Potentiometric Surface of the Ozark Aquifer in Northern Arkansas, 2004

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

Scientific Investigations Report 2005-5208

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

Potentiometric Surface of the Ozark Aquifer in Northern Arkansas, 2004

By T.P. Schrader

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

Scientific Investigations Report 2005-5208

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

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2005
For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: http://www.usgs.gov/

Contents

Plates

Figures

Tables

Potentiometric Surface of the Ozark Aquifer in Northern Arkansas, 2004

By T.P. Schrader

Abstract

The Ozark aquifer in northern Arkansas comprises dolomites, limestones, sandstones, and shales of Late Cambrian to Middle Devonian age, and ranges in thickness from approximately 1,100 feet to more than 4,000 feet. Hydrologically, the aquifer is complex, characterized by discrete and discontinuous flow components with large variations in permeability.

The potentiometric-surface map, based on 59 well and 5 spring water-level measurements collected in 2004 in Arkansas and Missouri, indicates maximum water-level altitudes of about 1,188 feet in Benton County and minimum water-level altitudes of about 116 feet in Randolph County. Regionally, the flow within the aquifer is to the south and southeast in the eastern and central part of the study area and to the northwest and north in the western part of the study area. Comparing the 2004 potentiometric-surface map with a predevelopment potentiometric-surface map indicates general agreement between the two surfaces. Potentiometric-surface differences could be attributed to differences in pumping related to changing population from 1990 to 2000, change in source for public supplies, processes or water use outside the study area, or differences in data-collection or map-construction methods.

Introduction

The Ozark aquifer is the largest aquifer, both in area of outcrop and thickness, and the most important source of freshwater in the Ozark Plateaus physiographic province, supplying water to large areas of northern Arkansas, southern Missouri, northeastern Oklahoma, and southeastern Kansas. Water use from the Ozark aquifer in Arkansas was estimated to be 30.8 million gallons per day (Mgal/d) in 2000 (Holland, 2004). Water use was 32.3 Mgal/d in 1985, 33.3 Mgal/d in 1990, and 35.8 in 1995 (Holland, 1987: Holland, 1993; Holland, 1999). Water use increased about 11 percent from 1985 to 1995, then decreased about 14 percent from 1995 to 2000. Water use from the Ozark aquifer declined when some public suppliers converted from a ground-water to a surface-water source and a decline in domestic ground-water supply when some domestic users connected to surface-water source public suppliers (T.W. Holland, written commun., U.S. Geological Survey, 2005). A good understanding of changes and trends in water levels is important for continued use, planning, and management of this resource.

The U.S. Geological Survey (USGS) in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Commission conducted a study of the potentiometric surface of the Ozark aquifer. The study is part of an ongoing effort to monitor ground-water levels in Arkansas' major aquifers. This report presents the potentiometric-surface map of the Ozark aquifer within the Ozark Plateaus of northern Arkansas (figs. 1 and 2), representing conditions during 2004.

The study area includes Arkansas counties lying completely or partially within the Ozark Plateaus of the Interior Highlands major physiographic division (Fenneman, 1938). The study area is bounded on the north by Missouri, on the west by Oklahoma, on the east by the Mississippi Alluvial Plain, and on the south by the Ouachita Province (fig. 1).

The potentiometric-surface map presented in this report was prepared from ground-water level data collected by the USGS during February 2004. Additionally, streambed altitudes in areas where the aquifer is unconfined and hydraulically connected to the surface were used as bounding (maximum ground-water level) values. Spring locations were documented in outcrop areas. Water levels from springs in the Ozark aquifer were determined as land-surface altitude from topographic maps and used as reference points.

Aquifer Description

The Ozark Plateaus aquifer system (fig. 2) in and adjacent to the Ozark Plateaus is divided into five hydrogeologic units based on relative rock permeability and well yields. These units crop out in a concentric pattern centered on and dipping away from the St. Francois Mountains of southeastern Missouri. The boundaries between these hydrologic units do not always conform to geologic time divisions or formation boundaries, but were chosen to delineate groups of rocks having similar hydrologic properties. These geohydrologic units consist of rocks that range in age from Cambrian to Mississippian and are the St. Francois aquifer, St. Francois confining unit, Ozark aquifer, Ozark confining unit, and Springfield Plateau aquifer (Imes and Emmett, 1994). The St. Francois aquifer and St. Francois confining unit underlie the Ozark aquifer. The Ozark confining unit overlies the Ozark aquifer. The Springfield Plateau aquifer overlies the Ozark confining unit (table 1).

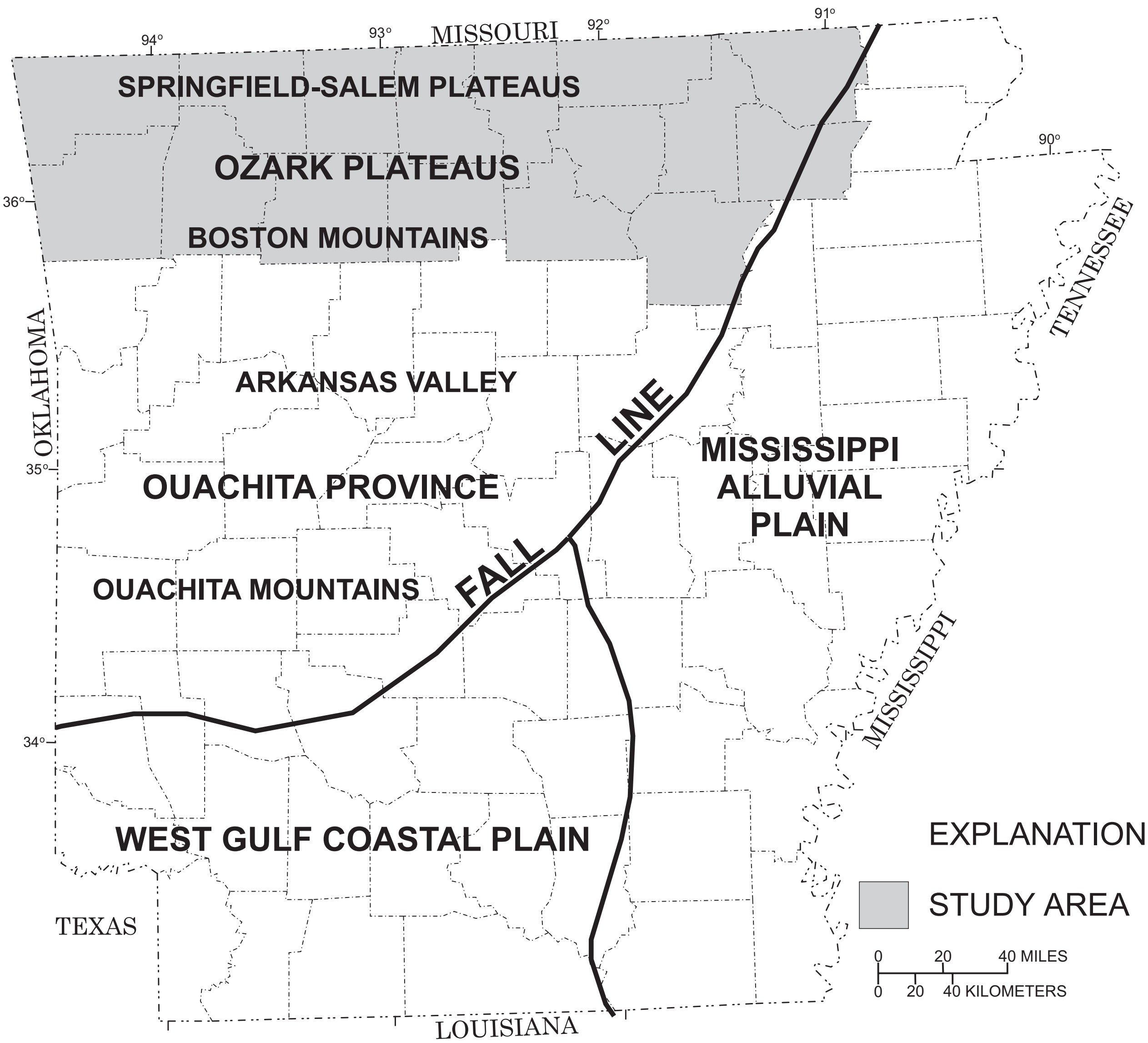


Figure 1. Location of study area.

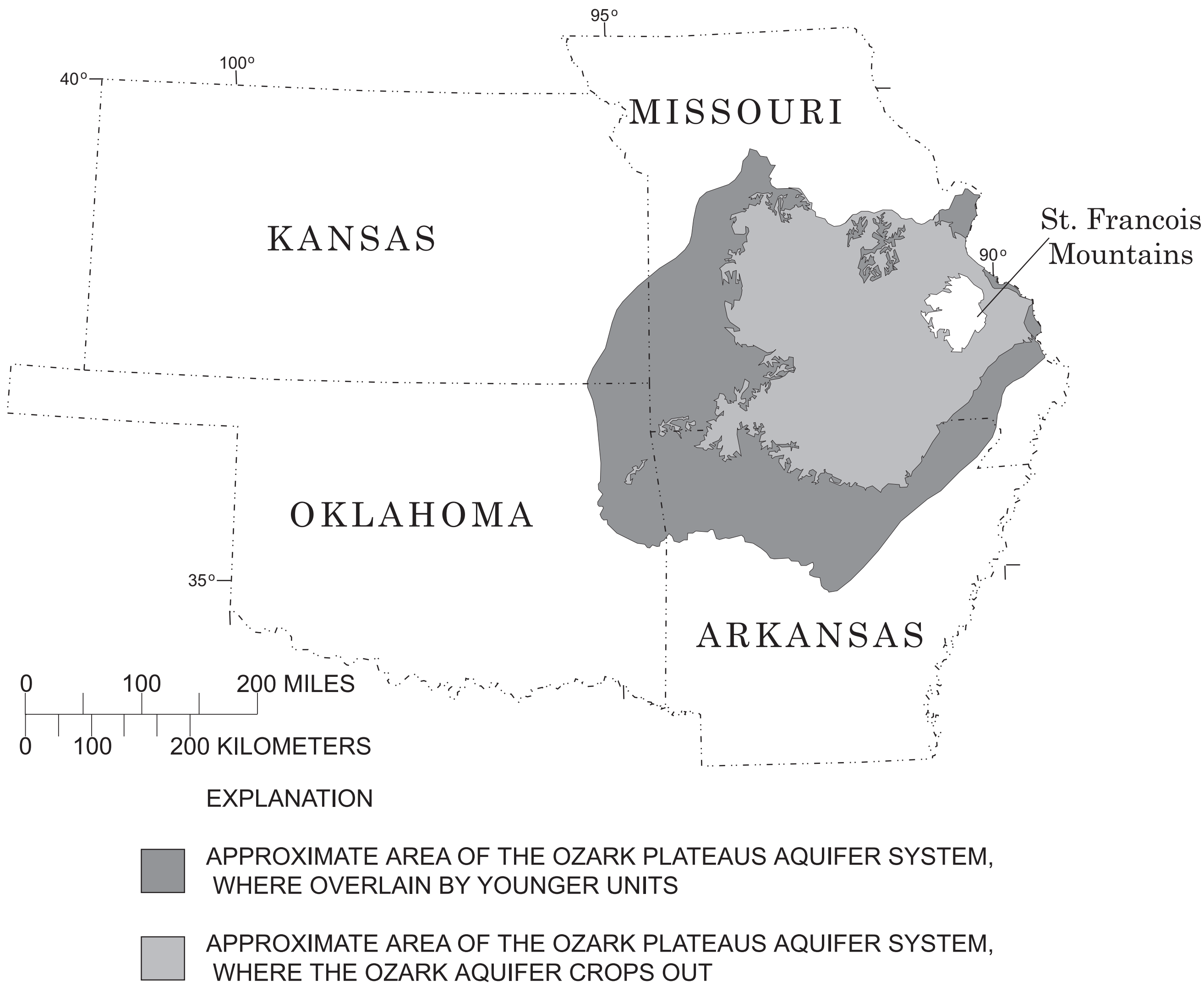


Figure 2. Location of Ozark Plateaus aquifer system.

Table 1. Stratigraphic column with descriptions of lithologic and geohydrologic properties of the Ozark aquifer and adjacent confining units within Arkansas (modified from Lamonds, 1972; Imes, 1990; Imes and Smith, 1990)

ERA	PERIOD	GEOLOGIC UNIT	GEOHYDROLOGIC UNIT	LITHOLOGY	THICKNESS (feet)	GEOHYDROLOGY
Paleozoic	Devonian	Chattanooga Shale	Ozark confining unit	Shale unit that crops out in a narrow band that outlines the Ozark aquifer and is missing where the Ozark aquifer is exposed at the surface.	0 - 200	Unit is relatively impermeable because of large shale content.
		Clifty Limestone	Ozark aquifer	Chert with lenses of limestone, dolomite, and cherty sandstone.	0 - 250	The residual cherty rubble, weathered from cherty limestone and sandstone of the unit, may yield 2 to 5 gallons per minute.
		Penters Chert				
	Silurian	Lafferty Limestone		Limestone, dolomite, sandstone, and minor amounts of shale	0 - 2,000	The limestones and dolomites commonly yield 5 to 10 gallons per minute from solution channels, bedding planes, and fractures. Similar yields may be obtained from the sandstone where it is porous or fractured. These units contain many springs. Yields from springs and some wells may exceed 50 gallons per minute.
		St. Clair Limestone				
		Brassfield Limestone				
	Ordovician	Cason Shale				
		Fernvale Limestone				
		Kimmswick Limestone				
		Plattin Limestone				
		Joachim Dolomite				
		St. Peter Sandstone				
		Everton Formation				
		Smithville Formation		Dolomite, dolomitic limestone, and minor amounts of sandstone and shale.	100 - 1,000	The solution channels and fractures in the dolomite and dolomitic limestone commonly yield 5 to 10 gallons per minute. Wells that tap large solution channels may yield more than 50 gallons per minute, but large yields are uncommon. These units yield water to several large springs.
		Powell Dolomite				
		Cotter Dolomite				
		Jefferson City Dolomite				
		Roubidoux Formation		Sandstone and sandy dolomite. Not exposed in Arkansas.	100 - 250	Yields of as much as 450 gallons per minute may be obtained from some wells, but yields are highly variable and generally average less than 150 gallons per minute.
		Gasconade Dolomite		Dolomite, sandy dolomite, and sandstone. Not exposed in Arkansas.	350 - 650	The most productive water-bearing part of this unit is the Van Buren Formation. Wells that tap into the Van Buren Formation commonly yield 150 to 300 gallons per minute and may yield as much as 500 gallons per minute.
		Van Buren Formation				
	Cambrian	Eminence Dolomite				
		Potosi Dolomite				
		Doe Run Dolomite	St. Francois confining unit	Shale and shaley dolomite, siltstone, and limestone conglomerate. Shales present both as distinct beds and disseminated throughout dolomite matrix. Not exposed in Arkansas.	0 - 750	Permeability is minimal to moderate. Unit is more permeable where transected by fault and fracture zones.
		Derby Dolomite				
		Davis Formation				

The Ozark aquifer in Arkansas is composed of dolomites, limestones, sandstones, and shales of Upper Cambrian to Middle Devonian age (table 1) and ranges in thickness from approximately 1,100 feet (ft) in the northwestern corner of the State to more than 4,000 ft in the west-central portion of the State (Imes, 1990). Most wells completed in the aquifer yield between 50 and 100 gallons per minute (gal/min) although some wells may yield as much as 600 gal/min (Imes and Emmett, 1994; Adamski and others, 1995).

The Ozark aquifer is underlain by the St. Francois confining unit (the uppermost geologic unit of which is the Doe Run Dolomite; table 1). The Ozark aquifer is exposed in much of southern and central Missouri and north-central Arkansas (fig. 2) where uplift of the Ozark dome and erosion of younger rocks has formed a deeply dissected, rugged topography that is the primary recharge area of the aquifer. The aquifer is overlain by the Ozark confining unit mainly in the southern and western part of the study area (table 1). Within the Mississippi Alluvial Plain, east and southeast of the outcrop area (figs. 1 and 2), thick deposits of Cretaceous-, Tertiary-, and Quaternary-age sediments unconformably overlay the Ordovician-age rocks of the Ozark aquifer. Within this part of the Mississippi Alluvial Plain, major rivers receive substantial discharge from the adjacent Ozark aquifer (Mesko and Imes, 1995).

The geohydrology of the Ozark aquifer is complex, consisting of a combination of discrete and discontinuous flow components resulting from spatial variations in regolith thickness, faults, the presence of chert nodules, lithology, and cementation. Primary porosity and permeability are low for most rock units of the aquifer, although secondary permeability resulting from fracturing, bedding planes, and dissolution of the carbonate rocks is spatially variable and ranges from moderate to large (Adamski, 1996). Hydraulic conductivity ranges from $1x10^{-8}$ feet per second (ft/s) to more than $1x10^{-3}$ ft/s (Imes and Emmett, 1994). The principal recharge area for the aquifer is in central and south-central Missouri and north-central Arkansas, where the aquifer is hydraulically connected to the surface and the potentiometric surface mimics the land-surface topography.

Beneath the Mississippi Alluvial Plain (fig. 1), the rocks composing the Ozark aquifer dip at about 45 feet per mile (ft/mi) to the southeast. In the northern part of the study area, the regional dip is about 26 ft/mi southward, increasing to 175 ft/mi or more at the southern boundary of the Ozark Plateaus (Imes, 1990). The depth of the Ozark aquifer increases to more than 4,000 ft below land surface in the southern part of the study area. In this area, water quality is affected by increasing amounts of dissolved solids, fluoride, sulfide, and radium as water moves downdip, away from recharge areas (Imes and Emmett, 1994). The combination of greater depth and poorer water quality limits the viability of the Ozark aquifer as an economic source of water in the southernmost part of the study area.

Potentiometric Surface

The potentiometric-surface map (plate 1) indicates the altitude to which water levels would rise in wells completed in the Ozark aquifer. Water levels were measured during February 2004, to the nearest 0.01 ft from a measuring point of known altitude using a graduated steel tape or electric water-level indicator. The altitude of the land surface was determined by first locating the wells and springs using a global positioning system instrument to read the latitude and longitude. The location then was plotted using a computer plotting program along with the altitude of land surface from digital 7.5-minute USGS topographic quadrangle maps. The potentiometric surface was contoured using the measured water-level data (table 2) from 59 wells and 5 springs. Additional bounding values were used where the Ozark aquifer is exposed at the surface. Land-surface contours and stream altitudes from a 1:500,000 scale topographic map of Arkansas (U.S. Geological Survey, 1990) were considered in the construction of the potentiometric-surface map (plate 1) to prevent contours from crossing streams at inappropriate locations, and to reflect the general land-surface topography where appropriate.

The Ozark aquifer covers a large area in Arkansas and has variable thickness and hydrologic properties. Data point distribution is sparse in some areas. The potentiometric-surface map is intended to show the general configuration of the potentiometric surface and should not be used to estimate exact water-level altitude or depth to water at any given location.

The extent of the potentiometric-surface map presented on plate 1 covers approximately half the area of the Ozark Plateaus in Arkansas (fig. 1). The Ozark aquifer in the southern part of the study area is not a viable source of water because of the greater depths and poorer water quality. Few wells have been constructed in that area and data are not available for contouring purposes.

The potentiometric-surface map depicts the general direction of ground-water flow within the Ozark aquifer, with ground-water movement perpendicular to the contours in the direction of the hydraulic gradient. The direction of regional ground-water flow generally is to the south and southeast in the eastern and central part of the study area and to the northwest and north in the western part of the study area, but has greater variability in areas where the unconfined part of the aquifer is hydraulically connected to the surface. In these areas, the flow direction is affected more by local topography (flowing from high altitudes toward stream valleys).

The potentiometric-surface map indicates the highest water-level altitude of about 1,188 feet above NGVD of 1929 in Benton County. The water-level altitudes in this area are reflective of the influence of the land-surface topography and not the regional flow pattern of the aquifer. Water-level altitudes of less than 400 ft above NGVD of 1929 are mapped along the eastern and southeastern part of the study area in Lawrence, Randolph, and Sharp Counties. The lowest water level of 116 feet above NGVD of 1929 was measured in eastern Randolph County.

Table 2. Information pertaining to measured wells and springs in the Ozark aquifer in northwestern Arkansas and south-central Missouri, 2004.

[NA, not applicable,--, not available; Aquifer code designations are: 357BFLD, Brassfield Limestone; 364STPR, St. Peter Sandstone; 364EVRN, Everton Formations; 368PWLL, Powell Dolomite; 367CTTR, Cotter Dolomite; 367CRJF, Cotter-Jefferson City Dolomite; 368JFRC, Jefferson City Dolomite; 367RBDX, Roubidoux Formation, 367GNTR, Gunter Sandstone member of Van Buren Formation; 367POTS, Potosi Dolomite; Vertical datum is NGVD of 1929. Horizontal datum is NAD of 1983]

Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Station name	Land surface altitude (feet above NGVD of 1929)	Well depth (feet below land-surface datum)	Aquifer code of formation at depth of well	Water level altitude (feet above NGVD of 1929)	Depth to water (feet)	Date of measure-ment
				State of Arkansas				
				Baxter County wells				
361610	921143	19N11W31DAA1	640	193	367CTTR	555	84.97	2/11/2004
361714	923026	19N14W29DBC1	720	1,625	367GNTR	664	56.27	2/11/2004
362114	921423	20N11W35CCA1	600	295	367CTTR	565	35.44	2/11/2004
362309	921419	20N12W23CBA1	600	550	367RBDX	547	52.53	2/11/2004
362431	921912	20N13W13ABD1	620	209	367CTTR	548	72.02	2/11/2004
362435	922026	20N13W14ABC1	580	493	367CTTR	546	34.39	2/11/2004
362700	921558	21N12W33ACB1	610	500	367RBDX	567	42.93	2/11/2004
				Benton County Wells				
362004	935553	19N28W11BAD1	1,260	1,030	367RBDX	1,188	71.88	2/18/2004
361954	940618	19N29W07DAA1	1,210	1,659	367GNTR	1,065	144.68	2/18/2004
362456	942723	20N33W14ACD1	1,185	1,600	367GNTR	755	430.44	2/18/2004
362512	942720	20N33W14DBC1	1,230	1,614	367GNTR	803	426.78	2/18/2004
362417	943607	20N34W21ABD1	1,022	380	364EVRN	992	30.48	2/18/2004
362636	940138	21N29W35DDB2	1,405	1,769	367GNTR	1,063	342.15	2/18/2004
				Boone County Wells				
361150	930258	18N19W19BCC1	1,150	1,649	367GNTR	925	224.66	2/12/2004
361022	930050	18N19W33BBB1	1,300	2,055	367GNTR	718	582.36	2/12/2004
362703	925503	21N18W20CCD1	880	1,415	371POTS	643	237.24	2/11/2004
				Carroll County Wells				
362022	932604	19N23W04BAC1	1,365	1,587	367RBDX	1,164	200.96	2/17/2004
361918	932633	19N23W08ADD1	1,355	2,300	367GNTR	1,101	253.8	2/17/2004
362340	934458	20N26W16DCA1	1,198	1,332	367GNTR	1,062	136.4	2/17/2004
362313	934253	20N26W23ACA1	1,335	1,713	371POTS	1,048	287.1	2/17/2004
362939	934412	21N26W10CDC1	1,090	1,122	367GNTR	993	97.3	2/17/2004
362921	934641	21N26W17BCC1	1,010	1,058	367RBDX	968	41.76	2/17/2004

Table 2. Information pertaining to measured wells and springs in the Ozark aquifer in northwestern Arkansas and south-central Missouri, 2004.—Continued

[NA, not applicable,--, not available; Aquifer code designations are: 357BFLD, Brassfield Limestone; 364STPR, St. Peter Sandstone; 364EVRN, Everton Formations; 368PWLL, Powell Dolomite; 367CTTR, Cotter Dolomite; 367CRJF, Cotter-Jefferson City Dolomite; 368JFRC, Jefferson City Dolomite; 367RBDX, Roubidoux Formation, 367GNTR, Gunter Sandstone member of Van Buren Formation; 367POTS, Potosi Dolomite; Vertical datum is NGVD of 1929. Horizontal datum is NAD of 1983]

Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Station name	Land surface altitude (feet above NGVD of 1929)	Well depth (feet below land-surface datum)	Aquifer code of formation at depth of well	Water level altitude (feet above NGVD of 1929)	Depth to water (feet)	Date of measure-ment
				Fulton County Wells				
361707	913831	19N06W20DCA1	824.6	158	367CTTR	752	72.55	2/10/2004
361728	913503	19N06W23AAD1	680	1,630	367GNTR	453	226.67	2/10/2004
361647	913816	19N06W29AAD1	770	128	367CTTR	738	32.37	2/10/2004
362128	913631	20N06W27DBC1	550	165	368JFRC	485	64.77	2/10/2004
362210	914923	20N08W27ABD1	662	1,282	367GNTR	650	12.14	2/10/2004
362402	915904	20N09W18BAD1	875	950	367RBDX	758	116.85	2/10/2004
				Fulton County Springs				
361908	913431	19N06W12BDAA1SP	400	NA	367CTTR	400	0	2/10/2004
				Independence County Springs				
354949	913959	14N06W29BCC1SP	340	NA	367CTTR	340	0	2/10/2004
				Izard County Wells				
360753	920626	17N11W13AAD1	538	1,729	367RBDX	498	39.79	2/10/2004
361323	915549	18N09W15BCB1	742	600	367CTTR	591	150.98	2/10/2004
				Marion County Wells				
361300	922940	18N14W08BCC1	700	198	367CTTR	586	114.27	2/12/2004
361748	923222	19N15W14BAA2	640	--	367CTTR	499	141.17	2/12/2004
361634	923527	19N15W20ACC1	684	900	367RBDX	517	166.81	2/12/2004
361442	924124	19N16W33CCB1	841	753	367RBDX	554	287.39	2/12/2004
361512	925050	19N18W36BDC1	755	1,392	367RBDX	720	35.43	2/12/2004
362452	923951	20N16W03BAB2	895	600	368JFRC	766	129.04	2/11/2004
362225	924919	20N17W19ABC2	860	180	367CTTR	835	25.32	2/11/2004
				Newton County Wells				
360014	931130	16N21W34ABC1	870	190	364EVRN	804	65.79	2/12/2004
				Randolph County Wells				
361350	910944	18N02W02CAC1	361	128	367CRJF	309	52.38	2/9/2004
362440	905351	20N02E06AAC1	485	900	367RBDX	116	368.81	2/9/2004
362249	910959	20N02W15DAD1	440	170	367CTTR	415	25.31	2/9/2004

Table 2. Information pertaining to measured wells and springs in the Ozark aquifer in northwestern Arkansas and south-central Missouri, 2004.—Continued

[NA, not applicable,--, not available; Aquifer code designations are: 357BFLD, Brassfield Limestone; 364STPR, St. Peter Sandstone; 364EVRN, Everton Formations; 368PWLL, Powell Dolomite; 367CTTR, Cotter Dolomite; 367CRJF, Cotter-Jefferson City Dolomite; 368JFRC, Jefferson City Dolomite; 367RBDX, Roubidoux Formation, 367GNTR, Gunter Sandstone member of Van Buren Formation; 367POTS, Potosi Dolomite; Vertical datum is NGVD of 1929. Horizontal datum is NAD of 1983]

Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Station name	Land surface altitude (feet above NGVD of 1929)	Well depth (feet below land-surface datum)	Aquifer code of formation at depth of well	Water level altitude (feet above NGVD of 1929)	Depth to water (feet)	Date of measure-ment
				Searcy County Wells				
355126	923401	14N15W15AAC1	1,060	3,534	367GNTR	719	340.83	2/13/2004
355520	923718	15N15W19CDD1	1,100	550	364EVRN	754	346.45	2/12/2004
355750	924133	15N16W09BBA1	925	950	368PWLL	790	135.43	2/12/2004
355416	924025	15N16W34BAD1	1,000	485	364PLTN	815	184.67	2/12/2004
355819	924450	15N17W01CBA1	986	1,320	368PWLL	736	250.02	2/12/2004
360014	923603	16N15W29ACB1	1,090	640	364EVRN	949	141.2	2/12/2004
				Sharp County Wells				
355812	913318	15N05W06DDD1	645	482	364EVRN	542	103.32	2/10/2004
360233	913338	16N05W06DCC1	450	1,110	367RBDX	409	40.85	2/10/2004
360023	913654	16N06W27ACC1	650	1,000	367CTTR	555	94.87	2/10/2004
360818	912804	17N05W12BDC1	417	425	367CTTR	359	58.42	2/10/2004
360604	913854	17N06W29ABC1	525	900	367CTTR	443	82.13	2/10/2004
361325	913638	18N06W10CBC1	625	1,525	367GNTR	479	146.16	2/9/2004
361813	912337	19N04W15BAA1	584	611	367RBDX	528	55.65	2/9/2004
				Sharp County Springs				
360228	913211	16N05W17AABA1SP	495	NA	364STPR	495	0	2/10/2004
360325	913631	16N06W10AAA1SP	435	NA	364EVRN	435	0	2/10/2004
360325	913648	16N06W10ABBA1SP	455	NA	364EVRN	455	0	2/10/2004
				Washington County Wells				
355903	941807	15N31W17BBD1	1,195	2,097	367GNTR	1,151	44.07	2/18/2004
355652	941858	15N31W30CAD1	1,165	2,485	367GNTR	1,150	15.02	2/18/2004
360509	942242	16N32W09ABD1	1,135	1,815	367GNTR	992	142.61	2/18/2004
				State of Missouri				
				Ozark County Wells				
363206	923609	21N15W03BAB1	805	550	367GSCD	659	145.58	2/11/2004
363128	923719	21N15W04CCA1	722	505	367GSCD	653	69.03	2/11/2004

In most of the study area the general level and shape of the potentiometric surface has changed little since predevelopment, 1995, or 2001. A comparison of the predevelopment potentiometric surface (Imes, 1990) and the 2004 potentiometric surface indicates general agreement between the two surfaces with the exception of parts of Benton, Carroll, and Washington Counties. In northwestern Benton County water levels have declined and the direction of flow has changed from westward in the predevelopment potentiometric surface to northwestward in the 2004 potentiometric surface. In northeastern Benton and northwestern Carroll Counties water levels have declined. In northwestern Washington County water levels have declined and the direction of flow is northwestward, the same direction as in the predevelopment potentiometric surface. The potentiometric surface in 2004 is similar to the potentiometric surface in 1995 (Pugh, 1998) and 2001 (Schrader, 2001). Potentiometric-surface differences could be attributed to differences in hydrologic stresses (pumping related to changing population, differences in pumping for agricultural uses, or pumping conditions just prior to a water-level measurement) or data-collection and map-construction methods (time of year or different numbers and locations of water-level measurements used for constructing maps representing different years).

The Benton, Carroll, and Washington Counties area has been experiencing rapid growth in population and agricultural use since 1990. Population in these three counties has increased 36 to 57 percent from 1990 to 2000 (GIS Applications Laboratory, University of Arkansas at Little Rock, 2001). Water use, for the entire study area, from the Ozark aquifer has declined by 14 percent from 1995 to 2000. Water use from the Ozark aquifer in Benton, Carroll, and Washington Counties peaked in 1999 and 1998 at about 8 million gallons per day. In 2003 water use from the Ozark aquifer in these three counties declined to about 3.8 million gallons per day (Terrance W. Holland, U.S. Geological Survey, written commun., 2005). A decrease in water use would be expected to cause a rise in water levels. Water levels in Benton, Carroll, and Washington Counties in 1998, 2001, and 2004 are similar or have declined. Processes other than water use in these three counties are having a greater effect on water levels in the Ozark aquifer in Benton, Carroll, and Washington Counties. Changes in precipitation, flow in the aquifer because of dissolution in a karst environment, or water use outside the study area may affect water levels. The decline in water levels in this part of the study area may be caused by the effects of processes or water use outside the study area.

Summary

During February 2004, ground-water levels from 59 wells and 5 springs in the Ozark aquifer in northern Arkansas were measured, mapped, and contoured by the U.S. Geological Survey in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Commission and a potentiometric-surface map of the Arkansas part of the Ozark aquifer was constructed. The Ozark aquifer in northern Arkansas is composed of dolomites, limestones, sandstones, and shales of Upper Cambrian to Middle Devonian age which dip to the south and southeast away from the St. Francois Mountains of Missouri. The aquifer is complex, characterized by discrete hydrologic units with large variations in permeability. The principal recharge area for the aquifer is in central and south-central Missouri and north-central Arkansas, where the aquifer is hydraulically connected to the surface.

A potentiometric-surface map of the Ozark aquifer in northern Arkansas for 2004 indicates a maximum water-level altitude of about 1,188 ft in Benton County, and a minimum altitude of about 116 ft in Randolph County. The direction of regional ground-water flow is generally to the south and southeast in the eastern half of the study area and to the northwest and north in the western half of the study area except in areas where the aquifer is unconfined. In these areas, the potentiometric surface generally mimics the land-surface topography. The 2004 potentiometric-surface map generally is similar in shape to a predevelopment potentiometric-surface map except in three northwestern counties. Potentiometric-surface differences could be attributed to differences in pumping related to changing population from 1990 to 2000, change in source for public supplies, processes or water use outside the study area, or differences in data-collection or map construction methods.

Selected References

Adamski, J.C., 1996, Nutrients and pesticides in ground water of the Ozark Plateaus in Arkansas, Kansas, Missouri, and Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 96-4313, 28 p.

Adamski, J.C., Petersen, J.C., Freiwald, D.A., and Davis, J.V., 1995, Environmental and hydrologic setting of the Ozark Plateaus study unit, Arkansas, Kansas, Missouri, and Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 94-4022, 69 p.

Brahana, J.V., Gonthier, G.J., and Remsing, L.M., 1991, Hydrogeologic data for Boone County, Arkansas: U.S. Geological Survey Open-File Report 91-518, 36 p.

Brahana, J.V., Leidy, V.A., Lindt, J., and Hodge, S.A., 1993, Hydrogeologic data for Carroll County, Arkansas: U.S. Geological Survey Open-File Report 93-150, 32 p.

Bryant, C.T., Ludwig, A.H., and Morris, E.E., 1985, Ground-water problems in Arkansas: U.S. Geological Survey Water-Resources Investigations Report 85-4010, 24 p.

Bush, W.V., Haley, B.R., Stone, C.G., Holbrook, D.F., and McFarland, J.D. III, 1980, A guidebook to the geology of the Arkansas Paleozoic area (Ozark Mountains, Arkansas Valley, and Ouachita Mountains): Arkansas Geological Commission Guidebook 77-1, 79 p.

Caplan, W.M., 1957, Subsurface geology of northwestern Arkansas: Arkansas Geological and Conservation Commission Information Circular 21, 14 p.

Caplan, W.M., 1960, Subsurface geology of pre-Everton rocks in northern Arkansas: Arkansas Geological and Conservation Commission Information Circular 21, 17 p.

Fenneman, N.M., 1938, Physiography of eastern United States: New York, McGraw-Hill Book Co., Inc., 714 p.

Frezon, E.S., Glick, E.E., 1959, Pre-Atoka rocks of northern Arkansas: U.S. Geological Survey Professional Paper 314-H, 18 p.

GIS Applications Laboratory, University of Arkansas at Little Rock, 2001, Percent total population change; Arkansas by county: 1990 - 2000: accessed August 10, 2001, at URL http://argis.ualr.edu/00_pop_chg.pdf.

Holland, T.W., 1987, Use of water in Arkansas, 1985: Arkansas Geological Commission Water Resources Summary 16, 27 p.

Holland, T.W., 1993, Use of water in Arkansas, 1990: U.S. Geological Survey Open-File Report 93-48, 1 sheet.

Holland, T.W., 1999, Water use in Arkansas, 1995: U.S. Geological Survey Open-File Report 99-188, 1 sheet.

Holland, T.W., 2004, Estimated water use in Arkansas, 2000: U.S. Geological Survey Scientific Investigations Report 2004-5230, 31 p.

Imes, J.L., 1990, Major geohydrologic units in and adjacent to the Ozark Plateaus Province, Missouri, Arkansas, Kansas, and Oklahoma--Ozark aquifer: U.S. Geological Survey Hydrologic Investigations Atlas HA-711-E, 3 sheets, scale 1:750,000.

Imes, J.L., and Emmett, L.F., 1994, Geohydrology of the Ozark Plateaus aquifer system in parts of Missouri, Arkansas, Oklahoma, and Kansas: U.S. Geological Survey Professional Paper 1414-D, 127 p.

Imes, J.L., and Smith, B.J., 1990, Areal extent, stratigraphic relation, and geohydrologic properties of regional geohydrologic units, Missouri: U.S. Geological Survey Hydrologic Investigations Atlas HA-711-I, 3 sheets, scale 1:750,000.

Kilpatrick, J.M., and Ludwig, A.H., 1990, Ground-water resources of the upper White River basin in Arkansas: U.S. Geological Survey Open-File Report 88-724, 48 p.

Lamonds, A.G., 1972, Water-resources reconnaissance of the Ozark Plateaus Province, northern Arkansas: U.S. Geological Survey Hydrologic Investigations Atlas HA-383, 2 sheets, scale 1:500,000.

Leidy, V.A., and Morris, E.E., 1990, Hydrogeology and quality of ground water in the Boone Formation and Cotter Dolomite in karst terrain of northwestern Boone County, Arkansas: U.S. Geological Survey Water-Resources Investigations Report 90-4066, 57 p.

Mesko, T.O., and Imes, J.L., 1995, Discharge of ground water along the Ozark Escarpment in southeastern Missouri and northeastern Arkansas: U.S. Geological Survey Water-Resources Investigations Report 95-4103, 12 p.

Pugh, A.L., 1998, Potentiometric surface of the Ozark aquifer in northern Arkansas, 1995: U.S. Geological Survey Water-Resources Investigation Report 98-4000, 7 p.

Schrader, T. P., 2001, Potentiometric surface of the Ozark aquifer in northern Arkansas, 2001: U.S. Geological Survey Water-Resources Investigation Report 01-4233, 11 p.

U.S. Geological Survey, 1990, State of Arkansas (Topographic): U.S. Geological Survey Map Publication 34092-E1-ST-500, scale 1:500,000, 1 sheet.

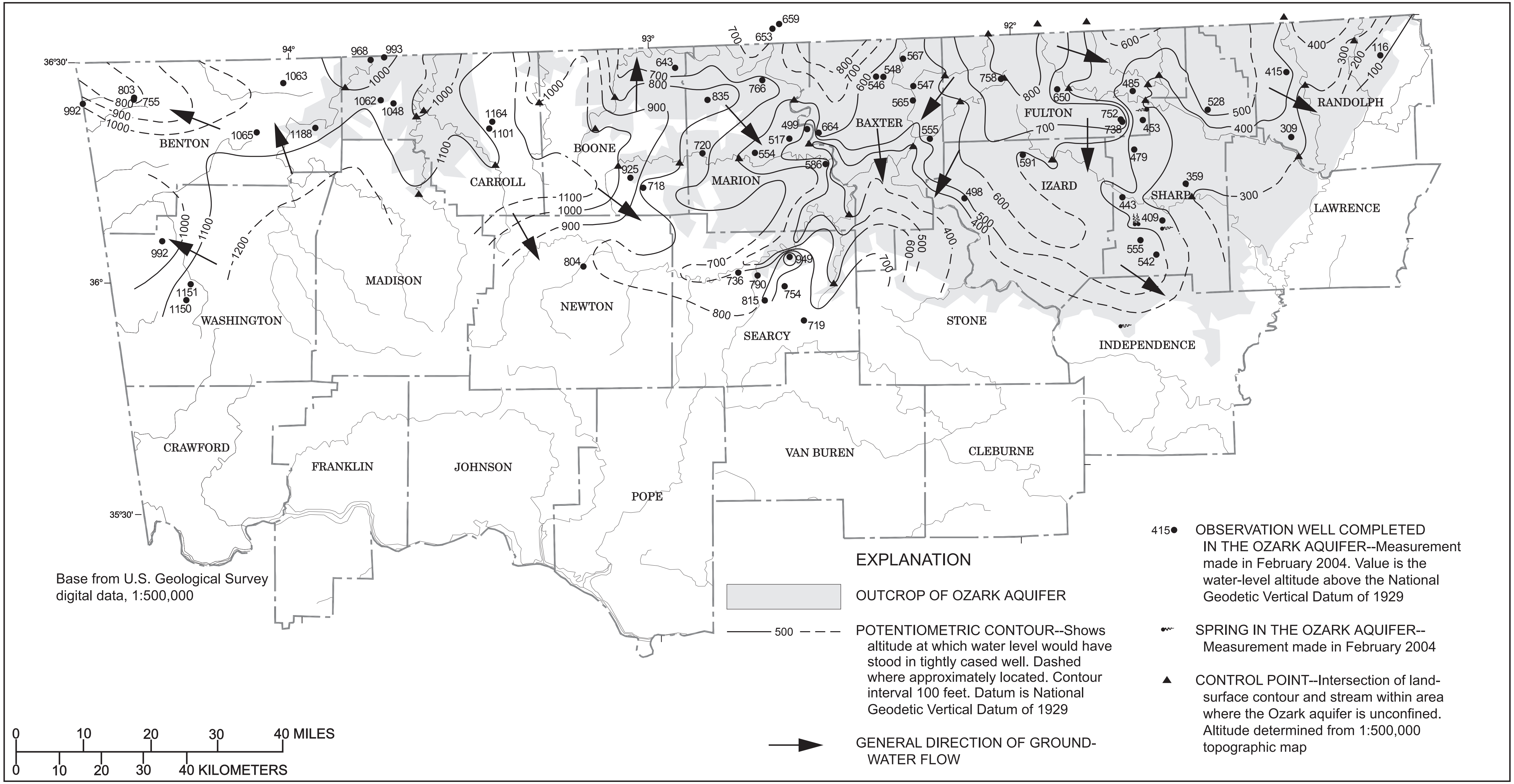
Wise, O.A., and Caplan, W.M., 1979, Silurian and Devonian rocks of northern Arkansas: Arkansas Geological Commission Information Circular 25, 14 p.

Schrader, T.P.—POTENTIOMETRIC SURFACE OF THE OZARK AQUIFER IN NORTHERN ARKANSAS, 2004—U.S. Geological Survey Scientific Investigations Report 2005-5208

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

USGS science for a changing world
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS REPORT 2005-5208
Potentiometric-surface map of the Ozark aquifer-Plate 1
Schrader, T.P., 2005, Potentiometric surface of the Ozark aquifer in northern Arkansas, 2004



POTENTIOMETRIC SURFACE OF THE OZARK AQUIFER IN NORTHERN ARKANSAS, 2004

T.P. SCHRADER

2005