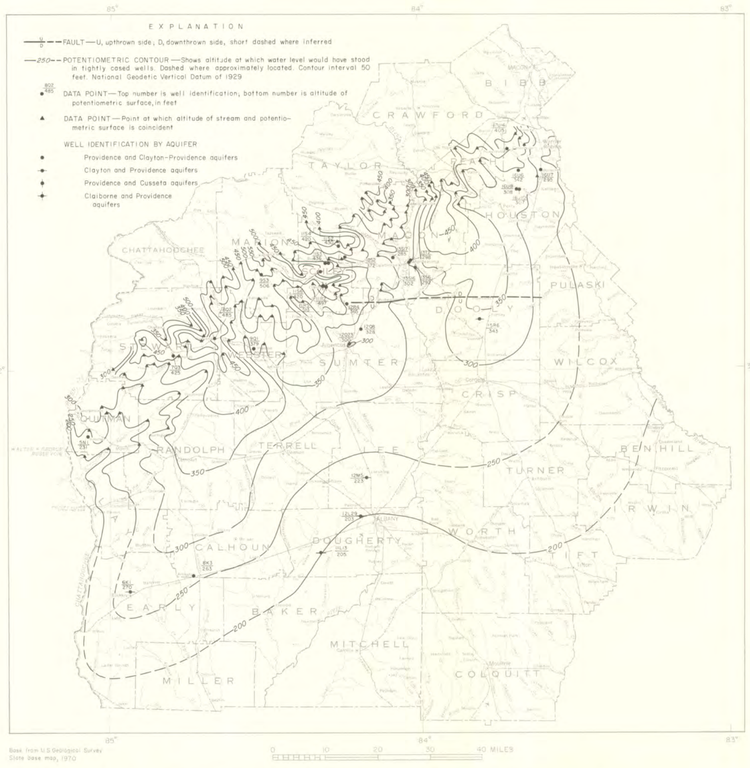

Figure 9.—Estimated potentiometric surface of the Providence aquifer, 1951.

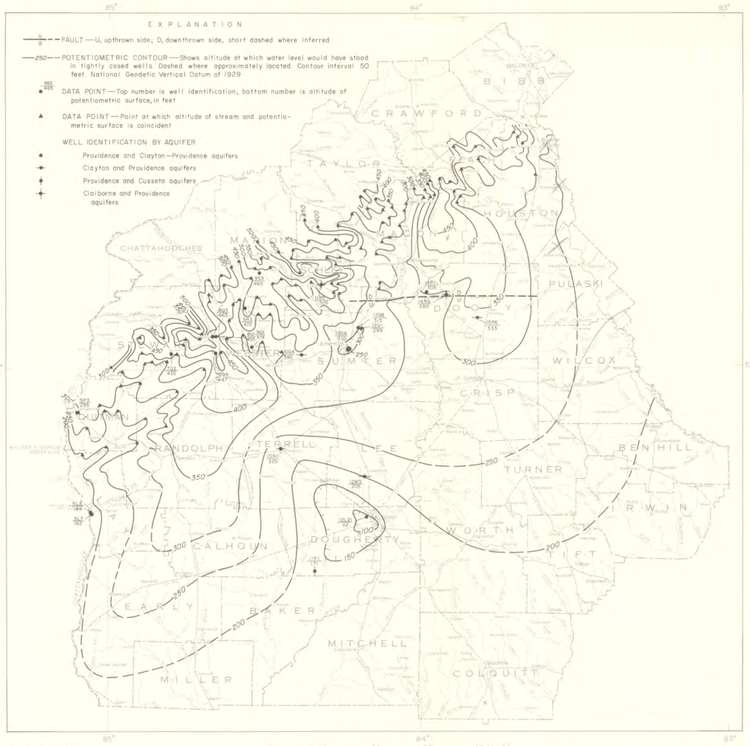

Figure 10.—Potentiometric surface of the Providence aquifer, October 1980.

POTENTIOMETRIC SURFACE

The potentiometric surface of an aquifer is an imaginary surface representing the altitude to which water would rise in tightly cased wells that penetrate the aquifer (Lohman, 1972, p. 8). The potentiometric surface is highest in areas of recharge and lowest in areas of discharge, indicating that ground water flows from areas of recharge toward areas of discharge. Where discharge exceeds recharge, the potentiometric surface is lowered, forming a cone of depression.

ESTIMATED 1951 POTENTIOMETRIC SURFACE

The predevelopment potentiometric surface of an aquifer represents natural conditions before man-induced stresses, such as pumping, were applied. Because ground-water withdrawals from the Providence aquifer prior to 1951 were limited mainly to pumping centers at Albany and Americus, the 1951 potentiometric surface over most of the study area closely resembles the predevelopment potentiometric surface. Declines between the predevelopment potentiometric surface and the 1951 surface were about 43 ft at Americus, and 12 ft at Albany.

The estimated potentiometric surface of the Providence aquifer for 1951 is shown in figure 9 and was constructed from potentiometric data collected during 1941-69.

Flow directions within the Providence aquifer in 1951 generally were from the outcrop area southward and toward major rivers and streams. Two major discharge areas--the Chattahoochee River in the west and the Ocmulgee River in the east--acted as boundaries to the ground-water flow system. This naturally occurring discharge is indicated by potentiometric contours that bend upstream in an inverted "V" pattern, showing that the hydraulic gradient is toward the stream. Potentiometric contours also indicate that two major ground-water divides--one to the southwest between the Chattahoochee and Flint Rivers, and the other to the southeast between the Flint and Ocmulgee Rivers--generally corresponded to interstream drainage divides. In the outcrop area, these ground-water divides were areas of significant aquifer recharge.

In the vicinity of Americus, the primary flow direction in 1951 was toward the center of a cone of depression that had formed as a result of many years of heavy ground-water withdrawals. The bending of the contour lines northwest of Albany may be an indication of a developing cone of depression at Albany.

OCTOBER 1980 POTENTIOMETRIC SURFACE

The October 1980 potentiometric surface of the Providence aquifer is shown in figure 10. This surface is similar to the 1951 potentiometric surface, with the exception of the development of a major cone of depression at Albany, in Dougherty County, and expansion of the existing cone at Americus, in Sumter County. In these areas, discharge from the aquifer exceeds recharge, which causes a reduction in compressive aquifer storage and a corresponding depression in the potentiometric surface.

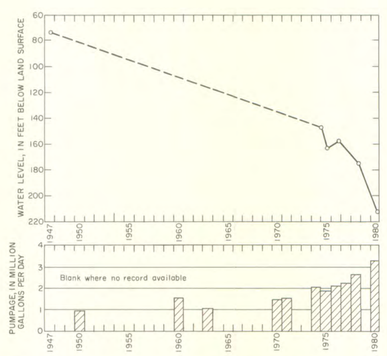

Figure 12.—Water level in well 12Q6 at Americus and average daily ground-water withdrawals by the city of Americus.

Figure 11.—Water-level declines in the Providence aquifer, 1951-80.

LONG-TERM WATER-LEVEL DECLINES

Long-term water-level declines in the Providence aquifer occurred during the period 1951-80 and are shown in figure 11. Declines in excess of 50 ft occurred in parts of Sumter, Lee, Dougherty, and Terrell Counties. Because the aquifer has low transmissivity and is recharged by precipitation 15 to 45 miles north of these areas, most of the decline may be attributed to increases in regional pumpage and the inability of the aquifer to transmit sufficient quantities of water to the areas of use. It is likely that increases in pumpage and the resulting water-level declines in the Clayton aquifer have increased the potential for upward leakage from the Providence and, therefore, contributed to the water-level decline.

Americus.--Heavy pumpage from municipal and industrial wells caused water levels in the Providence aquifer at Americus to decline 136 ft from 1947-80 (fig. 12). Water-level measurements of an Americus city well (12Q6), which taps the Providence and Cusseta aquifers, show that water levels declined 90 ft from 1947-75, rose 3 ft from 1975-76, and dropped 49 ft from 1976-80 (fig. 14). These declines correspond to a general increase in ground-water withdrawals in Americus since 1950 (fig. 12).

Albany.--Heavy pumpage from municipal wells in Albany caused water levels in the Providence aquifer to decline more than 100 ft from 1950-78 (fig. 11). Mean monthly water levels in test well 12L21, near the center of pumpage, showed a decline of 12.1 ft from December 1979 to December 1980 (fig. 13). This decline corresponded to an increase in municipal pumpage.

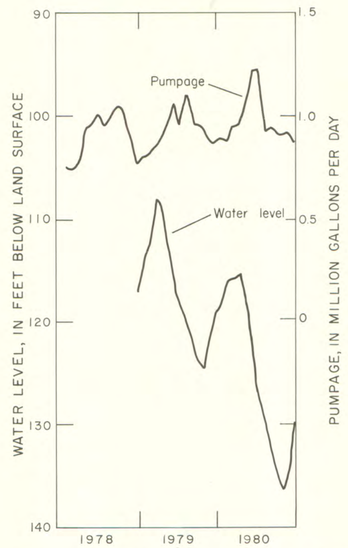

Figure 13.—Estimated mean monthly pumpage from the Providence aquifer by the city of Albany, 1978-80, and mean monthly water-levels in the Providence aquifer at well 12L21 at Albany, 1979-80.

Cartography by Willis G. Hester

HYDROGEOLOGY OF THE PROVIDENCE AQUIFER OF SOUTHWEST GEORGIA.

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1983