Prepared in cooperation with the
ARKANSAS GEOLOGICAL COMMISSION,
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION,
LOCAL CONSERVATION DISTRICTS,
and the
U.S. SOIL CONSERVATION SERVICE

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

INTRODUCTION

The study area, which coincides with the Mississippi Alluvial Plain is a highly agricultural part of Arkansas. Rice was one of the first staples grown with economic success in the area. Today, rice and soybeans are probably the two main staples grown throughout the area and both are dependent on freshwater for irrigation. Historically and to the present (1985), the main source of freshwater has been the Mississippi River Valley alluvial aquifer, henceforth referred to as the alluvial aquifer (an aquifer is a water-bearing layer of rock or sediment that will yield water in a usable quantity to a well or spring). Approximately 3.4 billion gal/d of water were withdrawn from the alluvial aquifer in 1980, mostly for rice production (Holland and Ludwig, 1981).

The U.S. Geological Survey (USGS), with the cooperation of the Arkansas Geological Commission (AGC), has been monitoring water levels in the alluvial aquifer for several years with a network of wells within the Mississippi Alluvial Plain of Arkansas to observe the effects of large withdrawals for irrigation on water levels (Edds, 1984; Edds and Spencer, 1985; Edds and Fitzpatrick, 1984; Plafcan and Edds, 1986). In 1984, this network was enhanced by additional monitor wells which are measured by local District personnel of the U.S. Soil Conservation Service (SCS) (Plafcan, 1985). The purpose of this report, which was prepared in cooperation with the AGC, the Arkansas Soil and Water Conservation Commission (ASWCC), local Conservation Districts and the SCS, is to illustrate the effect of withdrawals from the alluvial aquifer.

Maps shown in this report were prepared from data collected by both the USGS (Edds and Spencer, 1985) and the SCS (Plafcan, 1986). They show the potentiometric surface of the alluvial aquifer before and after the pumping season of 1985, the depth-to-water in the spring of 1985, and the change in water levels between the spring of 1980 and the spring of 1985. Hydrographs showing long-term water-level changes in the alluvial aquifer also are included.

AQUIFER DESCRIPTION

The alluvial aquifer is composed of flood plain and terrace deposits of Quaternary age. The flood plain deposits generally grade from gravel and coarse sand in the lower part to silt and clay in the upper part. Lithology of the terrace deposits is similar to those in the flood plain (Boswell and others, 1968). The alluvial deposits generally range in thickness from 50 to 200 feet. Alluvial deposits generally are thinnest near the Fall Line (the physiographic boundary between the Coastal Plain and the Interior Highlands) and thicken eastward. The upper clay layer varies in thickness from a few feet to more than 75 feet, and where present, forms a confining layer for water in the coarser material below. Heavy pumpage in some areas has resulted in the decline of water levels below the bottom of the clay layer. Yields of wells generally range from 1,000 to 3,000 gal/min, (Petersen and others, 1985). The aquifer is discontinuous at Crowleys Ridge, an erosional remnant of Tertiary strata that extends from north of the Missouri-Arkansas boundary to Helena, Arkansas. Material in the ridge is much less permeable than the alluvial sand and gravel (Boswell and others, 1968) and thus is little used for irrigation.

Thickness of the clay layer affects recharge to the coarser material below. In areas where a thick clay layer prevents infiltration of precipitation, horizontal flows from adjacent areas are generally the most important source of recharge. In areas where the clay layer is thin, infiltration of precipitation may be the most important source of recharge. Recharge also may occur from streams and lakes during periods of high stream stage.

POTENTIOMETRIC SURFACE MAPS

The potentiometric-surface maps indicate the altitude to which water levels would rise in tightly cased wells that penetrate the alluvial aquifer. The maps shown are for the spring and fall, 1985. The map that reflects pre-pumping conditions during spring is based on water-level measurements collected by the U.S. Geological Survey and the U.S. Soil Conservation Service in 729 wells between February and June 1985. The map that reflects post-pumping conditions during fall is based on water-level measurements collected by the U.S. Soil Conservation Service in 432 wells between August and December 1985.

Both potentiometric surface maps reflect the general flow patterns within the aquifer, with movement being perpendicular to the contours in the direction of the hydraulic gradient. Hydraulic gradients are highest in the spring, when the aquifer has recovered from the previous pumping season. The regional direction of ground-water flow is south and southeast, except where affected by heavy pumping, and near reaches of the Mississippi and other rivers where they are in hydraulic connection with the alluvial aquifer. The potentiometric contours in Crittenden and Mississippi Counties show that the direction of flow before the pumping season in this area is away from the river. An area centered in Arkansas County and another in Poinsett and Cross Counties are marked by large cones of depression that result from large ground-water withdrawals for irrigation. In 1981, Arkansas County used 380 Mgal/d and Cross and Poinsett Counties together used 593 Mgal/d for irrigation (Hall and Holland, 1984), most of which came from alluvial deposits. Smaller cones of depression are indicated in Greene, Monroe, and St. Francis Counties.

Mean water levels after the pumping season were 3.7 feet lower than those before the pumping season (Plafcan, 1986). Infiltration (or recharge) from a river stops and drainage into the river from the aquifer begins when the water level in the river falls below the water level in the aquifer. A decline in stage in the Mississippi River between the spring and fall resulted in that river changing from a source of recharge to a drain for the aquifer.

WATER-LEVEL CHANGE MAP

Of the 247 wells monitored by the USGS over the 5-year period, 81 showed a net increase and 166 showed a net decrease in water-level altitudes. Declines greater than 6 feet occurred extensively in two locations--central Lonoke and Prairie Counties and in parts of Craighead, Jackson and Poinsett Counties. Both areas are influenced by heavy pumping. Approximately 405 Mgal/d were withdrawn, mostly from the alluvial aquifer, for irrigation in Lonoke and Prairie Counties in 1980 (Holland and Ludwig, 1981), and approximately 303 Mgal/d were withdrawn in Poinsett County. Localized areas of water-level decline greater than 6 feet occurred in Arkansas, Cross, Desha, Drew, Greene, Lee, Lincoln, and White Counties. Localized areas with a water-level rise greater than 6 feet occurred near major streams and probably reflects infiltration from the streams.

Hydrographs for three wells completed in the alluvial aquifer in Poinsett, Mississippi, and Lonoke Counties illustrate long-term water-level changes. The wells in Lonoke and Poinsett Counties are in areas of heavy withdrawals, and their hydrographs show long-term nearly continuous declines of water levels. The hydrograph for the well in Mississippi County shows small seasonal fluctuations related to stages in the Mississippi River and local changes in storage, but does not indicate a long-term decline of water level over the last 20 years.

DEPTH-TO-WATER MAP

Water levels in the alluvial aquifer are shallowest near the Fall Line and near streams that penetrate the aquifer such as the Arkansas, White, and Mississippi Rivers. The water levels are shallow along the Fall Line because the alluvial aquifer is thinnest along the Fall Line. Water levels in the aquifer near penetrating streams are shallow for two reasons: decreased use of ground water due to availability of surface water and infiltration of water from the river into the aquifer. The deepest water levels, those greater than 100 feet below the land surface, correspond to the areas of large ground-water withdrawals in Arkansas, Lonoke, Poinsett, and Cross Counties.

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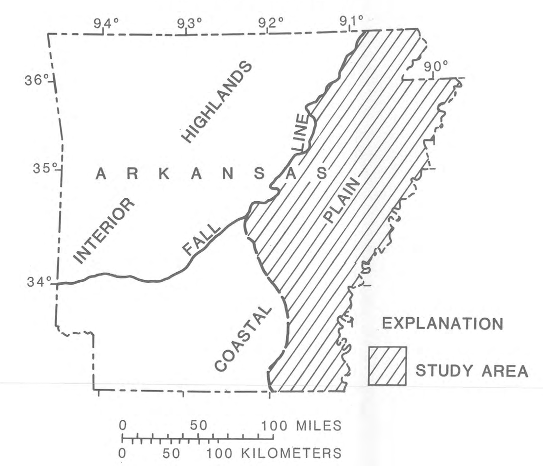

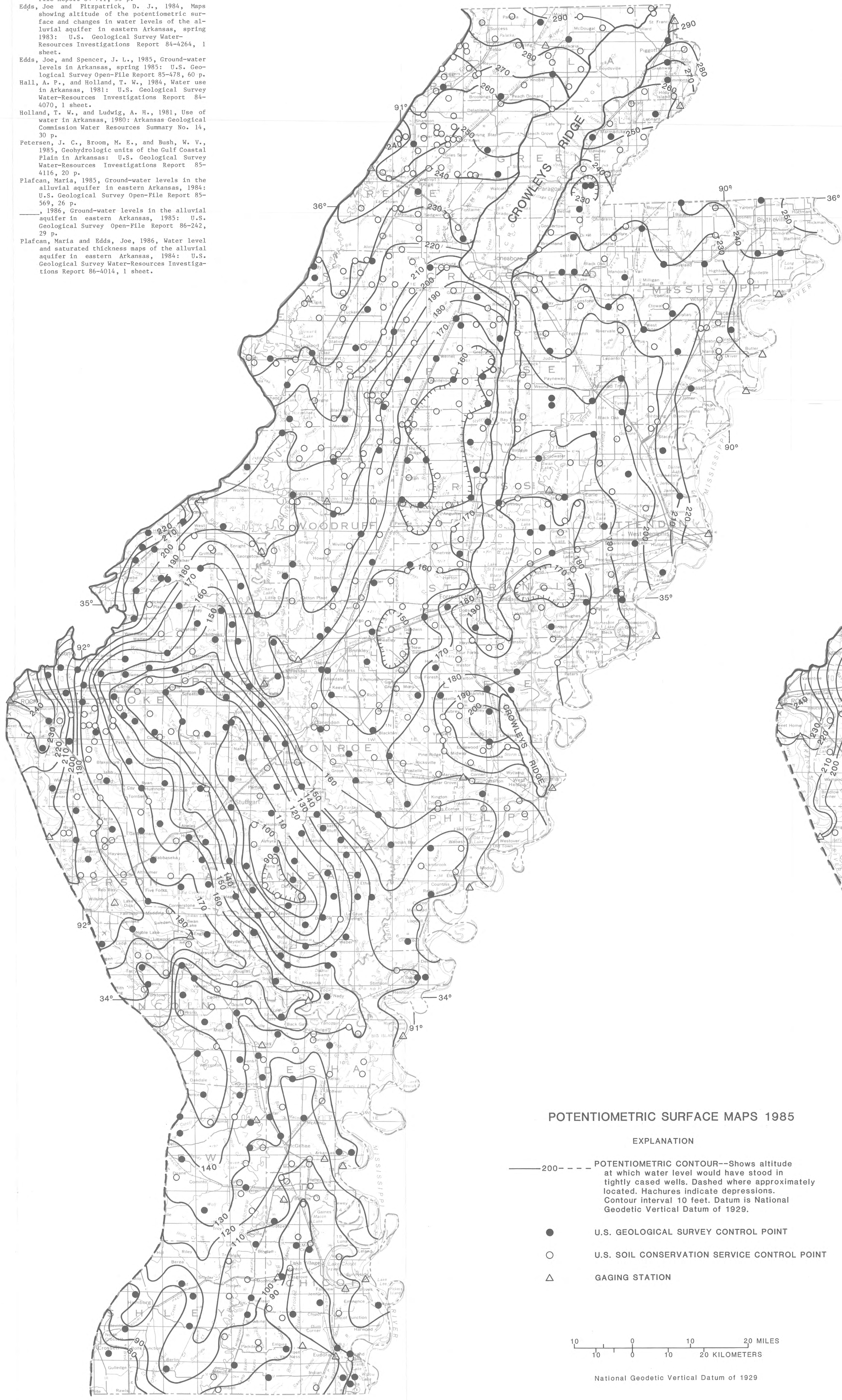

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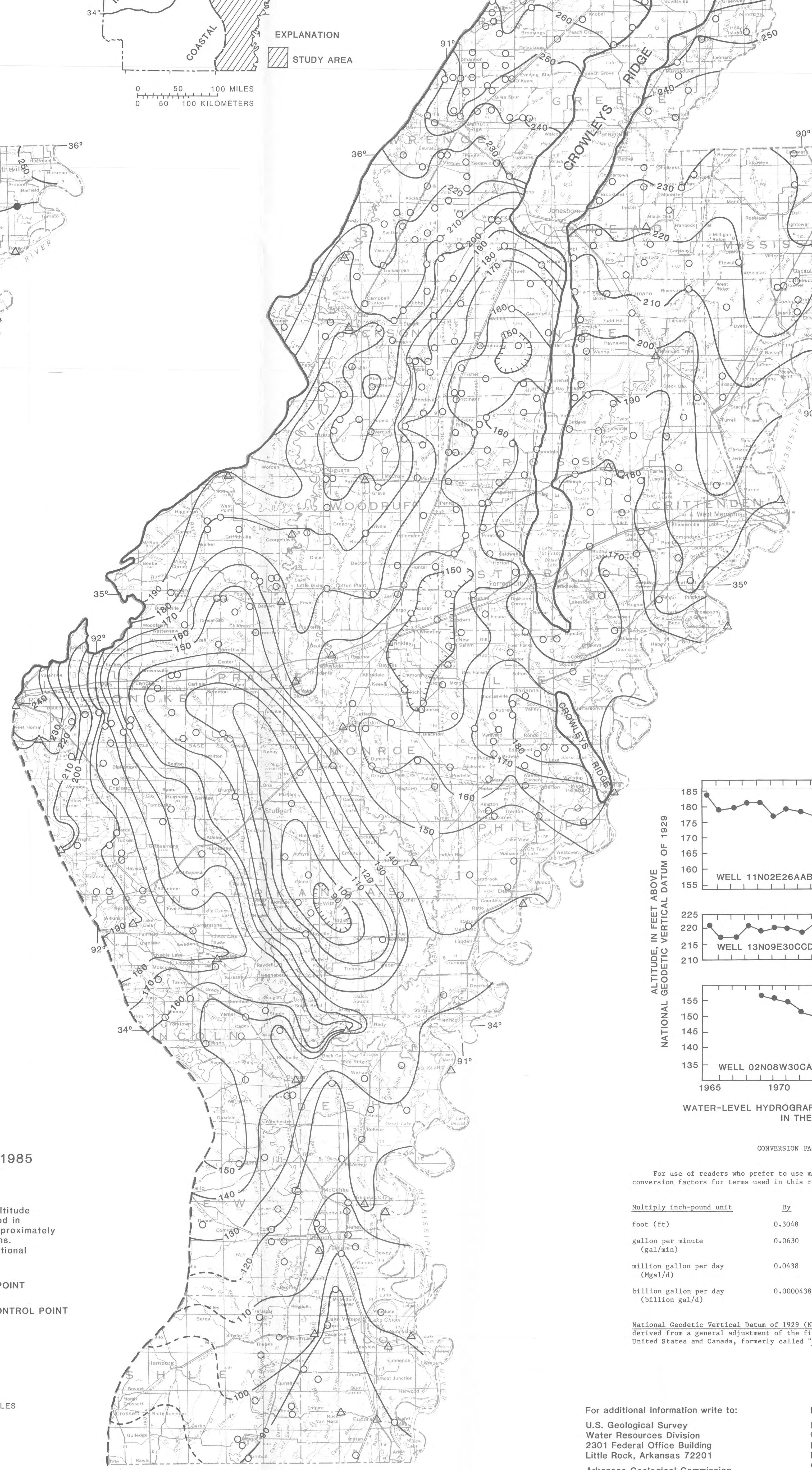


FALL

POTENTIOMETRIC SURFACE MAPS 1985

EXPLANATION

——200– – – – POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Hachures indicate depressions. Contour interval 10 feet. Datum is National Geodetic Vertical Datum of 1929.

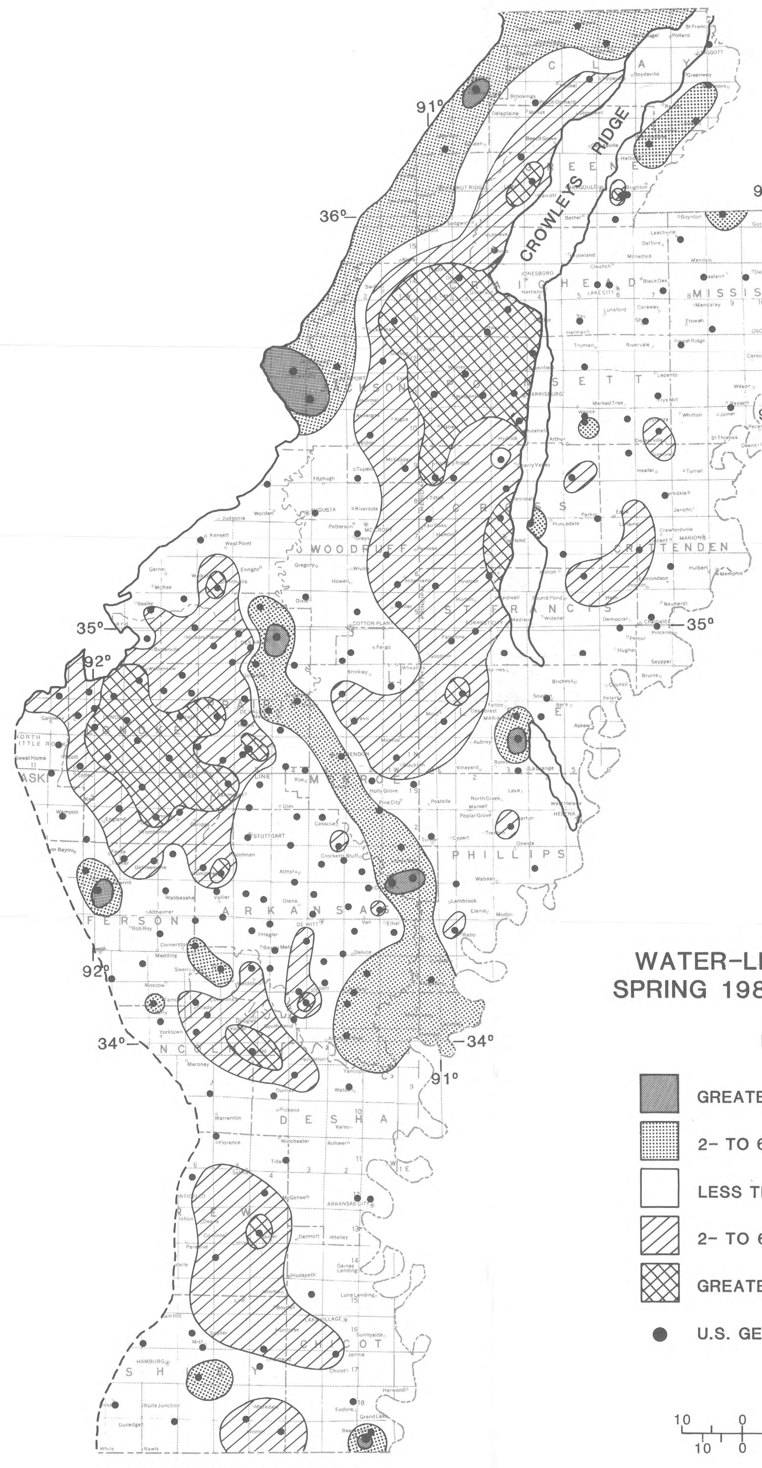
● U.S. GEOLOGICAL SURVEY CONTROL POINT

○ U.S. SOIL CONSERVATION SERVICE CONTROL POINT

△ GAGING STATION

10 0 10 20 MILES
10 0 10 20 KILOMETERS

National Geodetic Vertical Datum of 1929



WATER-LEVEL CHANGE MAP SPRING 1980 TO SPRING 1985

EXPLANATION

GREATER THAN 6-FOOT RISE

2- TO 6-FOOT RISE

LESS THAN 2-FOOT CHANGE

2- TO 6-FOOT DECLINE

GREATER THAN 6-FOOT DECLINE

● U.S. GEOLOGICAL SURVEY CONTROL POINT

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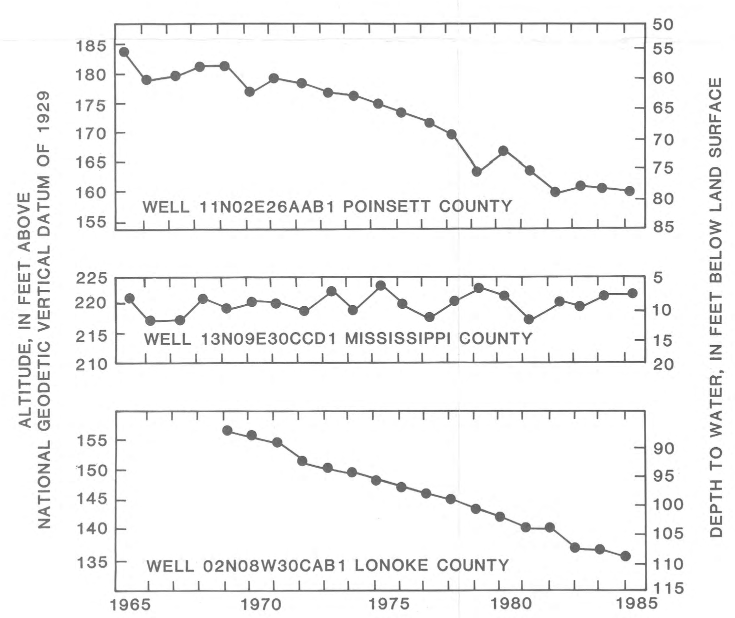
10 0 10 20 30 40 KILOMETERS



WATER-LEVEL HYDROGRAPHS FOR SELECTED WELLS COMPLETED IN THE ALLUVIAL AQUIFER

CONVERSION FACTORS

For use of readers who prefer to use metric units (International System), conversion factors for terms used in this report are listed below:

Multiply inch-pound unit	By	To obtain metric unit
foot (ft)	0.3048	meter (m)
gallon per minute (gal/min)	0.0630	liter per second (L/s)
million gallon per day (Mgal/d)	0.0438	cubic meter per second (m^3/s)
billion gallon per day (billion gal/d)	0.00004381	cubic meter per second (m^3/s)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A Geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level."

For additional information write to:

U.S. Geological Survey
Water Resources Division
2301 Federal Office Building
Little Rock, Arkansas 72201

Arkansas Geological Commission
3815 West Roosevelt Road
Little Rock, Arkansas 72204

Arkansas Soil and Water Conservation Commission
#1 Capitol Mall, Suite 2D
Little Rock, Arkansas 72201

For purchase write to:

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Box 25425, Denver Federal Center
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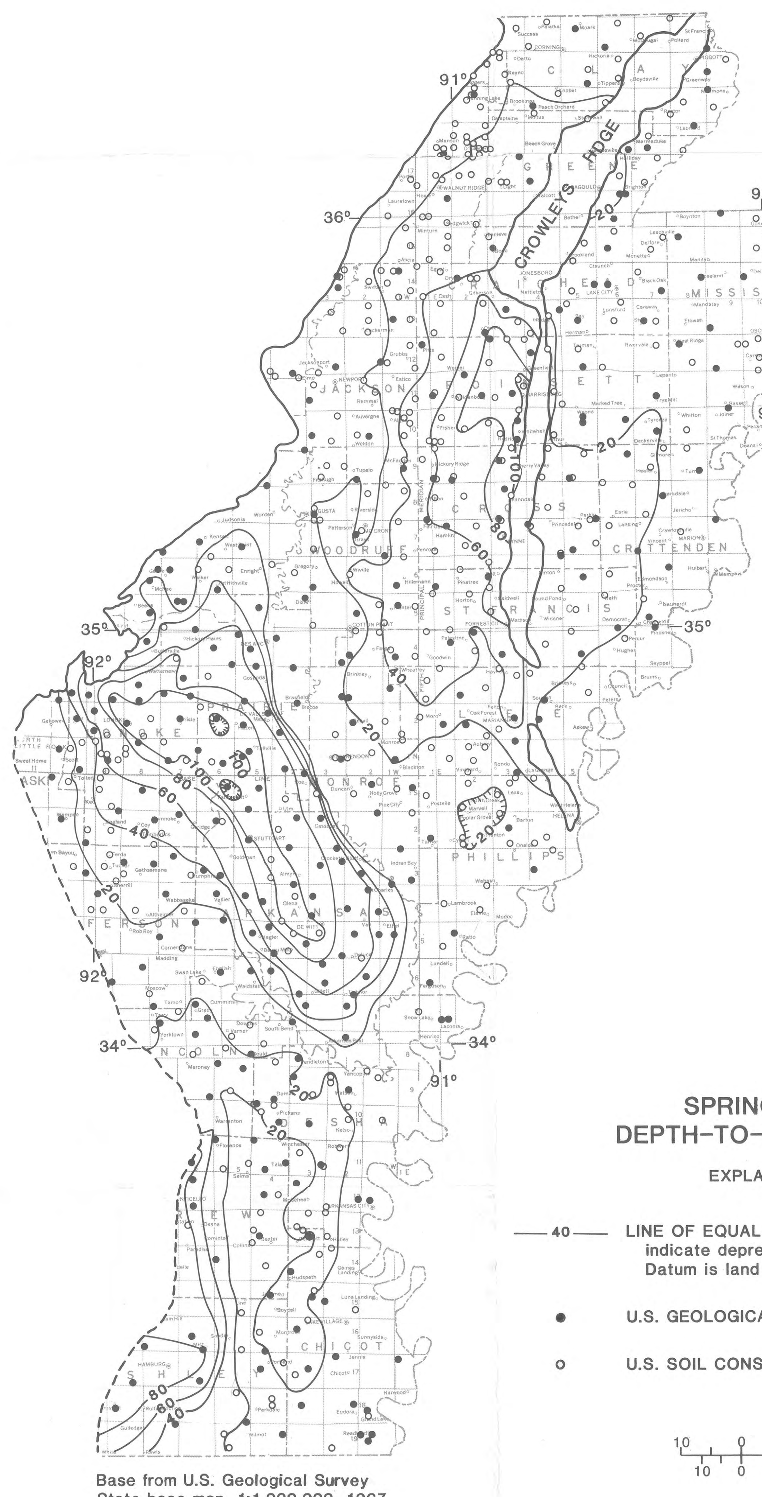

SPRING 1985 DEPTH-TO-WATER MAP

EXPLANATION

—40— LINE OF EQUAL DEPTH TO WATER—Hachures indicate depression. Contour interval 20 feet. Datum is land surface.

● U.S. GEOLOGICAL SURVEY CONTROL POINT

○ U.S. SOIL CONSERVATION SERVICE CONTROL POINT

10 0 10 20 30 40 MILES
10 0 10 20 30 40 KILOMETERS

WATER-LEVEL MAPS OF THE ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1985

By Maria Plafcan and D.T. Fugitt