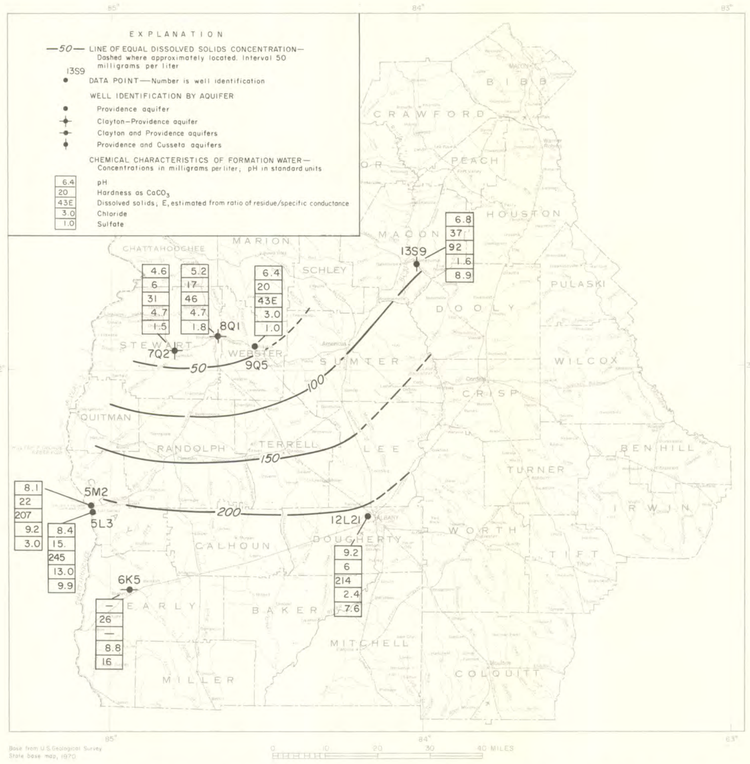

Figure 14.—Significant chemical characteristics of ground-water from the Providence aquifer.

WATER QUALITY

Analyses of water samples obtained from the Clayton and Providence aquifers are listed in table 4. Water obtained from the Providence aquifer is soft and has a relatively high sodium content. In most areas the water contains no constituent concentrations that exceed the Georgia Environmental Protection Division (1977) or U.S. Environmental Protection Agency (1977) standards for safe drinking water (table 4).

Although the few water-quality analyses available are unevenly distributed within the study area, the data indicate that dissolved solids and most other constituent concentrations increase from the outcrop area southward (fig. 14, table 4). Values of pH also increase southward and range from a low of 4.6 at well 7Q2, near the outcrop area, to a high of 9.2 at well 12L21, in Albany.

A diagram showing the chemical classification of ground water according to type is given in figure 15. The plots represent the percentage concentrations in milliequivalents per liter of the two groups of major cations and anions in the water.

A comparison of samples obtained from the Clayton and Providence aquifers indicates that water from each aquifer has distinct chemical characteristics. Water from the Providence aquifer generally is a soft sodium bicarbonate type (well 12L21), whereas water from the Clayton aquifer generally is a hard calcium bicarbonate type (well 7N1). Wells tapping both aquifers yield water that is a mixture of the two types (well 6K5).

In the Albany area, the chemical characteristics of water from the Clayton aquifer are similar to those of water from the Providence aquifer. Well 12L20 taps the Clayton aquifer and yields a sodium bicarbonate type water. Such similarity of water quality probably indicates that significant quantities of water leak upward from the Providence aquifer into the Clayton aquifer (Hicks and others, 1981, p. 13).

Figure 16.—Average daily ground-water withdrawals by the city of Albany.

WATER USE

The Providence aquifer supplied more than 8.8 Mgal/d to municipalities, industries, and agriculture during 1980 (table 5). Major users of the Providence include the cities of Americus and Albany; industries in Houston, Clay, and Pulaski Counties; and agricultural users in Macon, Lee, Houston, and Randolph Counties.

Americus.--The city of Americus is supplied by a system of five multiaquifer wells which produced an average of 3.2 Mgal/d in 1980. The Providence aquifer supplied an estimated 0.7 Mgal/d, or about 22 percent of the total yield. Records indicate that water use in Americus increased about 230 percent since 1950. Most of the increase occurred during 1970-80 (fig. 12).

Albany.--A system of 23 multiaquifer wells supplied an average of 16.1 Mgal/d to the city of Albany during 1980. The Providence aquifer supplied an estimated 1.0 Mgal/d, or 6 percent of the total yield. Records indicate that Albany municipal use increased about 11.2 Mgal/d or 240 percent from 1950-80 (fig. 16).

Table 5.--Estimated ground-water use from the Providence aquifer, 1980

County	Ground-water use (Mgal/d)			
	Agricultural[1]	Industrial	Municipal	Total
Clay	--	1.11	0.19	1.30
Dooly	0.01	--	.03	.04
Dougherty	--	--	.97	.97
Houston	.44	1.42	.02	1.88
Lee	.69	--	--	.69
Macon	.82	.13	--	.95
Pulaski[2]	--	.68	.31	.99
Randolph	.38	--	--	.38
Schley	.07	.07	--	.14
Stewart	--	--	.15	.15
Sumter	.14	.07	.68	.89
Terrell	--	--	.10	.10
Webster	--	--	.30	.30
Total	2.55	3.48	2.75	8.78

1 Values are estimated growing-season withdrawals averaged over a 365-day period.
2 Providence-Cusseta aquifer.

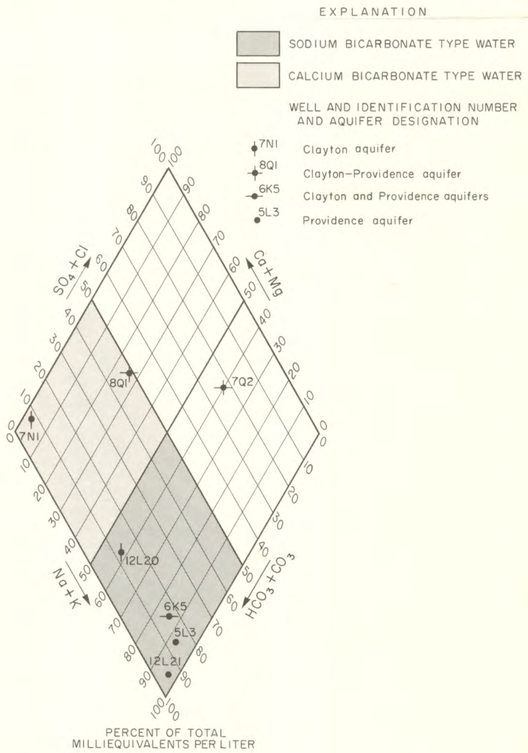

Figure 15.—Chemical classification of ground water according to type.

Table 4.--Chemical analyses of well water from the Providence and Clayton aquifers

[Analyses by U.S. Geological Survey, except as noted. Aquifer(s): Pr, Clayton; Pr-Kp, Clayton-Providence; Kp, Providence; Kc, Cusseta. <, less than]

Well No.	Owner or name	Aquifer(s)	Date sampled	Milligrams per liter: Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Nitrite (NO_2)	Dissolved solids: Residue at 180° C	Sum of constituents	Hardness: Calcium, magnesium	Noncarbonate	Specific conductance, in microhms at 25°C	Field pH	Temperature, in degrees Celsius	Color, in platinum-cobalt units	Carbon dioxide, mg/L as CO_2 1/	Micrograms per liter: Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Strontium (Sr)	Zinc (Zn)
Georgia Environmental Protection Division standards for safe drinking water, 1977											250	250	2/			500	500	3/					15							1,000	300	50	50	2.0	10		5,000
5L3	Pr. Gaines	Kp	4-8-58	16	5.6	1.5	90	1.7	226	185	12	15	1.0	0.00	--	251	254	20	0	403	8.3	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--
			4-17-67	14	4.4	1.0	87	1.4	218	185	9.9	13	.8	.00	--	245	243	13	0	395	8.4	21.0	0	--	--	--	--	--	--	--	--	--	--	--	130	--
3N2	USA Corps of Engrs. test well 3	Kp	8-27-57	16	6.8	1.2	70	1.4	198	--	3.0	9.2	.6	.0	--	207	--	22	0	328	8.1	20.0	--	--	--	--	--	--	30	--	--	--	--	--	--	--
12L21	USGS test well 10	Kp	11-21-78	12	1.7	.4	85	1.6	200	190	7.6	2.4	.6	.090	0.0	214	223	6	0	358	9.2	24.0	0	0.2	40	0	3	1	0	50	10	0	0.6	0	--	0
12L20	USGS test well 6	Pr	3-7-78	20	12	6.0	33	2.8	140	110	13	1.5	.2	.03	.00	160	158	55	0	231	7.2	22.8	10	14	20	0	0	0	0	180	11	10	<.5	0	360	0
6K5	Blakely, 1	Pr,Kp	5-16-46	16	5.8	2.7	74	--	191	157	16	8.8	.4	.5	--	218	--	26	0	--	--	25.0	3	--	--	--	--	--	--	60	--	--	--	--	--	--
13S9	Southern Frozen Foods, 2	Kp,Kc	4/6-6-62	--	--	--	--	--	35	35	3.0	3.0	1.0	--	--	--	--	37	8	--	6.3	--	15	.0	--	--	--	--	--	3	--	--	--	--	--	--
			5/10-1-69	--	--	--	--	--	--	32	--	--	--	--	--	--	--	32	--	--	6.7	--	--	13	--	--	--	--	--	1	--	--	--	--	--	--
			6-24-74	49	12	1.6	1.6	.3	44	36	8.9	1.6	.4	.00	.00	92	98	37	0	96	6.8	21.0	9	11	20	2	--	10	3	360	4	25	.1	0	--	9
7N1	USGS, Cuthbert observation well	Pr	6-22-78	20	56	3.7	1.8	1.5	170	140	8.0	2.1	.0	.90	.00	200	178	160	16	270	6.8	22.0	5	43	20	1	0	0	0	530	3	40	<.5	0	170	10
7Q2	Lompkin, 3 (1A)	Kp	6-25-74	7.8	1.3	.6	3.5	.8	3	2	1.5	4.7	.0	6.6	.00	31	28	6	3	28	4.6	19.0	3	121	30	4	3	0	20	0	36	17	<.5	3	--	8
8Q1	Richland, 3	Pr-Kp	6-20-68	8.3	7.9	.5	3.3	.4	18	15	.0	4.0	.1	11	--	55	44	22	6	67	6.3	--	0	14	--	--	--	--	--	--	--	--	--	--	0	--
			6-27-74	9.7	6.0	.4	2.3	.6	11	9	1.8	4.7	.0	9.7	.00	46	41	17	8	42	5.2	20.0	3	111	30	0	4	0	2	10	19	0	<.5	3	--	8
9Q1	Preston, 1	Kp	6/12-14-48	11	7.5	.7	--	--	--	--	--	--	--	--	--	--	--	22	--	--	6.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			7/3-31-72	--	--	--	--	--	--	16	--	--	--	--	--	--	--	16	--	--	6.7	--	--	6.3	--	--	--	--	--	<100	--	<50	--	--	--	--
9Q2	Preston, 2	Kp	7/12-3-62	11	--	.4	0.0	--	--	19	0.0	.7	.0	--	--	--	--	20	--	--	6.2	--	--	24	--	--	--	--	--	699	--	0	--	--	--	--
9Q5	Preston, 3	Kp	8/8-27-73	10	8.0	.0	--	--	27	22	1.0	3.0	.0	--	--	--	--	20	0	60	6.4	--	5	.0	--	--	--	--	--	10	--	0	--	--	--	--
Average values for Providence aquifer				11.6	5.5	0.7	42.6	1.1	113	71	4.1	6.3	0.3	4.3	0.00	150	139	17	2	210	--	20.8	2	39.5	33	1	3	0.5	7	--	22	3	--	2	65	3

1/ Carbon dioxide concentration calculated from measured values of pH and bicarbonate ion.
2/ State standards for fluoride are met according to temperature.
3/ Water having a $CaCO_3$ hardness of 0 to 60 mg/L is classified "soft"; 61 to 120 mg/L, "moderately hard"; 121 to 180 mg/L, "hard"; and more than 181 mg/L, "very hard."
4/ Parker Laboratory, Inc., Charleston, S.C.
5/ Georgia Dept. of Public Health.
6/ Black Laboratories, Gainesville, Fla.
7/ Law and Co., Atlanta, Ga.

SUMMARY

The predominantly sand Providence aquifer lies within the Coastal Plain physiographic province of southwest Georgia and ranges in thickness from 38 to 386 feet. Estimated transmissivities range from 760 feet squared per day in Schley County to 4,600 feet squared per day in Clay County.

Recharge water enters the aquifer in the northeastward-trending outcrop belt and flows southward, bounded by the Ocmulgee River on the east and the Chattahoochee River on the west. Additional recharge is received through leakage from underlying units. Discharge from the aquifer to streams occurs both in the outcrop area and downdip through overlying units. Idle multiaquifer wells in Albany and Dawson provide conduits for upward discharge of water from the Providence aquifer.

During 1980, an estimated 8.8 million gallons per day was pumped from the Providence aquifer. From 1950-80, ground-water use increased 230 percent in Americus and 240 percent in Albany, causing water levels in the aquifer to decline more than 100 feet.

Water from the Providence is a soft, sodium bicarbonate type which generally contains no constituent concentrations that exceed the Georgia Environmental Protection Division and U.S. Environmental Protection Agency standards for safe drinking water.

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HYDROGEOLOGY OF THE PROVIDENCE AQUIFER OF SOUTHWEST GEORGIA.

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