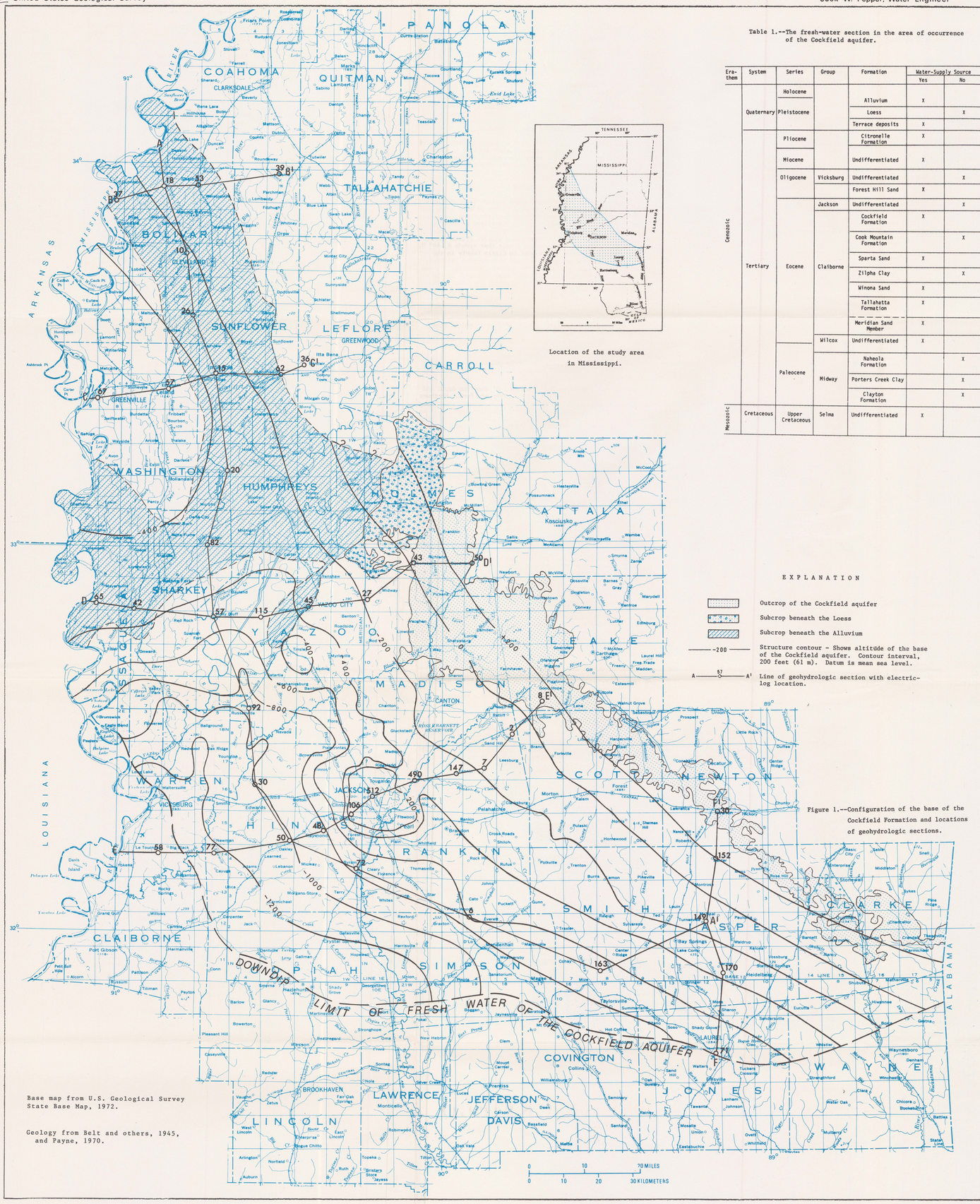
Department of the Interior
United States Geological Survey

Prepared in cooperation with the
Mississippi Board of Water Commissioners
Jack W. Pepper, Water Engineer

WATER-RESOURCES INVESTIGATIONS 77-17
SHEET 1 OF 3 OPEN-FILE REPORT



Base map from U.S. Geological Survey
State Base Map, 1972.

Geology from Belt and others, 1945,
and Payne, 1970.

Location of the study area
in Mississippi.

Figure 1.--Configuration of the base of the Cockfield Formation and locations of geohydrologic sections.

Table 1.--The fresh-water section in the area of occurrence of the Cockfield aquifer.

Era-them	System	Series	Group	Formation	Water-Supply Source: Yes	Water-Supply Source: No
Cenozoic	Quaternary	Holocene		Alluvium	X	
		Pleistocene		Loess		X
				Terrace deposits	X	
	Tertiary	Pliocene		Citronelle Formation	X	
		Miocene		Undifferentiated	X	
		Oligocene	Vicksburg	Undifferentiated		X
				Forest Hill Sand	X	
		Eocene	Jackson	Undifferentiated		X
			Claiborne	Cockfield Formation	X	
				Cook Mountain Formation		X
				Sparta Sand	X	
				Zilpha Clay		X
				Winona Sand	X	
				Tallahatta Formation	X	
				Meridian Sand Member	X	
			Wilcox	Undifferentiated	X	
		Paleocene	Midway	Naheola Formation		X
				Porters Creek Clay		X
				Clayton Formation		X
Mesozoic	Cretaceous	Upper Cretaceous	Selma	Undifferentiated	X	

EXPLANATION

- Outcrop of the Cockfield aquifer
- Subcrop beneath the Loess
- Subcrop beneath the Alluvium
- -200 — Structure contour - Shows altitude of the base of the Cockfield aquifer. Contour interval, 200 feet (61 m). Datum is mean sea level.
- A — 57 — A' Line of geohydrologic section with electric-log location.

THE COCKFIELD AQUIFER IN MISSISSIPPI

INTRODUCTION

A large amount of information is available on the aquifers of Mississippi. This atlas is one of a series designed to describe the character, potential, and the extent of development of the aquifers. This description of the Cockfield aquifer is the sixth in the series. Information on the aquifer was obtained as part of the cooperative programs of the U.S. Geological Survey with the Mississippi Board of Water Commissioners and other State and federal agencies.

The Cockfield Formation in the upper part of the Claiborne Group of Eocene age (table 1) is a principal source of water supplies in Mississippi. Beds of sand in the Cockfield Formation contain freshwater (water having less than 1,000 milligrams per liter dissolved solids) in about 30 percent of the State.

GEOLOGY AND HYDROLOGY

The Cockfield Formation is overlain by the Jackson Group and underlain by the Cook Mountain Formation. Deposits of the Jackson Group and of the Cook Mountain Formation commonly act as confining beds for water in the Cockfield Formation. Although the term "Cockfield aquifer" is used to emphasize the water-bearing characteristics of the formation, the Cockfield, in places, actually is more of an aquifer system than a single aquifer. The formation crops out in a belt that trends S. 60° E. from Holmes and Carroll Counties in the west to Clarke County in the east (fig. 1). The formation along the outcrop belt narrows eastward. The Cockfield beds have been uplifted by the Jackson Dome (fig. 2), and crop out in a small area along the Pearl River near Jackson. In the Mississippi-Yazoo flood plain the Cockfield Formation has been deeply eroded and was later covered with as much as 200 ft (61 m) of Mississippi River alluvium. The Cockfield is also covered by a mantle of loess about 75 ft (23 m) thick in Holmes County. The mantle thins eastward from Holmes County.

The Cockfield Formation consists of beds of fine to medium sand, sandy carbonaceous clay, and thin beds of lignite. Massive beds of sand are common. The thickness of the formation ranges from about 50 ft (15 m) in the eastern part of the outcrop area to about 600 ft (180 m) downdip near the limit of freshwater. The Jackson and Tinsley Domes, the Mississippi embayment trough, and the Monroe Uplift have had considerable influence on the thickness, depth, and configuration of the geologic units (figs. 3-8).

Geohydrologic cross-sections A-A' through E-E' show the depth and position of the Cockfield with respect to the other aquifers. Northwest from Jackson, the underlying Cook Mountain Formation becomes sandy, thus making a less effective confining bed. Beneath the Cook Mountain is the Sparta Sand (figs. 3-8) which may be hydraulically connected with both the Cook Mountain or the Mississippi River valley alluvial aquifer in some places.

WATER USE

The Cockfield aquifer is the source of ground water for more than 80 municipal, community, and institutional water systems in northwestern and central Mississippi (table 2). The largest withdrawal from the aquifer is in the Greenville-Leland area in Washington County where about 7.3 Mgal/d (320 L/s) was pumped in 1975 (fig. 9). The Cockfield aquifer has been relatively unused for public supply in Jackson, but suburban use has increased to about 5 Mgal/d (220 L/s). The total withdrawal for the State from the Cockfield in 1975 was about 25 Mgal/d (1,095 L/s). Utilization of the aquifer has been minimal in some areas due to low yields, excessively colored water, or high dissolved solids.

RECHARGE, MOVEMENT, AND WATER LEVELS

The Cockfield aquifer in Mississippi is recharged directly by precipitation in the outcrop areas and, to a much lesser extent, by infiltration from streams (near Jackson). The aquifer also may be recharged in northwestern Mississippi where it is hydraulically connected to the Mississippi River valley alluvial aquifer. Water moves from the outcrop area in the hills east of Holmes County to the northwest, west, and south. Water-table conditions exist in the outcrop area, but as water moves downdip it is confined by beds of the overlying Jackson Group and underlying Cook Mountain Formation. Where the Cockfield's overlying beds have been removed by erosion and replaced by the Mississippi River alluvium, water levels in the Cockfield, which is commonly 10 to 20 ft (3 to 6 m) below land surface, generally coincide with the water levels in the alluvial aquifer. The altitude of the potentiometric surface in most of the outcrop area (fig. 10) is about 420 ft (128 m); at Greenville near heavy pumping, the altitude of the potentiometric surface is about 60 ft (18 m).

Long-term water-level trends indicate an average decline of about 1.5 ft (0.5 m) per year. However, one well, Scott L1, (figs. 11 and 12) shows a gradual rise in water levels since 1967 due to a reduction in nearby pumping in the Forest area.

WELL AND AQUIFER CHARACTERISTICS

Major wells in the Cockfield range in depth from 220 to 1,260 ft (67 to 384 m). The shallowest wells are near the outcrop and the deepest are in Hinds County. The greatest production from a Cockfield well is 1,530 gal/min (97 L/s) at Greenville, which is near the axis of the Mississippi embayment trough where the aquifer thickness is about 600 ft (183 m).

Specific capacity of wells in the Cockfield ranges from 1.6 to 43 (gal/min)/ft or 0.34 to 9.0 (L/s)/m. Figure 13 shows specific capacity for a wide range of transmissivities, assuming a well efficiency of 100 percent (Lohman, 1972).

The following table shows the range of hydraulic characteristics determined from 27 pumping tests.

	Transmissivity		Hydraulic conductivity		Storage coefficient
	$(ft^3/d)/ft$	$(m^3/d)/m$	$(ft^3/d)/ft^2$	$(m^3/d)/m^2$	dimensionless
Maximum	21,000	1,950	120	37	0.001
Median	4,600	430	50	15	.0004
Minimum	80	7	1	.3	.00007
No. of tests	27		27		7

Note: To convert transmissivity and hydraulic conductivity, in cubic feet per day, to the former terms of transmissibility and permeability, in gallons per day, multiply by 7.48.

The maximum transmissivity computed was 21,000 $(ft^3/d)/ft$ or 1,950 $(m^3/d)/m$ for a well near Leland in Washington County. The table of aquifer characteristics and the time-distance graph (fig. 14) can be used in planning more efficient well systems through adequate spacing and proper design.

QUALITY

The Cockfield aquifer contains moderately hard calcium bicarbonate type water in the outcrop area. Total mineralization increases as the water moves downdip and the water changes from a calcium bicarbonate to a sodium bicarbonate type. Generally, the water is of good quality (table 3).

The dissolved-solids concentration in the water increases downdip to the west and the south (fig. 15). Water containing 500-1,000 mg/L (milligrams per liter) of dissolved solids is tolerated at several places in the northwestern part of the area because of the economics of drilling and production as the Cockfield is either the shallowest aquifer or will yield more water to wells.

Color is a common problem in the Cockfield, especially in the western and southern parts of the area (fig. 16). Color generally increases with depth and may be a result of contact of the water with lignite. At shallow depths near the outcrop area iron occurs in concentrations greater than 0.3 mg/L. The water is slightly saline southwest of Greenville (fig. 17). The relatively high salinity of the water may be the result of restricted circulation in the aquifer in the vicinity of the Monroe Uplift and the Mississippi embayment trough.

WATER-SUPPLY POTENTIAL

The Cockfield aquifer will continue to be a major source of water supply in Mississippi and well fields producing 1 to 3 Mgal/d or 0.04 to 0.13 m^3/s can be developed in many places. Where water quality in the aquifer is poor, other aquifers may be utilized or the water may be mixed with water from other aquifers or treated to improve the quality. In areas where the sands are thick (for example, in Washington County), 500 to 1,000 gal/min or 31.5 to 63.1 L/s can be produced from individual wells.

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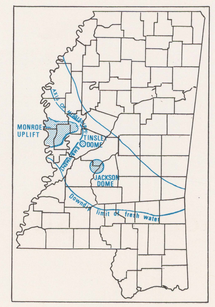

Figure 2.--Structural features affecting the Cockfield aquifer.

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1976

Jackson, Mississippi

Cartography by Frances M. Hester