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WATER-RESOURCES INVESTIGATIONS 79-28
SHEET 1 OF 2 OPEN-FILE REPORT

THE OLIGOCENE AQUIFER SYSTEM IN MISSISSIPPI

This atlas is the 12th in a series designed to consolidate and present information available about the individual aquifers of Mississippi. This atlas, prepared by the U.S. Geological Survey in cooperation with the Mississippi Board of Water Commissioners, describes the location, characteristics, current use, and potential development of the Oligocene aquifer system.

LOCATION, THICKNESS, AND STRATIGRAPHIC RELATIONS

The Oligocene Series in Mississippi consists of the Chickasawhay Limestone, and the Byram Formation and the Marianna Limestone of the Vicksburg Group, and the underlying Forest Hill Sand. In Jasper, Wayne, and Clarke Counties, the Red Bluff Clay is the time equivalent of the Forest Hill Sand. The Forest Hill Sand/Red Bluff Clay equivalent units are now included in the Vicksburg Group by the U.S. Geological Survey. For the purposes of this atlas the Vicksburg is restricted to exclude the units. The Chickasawhay Limestone is not known to be an aquifer (table 1).

The aquifer system crops out in a band 5 to 10 miles wide, that trends southeast across the state from the Warren-Yazoo County line to northeastern Wayne County (fig. 1). In the northwest part of the area, the formations dip to the southwest at 12 ft/mi. At the southeastern end of the outcrop, the dip is 42 ft/mi. The average dip for the entire area is 30 ft/mi. In Hinds and Rankin Counties, the beds have been uplifted by the Jackson Dome, and the outcrop curves around the southwest flank of the dome.

Figures 2 through 5 are geohydrologic sections that show the stratigraphic relations, limits of freshwater, and the variable thickness of the Oligocene aquifer system. The sections were constructed with the aid of electric logs at the indicated well sites.

The Chickasawhay Limestone is a soft, fossiliferous, clayey to sandy limestone interbedded with marls and clays. Like the formations of the Vicksburg Group it is a marine sediment.

The Vicksburg Group, consisting of the Byram Formation and the Marianna Limestone, ranges from 70 to 160 feet in thickness near the outcrop area. It thickens downdip to nearly 300 feet in Lamar and Marion Counties in south Mississippi (Taylor, 1971). The formations of the Vicksburg Group are irregular in thickness and discontinuous across the state.

The water-bearing unit of the Byram Formation is the Glendon Limestone Member, consisting of alternating beds of limestone and marl, and ranging in thickness from 15 to 50 feet. The ground water is found in the irregular sand beds and solution channels of the limestone.

The Marianna Limestone ranges from less than 50 feet in thickness in Wayne County to a thin wedge in Warren County (MacNeil, 1944). The Mint Springs Marl Member, the water-bearing unit of the Marianna Limestone, consists of gray-green, fine-to-coarse glauconitic sand, and is fossiliferous to very fossiliferous. Thickness averages 15 feet and generally does not exceed 30 feet.

The Forest Hill Sand ranges in thickness from 35 to 220 feet and averages 100 feet. It is generally thinner in the east than in the west. The Forest Hill Sand consists of blue-gray to brown clay, silt, and irregular beds of sand. The sand beds are commonly less than 20 feet in thickness but beds as thick as 80 feet have been reported. The total sand section of the Forest Hill Sand is less than 40 percent. To the southeast the lithology changes, sand content decreases, and in Jasper, Wayne, and Clarke Counties, the formation is known as the Red Bluff Clay. Sand content also decreases downdip from the entire outcrop.

The Forest Hill lies unconformably on the Yazoo Clay (Jackson Group) of Eocene age. Contours showing the configuration of the base of the Forest Hill are shown in figure 1. The Yazoo Clay, a major confining unit, ranges in thickness from 300 to 500 feet. The next aquifer below the Yazoo Clay is the Cockfield Formation of the Claiborne Group.

Unconformably overlying the Oligocene aquifer system and cropping out to the south in most of the area is the Catahoula Sandstone of Miocene age. The Paynes Hammock Sand is the uppermost unit of Oligocene deposits in Wayne County and possibly Jasper County, but it has not been identified elsewhere in the state.

WATER USE

The Oligocene aquifers are of local importance primarily for domestic and farm use. Yields to wells are generally less than 150 gal/min (table 2), but some small industrial and public-water supplies rely on the Oligocene aquifers. The depth to the top of the Cockfield (600 feet or more) makes the Oligocene the most economical source of water in and near the outcrop area. As distance from outcrop increases, the number of Oligocene wells decreases because of decreasing sand content, increasing salinity, and the availability of shallower Miocene aquifers. Total withdrawal in 1977 was about 1.4 Mgal/d.

RECHARGE, MOVEMENT, AND WATER LEVELS

The principal source of recharge is precipitation on the outcrop. The water level is very shallow in the outcrop area, particularly at the southeast end of the outcrop belt. Water levels are above the land surface where local confining beds overlie the water-bearing sands. The water surface slopes to the southwest at 3 to 4 ft/mi from the center of the outcrop band, but slopes are steeper at the extreme east and west ends of the outcrop band.

Regional movement of ground water is generally downdip except in Hinds County where movement is towards the Big Black River flood plain. Movement toward the southeast is hindered by the Red Bluff Clay (fig. 6). The smaller pore spaces transmit less water and a steeper hydraulic gradient is required to push the water through the clay.

In Copiah County the water level in the Forest Hill Sand declined 30 feet from 1963 to 1978, an average of 2 feet per year. In the Vicksburg Group in Lamar County the water level declined on average of 0.5 feet per year from 1963 to 1968.

WATER QUALITY

Water in the Oligocene aquifers is generally soft, slightly alkaline, and of the sodium bicarbonate type (table 3). Dissolved-solids concentrations increase downdip, exceeding 1,000 mg/L (milligrams per liter) along a line roughly parallel to and 30 miles southwest of the outcrop (fig. 1).

Concentrations of sulfate, calcium, and magnesium are higher in water from shallow wells than from deep wells downdip in the Forest Hill Sand. The ion exchange properties of the formation remove the calcium and magnesium ions substituting sodium ions as they move downdip, resulting in lower concentrations of the former. The greater sulfate concentration in water from the shallow wells is probably due to the oxidation of sulfide minerals in the Forest Hill Sand in the area of outcrop. Fluoride concentrations generally increase with depth, but vary widely even in water from wells of the same depth. In Lamar County and at scattered locations in Hinds County, fluoride concentrations are greater than those recommended for public-water supplies.

Although the water is generally of good quality for irrigation and domestic purposes, objectionably high concentrations of iron and color are present locally. In Hinds County, color exceeds 30 platinum-cobalt units in most of the wells sampled. Iron exceeds 0.3 mg/L in water from several wells in most counties. Very high concentrations are probably caused by rusty water pipes.

HYDRAULIC CHARACTERISTICS AND WELL YIELDS

Although most wells in the Oligocene aquifers pump less than 150 gal/min (table 2), pumping rates of 500 gal/min have been reported for public-supply wells V71 and V59 in Hinds County.

The results of three aquifer tests for the Vicksburg Group are reported below (Newcome, 1971 and Taylor and others, 1968):

County	Well No.	Pumping rate (gal/min)	Specific capacity [(gal/min)/ft]	Aquifer thickness (ft)	Hydraulic conductivity (ft/d)	Transmissivity (ft^2/d)
Wayne	N6	385	12	55	60	3,300
Lamar	J1d	157	1.5	217	4	900
Lamar	J4d	95	2.5	150	7	1,100

Only one test is available for the Forest Hill Sand, at well Q9 in Rankin County. A pumping rate of 51 gal/min was reported. The transmissivity was 120 ft^2/d, hydraulic conductivity 3 ft/d, and storage coefficient .0001 (Newcome, 1971). (To convert transmissivity and hydraulic conductivity in ft^2/d and ft/d to the older terms of transmissibility and permeability in gallons per day, multiply by 7.48.)

Results of aquifer tests for both the Vicksburg Group and Forest Hill Sand are expected to vary due to variable sand thickness and distribution. Lower transmissivities are expected toward the southeast and downdip where sand content decreases.

POTENTIAL FOR DEVELOPMENT

The Oligocene aquifers will continue to provide water for domestic and farm use. Additional development of low-yield public and industrial wells is also probable. Individual wells in Hinds and Wayne Counties yield over 300 gal/min, and currently produce about 200,000 gal/d (table 2). Groups of wells in these areas could yield over 1 Mgal/d if properly developed. However, increased drawdown with time and mutual interference between wells would lower the yield somewhat over a period of time.

The depth to the next source of water, the Cockfield Formation, 600 feet below the base of the Oligocene aquifers, enhances the value of the Oligocene aquifers for low-yield wells.

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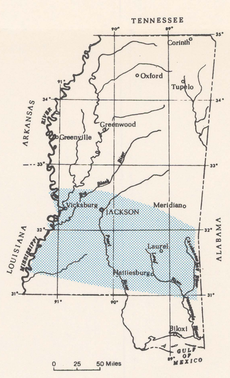
To convert inch-pound units to International System units

Multiply	by	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	0.044	cubic meter per second (m^3/s)
foot per mile (ft/mi)	0.189	meter per kilometer (m/km)
gallon per minute per foot (gal/min)/ft	0.21	liter per second per meter (L/s)/m
cubic foot per day per square foot ($ft^3/d)/ft^2$	0.305	cubic meter per day per square meter ($m^3/d)/m^2$
cubic foot per day per foot ($ft^3/d)/ft$	0.093	cubic meter per day per meter ($m^3/d)/m$

Table 1.--Freshwater section in the area of occurrence of the Oligocene aquifers.

Erathem	System	Series	Group	Formation	Water-Supply Source: Yes	Water-Supply Source: No
Cenozoic	Quaternary	Holocene and Pleistocene		Alluvium	X	
				Loess		X
				Terrace Deposits	X	
	Tertiary	Pliocene		Citronelle Formation	X	
		Miocene		Pascagoula Formation	X	
				Hattiesburg Formation	X	
				Catahoula Sandstone	X	
		Oligocene		Paynes Hammock Sand	X	
				Chickasawhay Limestone		X
			Vicksburg	Byram Formation	X	
				Marianna Limestone	X	
				Forest Hill Sand / Red Bluff Clay	X	/ X
		Eocene	Jackson	Yazoo Clay		X
				Moodys Branch Formation		X
			Claiborne	Cockfield Formation	X	
				Cook Mountain Formation		X
				Sparta Sand	X	



Location of study area in Mississippi.

Figure 1.--Location of the outcrop, configuration of the base of the Oligocene aquifer system, and location of geohydrologic sections.

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1979

Jackson, Mississippi