DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
ARKANSAS GEOLOGICAL COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA-377 (SHEET 1 OF 2)

GROUND WATER

INTRODUCTION

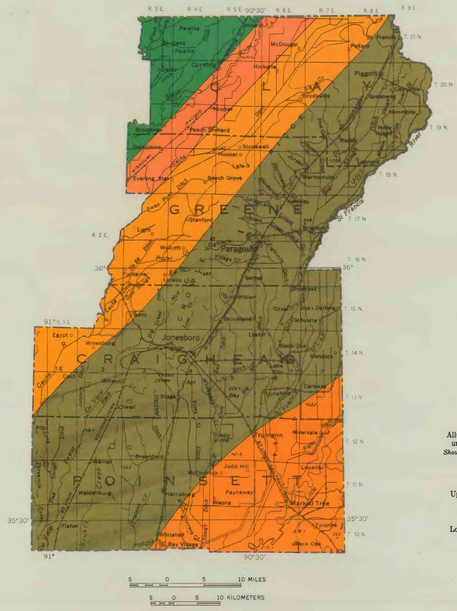
Water is available in Clay, Greene, Craighead, and Poinsett Counties from ground-water and surface-water sources. However, ground water is more accessible in many places than surface water. Ground water is available from the alluvium, which covers all the area except Crowleys Ridge, and is also available from other formations below the alluvium.

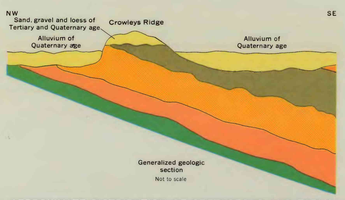
Surface water is available from the Black and Cache Rivers west of Crowleys Ridge, and from the St. Francis and Little Rivers, and from many ditches and laterals east of the ridge. Continuous water supplies are not available from streams on Crowleys Ridge, but additional surface-water supplies could be made available from reservoir storage on the ridge. Average annual streamflow ranges from 1.2 cfs per sq mi (cubic feet per second per square mile) in the western part of the four counties to 1.4 cfs per sq mi in the eastern part. Average annual precipitation is about 48 inches.

Use of water in the area for agriculture greatly exceeds all other uses combined, and progressively greater amounts of water are being used for irrigation. In 1965, 111.4 mgd (million gallons per day) was used for rice irrigation, and 71.5 mgd was used for irrigation of other crops. An additional 16.9 mgd was used by industry, municipalities, and others. Of these amounts, 180.1 mgd was ground water and 19.7 mgd was surface water, or a total of 199.8 mgd. More than 80 manufacturing firms, many of which are closely allied to agriculture, use moderate amounts of water, mostly from municipal supplies.

PURPOSE AND SCOPE

This report summarizes the results of an investigation of the water resources of the four counties. The study was made to determine the occurrence, quantity, availability, and quality of ground and surface water and the variability in these supplies. In addition, water problems peculiar to the area are defined and corrective measures suggested. The data given will serve as a basis for technical guidance in future development of the water resources of the area.





APPROXIMATE DISTRIBUTION OF CRETACEOUS AND EARLY TERTIARY FORMATIONS BENEATH THE LATE TERTIARY DEPOSITS AND ALLUVIUM OF QUATERNARY AGE

EXPLANATION

- Alluvium of Quaternary age and undifferentiated Tertiary age — *Shown on section only, mantles most of area*
- Upper part of Claiborne Group
- Lower part of Claiborne Group (Memphis aquifer)
- Wilcox Group
- Midway Group
- Arkadelphia Marl and Nacatoch Sand undifferentiated
- Contact

TERTIARY / CRETACEOUS

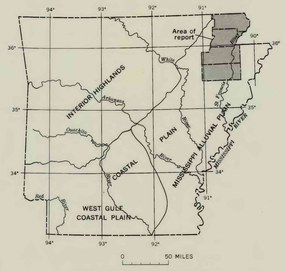
GEOLOGY

Geologic formations ranging in age from late Cretaceous to Quaternary are found in the area. The Cretaceous to early Tertiary Formations trend northeast-southwest and dip to the southeast. These formations thicken and increase in depth below the land surface in the downdip direction. Aquifers in these formations are the Nacatoch Sand of Cretaceous age, and the lower Wilcox and Memphis aquifers of Tertiary age. Late Tertiary deposits, consisting of nearly flat-lying beds of sand, gravel, and loess, cap Crowleys Ridge. These deposits are not considered to be an aquifer, because the sand and gravel are too thin. Sand, gravel, and clay of Quaternary age overlie the older formations in the Mississippi Alluvial Plain. The Quaternary alluvium is the principal aquifer in the area.

GENERALIZED GEOLOGIC COLUMN

[The principal sources of ground water are the alluvium, the Memphis aquifer, the lower Wilcox aquifer, and the Nacatoch Sand]

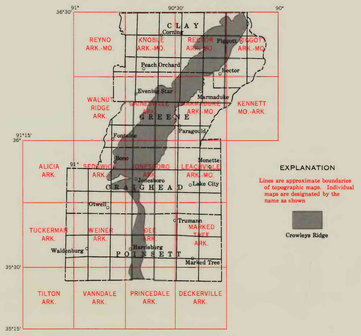
System	Subdivision		Formation or aquifer	Thickness (feet)	Lithologic and water-bearing characteristics
Quaternary			Alluvium	As much as 100	Clay and silt, grading downward into sand and gravel. May yield 2,000 or more gpm (gallons of water per minute) to wells penetrating the entire thickness of the aquifer.
			Loess	-------	Silt, windblown; limited to Crowleys Ridge. Does not yield water to wells.
Tertiary	Late Tertiary		Sand and gravel	-------	Sand and gravel; limited to Crowleys Ridge. Too thin to be of value as an aquifer.
	Early Tertiary	Claiborne Group	Not differentiated	-------	Sand, dark-colored, gray to grayish-brown, fine to medium. Interbedded with layers of dark carbonaceous shale, silt, and impure lignite. Does not yield water to wells.
			Memphis aquifer	As much as 750	Sand, fine to gravelly; principally thick-bedded, containing clay layers which may attain thickness of 20 feet. Crops out along Crowleys Ridge in parts of Clay, Craighead, and Greene Counties. Covered by Quaternary deposits east and west of Crowleys Ridge. May yield 500 or more gpm to wells.
		Wilcox Group	Not differentiated	-------	Clay, gray, greenish-gray, and brown. Contains thin beds of lignite. Does not yield water to wells.
			Lower Wilcox aquifer	100–300	Sand, fine to medium, thick. Wells may yield 500 to 1,000 or more gpm. Well yields tend to diminish westward, as the sandy phase thins.
		Midway Group	Not differentiated	-------	Clay, blue-gray to dark-gray, and gray; calcareous, fossiliferous. Contains scattered lenses of limestone. Does not yield water to wells.
			Arkadelphia Marl	-------	Marl, dark. Does not yield water to wells.
Cretaceous			Nacatoch Sand	As much as 400	Sand and clay. Yields fresh water in the northern part of the project area and salt water in the southern part. The sand phase seems to be thin or absent in the western part of the area. Wells in the lower altitudes may flow.



LOCATION OF REPORT AREA

The report area comprises 2,708 square miles in the Mississippi Alluvial Plain of the Coastal Plain in northeastern Arkansas. Crowleys Ridge, an erosional remnant of rolling hills rising as high as 200 feet above the Mississippi Alluvial Plain, traverses the area in an arc from northeast Clay County to south-central Poinsett County. West of the ridge, the alluvial-plain surface is characterized by flood plains and low terraces in the interstream areas. East of the ridge is the broad flood plain of the Mississippi River, with a narrow, low terrace bordering the ridge.

The land surface of the alluvial plain generally slopes south and west, from an altitude of about 310 feet in northern Clay County to about 230 feet in southwestern Poinsett County. However, the alluvial plain is about 30 feet lower to the east of Crowleys Ridge than to the west of the ridge.



INDEX TO TOPOGRAPHIC MAPS

The area is covered by 20 topographic maps which are available at a nominal cost. These maps each cover 15′ of latitude and longitude (approximately 14x17 miles), and are useful for design of drainage canals and for determination of land-surface altitudes (elevations).

Maps may be ordered from:

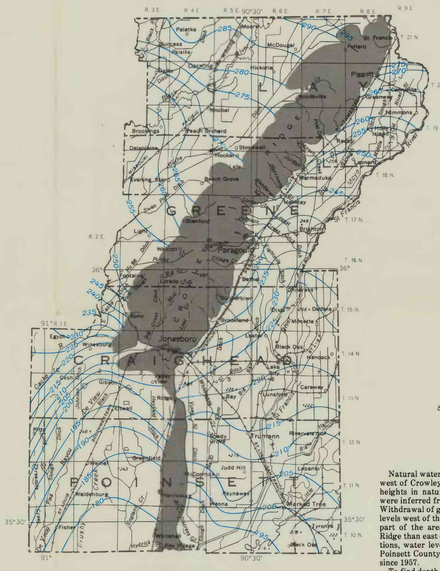
U.S. Geological Survey
Denver, Colorado 80225

Arkansas Geological Commision
Little Rock, Arkansas 72201

EXPLANATION

Lines are approximate boundaries of topographic maps. Individual maps are designated by the name as shown

Crowleys Ridge



WATER LEVELS IN THE ALLUVIUM

Natural water levels in the alluvium were 25–30 feet higher west of Crowleys Ridge than east of the ridge. The relative heights in natural water levels east and west of the ridge were inferred from topographic and stream-channel altitudes. Withdrawal of ground water for irrigation has lowered water levels west of the ridge to the extent that in the southwestern part of the area water levels are lower west of Crowleys Ridge than east of the ridge. Based on inferred natural conditions, water levels have declined 40–50 feet in southwestern Poinsett County—30–40 feet more than the observed decline since 1957.

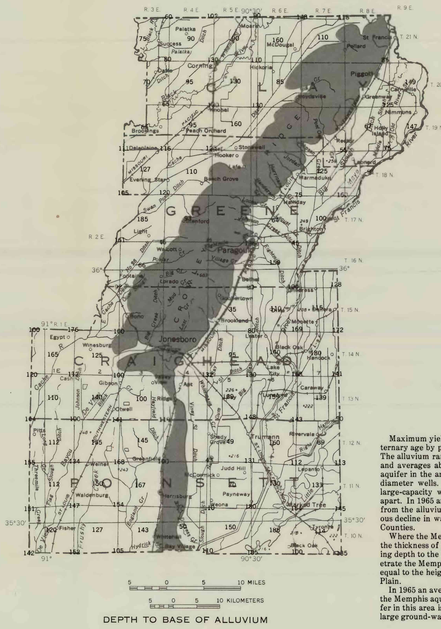
To find depth to water:

1. Determine water-level altitude from water-level map.
2. Determine land-surface altitude from topographic maps.
3. Subtract value determined in step 1 from value determined in step 2; result is depth to water, in feet, below land surface.

EXPLANATION

Crowleys Ridge

220 — Water-level contour — *Shows altitude of water level in alluvium of Quaternary age in spring of 1967. Contour interval 5 feet. Datum is mean sea level*



DEPTH TO BASE OF ALLUVIUM

EXPLANATION

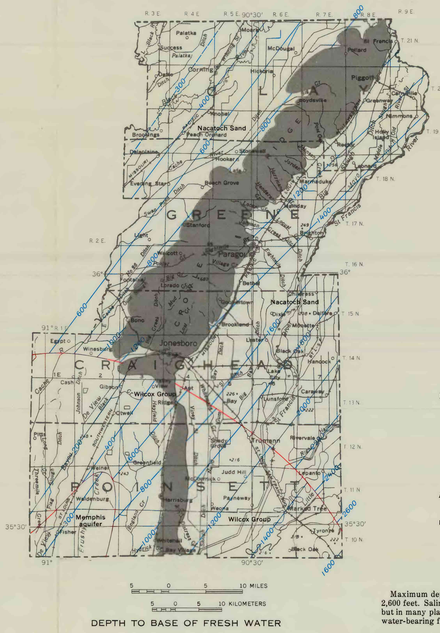
Crowleys Ridge

135 — Depth to base of alluvium, in feet below land surface

Maximum yields can be obtained from the alluvium of Quaternary age by penetrating the full thickness of the alluvium. The alluvium ranges in thickness from about 35 to 185 feet, and averages about 125 feet. The alluvium is the principal aquifer in the area and yields as much as 2,000 gpm to large-diameter wells. To avoid excessive water-level drawdown, large-capacity wells should be spaced 1,000 feet, or more, apart. In 1965 an average of 172.9 mgd of water was pumped from the alluvium. This rate of withdrawal has caused serious decline in water levels in western Craighead and Poinsett Counties.

Where the Memphis aquifer directly underlies the alluvium, the thickness of the alluvium can be used as a minimum drilling depth to the Memphis aquifer. On Crowleys Ridge, to penetrate the Memphis aquifer, wells should be drilled to a depth equal to the height of the ridge above the Mississippi Alluvial Plain.

In 1965 an average of 3.76 mgd of water was pumped from the Memphis aquifer in the four counties. The Memphis aquifer in this area is more than 80 percent sand and represents a large ground-water reserve.



DEPTH TO BASE OF FRESH WATER

EXPLANATION

Nacatoch Sand

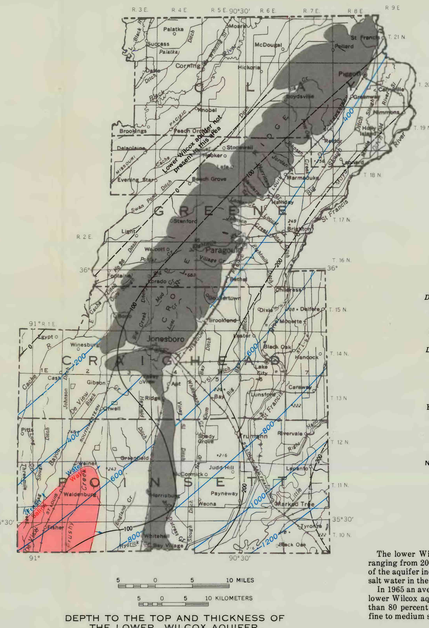
Boundary of area in which the indicated geologic units contain the lowermost body of fresh water (after Cushing, 1966)

Crowleys Ridge

800 — Line of equal depth to base of fresh water — *Dashed where approximately located. Interval 100 and 200 feet. Datum is land surface*

Note: Fresh water occurs under Crowleys Ridge but depth lines are not shown because of irregular topography on ridge.

Maximum depths to base of fresh water range from 200 to 2,600 feet. Saline water is at greater depth in the project area, but in many places is separated from the fresh water by non-water-bearing formations.



DEPTH TO THE TOP AND THICKNESS OF THE LOWER WILCOX AQUIFER

EXPLANATION

600 — Line of equal depth to top of Lower Wilcox aquifer — *Dashed where approximately located. Interval 200 feet. Datum is land surface*

200 — Line of equal thickness of Lower Wilcox aquifer — *Dashed where approximately located. Interval 100 feet*

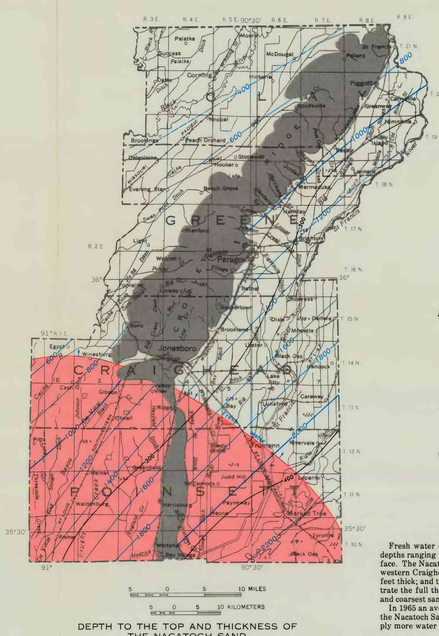
Fresh Water / Saline Water — Freshwater-saline water boundary (after Hosman and others, 1968)

Crowleys Ridge

Note: Fresh water is available from Lower Wilcox aquifer under Crowleys Ridge but depth lines are not shown because of irregular topography on ridge.

The lower Wilcox aquifer yields fresh water from depths ranging from 200 to 1,600 feet. Depth to the top and thickness of the aquifer increase to the southeast. The aquifer contains salt water in the southwest corner of Poinsett County.

In 1965 an average 3.21 mgd of water was pumped from the lower Wilcox aquifer in the four counties. In this area more than 80 percent of the lower Wilcox aquifer is composed of fine to medium sand.



DEPTH TO THE TOP AND THICKNESS OF THE NACATOCH SAND

EXPLANATION

2000 — Lines of equal depth to top of Nacatoch Sand — *Dashed where approximately located. Interval 200 feet. Datum is land surface*

400 — Lines of equal thickness of Nacatoch Sand — *Interval 200 feet*

Fresh water / Saline water — Freshwater-saline water boundary (after Boswell and others, 1965)

Crowleys Ridge

Note: Fresh water is available from the Nacatoch Sand under Crowleys Ridge but depth lines are not shown because of irregular topography on ridge.

Fresh water can be obtained from the Nacatoch Sand at depths ranging from about 400 to 2,200 feet below land surface. The Nacatoch contains salt water in Poinsett and southwestern Craighead Counties. The aquifer is as much as 400 feet thick; and to obtain the greatest yield, wells should penetrate the full thickness and should be screened in the thickest and coarsest sands.

In 1965 an average of 0.25 mgd of water was pumped from the Nacatoch Sand in the four counties. The aquifer can supply more water than that withdrawn in 1965.

PROBLEMS

DECLINE OF GROUND-WATER LEVELS IN THE QUATERNARY ALLUVIUM

Water levels in the alluvium in western Poinsett and Craighead Counties have declined as much as 55 feet. Water-level declines can be caused by below-normal recharge from precipitation and by pumpage. The continued decline in water levels since the early 1900's in this area is caused by withdrawal of water for irrigation.

Natural water levels in western Craighead and Poinsett Counties, inferred from stream-channel and land-surface altitudes, were about 5–15 feet below land surface. Irrigation of rice began in the early 1900's, and drillers' records indicate that during the early years of irrigation, water levels declined 5–20 feet below their natural levels.

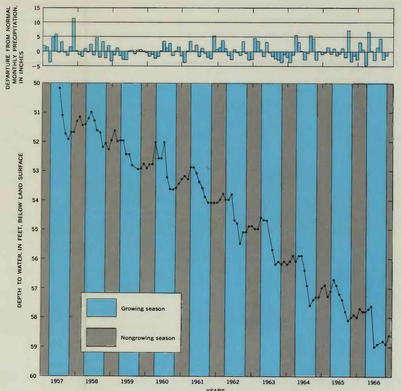
Continued and increased irrigation of rice, and in later years of row crops, caused continued decline of water levels. By 1938 maximum depth to water was about 35 feet below land surface in southwestern Poinsett County, and by 1966 the maximum depth to water was 55 feet.

Drawdown of water levels is a natural result of withdrawal of water from a well. The drawdown creates a hydraulic gradient in the aquifer, causing water to move toward the well. If pumping remains constant and if pumping does not exceed the rate of replenishment to the aquifer, the water level decline will stabilize. If pumpage exceeds recharge to the area, water will be withdrawn from storage and water levels will continue to decline. Pumpage in the counties has increased from 86.5 mgd in 1960, to 180.1 mgd in 1965. Based on the nature of the material at the surface, the transmissibility of the alluvium, and the hydraulic gradient to the area of withdrawal, it is estimated that pumpage in 1966 exceeded the recharge to the area by underflow and infiltration of precipitation by about one-third. Water levels in the area will continue to decline unless withdrawal from the alluvium is reduced or recharge is increased.

The remaining saturated thickness of the alluvium in western Craighead and Poinsett Counties ranges from 65 to 95 feet. Continued lowering of water levels will decrease the saturated thickness of the aquifer, and well yields will decline. If the water-level decline is extrapolated at the rate of 1.0 foot per year, yields from many wells in the area will be less than 600 gpm in about 50 years from the present (1968).

Western Craighead and Poinsett Counties do not have an immediate water shortage. However, continued withdrawal from the alluvial aquifer in excess of recharge will cause serious depletion in the next few decades. The problem of depletion in this area can be easily and economically solved if solutions are applied early.

Reduced withdrawal from the alluvial aquifer and diminished drawdowns can be effected by use of surface water and use of water from deeper aquifers. Surface-water reservoirs to store storm runoff can be constructed both on Crowleys Ridge and on the alluvial plain. The Memphis aquifer and the Wilcox Group are potential sources of water for irrigation in the area.



REPRESENTATIVE GROUND-WATER LEVELS IN QUATERNARY ALLUVIUM AND PRECIPITATION DEPARTURE FROM NORMAL IN SOUTHWESTERN CRAIGHEAD COUNTY

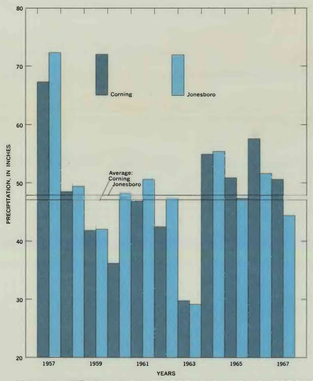
Water-level measurements in section 35, township 13 north, range 2 east, show a decline of about 0.7 foot per year from 1957 to 1963, and 1.0 foot per year from 1963 to 1966. Rainfall records show an accumulative deficiency from 1958 to 1963, and an accumulative excess from 1963 to 1967, indicating there is no correlation between water-level declines and rainfall. Records for other wells in western Poinsett County show a corresponding decline of 0.6–0.9 foot per year.

TOTAL ANNUAL PRECIPITATION

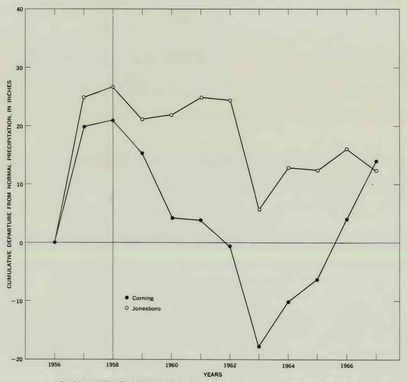
A comparison of precipitation at Corning and at Jonesboro indicates that total annual precipitation is reasonably well distributed over the area. However, the yearly difference between the stations may be more than 15 inches.

CUMULATIVE DEPARTURE FROM NORMAL PRECIPITATION

Rainfall in 1957 was about 20–26 inches in excess of normal and in 1958 was slightly more than normal. From 1958 to 1963, the accumulated deficiency was about 21 inches at Jonesboro and about 39 inches at Corning. From 1963 to 1967, total rainfall was as much as 14 inches greater than normal.



ANNUAL PRECIPITATION AT CORNING AND JONESBORO



CUMULATIVE DEPARTURE FROM NORMAL PRECIPITATION AT CORNING AND JONESBORO

Base from U.S. Geological Survey
State base map

WATER RESOURCES OF CLAY, GREENE, CRAIGHEAD, AND POINSETT COUNTIES, ARKANSAS

By
Marion S. Hines, Raymond O. Plebuch, and A. G. Lamonds

1972

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