HYDROLOGIC ATLAS 6

POTENTIOMETRIC SURFACE of the PRINCIPAL ARTESIAN AQUIFER in GEORGIA, MAY 1980

by

Richard E. Krause and Larry R. Hayes

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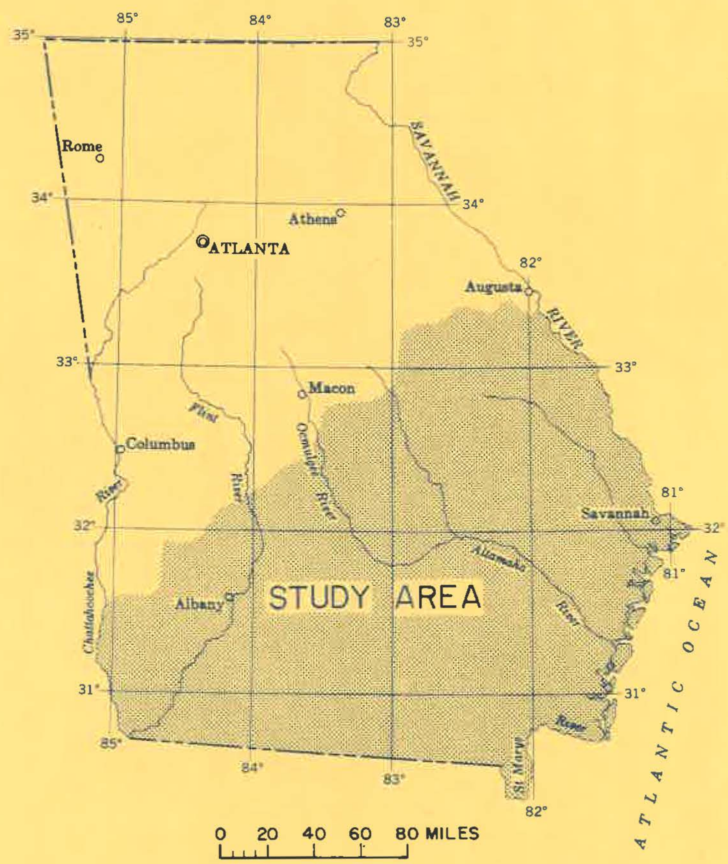

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The principal artesian aquifer is a sequence of carbonate rocks that extends from the southern tip of South Carolina, across the Coastal Plain of Georgia, and into southeastern Alabama. It also underlies all of Florida, where it is called the Floridan aquifer. The aquifer consists of several formations of Eocene to Miocene age, but in Georgia the most productive part of the aquifer is the Ocala Limestone of late Eocene age.

The aquifer is at or near land surface in a band 20 to 60 miles wide along its northwest limit. Within this band, it ranges in thickness from less than 50 feet to more than 200 feet. It dips gently southeastward to a depth of more than 600 feet below land surface in Glynn County, where it is more than 500 feet thick. In the southwestern part of the State, the aquifer is about 50 to 75 feet below land surface and ranges in thickness from about 150 to 200 feet. The aquifer is confined by clay beds in the Hawthorn Formation except near its northwest limit, where it is at or near the surface and in areas where the Hawthorn Formation has been eroded away, such as in the Valdosta area and along the Flint and Chattahoochee Rivers.

Water-bearing characteristics of the aquifer are chiefly the result of the solution of the carbonate rocks by ground water. Much of this solution occurred along paths of weakness, such as joints and faults, resulting in high effective porosity, a measure of the aquifer's void space, and high transmissivity, a measure of the rate at which water can be transmitted through the aquifer. In some areas, the aquifer contains cavities ranging from a few feet to more than 50 feet high. Wells that are open to these large caverns yield as much as 10,000 gallons per minute. In areas where the aquifer is thin, or is of lower transmissivity, wells may yield 500 gallons per minute or less. Total pumpage from the aquifer in Georgia was more than 600 million gallons per day during 1980.

This map shows the potentiometric surface of the principal artesian aquifer in Georgia. It is based on water-level and pressure measurements made in more than 800 wells in Georgia and in adjacent parts of South Carolina, Florida, and Alabama, May 12-23, 1980.

The potentiometric surface depicts the altitude at which water would have stood in tightly cased wells open to the principal artesian aquifer. It also indicates the ground-water flow regimen within the aquifer. Recharge, mostly from rainfall, occurs by leakage through overlying sediments, and in areas where the confining bed is thin or absent. Recharge areas have relatively high potentiometric surfaces. Discharge, from pumping or as natural seepage to streams, or springs, forms areas of relatively low potentiometric surface. Regional flow within the aquifer is from areas of high potentiometric surface to areas of low potentiometric surface, and the direction of flow is perpendicular to the potentiometric contours.

Variations in aquifer transmissivity also affect the potentiometric surface. In parts of the aquifer having lower transmissivity, the potentiometric gradient is steep and contours are closely spaced. More highly transmissive parts of the aquifer produce a flat potentiometric surface and contours are spaced farther apart.

The Gulf Trough is a feature that significantly affects the ground-water flow and hence the potentiometric surface. The Gulf Trough is a series of structurally controlled depositional basins containing fine sediments of low transmissivity. It extends from Decatur County in the southwestern part of the State to Effingham County along the Savannah River (Gelbaum, 1978). Ground-water flow toward the southeast is impeded as it crosses the Trough, resulting in a very steep potentiometric gradient.

In much of the area northwest of the Gulf Trough, where the aquifer is near land surface and locally is poorly confined, the configuration of the potentiometric surface is controlled chiefly by recharge from rainfall and by discharge to streams. Recharge generally occurs in areas of high altitude, causing the potentiometric contours to bend downgradient, as in the area between eastern Worth and western Irwin Counties. Natural discharge from the aquifer occurs to streams that have stages lower than the potentiometric surface in the aquifer and are hydraulically connected to it. This discharge causes the potentiometric contours to bend upgradient. Examples of this occur along the Chattahoochee River, the Flint River downstream of Albany, and the Ocmulgee River in Pulaski County and between Wilcox and Dodge Counties.

In the area southeast of the Gulf Trough, the transmissivity of the aquifer is high and the potentiometric surface is relatively flat. A potentiometric high near Valdosta in the western part of this area is caused by recharge of about 70 million gallons per day from the Withlacoochee River (Krause, 1979).

Major features of the potentiometric surface are depressions caused by heavy pumpage from the aquifer. The size of the depressions is related to the quantity of water pumped, the transmissivity of the aquifer, and the quantity of water available from recharge. In the coastal area, pumpage at both Savannah and Doctortown is about 75 million gallons per day, but because of lower aquifer transmissivity and less available recharge, the cone of depression at Savannah is much larger than at Doctortown. Because of high transmissivity at Brunswick, pumpage of about 105 million gallons per day has generated a cone of depression of about the same size as at Doctortown. In the Dougherty Plain area of southwest Georgia, pumpage of about 210 million gallons per day, primarily for irrigation use, has not generated a cone of depression because of high aquifer transmissivity, a large amount of recharge during periods of abundant precipitation, and wide distribution of pumpage.

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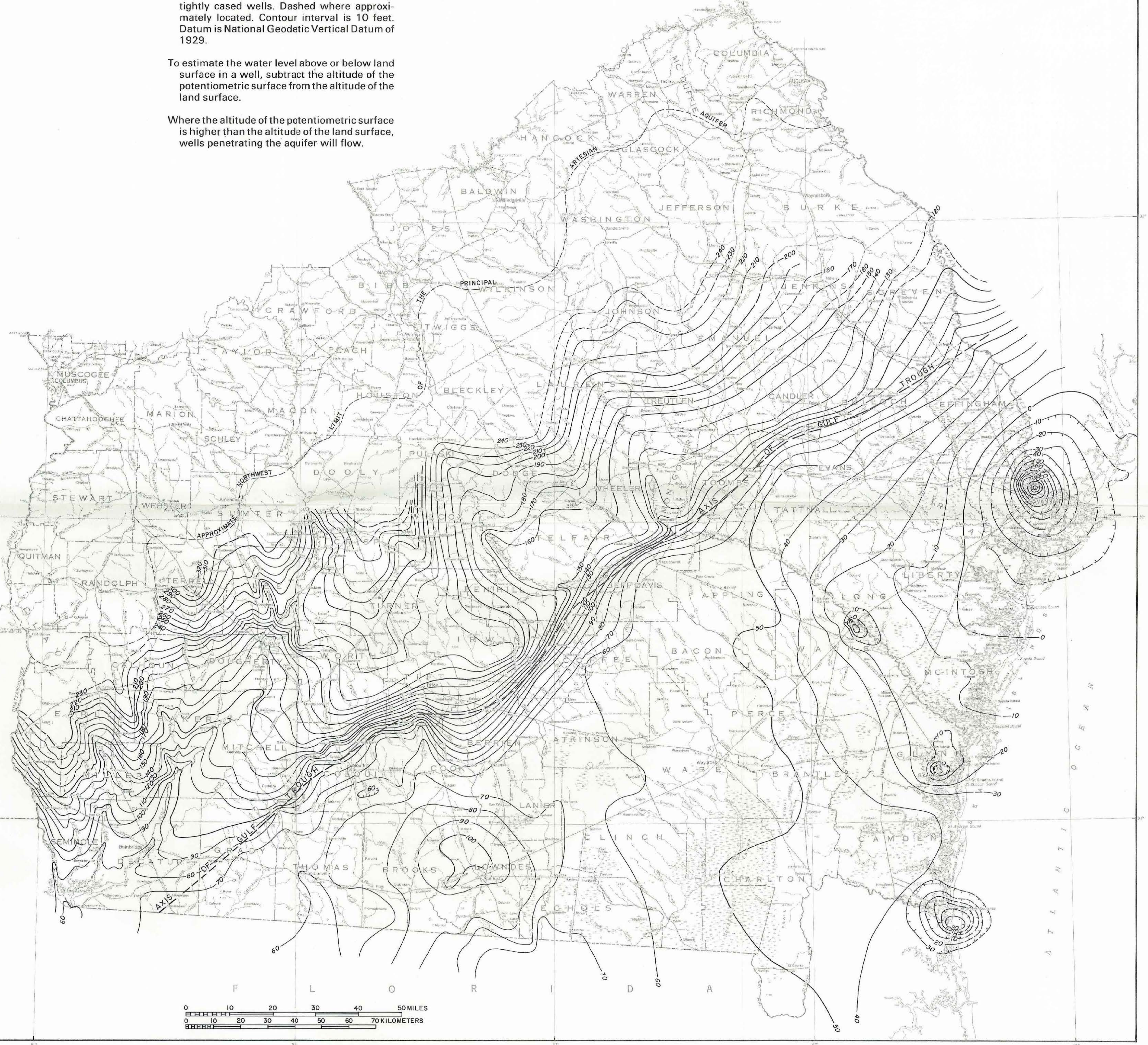
EXPLANATION

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

To estimate the water level above or below land surface in a well, subtract the altitude of the potentiometric surface from the altitude of the land surface.

Where the altitude of the potentiometric surface is higher than the altitude of the land surface, wells penetrating the aquifer will flow.



BASE FROM U.S.GEOLOGICAL SURVEY STATE BASE MAP, 1:500,000, 1963

CARTOGRAPHY BY W. G. HESTER

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