GROUND-WATER RESOURCES OF CLARENDON COUNTY, SOUTH CAROLINA

STATE OF SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES

LAND, WATER AND CONSERVATION DIVISION

WATER RESOURCES
REPORT 40
2006

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by

Roy Newcome, Jr.

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ABSTRACT

Clarendon County is well endowed with ground water suitable for all uses. Quantities obtainable from wells are adequate for public supplies, industrial uses, and irrigation. Well yields as great as 1,500 gallons per minute are obtained, and many wells can produce more than 100 gallons per minute. The water is of good quality, being soft and low in mineral content.

The Black Creek and Middendorf Formations, of Cretaceous age, contain sand aquifers throughout the Coastal Plain of South Carolina, and these aquifers supply most of the wells in Clarendon County. The deepest well recorded is 950 feet, but most wells are less than 500 feet.

Aquifer transmissivities ranging from 1,900 to 60,000 gallons per day per foot of aquifer width have been calculated from approximately 20 pumping tests of the aforementioned aquifers in Clarendon County and nearby in adjacent counties. Electric logs of wells indicate numerous sand aquifers to a depth of about 900 feet.

INTRODUCTION

Twenty-eight years ago (1978), Phillip Johnson of the U. S. Geological Survey (USGS) produced a report titled "Reconnaissance of the Ground-Water Resources of Clarendon and Williamsburg Counties, South Carolina." Published by the South Carolina Water Resources Commission as Report No. 13, the work was, in the opinion of this writer, considerably more than a reconnaissance. It provided a detailed description of the ground water in that area, leaving for later workers only the task of updating the evaluation of the resource in the light of information that has become available over the years. It is the intent of this report to reexamine Johnson's findings in Clarendon County and update them with newer data, particularly with regard to aquifer availability and hydraulics and water quality.

Location and Physiography of Clarendon County

Clarendon County is at the center of South Carolina's Coastal Plain. The county has a land area of 607 square miles and is bounded on the northwest by Sumter County, on the northeast and east by Florence and Williamsburg Counties, and on the south and southwest by Berkeley, Orangeburg, and Calhoun Counties (Fig. 1). The center of the county is about 60 miles from the coastline. In area, Clarendon ranks 24th among the State's 46 counties.

Slightly more than half of Clarendon County is drained by the Black River (Great Pee Dee River basin); the rest (southern part) is in the Santee River subbasin. The latter includes Lake Marion, which occupies about 100 square miles along the border with Berkeley, Orangeburg, and Calhoun Counties. The central part of the county is drained by the Pocotaligo River before it flows into the Black River near the eastern border.

All or part of 21 USGS topographic maps, at a scale of 1:24,000, are included in the coverage of Clarendon County (Fig. 2). Land elevations above sea level range from 30 to 190 ft (feet). The highest elevations are in the northwest corner of the county and the lowest are in the southeast. In most of the county, the land surface can be described as gently sloping.

Climate

Typical of South Carolina's Coastal Plain, the climate is humid-subtropical in Clarendon County. Records at two long-term weather stations, Rimini near the west edge of the county and Manning in the center, reveal 45- and 48-inch average annual rainfall, respectively. The wettest months are June, July, and August, and the driest are October and November.

July is the warmest month, with a mean maximum temperature of 92.5° F, and January is the coldest, with a mean minimum of 34.7° F. The long-term average annual temperature is 64° F, and this is an indicator of the shallow ground-water temperature. The growing season for crops is generally from early March to late November, or about 200 days.

Population and Industry

The population of Clarendon County numbers about 33,400, more than 6,000 of whom have non-farm employment (U.S. Census 2000). The largest industrial employers are Federal Mogul (650), Arvin/Meritor Automotives (285), Trimaco Industries (210), Yanagawa of South Carolina (198), Southwoods-Arauco Lumber and Millwork (120), and Kaycee Manufacturing (100). There are numerous other private and public employers.

The chief farm product at present (2006) is chickens. Clarendon ranks second among the State's counties in corn production, with more than 1.5 million bushels (2002).

Manning is the largest town, with 4,025 people (Census 2000). Summerton has 1,061, Turbeville 602, and Paxville 248.

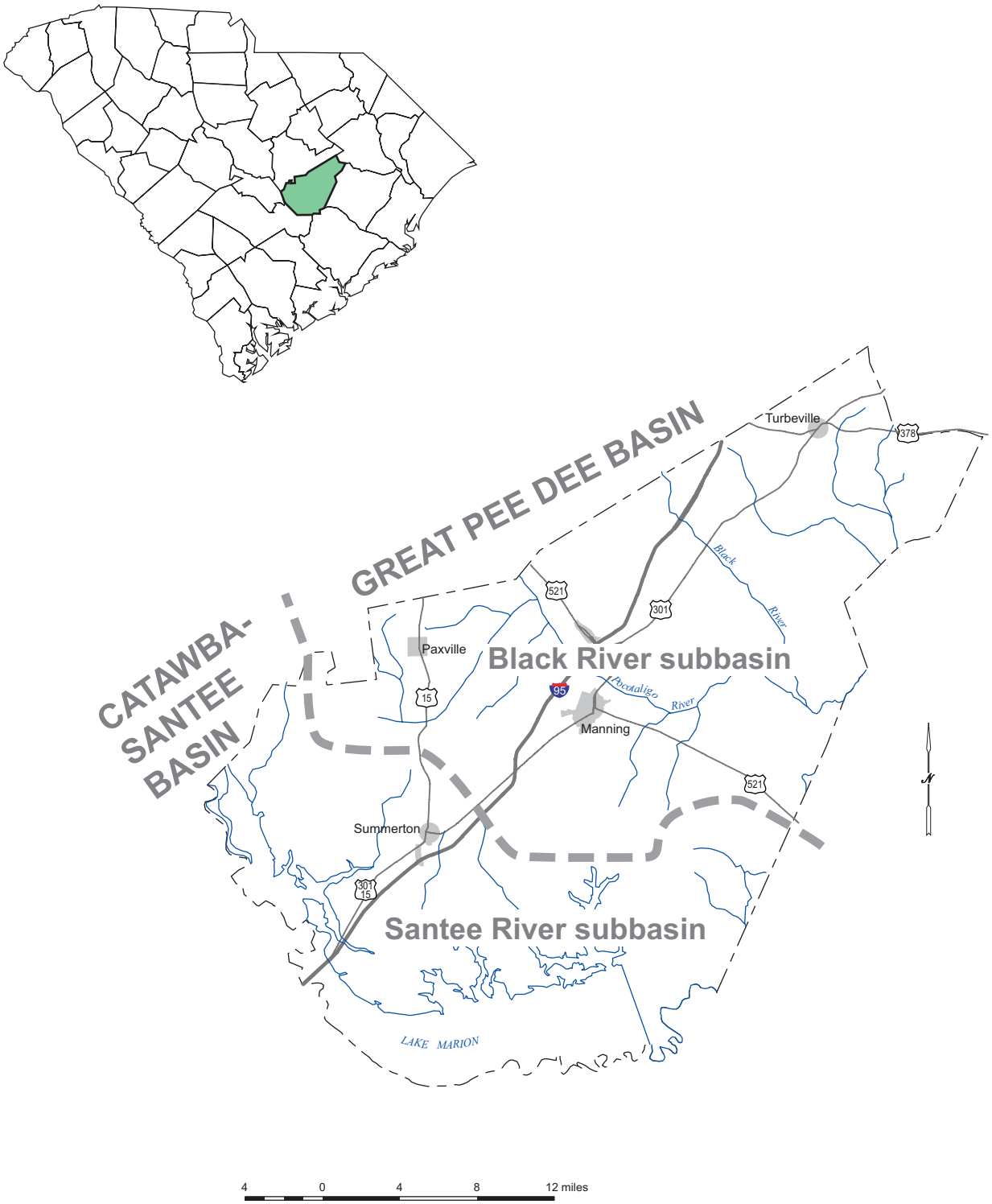


Figure 1. Location and drainage of Clarendon County, S.C.

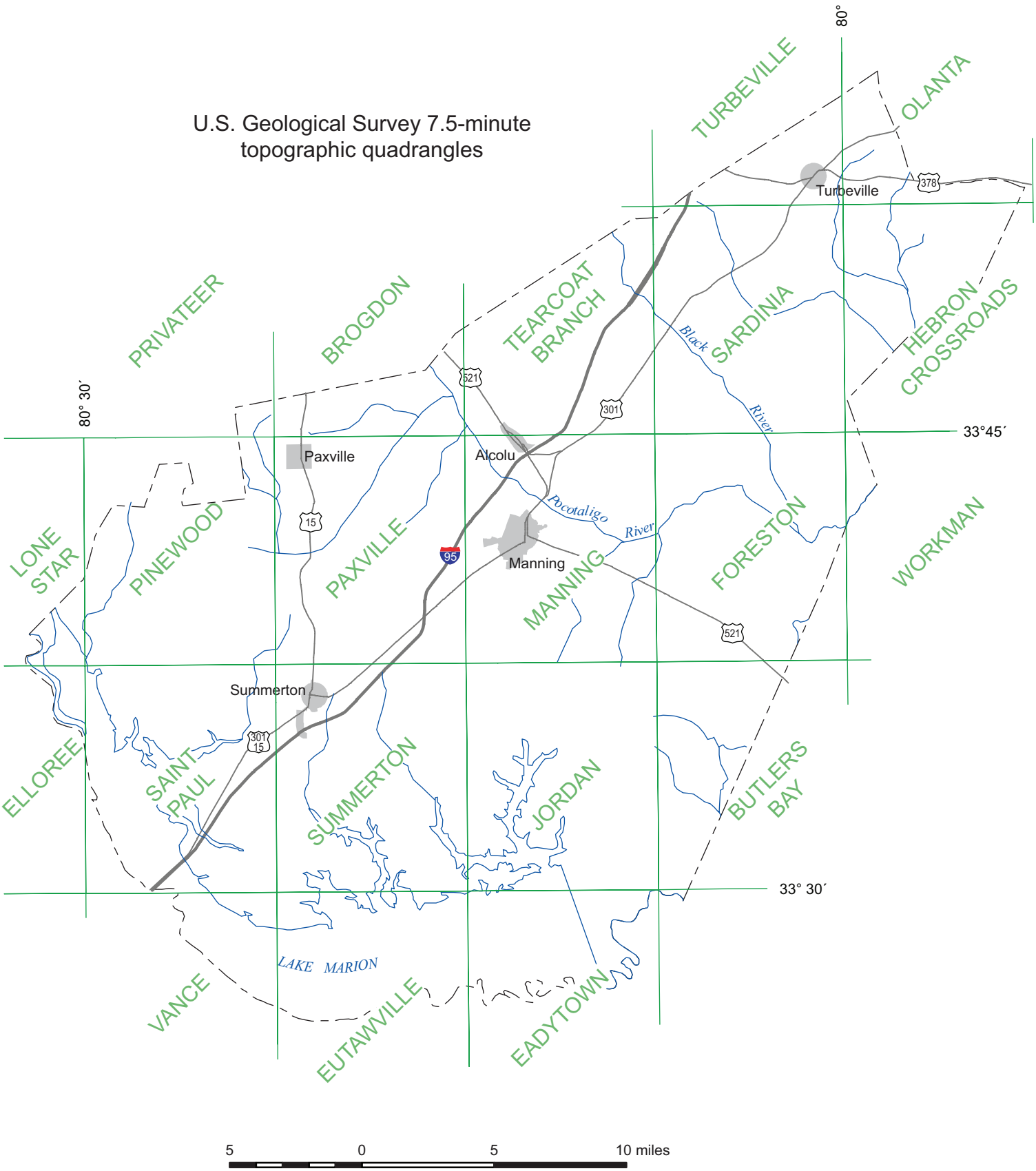


Figure 2. Topographic-map coverage of Clarendon County, S.C.

Water Supply

Wells serve the five public water-supply systems in Clarendon County. Table 1 contains descriptions of these systems. In 2005, the systems had the following pumpage rates, in millions of gallons per day (South Carolina Department of Health and Environmental Control):

Alcolu Water System	0.05
Barrineau Water System	0.09
Manning	1.07
Summerton	0.33
Turbeville	0.30

The Alcolu and Barrineau water systems support a water use of less than 100 gallons/day per person, indicating that those systems are basically rural domestic in type. The three towns, Manning, Summerton, and Turbeville, have per capita water uses of 194, 158, and 288 gallons/day. This reflects the commercial and industrial use of water from these municipal systems.

Few of the industries in Clarendon County have their own wells. The many irrigation wells attest to the agricultural development of the county. The large farms have numerous high-yield wells, some capable of pumping 1,000 to 1,500 gpm (gallons per minute).

AQUIFERS OF CLARENDON COUNTY

Sand beds of Cretaceous age constitute the chief aquifers of this county. Less important aquifers of Tertiary and Quaternary ages overlie the Cretaceous formations. The major Cretaceous aquifers are in the Black Creek Formation and underlying Middendorf Formation (formerly known as Tuscaloosa Formation). These two formations, probably 65 to 80 million years old, are difficult to differentiate in drilling operations and geophysical logging. From a hydrological standpoint, the aquifer descriptions and hydraulic properties permit little or no differentiation. Two prominent sources of maps using the names Black Creek and Middendorf are Colquhoun and others (1983) and Aucott and others (1987). For Clarendon County, these two sources do not differ greatly in their mapping of the two units (see Fig. 3). It can be said, in general, that the Black Creek Formation ranges in thickness from 350 ft at the northeast end of the county to 500 ft at the south end and the Middendorf thickness from 325 to 750 ft over the same distance.

The uppermost Cretaceous unit is the Peedee Formation. It overlies the Black Creek Formation and is 125 to 225 ft thick in Clarendon County. Although the Peedee contains some sand beds capable of supplying domestic and small irrigation wells, it is not a likely source for large public, industrial, and irrigation supplies. The Black Mingo Formation, of Tertiary age, lies on the Peedee Formation and crops out in the middle third of Clarendon County. Its thickness in the county is 25 to 150 ft, and it is a mostly clayey unit with minor sand beds. Domestic wells obtain water from the Black Mingo and from the shallow water-table aquifer that lies above it.

Of more practical use in the search for water supplies is the total thickness of the Coastal Plain sediments, for it is this that defines the depth limit of the resource. Figure 4 suggests the base of the sediments (top of bedrock) to be 750 to 1,600 ft below sea level in Clarendon County. Available data indicate that freshwater exists in all the aquifers above the bedrock in the county.

Electric logs of wells provide the best means of locating aquifers. Clarendon County is in the fortunate position of being relatively well covered by these logs. Figure 5 shows their locations, and Table 2 lists the sand intervals (aquifers) that are indicated by the logs. An example of an electric log is depicted in Figure 6.

It should be noted here that the interpretation of electric logs is subjective to some extent. What appears to be a high-resistivity trace representing sand could instead be a shell bed or marl. It is always desirable to have carefully collected samples of the materials penetrated during drilling. The sand intervals listed in Table 2 are based on the writer's interpretation of the electric logs. The significant aquifers are indicated in Table 2 and often supply major wells for which yield and chemical-quality information is available; much of it is included later in this report.

WELLS

Water wells in Clarendon County are generally less than 300 ft deep, but at least one well reached 950 ft. Casings range in diameter from 4 inches to 16 inches. Nearly all of the aquifers are sand and require well screens. These have openings selected on the basis of sand-grain size and variation. The wells routinely are gravel-walled—that is, gravel of selected size is emplaced in the annular space between the well screen and the drilled hole. The gravel has the purpose of increasing the effective size of the well by allowing the finest grains of aquifer sand to pass through the screen while facilitating the bridging of coarser material that will gradually inhibit the movement of the fine material toward the well. In this manner, a well is "developed" by pumping until the discharge contains little or no sand.

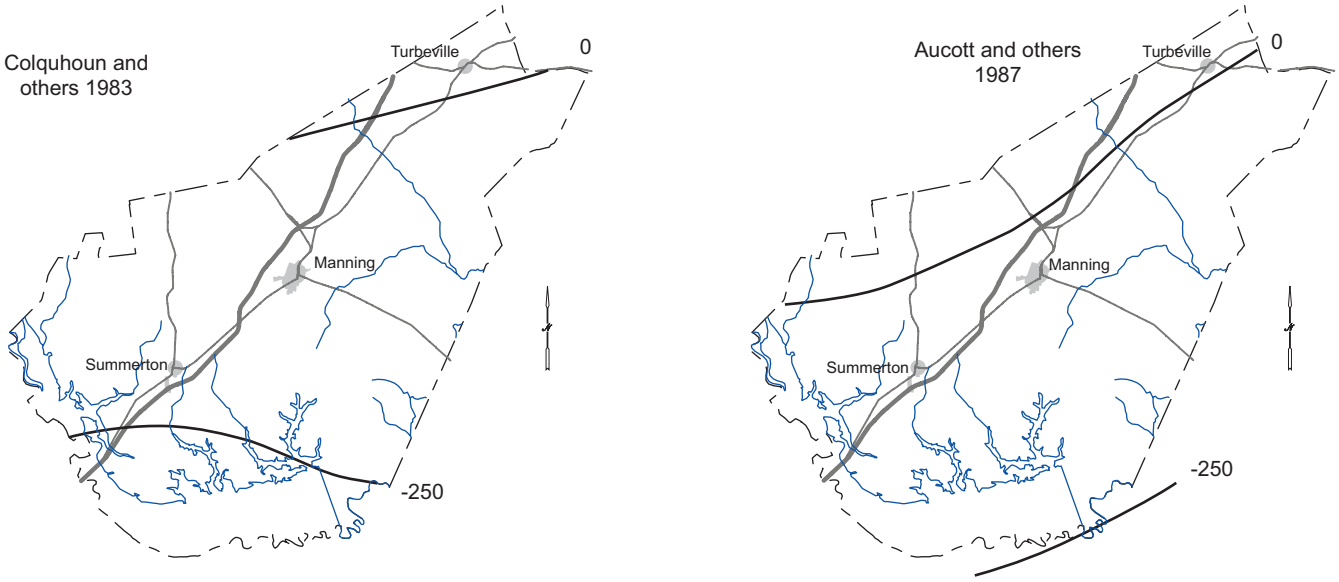
The largest well yield in DNR records for Clarendon County is 1,500 gpm from a 420-ft irrigation well (CLA-55) near Turbeville. Many wells yield, or are capable of yielding, 100 gpm or more and several yield more than 500 gpm. Locations of wells, for which DNR has records and which either yield more than 100 gpm or have been reported by the well drillers to have that capacity, are shown on the map of Figure 7. The wells are briefly described in Table 3.

AQUIFER HYDRAULICS

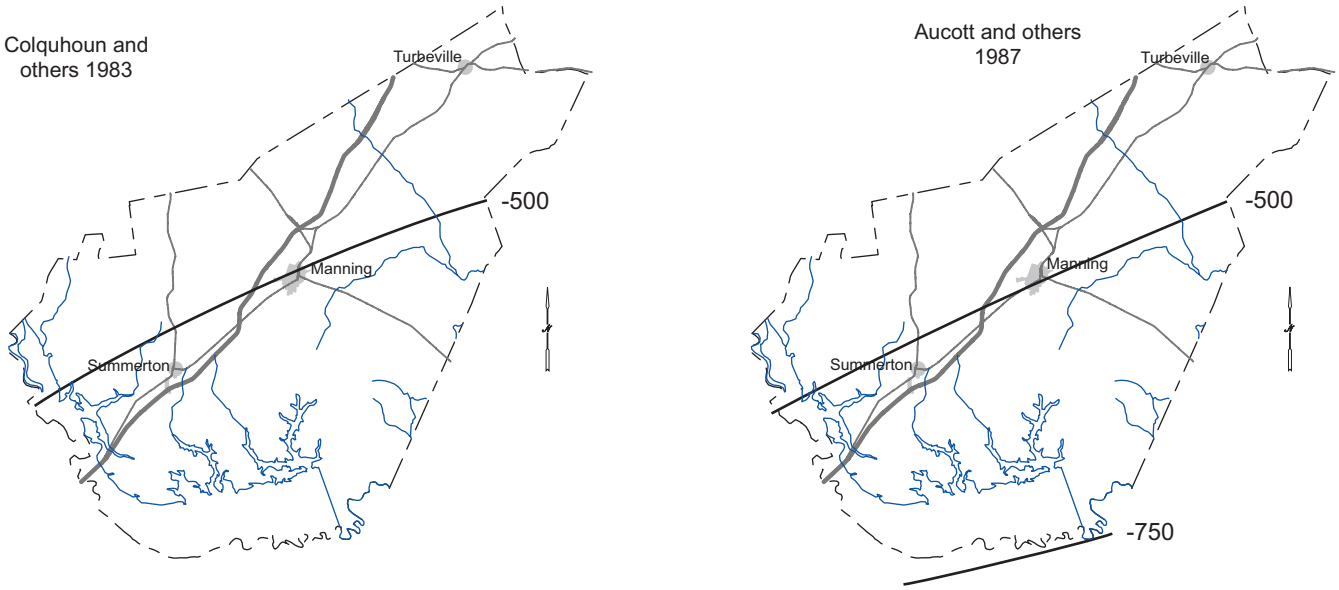
The capacities of wells and aquifers to produce water are measured by pumping tests. By pumping a well at a constant rate and measuring the resulting decline (drawdown) of the water level in the well, a graphical plot permits calculation of aquifer transmissivity, well specific capacity, and well

Table 1. Description of public water supplies in Clarendon County, S.C.

System and pumpage	Well name or location	Owner no.	Depth (feet)	Yield (gpm)	Electric log	Chemical analysis	Pumping test	County number	S.C. grid number	Date drilled
Alcolu Water System	At elevated tank	1	86	100	X			CLA-28	21S-c1	2/1972
	West of elevated tank	2	86	70				CLA-24	21R-w1	2/1972
Barrineau Water System	Elevated tank	1	470	210	X	X		CLA-60	17Q-o1	6/1986
	Intersection of roads 53 and 57	2	393	220	X		X	CLA-61	18R-b1	8/1986
Manning	Boundary St. (standby)	2	650	350	X			CLA-20	21S-m1	1/1965
	Hwy 301	3	717	675	X	X	X	CLA-29	21S-y1	10/1974
	Hwy 521	4	670	643	X			CLA-27	21S-s1	9/1963
	Keitt St.	5	764	750	X		X	CLA-64	21S-r4	11/1994
	Industrial park		750	800	X	X	X	CLA-146	22T-i1	2/2005
Summerton	Old well by small tank	1	625	400				CLA-14	23T-s2	1934
	New well by large tank	2	750	500	X	X		CLA-25	23T-v1	7/1970
Turbeville	Elevated tank	2	420	180	X		X	CLA-30	19Q-i3	2/1976
	Hwy 378	3	475	500			X	CLA-63	19Q-f1	12/1993
					Data available in DNR files					



**Top of Black Creek Formation,
in feet relative to sea level**



**Top of Middendorf Formation,
in feet relative to sea level**

Figure 3. Comparison of formation tops as mapped by two published sources.

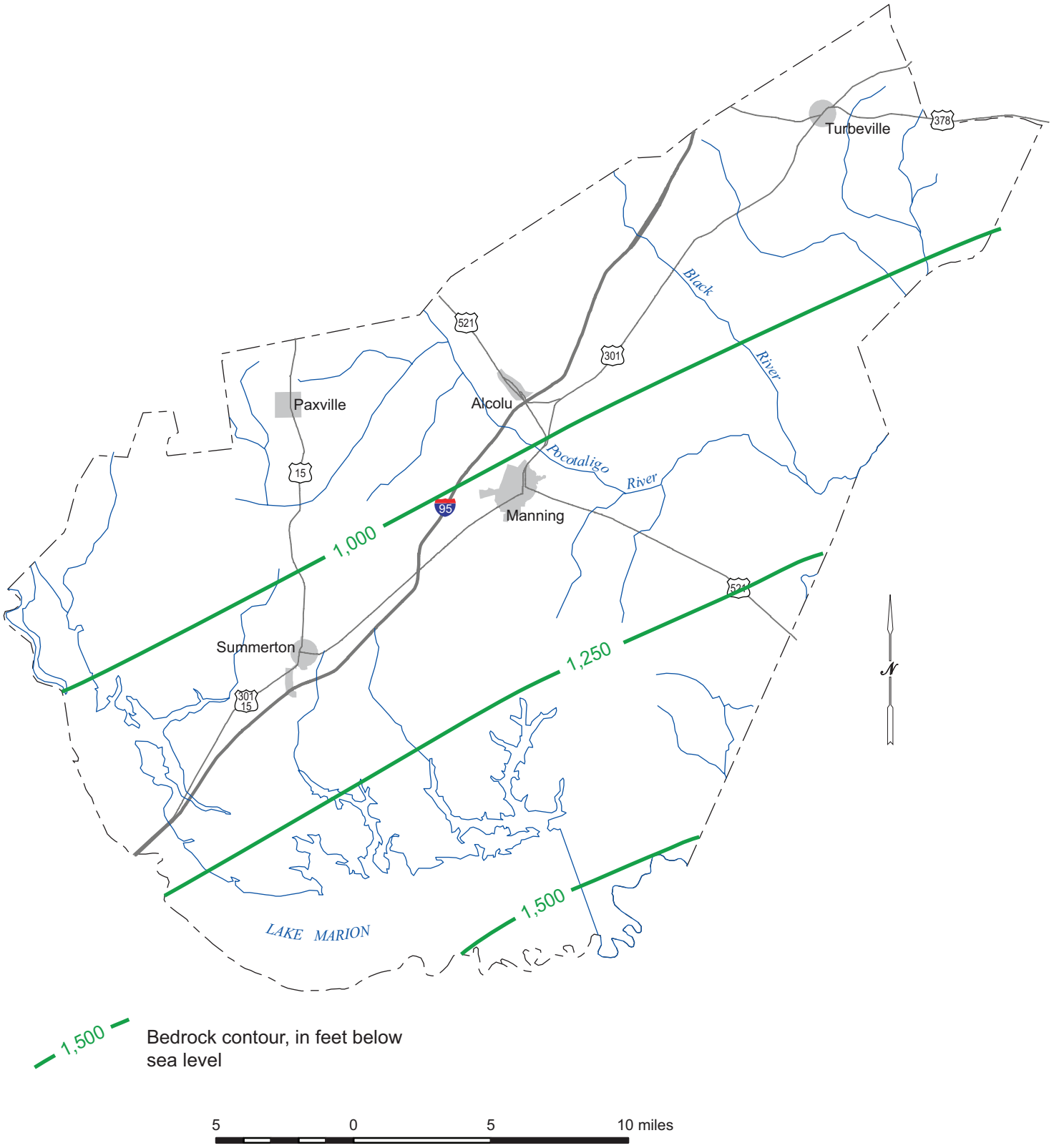


Figure 4. Bedrock contours in Clarendon County.

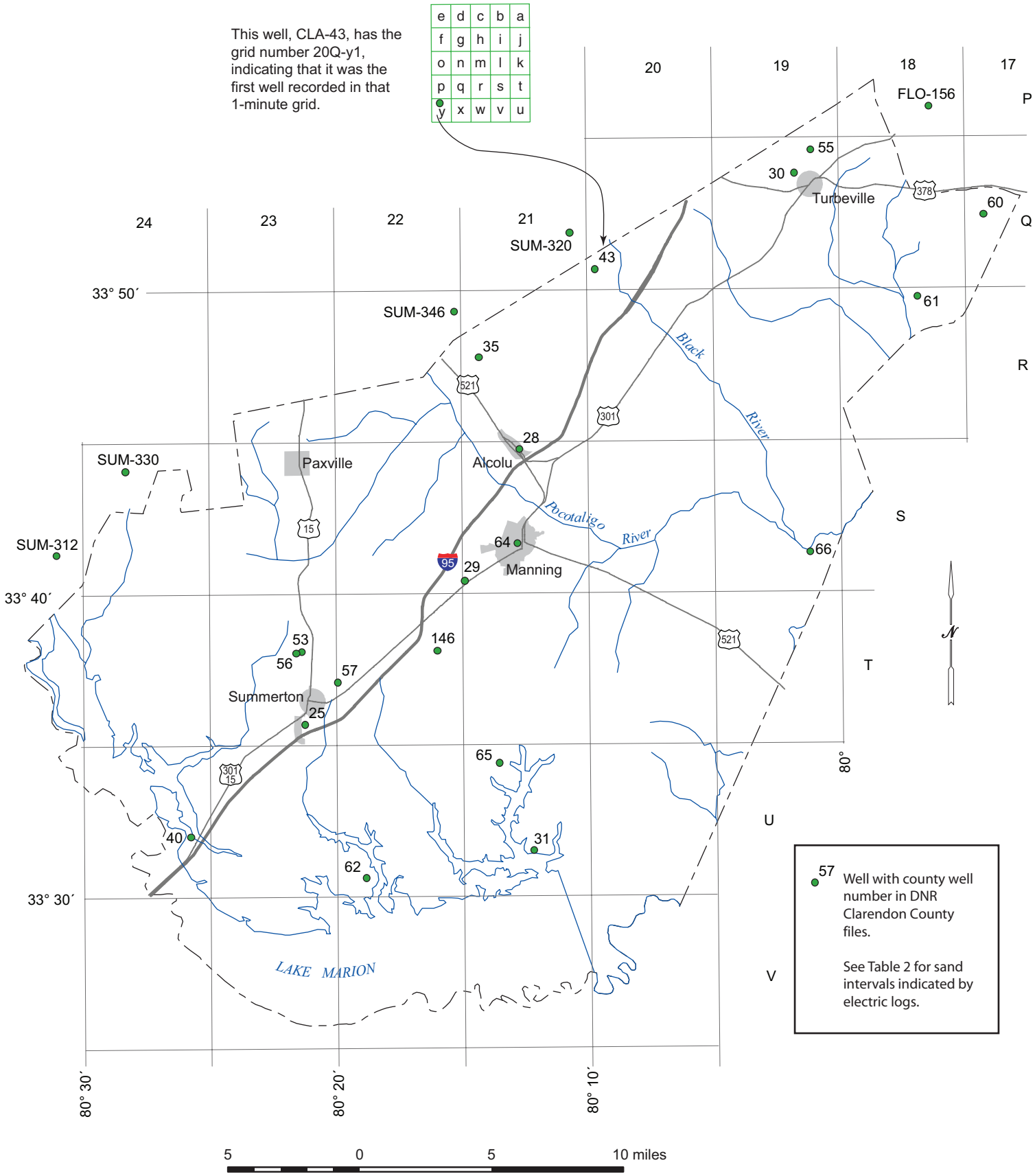


Figure 5. Locations of wells in and near Clarendon County for which electric logs are available.

Table 2. Sand intervals indicated by electric logs of wells in and near Clarendon County (see Fig. 5 for locations)

County well number	CLA-25	CLA-28	CLA-29	CLA-30	CLA-31	CLA-35	CLA-40	CLA-43	CLA-53	CLA-55	CLA-56	CLA-57
S.C. grid number	23T-v1	21S-c1	21S-y1	19Q-i3	21U-r1	21R-o1	24U-t2	20Q-y1	23T-l1	19Q-b1	23T-i1	22T-o1
Elevation, in feet MSL	130	110	137	120	80	135	82	120	140	118	140	133
Log depth (ft)	754	410	768	423	354	181	758	358	485	540	943	716
Sand intervals, in feet below land surface	170-180	5-32	45-80	132-144	65-95	24-40	20-100	-37	11-50	200-214	345-394	18-50
	196-278	64-84	150-165	164-188	120-145	68-78	115-164	52-75	123-135	230-284	438-450	100-124
	636-742	106-140	188-216	212-216	200-235	88-106	195-213	226-238	150-220	324-334	470-488	168-300
			518-540	230-254	270-350	124-172	225-236	290-309	370-385	346-394	510-568	456-489
			616-656	276-300			246-310	315-336		410-424	593-692	500-566
			660-704	356-370			410-438			462-478	712-734	590-640
			710-734	404-420			480-544			498-540	786-880	645-716
							588-618					
							632-647					
							652-734					
							740-758					
Well yield (gpm)	350	150	750	500						1,500		300

County well number	CLA-60	CLA-61	CLA-62	CLA-64	CLA-65	CLA-66	CLA-146	FLO-156	SUM-312	SUM-320	SUM-330	SUM-346
S.C. grid number	17Q-o1	18R-b1	22U-x1	21S-r4	21U-d1	19S-s1	22T-i1	18P-v1	25S-s4	21Q-t1	24S-d3	22R-a1
Elevation, in feet MSL	90	80	80	125	107	90	135	100	147	130	175	138
Log depth (ft)	490	430	519	765	238	500	770	520	725	335	835	668
Sand intervals, in feet below land surface	150-160	223-230	30-55	102-116	30-58	22-55	115-130	105-121	160-207	12-50	20-70	75-90
	180-235	304-318	192-215	150-198	65-102	80-91	183-210	145-186	412-430	53-78	120-128	112-138
	245-290	354-395	285-303	268-276	125-150	94-101	233-276	195-222	490-500	162-175	142-180	263-300
	300-340		427-454	512-526	158-162	103-108	365-382	268-284	530-535	190-200	380-408	330-425
	350-475		470-501	530-550	170-198	111-120	396-404	304-320	630-715	220-265	420-495	435-493
				560-575	202-224	185-202	456-463	360-390		328-335	513-524	510-525
				580-590		248-260	500-532	410-420			579-636	570-668
				654-668		285-305	540-560	438-444			682-740	
				720-760		310-321	634-724	468-520				
						460-476	756-768					
Well yield (gpm)		150	155	780	118		800	300	350	350	350	1,200

NOTE: Significant aquifers are shaded.

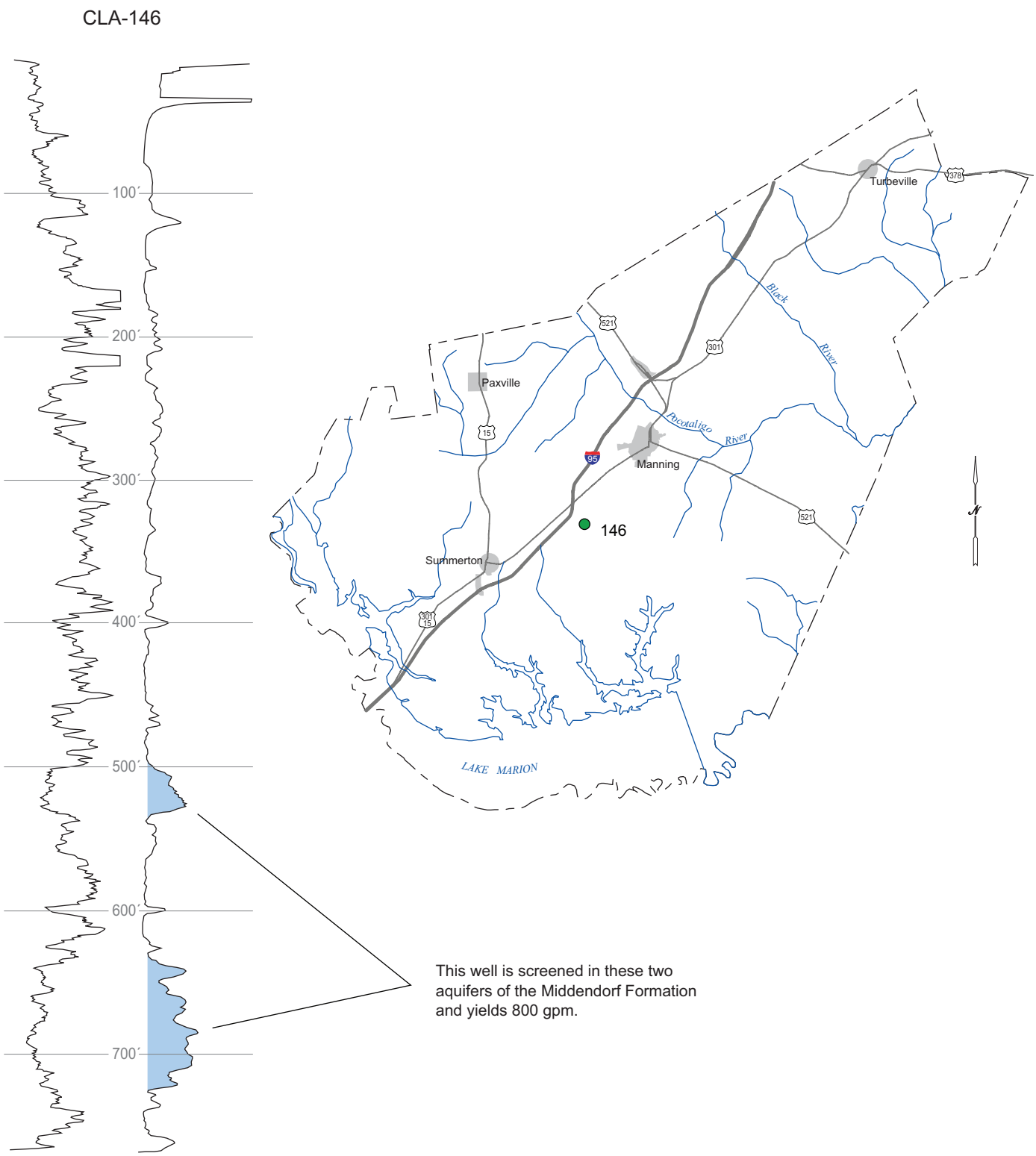


Figure 6. Electric log of a well near Manning, illustrating the identification of aquifers by means of the electrical resistivity.

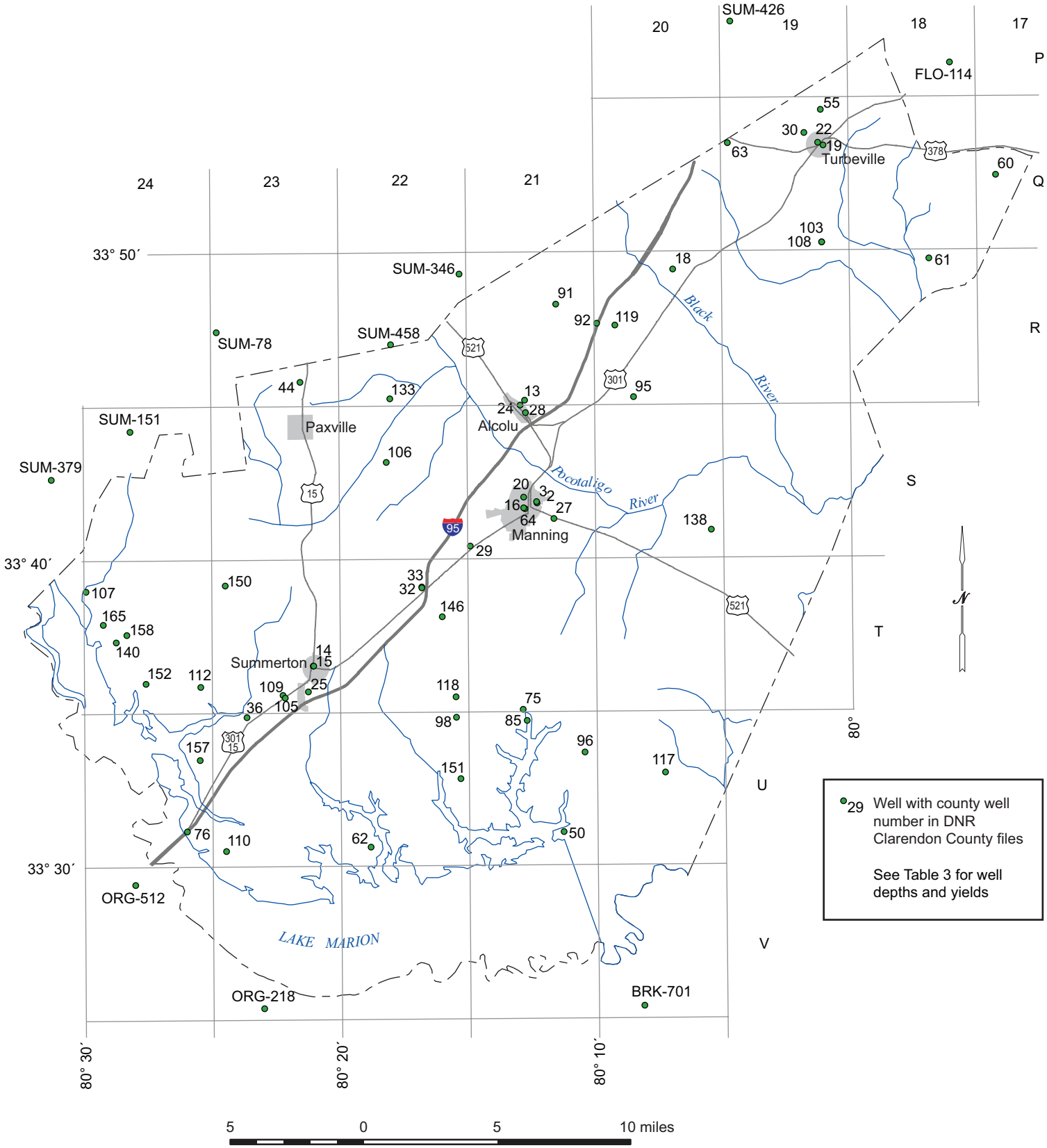


Figure 7. Locations of wells capable of yielding more than 100 gpm in Clarendon County and selected large wells in adjacent counties.

Table 3. Descriptions of major wells shown on Figure 7 (yields greater then 100 gpm)

CLARENDON COUNTY							
County well no.	S.C. grid no.	Depth (ft)	Yield (gpm)		County well no.	S.C. grid no.	Depth (ft)	Yield (gpm)
CLA-2	21S-r1	480	250		CLA-76	24U-s1	275	160
CLA-3	21S-r2	600	250		CLA-85	21U-c2	210	180
CLA-13	21R-w3	550	250		CLA-91	21R-i1	626	1,000
CLA-14	23T-s2	625	474		CLA-92	20R-o1	625	1,200
CLA-15	23T-s1	675	675		CLA-95	20R-x1	570	600
CLA-16	21S-r3	610	200		CLA-96	21U-j1	310	600
CLA-18	20R-b1	457	500		CLA-98	22U-a1	240	120
CLA-19	19Q-i2	352	500		CLA-103	19Q-v1	430	500
CLA-20	21S-m1	650	350		CLA-105	23T-w2	786	1,000
CLA-22	19Q-i1	322	150		CLA-106	22S-g1	338	150
CLA-24	21R-w1	86	150		CLA-107	24T-f2	210	300
CLA-25	23T-v1	750	525		CLA-108	19Q-v2	475	300
CLA-27	21S-s1	670	643		CLA-109	23T-w3	239	200
CLA-28	21S-c1	86	150		CLA-110	23U-y1	349	800
CLA-29	21S-y1	717	754		CLA-112	24T-u1	700	300
CLA-30	19Q-i3	420	503		CLA-117	20U-h1	200	400
CLA-32	22T-b1	213	200		CLA-118	22T-u1	240	200
CLA-33	22T-b2	216	200		CLA-119	20R-o2	528	400
CLA-36	23U-d1	491	150		CLA-133	22R-x1	195	300
CLA-44	23R-b1	100	130		CLA-138	20S-u1	620	300
CLA-50	21U-s1	140	150		CLA-140	24T-n1	275	500
CLA-55	19Q-b1	420	1,500		CLA-146	22T-i1	750	800
CLA-60	17Q-o1	470	305		CLA-150	23T-e2	270	325
CLA-61	18R-b1	393	608		CLA-151	22U-k1	260	300
CLA-62	22U-x1	320	140		CLA-152	24T-w1	240	500
CLA-63	19Q-f1	475	500		CLA-157	24U-j1	419	1,000
CLA-64	21S-r4	764	780		CLA-158	24T-n2	230	300
CLA-75	21T-w2	210	180		CLA-165	24T-o2	210	40
ADJACENT COUNTIES								
County well no.	S.C. grid no.	Depth (ft)	Yield (gpm)		County well no.	S.C. grid no.	Depth (ft)	Yield (gpm)
ORG-218	23V-x1	424	1,250		SUM-78	23R-o1	317	900
ORG-512	24V-d2	335	600		SUM-151	24S-d1	750	500
					SUM-346	22R-a1	670	1,200
BRK-701	20V-x1	240	200		SUM-379	25S-l7	695	400
					SUM-426	19P-o1	521	1,000
FLO-114	18P-s1	343	450		SUM-458	22R-m1	497	1,000

efficiency. If an observation well is available, another parameter, storage coefficient, can be calculated. Most frequently, pumping tests in South Carolina involve only the pumped well; however, because in nearly all cases artesian conditions prevail, a storage coefficient can be assumed for the purpose of predicting drawdown effects for various times and distances.

More than 20 pumping tests are available in DNR files for Clarendon County and for nearby sites in adjacent counties. Most of these are shown on the map of Figure 8 and described in Table 4. The practical use of transmissivity values obtained from pumping tests is illustrated by the graphs of Figure 9. These graphs can be used to predict the drawdown effects, at various times and distances, of pumping at selected discharge rates from aquifers representing a wide range of transmissivity.

Factors controlling transmissivity are aquifer thickness and hydraulic conductivity (permeability). Transmissivity determined by a pumping test is divided by aquifer thickness to obtain hydraulic conductivity (K). Examination of the test results of Table 4 reveals a wide range in K values. Needless to say, a thick and highly permeable aquifer is most desirable where large well production is needed.

WATER QUALITY

Complete or partial chemical analyses are available for 23 wells in Clarendon County (Fig. 10). Aquifers represented by the analyses are in the Middendorf, Black Creek, Peedee, and Black Mingo Formations. An examination of the analyses indicates water of good quality. Total dissolved-solids concentrations in 15 samples from wells in the Middendorf and Black Creek aquifers averaged 128 mg/L (milligrams per liter) and did not exceed 165 mg/L (Table 5). Few analyses are available for wells in the shallower formations, the Black Mingo and Peedee, but they suggest good water also.

The ground water usually is soft, and the pH typically is around 7.0 or slightly above. Few samples indicate acidic water. Iron concentrations are significantly above the recommended limit of 0.3 mg/L in only 3 of 23 samples tested.

WATER LEVELS

Potentiometric (water-level) maps of the Coastal Plain (Hockensmith, 2003) show that ground water in aquifers of the Middendorf Formation is moving in a generally southeast direction in Clarendon County (Fig. 11A). Elevations of water levels range, approximately, from 65 to 95 ft above sea level along the northwest boundary of the county to 50 ft along the southeast boundary. Figure 11B shows that ground-water in aquifers of the Black Creek Formation is moving toward the east, south, and west from a high of 100 ft above sea level in the central part of the county.

The potentiometric maps of Figure 11 are presented to give the reader a general impression of ground-water levels for these formations. It should be borne in mind that the Middendorf and Black Creek Formations both contain numerous sand aquifers (see Table 2), and it is likely that the lowermost and uppermost aquifers in each formation may have significantly different potentiometric levels.

Maps presented by Aucott and Speiran (1985) and Hockensmith (2003a and 2003b) suggest approximate potentiometric-surface declines of about 25 ft and 20 ft for the Black Creek and Middendorf Formations, respectively, between 1982 and 2001.

SUMMARY

Clarendon County has abundant ground-water resources of good quality. Considering yields of wells, depths of aquifers, and quality of water, the county is in a fortunate position for obtaining adequate water for domestic and public supplies, industry, and irrigation. Water is obtained chiefly from sand aquifers in the Black Creek and Middendorf Formations.

The files of DNR contain records of more than 65 wells in or closely proximate to Clarendon County that yield, or were reported by their drillers to be capable of yielding, 100 gpm or more. Of these, 9 wells yield 1,000 to 1,500 gpm and 19 others yield 500 gpm or more. The deepest of the high-yield wells is 786 ft. Only 5 of the wells are less than 200 ft deep.

Quality of the ground water is generally good, as indicated by the available chemical analyses. The water is soft and low in total dissolved solids, and the pH is usually above 7.0. Iron does not appear to be present in excessive concentrations.

Ground water is flowing generally coastward in the main aquifers of Clarendon County. Potentiometric levels have declined approximately 1 ft per year, on the average, for the last 25 years.

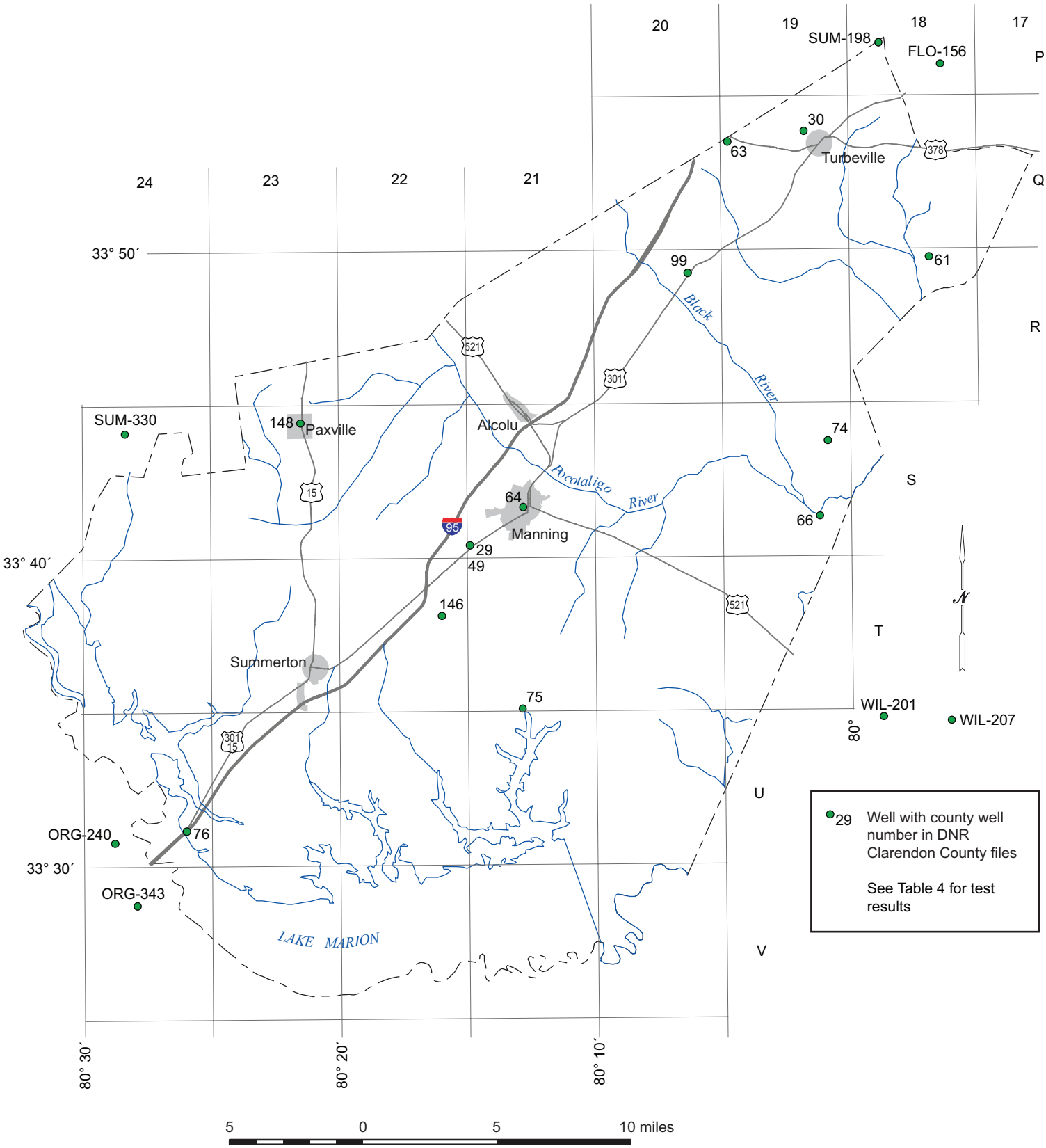
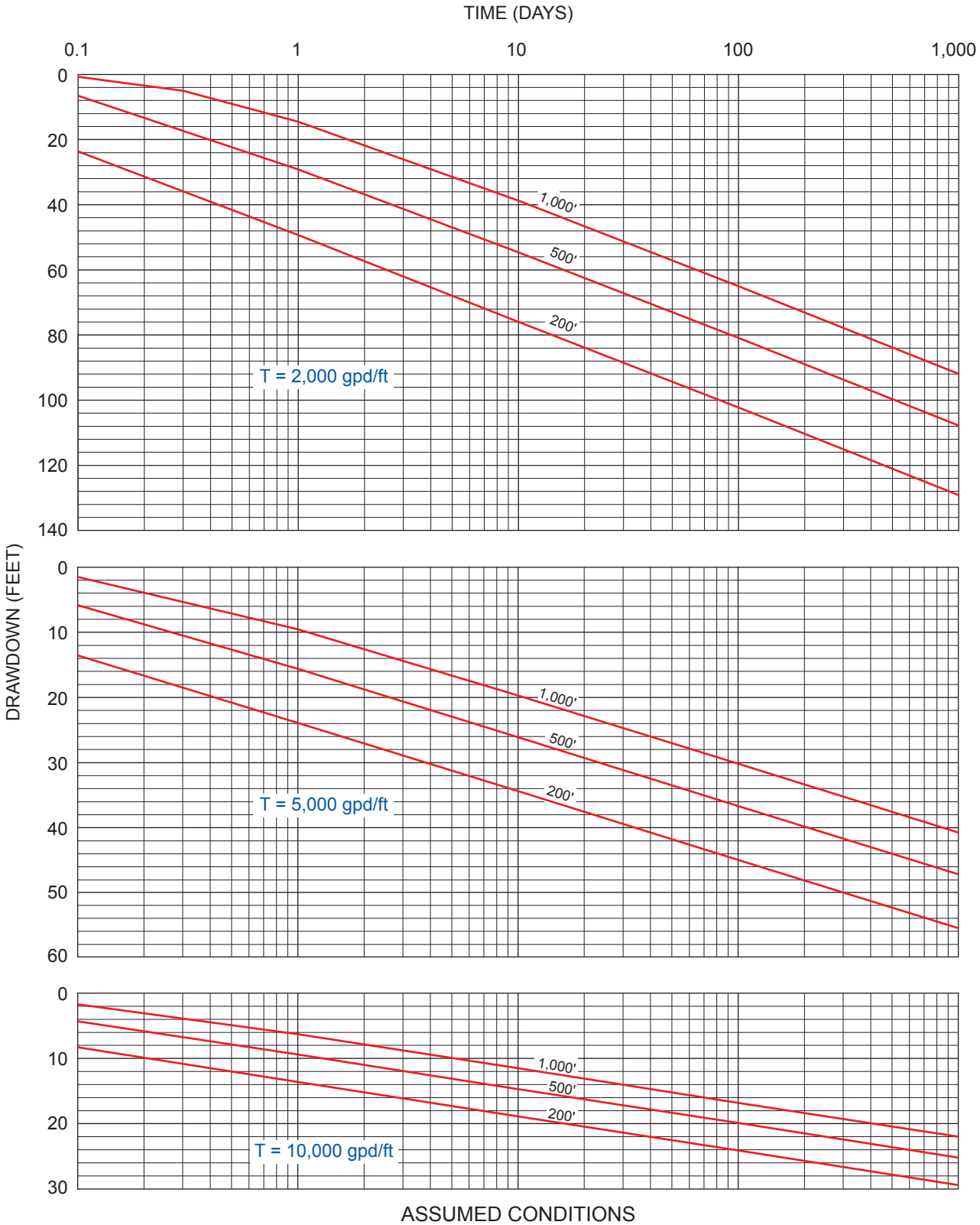


Figure 8. Locations of wells, in and near Clarendon County, for which pumping tests were made.

Table 4. Results of pumping tests made in and near Clarendon County

County well no.	S.C. grid no.	Location	Elec. log	Depth (ft)	Aquifer/ thick. (ft)	Date of test	Duration (hr) (dd/recov)	Static WL (ft)	Q (gpm)	Trans. (gpd/ft)	Sp. cap. (gpm/ft)	Well effic. (percent)
CLARENDON COUNTY												
CLA-29	21S-y1	Manning (west of town)	X	717	M/105	11/7/1974	24/1	23	754	40,000	15	75
CLA-30	19Q-i3	Turbeville	X	420	BC/65	3/2/1976	24/1	13	503	23,000	13	100
CLA-49	21S-y3	Manning (SW of town)		100	BM/20	4/8/1982	24/	21	40	2,500	1	90
CLA-61	18R-b1	Turbeville, 6 mi SE	X	393	BC/50	8/1986	19/	26	608	27,000	4.8	35
CLA-62	22U-x1	Goat Island	X	320	BC/50	12/13/1995	27/4	17	157	2,000	1.0	100
CLA-63	19Q-f1	Turbeville (prison)		475	BC/	4/1/1993	24/	24	500	20,000	7.7	75
CLA-64	21S-r4	Manning (Keitt St.)	X	764	M/50	11/21/1994	24/	30	757	31,000	9.8	65
CLA-66	19S-s1	Manning, 10 mi E	X	500	BC/	6/23/1997	24/4	23	80	7,700	2.1	55
CLA-74	19S-j1	Foreston, 7 mi NNE		420	BC/60	12/31/2002	6/	25	24	4,000	2.5	100
CLA-75	21T-w2	Manning, 7 1/2 mi S		210	BC/50	2/16/2001	24/8	26	185	15,000	3.9	50
CLA-76	24U-s1	North Santee		275	BC/	6/10/2003	24/2	22	160	5,000	2.3	90
CLA-99	20R-b2	Gable		280	BC/60	10/13/2000	6/	17	32	6,300	1.4	70
CLA-146	22T-i1	Manning, 6 mi SW	X	750	M/100	2/14/2005	24/3	50	800	60,000	21	70
CLA-148	23S-b2	Paxville		242	BC/90	7/5/2005	6/	46	35	1,900	3.0	100
FLORENCE COUNTY												
FLO-156	18P-v1	Olanta (water tank)	X	225	BC/30	5/3/1968	36/	5	300	7,500	3.3	85
ORANGEBURG COUNTY												
ORG-240	24U-x1	Santee State Park		185	BM/19	4/22/1971	24/1.5	12	150	6,600	1.4	40
ORG-343	24V-h1	Santee, 1 mi SE	X	349	BM,BC/90	9/15/1986	26/1.5	60	402	12,000	4.0	70
SUMTER COUNTY												
SUM-198	18P-q1	Woods Bay State Park		575	M/	9/8/1976	8/	27	115	8,700	3.1	70
SUM-330	24S-d3	Pinewood	X	741	M/55	9/8/1993	24/3	62	351	22,000	5.7	50
WILLIAMSBURG COUNTY												
WIL-201	18U-d1	Greeleyville	X	695	BC/150	6/7/1994	24/1	18	301	8,400	4.1	100
WIL-207	18U-b1	Greeleyville, 3 mi E		1,129	M/	12/10/2001	24/14	50	952	30,000	8.2	55

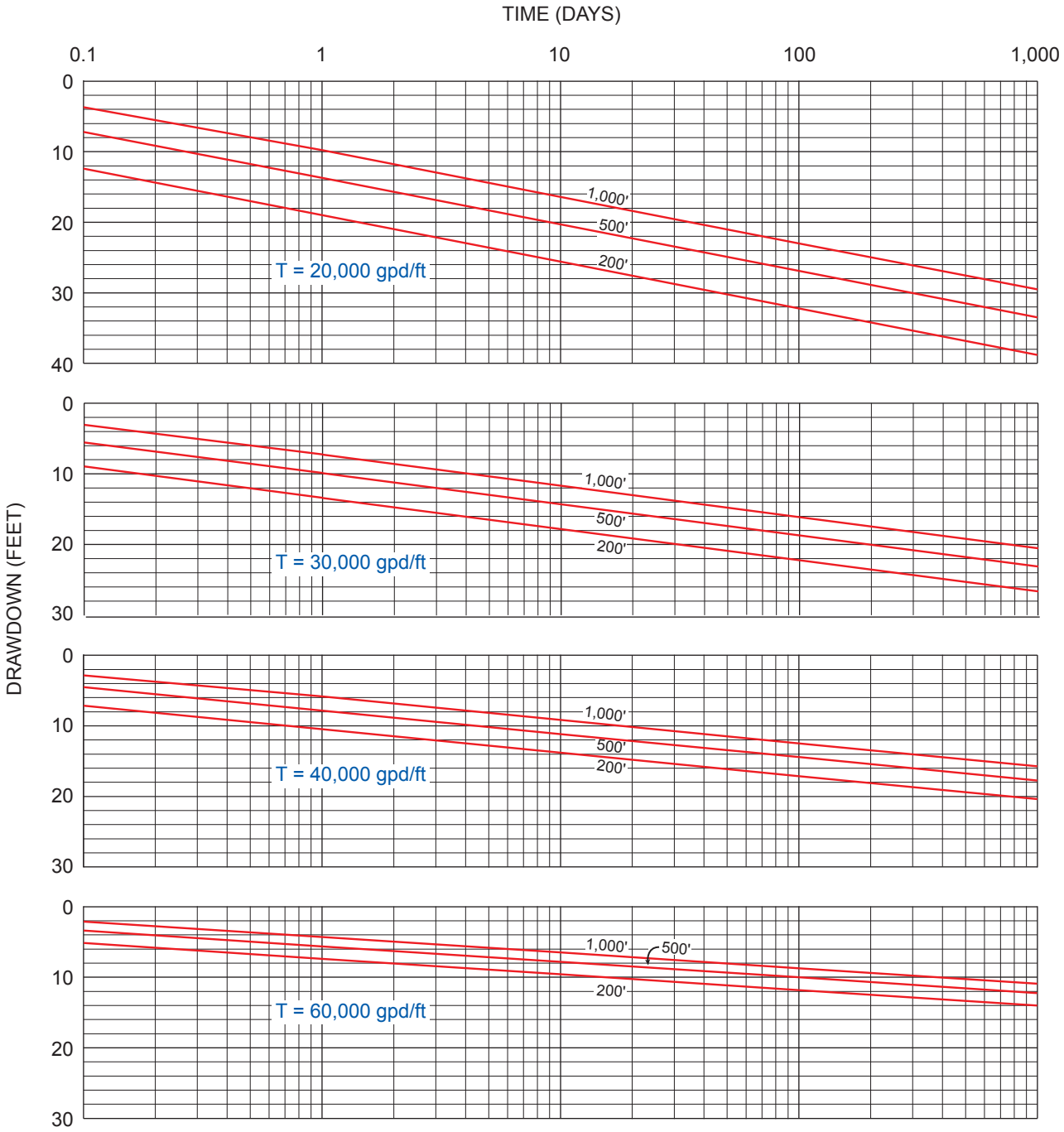
Explanation of table-heading abbreviations:
Elec. log – Electric log. X indicates that one is on file.
Aquifer/thick. (ft) – Name of aquifer. BM is Black Mingo Fm., BC is Black Creek Fm., M is Middendorf Fm. Thickness is given when it is apparent on electric log.
Static WL (ft) – Nonpumping water level.
Q (gpm) – Pumping rate, in gallons per minute, for test.
Trans. (gpd/ft) – Transmissivity, in gallons per day per foot of aquifer width. Divide by 7.48 to obtain units of cubic feet per day per foot.
Sp. cap. (gpm/ft) – Specific capacity in gallons per minute produced for each foot of water-level drawdown.
Well effic. (percent) – Well efficiency, the specific capacity achieved compared with what it should be for the indicated transmissivity.



ASSUMED CONDITIONS

- Pumping rate: 200 gpm. Transmissivity as indicated. Storage coefficient: 0.0002 (artesian)
- For other pumping rates, the drawdown will vary in direct proportion. For example, doubling the pumping rate will double the drawdown at a given distance and time.
- Transmissivity is given here in gallons per day per foot of aquifer width. To convert to cubic feet per day per foot (ft^2/d), divide by 7.48.

Figure 9a. Predicted pumping effects, at various times and distances, for the aquifers of Clarendon County, S.C.



ASSUMED CONDITIONS

- Pumping rate: 500 gpm. Transmissivity as indicated. Storage coefficient: 0.0002 (artesian)
- For other pumping rates, the drawdown will vary in direct proportion. For example, doubling the pumping rate will double the drawdown at a given distance and time.
- Transmissivity is given here in gallons per day per foot of aquifer width. To convert to cubic feet per day per foot (ft^2/d), divide by 7.48.

Figure 9b. Predicted pumping effects, at various times and distances, for the aquifers of Clarendon County, S.C.

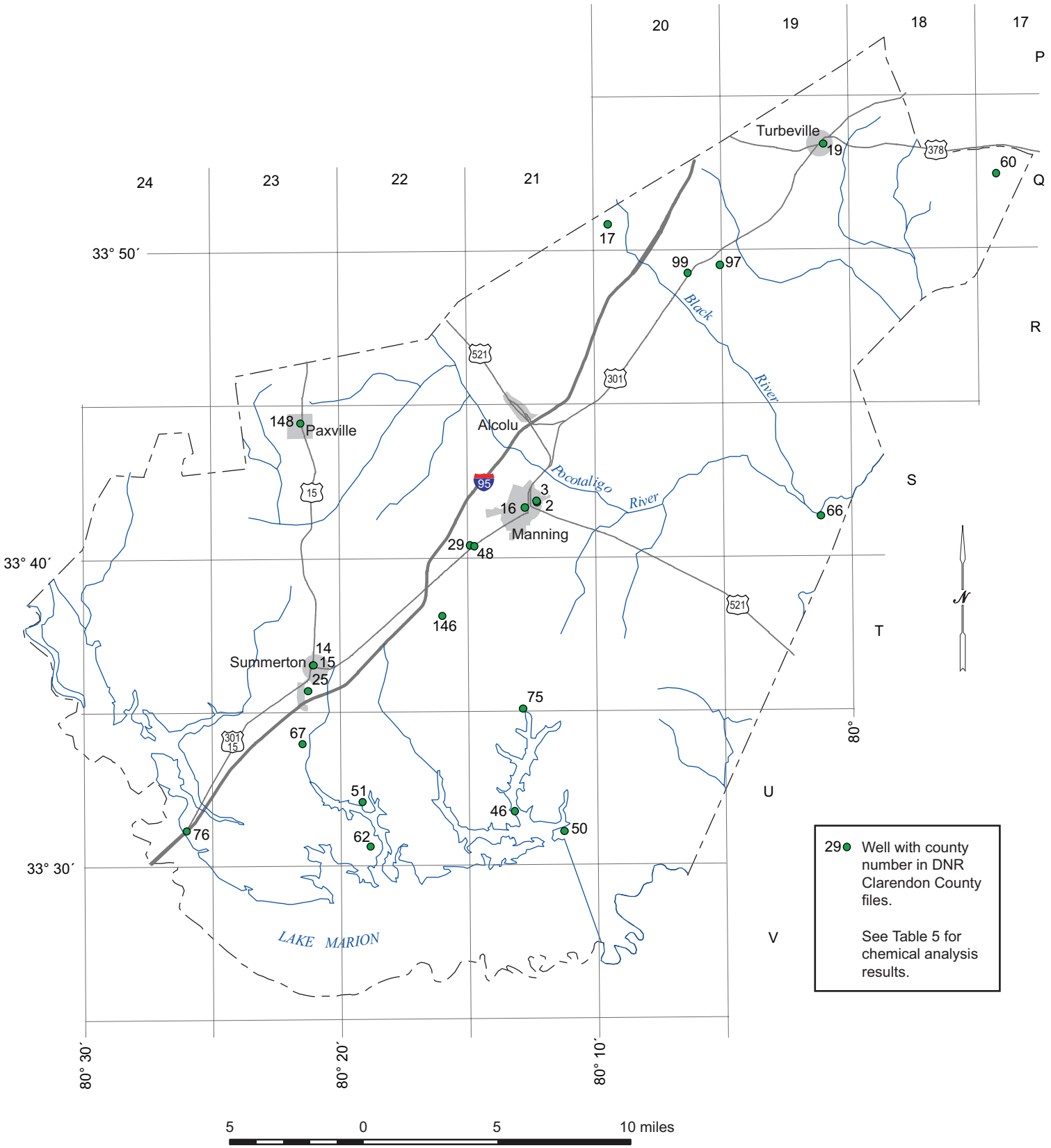


Figure 10. Locations of wells for which chemical analyses appear in Table 5.

Table 5. Chemical analyses of water from wells in Clarendon County, S.C. (constituents and hardness are in milligrams per liter)

County well no.	S.C. grid no.	Date	Depth (ft)	Aquifer	Silica	Iron	Manganese	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Sulfate	Chloride	Fluoride	Nitrate	Dissolved solids	Hardness	pH	Analyst
CLA-2	21S-r1	1/1955	480	M	27	0.00	-	4.6	1.1	38	3.6	95	8.6	8.0	0.5	2.1	138	16	7.3	U
CLA-3	21S-r2	1/1955	600	M	11	.00	-	2.6	.6	33	2.0	83	8.1	2.8	.4	.5	102	9	7.5	U
CLA-14	23T-s2	10/1956	625	BC	12	.01	-	3	.2	54	2.2	137	8.5	4.0	.6	.2	147	9	-	U
CLA-15	23T-s1	10/1956	675	M	12	.01	-	3.7	.2	52	1.9	135	7.0	1.5	.6	.5	144	10	7.5	U
CLA-16	21S-r3	1/1955	610	M	13	.08	-	2.3	.5	30	2.0	76	3.0	2.2	.3	.9	97	8	7.6	U
CLA-17	20Q-y2	9/1957	350	BC	36	.20	-	12	3.5	4.6	10	68	5.1	3.0	.1	.5	107	44	7.1	U
CLA-19	19Q-i2	3/1959	352	BC	34	< .12	-	7.2	.5	20	4.8	73	6.0	.7	.2	.2	108	20	7.9	U
CLA-25	23T-v1	7/1970	750	M	-	.02	0.0	2.8	.0	(43)		156	1.0	4	-	-	160	7	8.9	C
CLA-29	21S-y1	11/1974	717	M	-	.01	.0	4	.5	(50)		120	11	5	.5	-	132	12	8.5	C
CLA-46	21U-q1	5/1977	212	PD	10	4.00	.03	11	5.8	-	-	61	5	7	.2	-	-	-	7.6	C
CLA-48	21S-y2	1/1982	110	BM	-	.31	-	35	1.0	4.6	1.9	128	5.0	6.0	1.2	< .1	120	92	7.5	C
CLA-50	21U-s1	1/1980	140	PD	-	< .02	< .01	2.6	1.7	6.9	2.9	31	< 5.0	5.0	.25	.7	40	13	6.1	C
CLA-51	22U-o1	2/1983	315	BC	-	.20	.65	-	-	-	-	-	-	0	-	-	-	21	5.2	C
CLA-60	17Q-o1	7/1986	470	BC	-	< .02	< .01	.2	.1	27	1.8	57	8.0	1.1	.11	< .01	70	1	7.1	C
CLA-62	22U-x1	12/1995	320	BC	-	< .05	< .02	16	1.4	47	6.3	192	4.0	3.2	< .20	< .02	156	45	8.8	C
CLA-66	19S-s1	6/1997	500	BC	-	< .05	< .02	1.8	.2	49		140	5.7	2.1	.73	< .5	140	4	9.1	C
CLA-67	23U-i1	9/1997	23	BM	10	.00	.00	2.6	2.9	17	2.9	188	.5	19	.10	9.0	101	18	4.1	U
CLA-75	21T-w2	4/2001	210	BC	-	< .04	< .01	36	8.8	14	-	185	2.4	4.2	.21	< .5	165	126	6.9	C
CLA-76	24U-s1	6/2003	275	BC	-	.65	.03	-	-	12	-	76	-	2.3	.33	< .5	93	-	6.9	C
CLA-97	20R-a1	5/2000	248	BC	-	< .04	< .01	-	-	-	-	-	-	-	-	< .5	-	-	-	C
CLA-99	20R-b2	9/2000	280	BC	-	< .04	< .01	-	-	-	-	-	-	-	-	< .5	-	-	-	C
CLA-146	22T-i1	2/2005	750	M	-	.00	.00	5.5	.3	60	1.8	168	9.1	2.3	.96	< .05	165	15	8.9	C
CLA-148	23S-b2	6/2005	242	BC	-	1.5	.03	-	-	-	-	-	-	-	-	< .5	-	-	-	C

Note: Where bicarbonate, dissolved solids, or hardness was not reported, it was calculated if the available data permitted.
Aquifer: BM, Black Mingo; PD, Peedee; BC, Black Creek; M, Middendorf
Analyst: C, commercial; U, U.S. Geological Survey

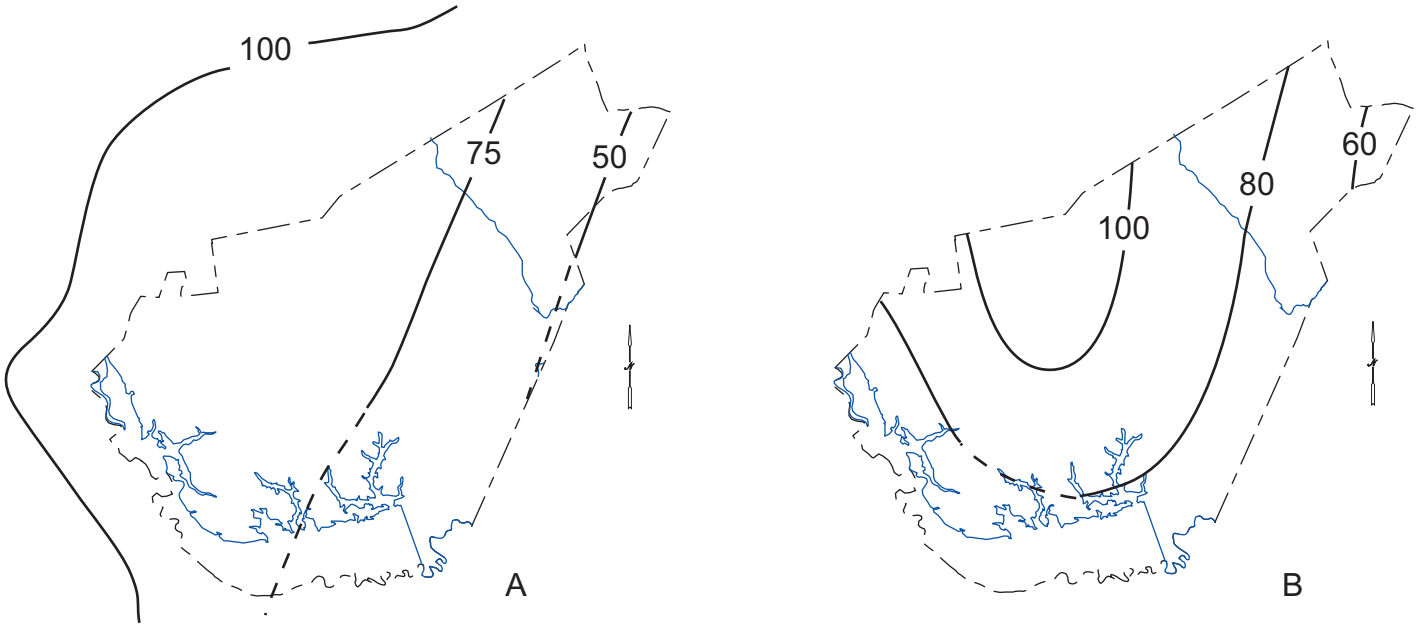


Figure 11. Potentiometric levels, in feet above sea level, of ground water in the Middendorf Formation (A) and Black Creek Formation (B) in Clarendon County (from Hockensmith, 2003).

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