356	319.4	323.53	-4.1
18S11W09ABC1	331012	921443	96.15	94.64	1.5
18S12W33BBB1	330651	922120	137.32	139.56	-2.2

Appendix 2. Difference in water level from 2003 to 2007 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal dautm is North American Datum of 1983; Negative values denote a decline, 2003 depth to water level from Schrader (2006)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2003 depth to water (feet below land-surface datum	2007 depth to water (feet below land-surface datum	Difference in water level from 2003 to 2007 (feet)
Union County—Continued					
18S14W06CCD1	331039	923531	386.17	342.8	43.4
18S15W33ADA1	330659	923858	372.64	359.87	12.8
18S15W35DAC1	330636	923707	306.48	283.78	22.7
18S16W10CDD1	331000	924445	325.82	314.68	11.1
18S16W11AAB1	331041	924314	379.23	337.3	41.9
18S16W11DAC1	331011	924316	416.88	412.75	4.1
18S16W12ACB1	331029	924232	453.75	433.04	20.7
18S16W28BBB1	330809	924611	329.96	319.2	10.8
18S17W22BDD1	330856	925056	359.82	340.69	19.1
18S18W11ACD2	331051	925615	280.7	267.28	13.4
19S10W16CBC1	330329	920904	84.28	88.33	-4.1
19S11W23ACA1	330255	921229	151.16	152.44	-1.3
19S11W25AAA1	330218	921113	148.02	151.2	-3.2
19S12W13AAA1	330411	921717	154.04	142.37	11.7
19S16W35DDC1	330109	924326	239.08	235.15	3.9
19S18W14ADA1	330452	925608	187.6	192.57	-5.0
Woodruff County					
05N01W11ABA1	350426	910407	56.02	60	-4.0
05N01W17DBB1	350311	910727	45.67	47.36	-1.7
05N02W31DCB3	350027	911456	11.3	16.24	-4.9
06N01W13ABA1	350852	910254	65.36	68.46	-3.1
06N01W13ADC1	350827	910247	67.99	68.38	-0.4
07N01W12BCB1	351442	910326	63.21	67.94	-4.7
08N01W12CDA1	351934	910311	78.37	74.86	3.5
08N02W26ADC1	351726	911004	34.84	33.83	1.0

Appendix 3. Specific conductance, temperature, and chloride data from wells completed in the Sparta-Memphis aquifer in Arkansas, summer 2007.

[Horizontal datum is North American Datum of 1983; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Time	Temperature (degrees Celsius)	Specifc conductance (µS/cm)	Chloride dissolved (mg/L)
Arkansas County							
02S04W06CDB1	343312	912849	7/31/2007	1055	23.3	466	--
02S05W34ABC1	342925	913147	7/30/2007	1625	24.3	390	--
03S04W26CDA1	342421	912438	7/05/2007	1100	23.7	429	7.5
03S05W15CBB1	342633	913229	7/30/2007	1550	24.2	330	6.5
03S06W30BBD1	342516	914216	7/30/2007	1045	24.0	347	12.6
04S01W04CBD1	342225	910808	7/05/2007	1230	23.2	854	--
05S03W04ADB1	341734	912007	7/03/2007	1245	23.4	393	10.4
06S02W22CDB1	340904	911331	7/03/2007	1100	28.0	409	13.2
07S03W06ABC1	340702	912248	7/03/2007	0805	23.6	193	--
08S02W09BCC1	340031	911448	7/03/2007	1015	24.6	238	8.7
Ashley County							
15S07W32CDD1	332118	915101	6/22/2007	0700	23.4	875	35.2
Bradley County							
13S09W06ACB2	333647	920417	6/25/2007	1610	26.7	362	11.4
13S09W06BDC1	333649	920406	6/25/2007	1650	27.1	390	--
13S11W17BCD1	333454	921607	6/25/2007	1510	25.6	419	--
14S09W16AAC1	332931	920218	6/25/2007	1730	25.6	499	--
Calhoun County							
11S14W12CAC3	334630	922928	6/21/2007	1320	21.6	189	12.5
11S14W13BAA1	334616	922922	6/21/2007	1300	19.5	124	--
13S13W32CDA1	333227	922742	6/21/2007	1400	22.1	431	23.8
13S15W36CBD1	333227	923532	6/21/2007	1430	24.8	282	8.4
14S13W12CCB1	333040	922404	7/23/2007	1030	24.3	431	14.6
14S15W16BAA1	333055	923912	6/21/2007	1520	26.9	688	76.7
Cleveland County							
09S09W04BBD1	335820	920237	7/02/2007	1640	25.6	174	--
09S11W01DCA1	335729	921134	7/02/2007	1700	24.2	282	3.3
10S09W23CDC1	334918	920021	7/02/2007	1605	27.0	224	--
10S09W35ACD1	334758	915957	7/02/2007	1545	25.0	234	2.2
11S11W16AAB1	334543	921423	7/02/2007	1510	26.2	366	5.7
Columbia County							
15S20W20CCB1	332453	931215	6/19/2007	1440	23.3	314	5.0
16S20W18ACD1	332053	931237	6/19/2007	1410	23.6	356	4.5
17S19W15AAB1	331546	930318	6/19/2007	1505	23.4	421	9.3

Appendix 3. Specific conductance, temperature, and chloride data from wells completed in the Sparta-Memphis aquifer in Arkansas, summer 2007.—Continued

[Horizontal datum is North American Datum of 1983; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Time	Temperature (degrees Celsius)	Specifc conductance (µS/cm)	Chloride dissolved (mg/L)
Columbia County—Continued							
17S20W17CDA1	331520	931201	7/23/2007	1410	23.7	383	8.2
18S20W06DDC1	331143	931249	6/19/2007	1300	22.8	297	3.8
18S20W18ABD1	331039	931255	6/19/2007	1235	24.3	262	3.1
18S21W17ACD1	331034	931759	6/19/2007	1115	22.0	232	2.4
18S22W27DDD1	330835	932159	6/19/2007	1200	21.6	215	3.3
19S20W09CBD1	330555	931129	7/23/2007	1440	23.6	229	3.1
19S23W11CDA2	330609	932744	6/19/2007	0800	21.8	178	3.7
19S23W11DDB1	330605	932722	6/19/2007	0820	19.4	189	4.5
Crittenden County							
06N09E23AAB1	350745	900553	8/16/2007	1600	24.5	254	23.3
Cross County							
07N05E04ADD1	351538	903330	8/16/2007	1130	21.6	190	2.6
09N03E22AAB2	352404	904518	8/16/2007	0900	19.0	335	3.2
09N03E22AAD1	352403	904512	8/16/2007	0840	19.6	333	3.6
09N04E30DCA1	352232	904218	8/16/2007	0930	22.6	459	3.1
09N04E30DCA1	352232	904218	8/22/2007	0911	23.9	449	3.1
Dallas County							
07S14W31AAA1	340425	923334	6/18/2007	0940	24.1	129	7.7
08S16W18ACC1	340152	924639	6/18/2007	1235	21.4	41	4.8
09S16W19CAA1	335605	924701	6/18/2007	1200	21.8	268	6.2
10S13W34ACA1	334832	922455	6/18/2007	1040	24.6	263	--
10S14W27CDB1	334908	923138	6/18/2007	1105	24.7	268	11.6
Desha County							
09S02W26AAC1	335346	911521	6/27/2007	1210	23.8	244	9.7
10S04W11CBC1	335034	912905	6/27/2007	1500	27.0	249	--
11S01W31BBB1	334225	911415	6/27/2007	1130	24.1	317	--
12S01W32CDB1	333629	911244	6/27/2007	0740	22.0	353	13.3
12S03W26CBB1	333749	912259	6/27/2007	0955	25.4	411	--
12S03W34DAD1	333643	912305	6/27/2007	1015	25.3	475	--
Drew County							
11S05W21CDC1	334352	913724	6/26/2007	1545	22.7	294	3.8
11S07W22BBC1	334450	914905	6/26/2007	1500	26.6	205	1.9
12S06W30BBD1	333807	914543	6/26/2007	1420	25.2	264	4.2
13S05W36ACB1	333151	913408	6/26/2007	1330	22.4	282	--

Appendix 3. Specific conductance, temperature, and chloride data from wells completed in the Sparta-Memphis aquifer in Arkansas, summer 2007.—Continued

[Horizontal datum is North American Datum of 1983; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Time	Temperature (degrees Celsius)	Specifc conductance (µS/cm)	Chloride dissolved (mg/L)
Jefferson County							
03S10W27AAD1	342502	920434	8/07/2007	0840	22.8	87	2.5
03S11W22ABC1	342651	921058	8/07/2007	1305	25.7	121	7.4
04S07W17BCC1	342140	914742	8/03/2007	0900	24.4	142	4.5
04S08W35BBD1	341909	915056	8/03/2007	0930	24.1	146	1.5
04S11W14BAD1	342220	921000	8/07/2007	1145	24.6	82	--
04S11W14BCA1	342218	921015	8/07/2007	1125	24.6	86	3.2
05S09W31DDC1	341337	920109	8/07/2007	1530	30.0	131	2.2
05S10W16CAA1	341637	920545	8/07/2007	1025	25.3	95	--
06S09W17CAD1	341159	920207	8/07/2007	1450	26.6	141	1.7
06S10W23ACA2	341123	920504	8/07/2007	1435	23.5	178	--
06S10W23ACD1	341116	920508	8/07/2007	1415	23.7	129	--
06S10W23DBA1	341105	920506	8/07/2007	1400	27.4	166	1.9
Lafayette County							
19S23W29BDB1	330352	933103	6/19/2007	0900	24.0	252	--
20S23W05ADB1	330223	933036	6/19/2007	0920	26.3	275	6.3
Lincoln County							
07S06W33BAA1	340445	914140	6/28/2007	0830	24.8	200	--
07S07W30CDC1	340444	915043	6/28/2007	1315	29.8	211	1.2
08S04W22AAA1	340105	912753	6/28/2007	0945	25.7	204	--
08S05W03BAA2	340310	913454	6/28/2007	0915	24.5	209	4.5
08S05W35ACC1	335907	913337	6/28/2007	0740	23.4	237	6.1
08S05W35ACC1	335907	913337	6/28/2007	1115	25.8	308	--
08S08W35DBB1	335858	915222	6/28/2007	1400	27.0	201	--
08S08W35DCB1	335851	915217	6/28/2007	1435	27.7	202	1.4
09S07W07DAD1	335634	915128	6/28/2007	1235	24.9	204	1.4
Lonoke County							
02N07W09AAA1	344906	914500	8/01/2007	1005	20.4	374	--
02N07W32DDD1	344453	914619	7/10/2007	1337	20.2	471	7.9
02N07W32DDD1	344453	914619	7/31/2007	1445	19.9	464	7.9
02N08W20BCA1	344710	915330	8/01/2007	0915	19.8	567	78.3
02N08W20BCD1	344708	915335	7/08/2007	0940	19.5	575	76.8
03N08W23DDD1	345152	915025	8/01/2007	1145	19.3	407	24.5
Monroe County							
01N03W14CCB1	344144	911801	8/13/2007	1130	23.5	892	162
01S02W22ADB1	343601	911158	8/13/2007	1615	21.6	731	66.1

Appendix 3. Specific conductance, temperature, and chloride data from wells completed in the Sparta-Memphis aquifer in Arkansas, summer 2007.—Continued

[Horizontal datum is North American Datum of 1983; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Time	Temperature (degrees Celsius)	Specifc conductance (µS/cm)	Chloride dissolved (mg/L)
Monroe County—Continued							
03N02W31ADD2	345008	911439	8/13/2007	1400	20.1	1,280	--
04N02W30BAD1	345617	911515	8/13/2007	1400	20.1	1,280	308
Nevada County							
14S21W04CCB1	333251	931708	6/18/2007	1500	20.8	159	3.8
14S21W20AAB1	333050	931723	6/18/2007	1520	19.6	166	4.8
Ouachita County							
12S16W26B AA1	333948	924304	7/23/2007	1145	22.7	250	6.8
12S19W14AAA1	334143	930105	6/21/2007	0915	19.6	35	2.4
13S16W28ADD1	333416	924451	6/21/2007	1145	22.4	591	84.4
13S19W28BCD1	333434	930418	6/21/2007	1000	21.5	109	3.7
15S18W36ADD1	332311	925436	6/21/2007	1040	24.4	281	31.7
15S19W10DCC1	332618	930318	6/21/2007	0810	21.7	186	5.0
Phillips County							
01S02E32DDC1	343324	905455	8/14/2007	0920	21.2	792	37.4
01S03E34DDC1	343323	904621	8/14/2007	1015	20.2	629	3.7
02S02E01ADC1	343323	905056	8/14/2007	1045	22.7	871	70.4
02S04E01CBB1	343244	903842	8/14/2007	1115	21.2	767	17.4
02S04E02CBC1	343243	903846	8/14/2007	1135	20.8	779	25.2
03S03E30DAA1	342403	904915	8/14/2007	1540	23.0	880	51.3
03S05E05BAB1	342755	903621	8/14/2007	1250	21.9	694	22.4
04S02E25CCC1	341824	905121	8/14/2007	1340	23.7	1,100	166
Prairie County							
02N06W08CD1	344810	914011	8/02/2007	1400	20.4	391	9.7
St. Francis County							
05N03E33ABA1	350025	904708	8/15/2007	0730	19.0	603	15.7
05N03E33ABA2	350020	904713	8/15/2007	0800	18.3	613	10.5
05N03E33ABA3	350020	904711	8/15/2007	0830	18.9	542	16.6
Union County							
16S14W15CAB1	331944	923218	6/19/2007	1730	21.4	448	30.2
16S15W20DAA1	331860	923958	6/19/2007	1635	24.1	492	33.1
16S16W01DDD1	332114	924211	7/24/2007	1010	21.5	454	20.7
16S18W34ABC2	331806	925709	6/19/2007	1555	23.4	318	5.9
17S12W32BBC1	331202	922219	6/20/2007	0900	25.7	864	125
17S13W31BAC1	331200	922916	6/20/2007	0805	25.5	727	94.8

Appendix 3. Specific conductance, temperature, and chloride data from wells completed in the Sparta-Memphis aquifer in Arkansas, summer 2007.—Continued

[Horizontal datum is North American Datum of 1983; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Time	Temperature (degrees Celsius)	Specifc conductance (µS/cm)	Chloride dissolved (mg/L)
17S13W31BAD1	331204	922907	7/24/2007	1225	26.7	736	94.2
Union County—Continued							
17S16W24BDB1	331357	924248	7/24/2007	0720	21.8	427	22.6
17S17W30DCD1	331257	925356	7/23/2007	1530	20.6	318	9.4
18S14W06CCD1	331039	923531	6/20/2007	1450	25.9	720	84.3
18S15W33ADA1	330659	923858	6/20/2007	1405	27.0	635	89.2
18S15W35DAC1	330636	923707	6/20/2007	1300	24.2	703	99.3
18S16W11DAC1	331011	924316	6/20/2007	1200	24.1	530	33.3
18S16W12ACB1	331029	924232	6/20/2007	1000	22.9	565	31
18S16W28BBB1	330809	924611	6/20/2007	1115	23.6	537	26.6
18S18W11ACD2	331051	925615	6/20/2007	1535	25.8	351	12.6
19S11W25AAA1	330218	921113	7/25/2007	1005	23.4	1,120	216
19S16W35DDC1	330109	924326	7/24/2007	1315	24.0	574	96.5

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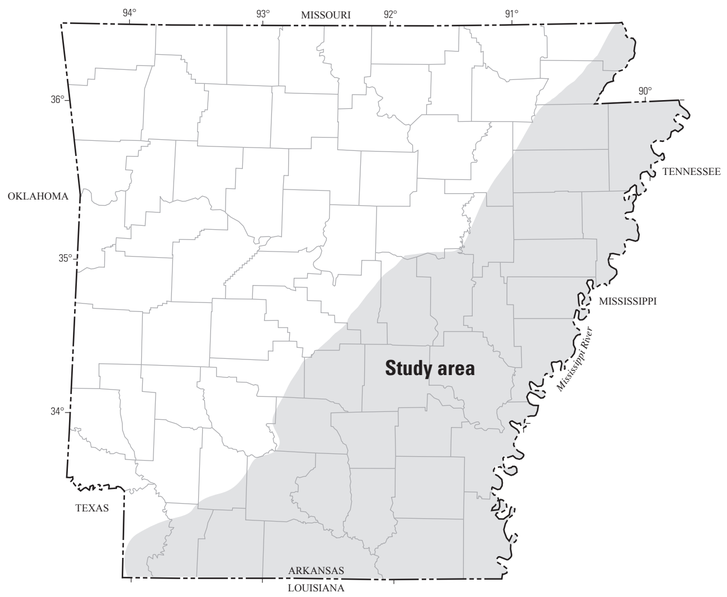
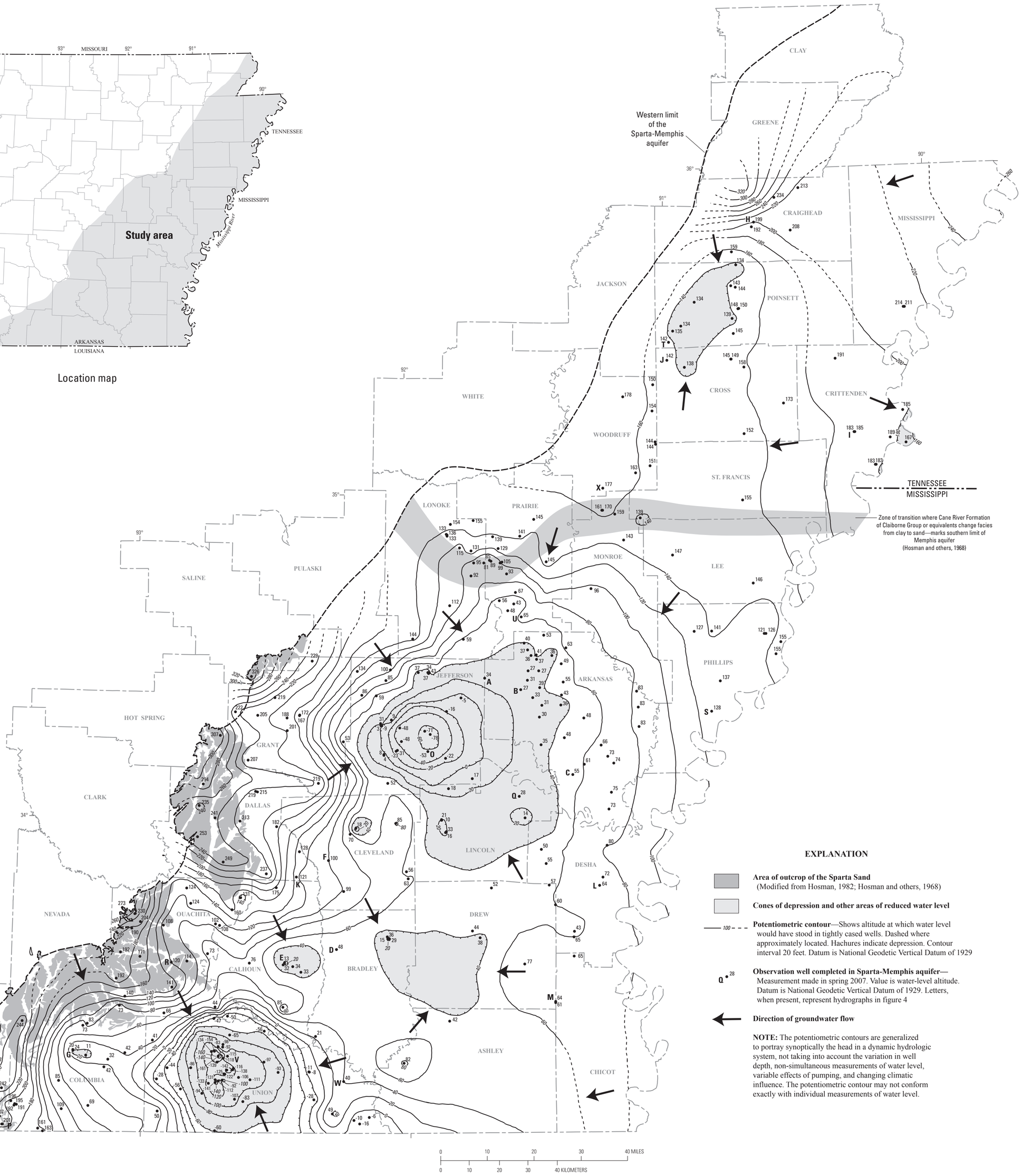
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
ARKANSAS NATURAL RESOURCES COMMISSION and the
ARKANSAS GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS REPORT 2009-5207
Potentiometric surface map for the Sparta-Memphis aquifer—PLATE 1
Schrader, T.P., 2009, Water levels and selected water-quality conditions in the Sparta-Memphis aquifer (Middle Claiborne aquifer) in Arkansas, spring-summer 2007



Location map



EXPLANATION

Area of outcrop of the Sparta Sand
(Modified from Hosman, 1982; Hosman and others, 1968)

Cones of depression and other areas of reduced water level

Potentiometric contour—Shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Hachures indicate depression. Contour interval 20 feet. Datum is National Geodetic Vertical Datum of 1929

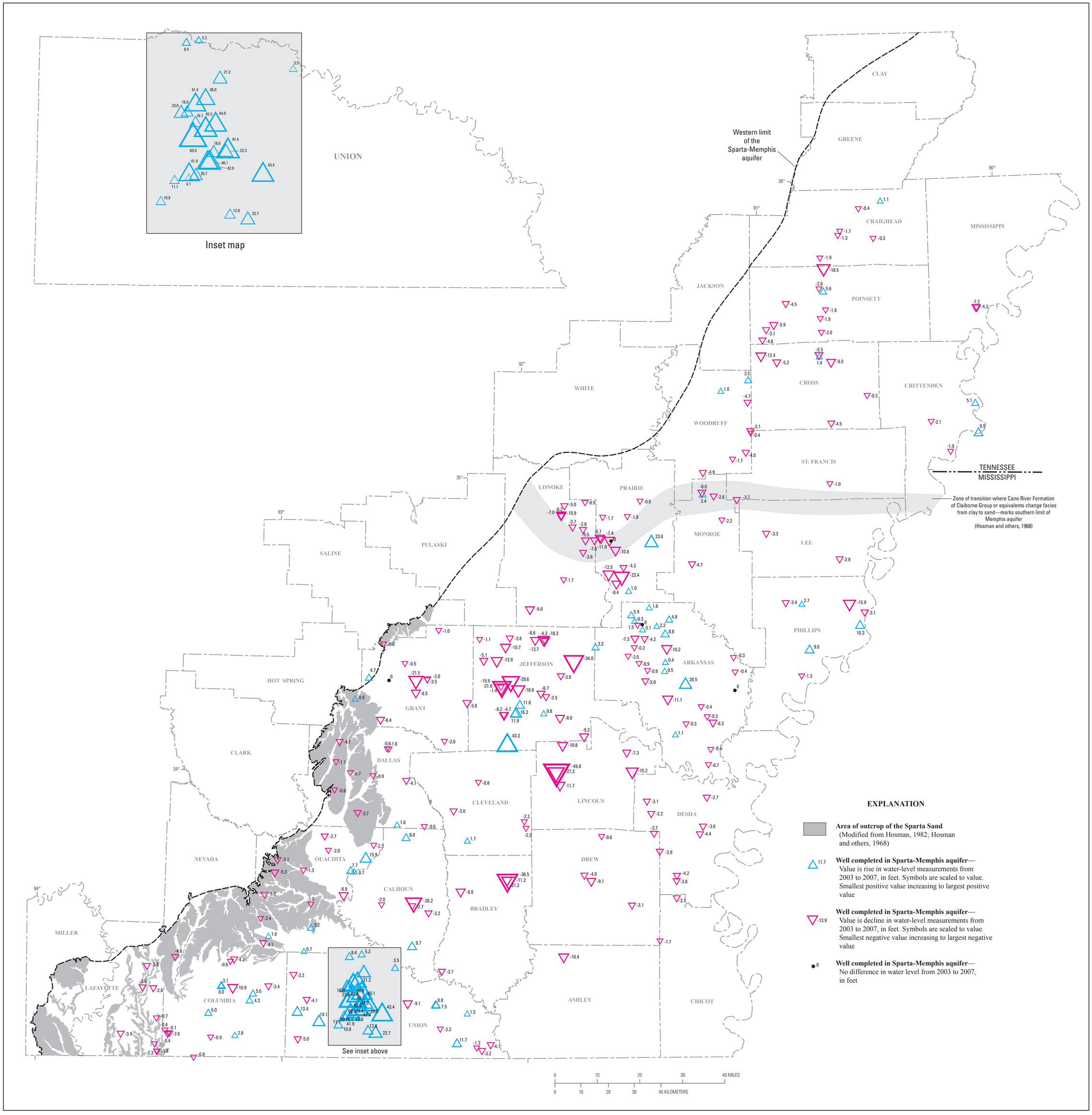
Observation well completed in Sparta-Memphis aquifer—Measurement made in spring 2007. Value is water-level altitude. Datum is National Geodetic Vertical Datum of 1929. Letters, when present, represent hydrographs in figure 4

Direction of groundwater flow

NOTE: The potentiometric contours are generalized to portray synoptically the head in a dynamic hydrologic system, not taking into account the variation in well depth, non-simultaneous measurements of water level, variable effects of pumping, and changing climatic influence. The potentiometric contour may not conform exactly with individual measurements of water level.

Potentiometric Surface for the Sparta-Memphis Aquifer in Arkansas, 2007

By
T.P. Schrader
2009



Water-Level Difference for the Sparta-Memphis Aquifer in Arkansas from 2003 to 2007

By
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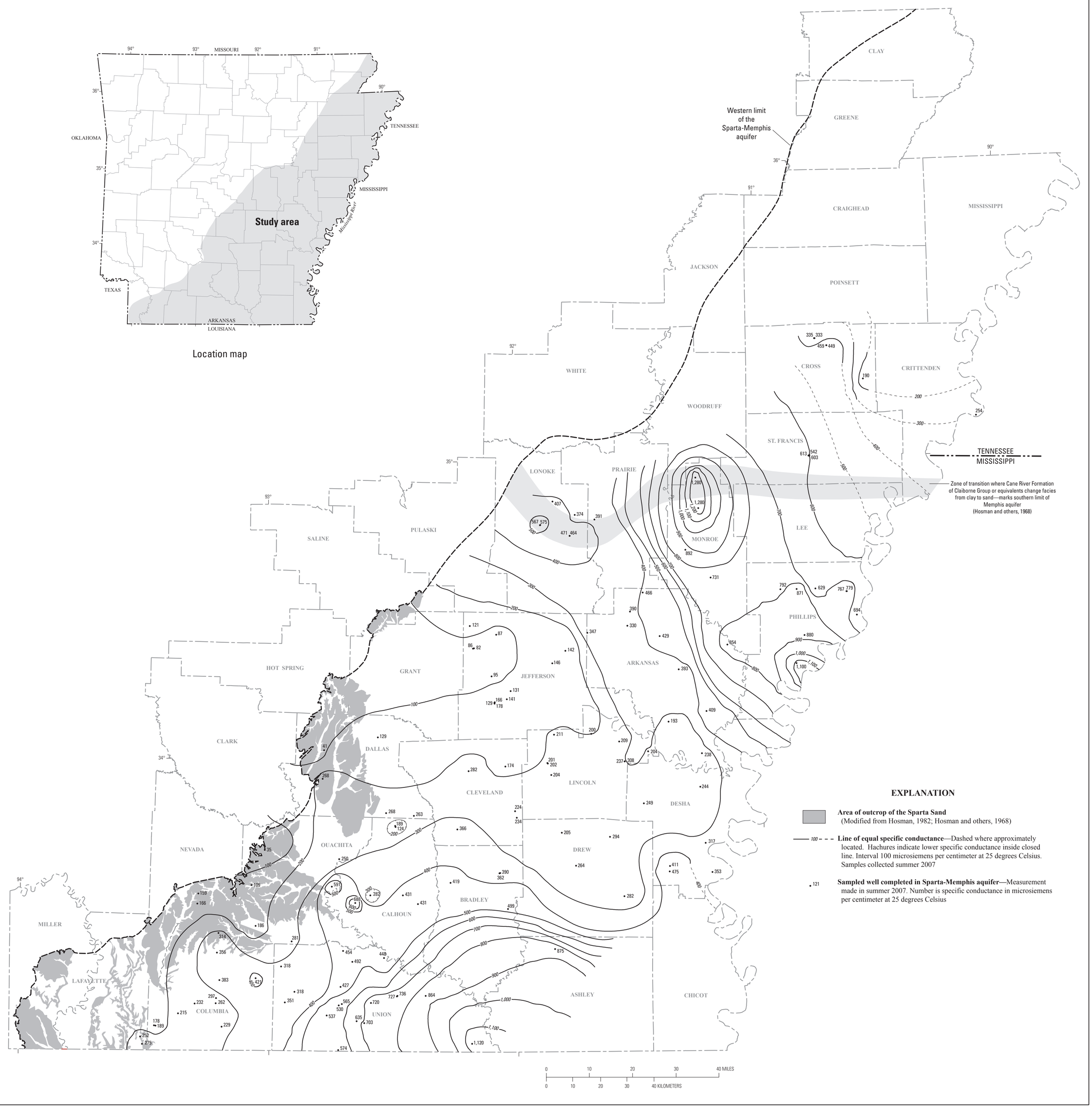
2009

Location map



Specific Conductance for the Sparta-Memphis Aquifer in Arkansas, 2007

By
T.P. Schrader

2009

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