POTENTIOMETRIC SURFACE OF THE BLACK CREEK AQUIFER IN SOUTH CAROLINA – NOVEMBER 1995

by

Brenda L. Hockensmith

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
WATER RESOURCES REPORT 16
1997

ABSTRACT

The potentiometric surface of the Black Creek aquifer for November 1995 shows that ground water flows generally to the southeast in most of the Coastal Plain of South Carolina. Flow is locally affected by pumping, as indicated by potentiometric lows at Marion, Johnsonville, Andrews, and coastal Georgetown County.

Comparing the November 1995 data with historical data shows that water levels near the outcrop areas of this aquifer are stable. In areas influenced by pumping, water levels have declined 50 to 175 feet (or even more) since the beginning of ground-water supply development.

INTRODUCTION

The Black Creek aquifer (as defined by Aucott, Davis, and Speiran, 1987) is an important source of water for public, industrial, and agricultural supplies in much of the Coastal Plain of South Carolina. The potentiometric (artesian-pressure) surface of an aquifer is defined by the levels at which the water stands in tightly cased wells completed in the aquifer. This map of the potentiometric surface of the aquifer was prepared by the South Carolina Department of Natural Resources, Water Resources Division (SCDNR-WRD), using data collected during November 1995. Historical trends in the ground-water levels are shown by hydrographs of selected wells.

METHOD OF INVESTIGATION

The boundaries of the Black Creek aquifer used for this investigation are those defined by Aucott, Davis, and Speiran (1987), who delineated the aquifer on the basis of geologic data (primarily geophysical well logs), water-level data, water-chemistry data, and previous investigations. They acknowledged that the complex deposition of sediments in the Coastal Plain makes aquifer delineation somewhat subjective. This aquifer has been studied extensively by Aucott and Speiran (1985a, and 1985b), Colquhoun and others (1983), Cooke (1936), Renken (1984), Siple (1957), and Stringfield and Campbell (1993).

The potentiometric map presented here was constructed from water levels collected in 82 wells during November 1995 (Table). The wells used by Stringfield and Campbell (1993) and Aucott and Speiran (1985a) were used, where possible, to facilitate comparison of the potentiometric maps of this aquifer made in 1982, 1989, and 1995. Data from additional wells, where available, were also used. For many of the wells, water-level elevations were calculated from surveyed wellheads.

The hydrographs were constructed from data collected by SCDNR-WRD and U.S. Geological Survey personnel. Where continuous records are available, monthly low water levels were plotted.

GEOHYDROLOGIC FRAMEWORK

The Coastal Plain formations compose a wedge of sediments that thickens from 0 at the Fall Line to more than 4,000 ft (feet) at the coastline. These sediments consist of sand, clay, and limestone of late Cretaceous and younger ages that have been deposited on a pre-Cretaceous basement of metamorphic, igneous, and consolidated sedimentary rocks.

The Black Creek aquifer is the youngest of the Cretaceous aquifers in the region. The aquifer is composed mostly of permeable sediments of the Black Creek Formation (hence its name), but locally it may include sediments from underlying or overlying formations. The aquifer comprises thin- to thick-bedded sand and clay beds that were deposited in marginal marine or delta plain environments. The coarsest sand and least clay content are found in the western part of the Coastal Plain.

The aquifer crops out in the eastern Coastal Plain along a narrow band extending from Lexington County to Sumter County, then along a wider area from Sumter County to Dillon County. It dips southeastward toward the coast. The top of the aquifer is at elevation 300, -250, and -1,000 ft msl (ft, referenced to mean sea level) at Aiken, Little River, and Charleston, respectively. Thickness ranges from about 100 ft near Aiken to more than 400 ft at the coast.

GROUND-WATER FLOW SYSTEM

The potentiometric surface of the Black Creek aquifer dips generally southeastward and defines regional ground-water flow in this aquifer. Near Aiken, water levels are the highest, exceeding 260 ft msl. In areas where the aquifer crops out, it is recharged mostly by precipitation. In the upper part of the Coastal Plain where stream valleys have become incised into the aquifer, it is drained by those streams. This is shown by the curving of contour lines upstream near the Savannah and Congaree Rivers. In the lower part of the Coastal Plain, the aquifer discharges into adjacent aquifers or through pumping wells.

Superposed on this surface are potentiometric lows resulting from ground-water withdrawals. Areas where the potentiometric surface is affected by pumping include coastal Georgetown and Horry Counties and northern Marion County. Cones of depression also have formed near Andrews in western Georgetown County and Johnsonville in Florence County. Andrews has the lowest point of the potentiometric map, with a water level more than 180 ft below mean sea level.

HISTORICAL TRENDS

Fluctuations in the potentiometric surface of the Black Creek aquifer have been observed since 1917. Aucott and Speiran (1985b) estimated the potentiometric level prior to development. They later compared their predevelopment surface map with that of November 1982 and found declines in Horry and Georgetown Counties (Aucott and Speiran, 1985a). Stringfield and Campbell (1993) observed declines between November 1982 and November 1989 at Marion and in northeastern Williamsburg County, in addition to the continued declines in Horry and Georgetown Counties.

The November 1995 data indicate little change in the potentiometric surface near the outcrop area in recent years. A comparison of 1995 data with the predevelopment potentiometric surface of Aucott and Speiran (1985b) indicates that little change has occurred in water levels along the Aiken-Barnwell County line. In AIK-825, water levels were noted to be 241 ft msl in November 1989 (Stringfield and Campbell, 1993) and in November 1995. More recently, no change in water level was noted in AIK-888 and levels rose about 2 ft and 7 ft in AIK-846 between April 1992 (Aadland, Gellici, and Thayer, 1995) and November 1995.

In northwestern Florence County, water levels remain relatively unchanged compared to 1989 (Stringfield and Campbell, 1993) and 1992 (Rodriguez, Newcome, and Wachob, 1994). Water levels reported by Aucott and Speiran (1985b) in the Florence area prior to development ranged from 106 to 120 ft msl. Data for FLO-99 are within this range and show a decline of 7 ft for the period of record (Hydrograph). There is also a seasonal fluctuation in the water levels, with the highs generally occurring in April. Seasonal low water levels are more variable and may occur as early as July and as late as December.

Water-levels for CAL-2 (Hydrograph) are within the 125 to 150 ft msl range estimated for predevelopment water levels in this area (Aucott and Speiran, 1985b), and they seem to be remaining near predevelopment levels. In eastern Allendale County, however, water levels (ALL-22) have declined more than 65 ft from the predevelopment levels and 30 ft since November 1989.

In southern Marion County, water levels are declining, according to the hydrograph for MRN-77. Predevelopment levels near the well were estimated to be higher than 45 ft msl (Aucott and Speiran, 1985b). Total decline has been more than 48 ft. Since October 1992, the average rate of decline has been about 2 ft/yr (ft per year). According to Rodriguez, Newcome and Wachob (1994), water levels are declining as a result of pumping at Johnsonville, 7 miles southwest of MRN-77. At Johnsonville, water levels were higher than 50 ft msl in 1955 (Aucott and Speiran, 1985b), but by November 1995 water levels had declined more than 85 ft to -35 ft msl.

Along the coast, the potentiometric low has shifted southwestward from Myrtle Beach to Pawleys Island. This is illustrated by the hydrographs of wells HOR-290 and GEO-84. Predevelopment water levels in Myrtle Beach wells were higher than 34 ft msl (Aucott and Speiran, 1985b). In HOR-290, the lowest recorded water level of -151.6 ft msl was noted in July 1988, for a cumulative decline of more than 188 ft. Average rates of decline in the Myrtle Beach area were estimated to be more than 9 ft/yr from 1975 to 1982 (Pelletier, 1985). From November 1973 to July 1988, the water level declined at a rate of more than 8 ft/yr in HOR-290. Since 1988 and 1991, when the public water suppliers in Horry County discontinued the use of Black Creek aquifer wells, potentiometric levels have recovered nearly 87 ft to -64.8 ft msl by November 1995, for an average recovery rate of about 12 ft/yr. Near Pawleys Island (GEO-84), however, the water level has declined by 124 ft from -10 ft msl in 1977 to -134 ft msl in November 1995. This is an average decline of nearly 7 ft/yr. Since December 1991, the rate of decline has been about 12 ft/yr. Assuming that Pawleys Island had the same predevelopment level as Murrells Inlet (40 ft msl at GEO-2 (Aucott and Speiran, 1985b), the total water level decline at Pawleys Island may exceed 174 ft.

A cone of depression is centered at Andrews, in western Georgetown County. The hydrograph of GEO-193, at Andrews, shows a decline for the period of record. The water level prior to development was above 50 ft msl (Aucott and Speiran, 1985b), but by November 1989 it had declined to -134 ft msl, and by November 1995 to -198 ft msl. This is a total decline of more than 248 ft, at an average rate of nearly 11 ft/yr between 1989 and 1995.

The potentiometric surface in northern Marion County appears to have recovered in recent years. From an elevation of 35 ft msl in 1982, the water level in MRN-9 declined to -45 ft msl in 1989 and then recovered to -32 ft msl in 1995. The cone of depression indicated by this well in 1995 is not documented on the 1992 potentiometric map by Rodriguez and others (1994). Because historical data are sparse, this trend is not conclusive.

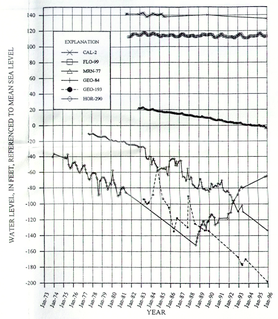
Data from COL-30 during November 1995 indicate a water-level elevation of 50.9 ft msl for the Black Creek aquifer at Walterboro. Previous investigations indicated that the direction of ground-water flow was eastward through Colleton County (Aucott and Speiran, 1985a, and 1985b). The November 1995 data suggest that ground-water flow is toward the southeast in northwestern Colleton County.

The potentiometric surface in Sumter County is believed to be depressed as a result of ground-water pumping in and around Sumter. Average ground-water pumpage in 1994 exceeded 12 million gallons per day for the city of Sumter and Shaw Air Force Base, located approximately 7 miles northwest of Sumter (Newcome, 1995). Since the portion of this water withdrawn from the Black Creek aquifer is not known and water-level data are sparse, the potentiometric contours have been approximated in Sumter County.

SUMMARY AND CONCLUSIONS

The potentiometric map of the Black Creek aquifer, constructed by using water-level data from 82 wells during November 1995, shows that ground water flows generally southeastward in most of the Coastal Plain of South Carolina. Potentiometric lows at Andrews, Johnsonville, Marion, and coastal Georgetown County indicate that ground-water flow is locally affected by pumping.

Historical data show that water levels are stable near the aquifer's outcrop area; however, fluctuations have occurred in areas influenced by pumping. The greatest decline in water level has occurred at Andrews, where it has dropped more than 248 ft from the predevelopment level. Water-level declines also have been recorded for Johnsonville and Pawleys Island. Following a decline of more than 188 ft at Myrtle Beach, water levels have recovered nearly 87 ft as a result of public water suppliers discontinuing the use of wells in favor of a surface-water source.



Hydrographs of wells HOR-290, MRN-77, GEO-84, GEO-193, FLO-99 and CAL-2

REFERENCES

Aadland, R.K., Gellici, J.A., and Thayer, P.A., 1995, Hydrogeologic framework of west-central South Carolina: South Carolina Department of Natural Resources, Water Resources Division Report 5.

Aucott, W.R., Davis, M.E., and Speiran, G.K., 1987, Geohydrologic framework of the Coastal Plain aquifers of South Carolina: U.S. Geological Survey Water-Resources Investigations Report 85-4271, 7 sheets.

Aucott, W.R., and Speiran, G.K., 1985a, Potentiometric surfaces of November 1982 and declines in the potentiometric surfaces between the period prior to development and November 1982 for the Coastal Plain aquifers of South Carolina: U.S. Geological Survey Water-Resources Investigations Report 84-4215, 7 sheets.

Aucott, W.R., and Speiran, G.K., 1985b, Potentiometric surfaces of the Coastal Plain aquifers of South Carolina prior to development: U.S. Geological Survey Water-Resources Investigations Report 84-4208, 5 sheets.

Aucott, W.R., and Speiran, G.K., 1984, Water-level measurements for the Coastal Plain aquifers of South Carolina prior to development: U.S. Geological Survey Open-File Report 84-803, 36 p, 1 sheet.

Colquhoun, D.J., Woollen, I.D., VanNieuwenhuise, D.S., Padgett, G.G., Oldham, R.W., Boylan, D.C., Bishop, J.W., and Howell, P.D., 1983, Surface and subsurface stratigraphy, structure and aquifers of the South Carolina Coastal Plain; Columbia, S.C., University of South Carolina, Department of Geology, 78 p.

Cooke, C.W., 1936, Geology of the Coastal Plain of South Carolina: U.S. Geological Survey Bulletin 867, 196 p.

Newcome, Roy, Jr., The 100 largest public water supplies in South Carolina: South Carolina Department of Natural Resources, Water Resources Division Report 3, 42 p.

Pelletier, A.M., 1985, Ground-water conditions and water-supply alternatives in the Waccamaw Capacity Use Area, South Carolina: South Carolina Water Resources Commission Report No. 144, 32 p.

Renken, R.A., 1984, The hydrologic framework for the sand aquifer of the Southeastern United States Coastal Plain: U.S. Geological Survey Water-Resources Investigations Report 84-4243, 30 p., 8 sheets.

Rodriguez, J.A., Newcome, Roy, Jr., and Wachob, Andrew, 1994, Ground-water resources of Darlington, Florence, Marion, and Marlboro counties, South Carolina: South Carolina Department of Natural Resources, Water Resources Division Report 1, 119 p.

Siple, G.E., 1957, Ground water in the South Carolina Coastal Plain: Journal of the American Water Works Assoc., v. 49, no. 3, p. 283-300.

Stringfield, W.J., and Campbell, B.G., 1993, Potentiometric surfaces of November 1989 and declines in the potentiometric surfaces between November 1982 and November 1989 for the Black Creek and Middendorf aquifers in South Carolina: U.S. Geological Survey Water-Resources Investigations Report 92-4000, 2 sheets.

State of South Carolina
The Honorable David M. Beasley, Governor

South Carolina Department of Natural Resources
Board Members

George G. Graham, D.D.S., Chairman	4th Congressional District
Thomas W. Miller, Vice Chairman	3rd Congressional District
Marion Burnside	Member-at-Large
Mary Pope M.H. Waring	1st Congressional District
Edward C. Lee	2nd Congressional District
Campbell D. Coxe	5th Congressional District
Edwin L. Oxner	6th Congressional District

Paul A. Sandifer, Ph.D., Director

Alfred H. Vang, Deputy Director, Water Resources

Hank Stallworth, Assistant Deputy Director

Rodney N. Cherry, Chief, Hydrology Section

Water-level elevations in wells completed in the Black Creek aquifer in South Carolina, November 1995

Well number	Grid number	Latitude, in degrees, minutes, and seconds	Longitude, in degrees, minutes, and seconds	Water level elevation above or below (-) mean sea level, in feet
AIK-825	40V-e6	332616	814614	241.1
AIK-846	36U-o3	332233	812908	276.7
AIK-459	38W-e2	332238	813827	225.9
AIK-863	40V-k6	331252	814532	151.0
AIK-888	39X-e64	331712	814319	172.6
AIK-893	39W-w4	332016	814231	208.7
AIK-898	39X-k36	331730	814028	176.0
AIK-2379	40W-q3	332109	814836	167.5
ALL-22	34B-k1	332500	814634	109
ALL-369	37Z-x10	330647	813021	163.0
ALL-376	35AA-q9	330130	812303	154.3
BAM-7	31X-m3	331742	810215	>90
BRN-324	34X-t3	331838	813622	192.0
BRN-328	37Y-o5	331209	813441	177.6
BRN-331	34Y-m4	331246	813727	176.1
BRN-353	34Y-s7	331044	811855	173.2
BRN-365	35X-e3	330915	812428	210.7
BRN-375	37X-p5	331630	813425	193.0
BRN-377	39Y-a2	331057	814043	166.1
BRN-389	37W-a8	331040	813001	217.9
BRN-393	38Y-b5	331445	813658	181.7
BRN-402	38Z-i18	331844	813626	168.9
BRN-406	37W-e3	331128	813048	177.6
BRN-418	37Y-f9	331346	813431	183.1
BRN-424	38Y-s11	331239	813927	172.2
BRN-431	34X-n59	331709	813806	182.4
BRN-437	39X-u8	331511	814021	173.7
BRW-1862*	2Q-j3	333134	785501	6.3
BRW-1863*	2Q-q6	333135	785502	4.6
BRW-1864*	2Q-j5	333133	785522	-7.8
CAL-2	27U-q2	331323	804304	135
CHN-182	12Y-t1	332103	792608	-7
CLA-32	22T-b1	331906	803649	111
CLA-36	23U-d1	331452	802340	108
COL-30	27CC-j1	325347	804042	50.9
DAR-118	15L-o3	341717	794449	108
DAR-98	19M-y2	341010	800402	160
DIL-28	10L-a1	341946	791553	67
FLO-99	15M-o2	341200	794441	113
FLO-114	16P-x1	335606	795601	73
FLO-148	12R-b3	334452	792640	-35
FLO-188	15O-e3	335500	794444	25
FLO-207	16Q-m2	335110	794720	47
FLO-276	16Q-q2	335122	794600	21
GEO-32	11D-t1	331242	792118	-56
GEO-37	14X-f1	331903	793949	-14
GEO-77	10W-c1	322415	791735	-85
GEO-80	7U-q2	331158	790322	-80.3
GEO-84	9W-t1	332009	791035	-134
GEO-85	10V-r2	331830	791643	-58
GEO-87	8V-j1	332046	790557	-74.3
GEO-131	7U-i3	331346	780145	-75.8
GEO-188	12W-r1	332143	792742	-18
GEO-193	13V-o2	332729	793451	-198
GEO-233	11Y-e3	331459	792332	-42
GEO-249	9T-e1	331943	791448	-33
HOR-1	7Q-x2	331058	790327	-23.1
HOR-225	9P-c2	331955	791208	9
HOR-247	6T-a1	331940	785507	-63
HOR-269	3R-n4	331747	784357	-53
HOR-290	6S-v2	331014	785623	-63.8
HOR-309	6R-q3	331607	785805	-44.7
HOR-319	7S-t1	332139	790123	-46.7
HOR-324	8S-c1	331410	790714	-35.2
HOR-339	4R-i1	331705	784605	-37.8
HOR-346	3Q-r1	331102	784218	-19.5
HOR-485	5O-g2	330327	785329	-18
HOR-673	7T-h2	331823	790221	-59
HOR-938	4R-q1	331610	784824	-45.4
HOR-976	3P-n1	331708	784410	-9
HOR-977	7N-j2	330824	790048	52
MRN-9	11M-p2	330957	792430	-32
MRN-77	10Q-p1	331543	791950	-3
ORG-256	31T-c2	330633	810025	217
ORG-385	31W-i6	332208	810151	170
RIC-318	27R-c2	330949	804217	112
SUM-206	20Q-g1	333350	800856	106
SUM-286	25S-i1	332238	802215	85
WIL-11	16S-y1	330956	794945	21
WIL-64	18U-e4	331431	795926	64
WIL-76	13S-i2	331430	793038	-8
WIL-124	13S-f1	331320	793423	-19

* Wells are located in North Carolina