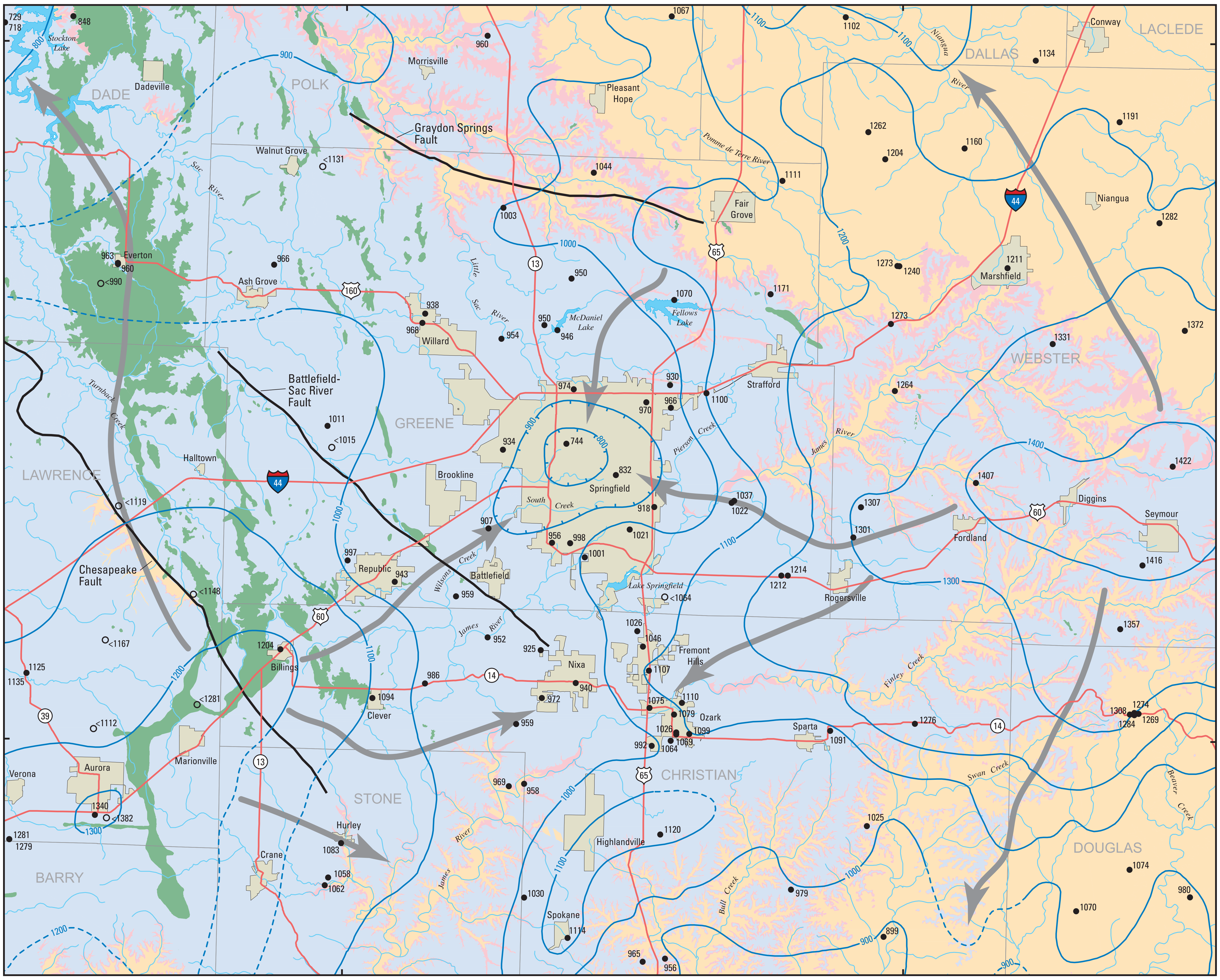

Base from U.S. Geological Survey digital data, 1991, 2006, 1:100,000;
U.S. Census Bureau digital data, 2000, 1:100,000;
Universal Transverse Mercator projection, North American Datum (NAD) 1983

0 10 20 MILES
0 10 20 KILOMETERS

Geohydrologic units modified from Missouri Department of Natural Resources digital data, 2007, 1:500,000

Introduction

A study of the water resources of the Springfield, Missouri, area in the 1970s determined that a cone of depression, formed by ground-water pumping, had developed in the Ozark aquifer beneath the city (Emmett and others, 1978). Continued ground-water usage in the 1970s and 1980s caused concern that ground-water resources would not be sufficient to meet the future needs of Springfield, Missouri, during periods of drought. As a result, a ground-water flow model of the Springfield area was developed by the U. S. Geological Survey (USGS) to assess the future role of ground water as a water source for the area (Imes, 1989). Results of the USGS model led to a decision by the City Utilities of Springfield to primarily rely on surface water from Stockton Lake as a source of city drinking water. Municipal and industrial ground-water usage continues in Springfield, but at lower rates than previously experienced (Jim Vandike, Missouri Department of Natural Resources, written commun., 2007).

Rapid growth in the area has caused commercial, industrial, and domestic water use to increase. Population growth has been especially rapid in Nixa, Ozark, and Republic, and water use in the vicinity of these cities has grown an estimated 39 percent since 1990 (Dintelmann and others, 2006). Unlike Springfield, ground water is the primary source of water for these cities. The increased stress on the Ozark aquifer (fig. 1), the primary aquifer in the study area, has raised new concerns about possible further water-level declines in the areas of increased ground-water use. Although there continues to be new development in the Ozark aquifer, since 1987 no new water-supply wells that produce water from the Springfield Plateau aquifer (fig. 1) have been allowed to be constructed in most of Greene and northern Christian counties (Jim Vandike, Missouri Department of Natural Resources, written commun., 2007). There is concern that if the potentiometric surface of the Ozark aquifer continues to decline, increased leakage of contaminants into the Ozark aquifer from the overlying Springfield Plateau aquifer (fig. 1) could occur (Jim Vandike, Missouri Department of Natural Resources, written commun., 2007). To address this concern, the USGS, in cooperation with Greene County, Missouri, the U.S. Army Corps of Engineers, and the Missouri Department of Natural Resources, constructed a map of the potentiometric surface of the Ozark aquifer for 2006–2007. The map can be compared to previously constructed potentiometric-surface maps by Emmett and others (1978) and Imes (1989) to evaluate changes in ground-water flow directions, but the comparison is beyond the scope of this report.

Geohydrologic unit	Stratigraphic unit	Lithology	Water-bearing properties
Western Interior Plains confining system	Pennsylvanian channel-sand deposits	Sand and clay	Hydraulic properties are unknown. Presumably, most of these localized, thin deposits are unsaturated.
Springfield Plateau aquifer	St. Louis Limestone Salem Formation Warsaw Formation Keokuk Limestone Burlington Limestone Elsey Formation Reeds Spring Formation Pierson Limestone	Limestone and chert	Aquifer with karst zone in upper part. Yield to wells usually is less than 20 gallons per minute. Adequate for domestic and stock use only. Contamination potential large because of extensive network of karst features and surficial position.
Ozark confining unit	Northview Shale Compton Limestone Bachelor Formation Chattanooga Shale	Shale, silt, and limestone	Confining unit with confining material primarily in the Northview Shale.
Ozark aquifer	Smithville Dolomite Cotter Dolomite Jefferson City Dolomite Roubidoux Formation Gasconade Dolomite Eminence Dolomite Potosi Dolomite	Dolostone and sandstone	Productive aquifer yielding about 1,000 gallons per minute to wells open to the entire sequence of rock units. Upper part of aquifer generally is less productive. Most productive rock units are the Roubidoux Formation, Gasconade Dolomite, and the Potosi Dolomite.

Figure 1. Correlation of geohydrologic units and stratigraphic units in the Springfield, Missouri, area (modified from Imes, 1989).

Hydrogeology of the Study Area

The study area encompasses approximately 2,870 square miles and is centered approximately on the city of Springfield, Missouri. The maximum land surface elevation (1,740 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29)) occurs in the east central part of the study area and the lowest land surface elevation (805 feet) occurs in the northwest part of the study area. The Ozark aquifer is confined in about two-thirds of the study area by the Ozark confining unit, and is unconfined elsewhere. A secondary aquifer, the Springfield Plateau aquifer, occurs above the Ozark confining unit; however, it typically yields sufficient water only for domestic and stock use. Currently (2007), water use from the Springfield Plateau aquifer is minor (Jim Vandike, Missouri Department of Natural Resources, written commun., 2007). The Springfield Plateau aquifer is confined locally by the Western Interior Plains confining system. There is a general downward hydraulic gradient from the Springfield Plateau aquifer to the Ozark aquifer (Imes, 1989). The Ozark aquifer and the Springfield Plateau aquifer exhibit karst features such as springs, caves, sinkholes, losing streams, and solution enlarged fractures. These features are important hydrologically because they can move water (and contaminants) into and through the ground-water system quickly, and can move ground water between surface-water drainage basins.

EXPLANATION

Western Interior Plains confining system

Springfield Plateau aquifer

Ozark confining unit

Ozark aquifer

Approximate direction of ground-water flow

900 **Potentiometric contour**—Shows altitude at which water level would have stood in tightly cased well. Hachures indicate depression of potentiometric surface. Dashed line indicates where approximately located. Contour interval 100 feet. Vertical datum is NGVD 29

848 **Ground-water level data control point**—Number is the altitude of the water level, in feet

<990 **Ground-water level data supplemental control point**—Well open to Springfield Plateau aquifer. Number is the altitude of the measured water level, in feet. Altitude of Ozark Aquifer water level is less than measured value of control point

Methods

An updated potentiometric-surface map was constructed using 119 water-level measurements collected from 115 wells. Data are available in the USGS National Water Information System (*http://water.data.usgs.gov/nwis*). The USGS made 88 measurements during the spring and summer of 2006, and made 17 additional measurements in the summer of 2007. Public water-supply managers reported 3 measurements from the spring and summer of 2006, and 11 measurements from the spring and summer of 2007. The potentiometric-surface map was drawn using ground-water level measurements made at existing wells that either were not pumping or were shut down for a brief period (usually about 15 minutes) to allow the water level in the well to recover. Water levels were measured to the nearest 0.01 foot with an electric tape, to the nearest 0.5 foot with an acoustic meter, or to the nearest 5 feet by taking an air-line reading. The largest source of error was from determining the land-surface altitudes from USGS 1:24,000 scale topographic maps, which are accurate to one-half of the contour interval (plus or minus 10 feet). Well locations were determined using hand-held Global Positioning System (GPS) units. Water-level measurements in wells that were open to the Springfield Plateau aquifer and the Ozark aquifer did not represent the potentiometric surface in the Ozark aquifer, but were used as supplemental control points to aid in contouring. In areas where the Ozark aquifer is exposed at the land surface, streambed elevations and some springs also were used to aid in contour delineation. The potentiometric surface was constructed using a 100- foot contour interval.

Potentiometric Surface

Potentiometric surface contours of the Ozark aquifer can be used to infer direction of ground-water flow. The horizontal component of ground-water flow is perpendicular to the potentiometric contour lines. Ground water flows away from ground-water highs and discharges to rivers or springs, or is captured by pumping wells. Ground-water recharge occurs to the Ozark aquifer from precipitation that infiltrates directly into the aquifer where it is exposed at the land surface or from flow from the overlying Ozark confining unit. Areas of ground-water usage are evident as cones of depression or as potentiometric contours that have shifted from pre-development positions as defined by Imes (1989). Based on the potentiometric contours, except for the northwest corner, nearly all of Greene County falls in the ground-water capture area for the ground-water cone of depression centered on the city of Springfield.

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Potentiometric Surface of the Ozark Aquifer near Springfield, Missouri, 2006–07

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