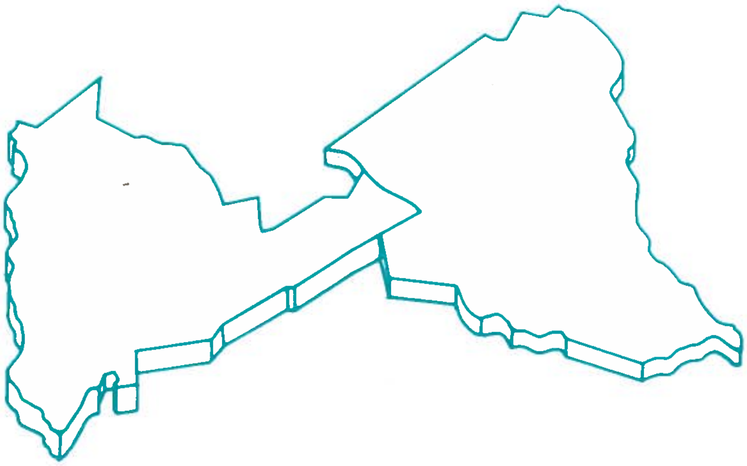
THE GROUND-WATER RESOURCES
OF
SUMTER AND FLORENCE COUNTIES
SOUTH CAROLINA



by

A. Drennan Park

SOUTH CAROLINA WATER RESOURCES COMMISSION

REPORT NUMBER 133

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Prepared by
South Carolina Water Resources Commission

in cooperation with
U.S. Geological Survey
and
City of Sumter, South Carolina

South Carolina Water Resources Commission
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CONVERSION FACTORS

English Units	Multiply by	Metric Units
ft (feet	3.048×10^{-1}	m (meters)
ft/d (feet per day)	3.048×10^{-1}	m/day (meters per day)
ft/s (feet per second)	3.048×10^{-1}	m/s (meters per second)
ft^3/s (cubic feet per second)	2.832×10^{-2}	m^3 (cubic meters per second)
ft^2/d (square feet per day)	9.290×10^{-2}	m^2/day (square meters per day)
gal (gallons)	3.785	L (liters)
gpm (gallons per minute)	6.309×10^{-2}	L/s (liters per second)
gpm/ft (gallons per minute per foot)	2.070×10^{-1}	(L/s)/m (liters per second per meter)
gpm/in^2 (gallons per minute per square inch)	$9.778 \times 10^{+1}$	(L/s)/m^2 (liters per second per square meter)
in (inches)	2.540	cm (centimeters)
in (inches)	2.540×10^{-1}	mm (millimeters)
in^2 (square inches)	6.452×10^{-4}	m^2 (square meters)
mi (miles)	1.609	km (kilometers)
Mgd (million gallons per day)	4.381×10^{-2}	m^3/s (cubic meters per second)

Temperature Conversion

°F (degrees Fahrenheit)	5/9 (°F-32)	°C (degrees Celsius)

Hydraulic Conversion

Transmissivity ft^2/d	7.48	Transmissibility gpd/ft
Hydraulic conductivity ft/d	7.48	Permeability gpd/ft^2

ABSTRACT

An abundant supply of good quality ground water exists in Sumter and Florence Counties. Water users in the two counties are greatly dependent on this ground water, and both counties rank among the highest in the state in terms of total ground-water use. Ground water currently supplies 100 percent of the drinking water needs of public and rural-domestic water users. More than 30 Mgd (million gallons per day) of ground water are withdrawn for public supplies and rural-domestic, industrial, and agricultural use. Approximately 25 Mgd are withdrawn from surface-water sources.

The sources of ground-water supply are the Tuscaloosa, Black Creek, Peedee, and shallow aquifer systems. Artesian aquifers within the Tuscaloosa and Black Creek aquifer systems provide almost half of the ground water withdrawn. These aquifers underlie the entire study area, and 10- and 12-inch diameter wells commonly yield from 500 to 2000 gpm (gallons per minute) per well. The hydraulic conductivities of Tuscaloosa and Black Creek aquifers range from 19 to 93 ft/day and generally increase from east to west.

The shallow and Peedee aquifer systems supply sufficient quantities of water for domestic and light industrial use. Individual wells tapping shallow aquifers in central and northern Sumter County yield up to 250 gpm, and are capable of supplying large quantities of ground water for industrial and municipal use.

The chemical quality of ground water is generally good. Total dissolved solids concentrations in the principal aquifers of Sumter County are commonly less than 100 mg/L, and in Florence County are commonly less than 200 mg/L. Chloride and sulfate concentrations are less than 50 mg/L.

High iron concentrations and corrosive ground water are problems for some water users in the study area. The maximum iron concentration recommended by the South Carolina Department of Health and Environmental Control is 0.3 mg/L, whereas ground water may locally contain more than 5.0 mg/L. In addition, the corrosive effect of high carbon dioxide concentrations and low pH results in abnormally short service life for some large-capacity wells. Shallow aquifers have been locally contaminated by nickel, nitrates, and petroleum products; and excessive application of fertilizers may be having a regional impact on shallow aquifers in the Florence area.

INTRODUCTION

BACKGROUND

In Sumter and Florence Counties, South Carolina (fig. 1), water for all public and domestic use and most industrial and agricultural use is supplied by ground water. Ground-water use in the two counties is among the highest in the state, and average daily municipal ground-water use by the cities of Sumter and Florence are, respectively, the largest and second largest in the state. The use of water is increasing constantly with the growth of towns and cities, the influx of industry, and the utilization of large-scale irrigation. Consequently, the dependence upon ground water becomes steadily greater.

This report is the result of a preliminary investigation of the ground-water resources of Sumter and Florence Counties. At the request of officials of the City of Sumter and the Santee-Wateree Regional Planning Council, a reconnaissance of current data was made to summarize the availability and quality of ground water and to make recommendations concerning future ground-water studies. Most of the information in this report was obtained from the files of the U. S. Geological Survey (USGS), and the South Carolina Water Resources Commission (SCWRC). Additional information was supplied by the South Carolina Department of Health and Environmental Control (SCDHEC), and various municipalities, consulting engineers, and well-drilling firms.

The investigation was completed as part of the County and Local Ground-Water Studies Program of the SCWRC. Most ground-water studies made by the SCWRC under this program are undertaken in cooperation with the USGS. The goal of the SCWRC is to complete reconnaissance-level ground-water studies of all Coastal Plain counties by 1985. More detailed planning- or management-level studies are either underway or planned for high water-use or problem areas. The status of these ground-water studies is depicted in figure 1.

PURPOSE AND SCOPE

The purpose of this report is to provide a general assessment of the ground-water resources of Sumter and Florence Counties. Existing file data from the SCWRC and USGS, well drilling companies, and engineering firms were compiled in order to define the general hydrogeologic framework and the occurrence, distribution, and general availability of ground water.

Field work consisted of inventorying the principal public-supply and industrial wells and selected irrigation and domestic wells. Most geophysical logs were obtained as a part of the USGS-SCWRC well-logging program. Within the scope of the study, the SCWRC updated well data, located potential water-level monitoring wells, and compiled data on the general water-quality and hydraulic characteristics of the major aquifer systems. Recommendations concerning future studies and data-collection programs were an important aspect of this investigation. These recommendations were considered in planning an ongoing reconnaissance-level study of Sumter, Florence, Lee, and Darlington Counties; a study being conducted cooperatively by the SCWRC and USGS.

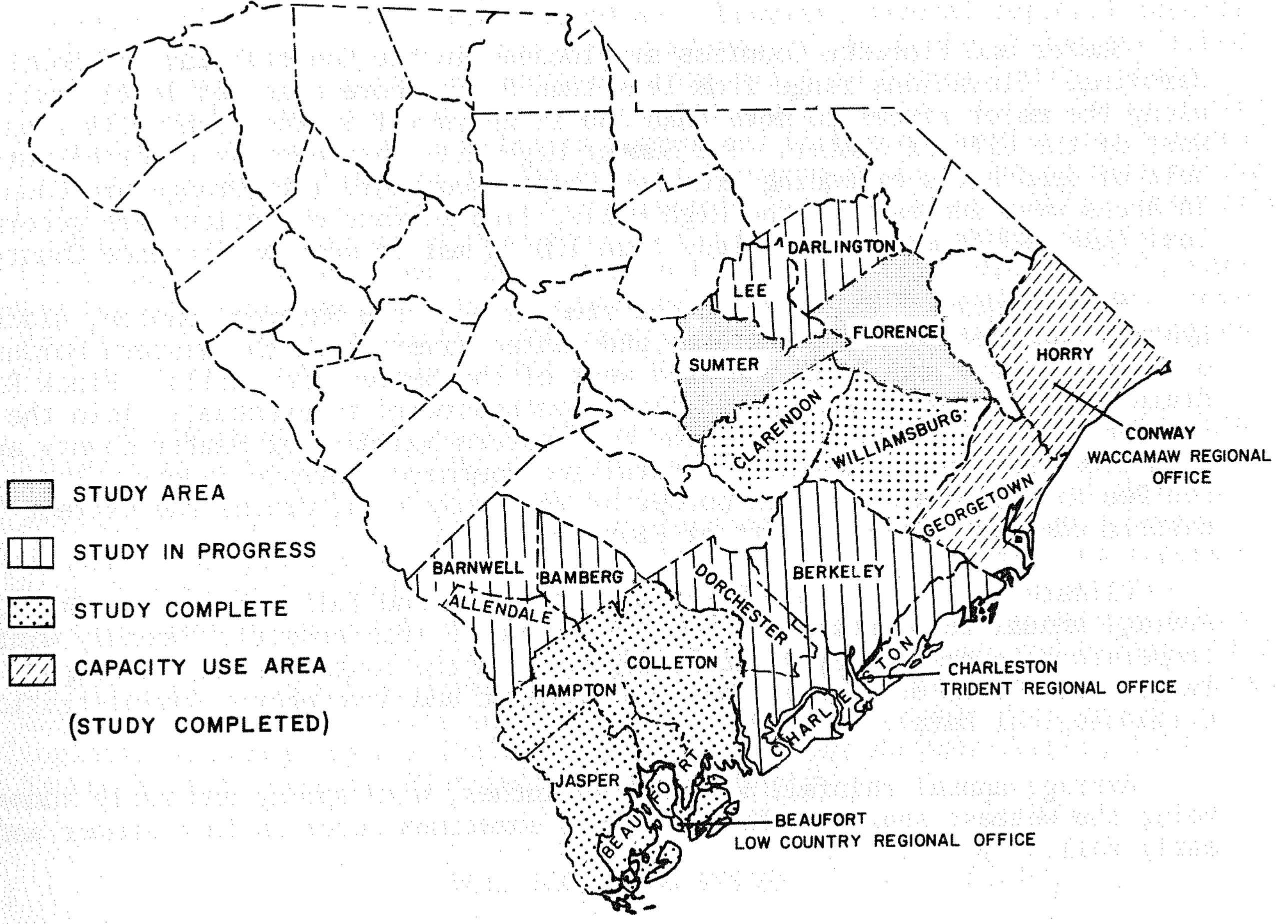

FIGURE 1. MAP OF SOUTH CAROLINA SHOWING LOCATION OF SUMTER AND FLORENCE COUNTIES, AND THE STATUS OF GROUND-WATER STUDIES IN THE COASTAL PLAIN AREA.

THE STUDY AREA

PHYSIOGRAPHY AND CLIMATE

Sumter and Florence Counties are located in the Coastal Plain of South Carolina. Elevations range from less than 80 ft above mean sea level (msl) along the major rivers to more than 350 ft above msl in the High Hills area west of the City of Sumter. The Sumter High Hills are part of a north-south belt of sand hills extending from Lee County southward into Orangeburg County. In areas west and east of the High Hills, land surface elevations are generally less than 180 ft msl and are less than 120 ft msl in much of Florence County.

Five principal rivers drain the study area: the Wateree, Santee, Black, Lynches, and Pee Dee. The Wateree and Santee Rivers mark the western border of Sumter County and drain the area west of the Sumter High Hills. Black River drains central Sumter County and flows southeastward to eventually join the Pee Dee River. Lynches River forms the eastern boundary of Sumter County and then flows southeast, draining central and southern Florence County. The Pee Dee River, on the eastern border of the study area, drains the extreme eastern edge and northern part of Florence County.

Climate is marked by mild springs, winters, and falls, and hot summers. Average annual temperature is about 65 degrees F (Fahrenheit). Monthly winter temperatures average from 48 to 55 degrees and the monthly summer average ranges from 74 to 81 degrees (National Oceanic and Atmospheric Administration, Climatological Data).

Average annual rainfall is about 48 inches, with spring and early summer being the wettest seasons. Mild droughts sometimes occur in late summer and early fall.

POPULATION AND ECONOMY

Sumter and Florence Counties are among the largest counties in the State, and had in 1977, estimated populations of 82,000 and 95,500 respectively (S. C. Division of Research and Statistical Services, 1978). The cities of Sumter and Florence have the two largest metropolitan populations in the area. A significant percentage of the population in the City of Sumter area is concentrated near Shaw Air Force Base.

Employment roughly is balanced between manufacturing and non-manufacturing activities. Major manufacturing activities are oriented toward the production of (1) furniture, fixtures, lumber and wood products, (2) food, and (3) textiles and apparel. Agriculture is an important part of the economy, and total agricultural receipts are among the highest in the state. The main agricultural products are cotton, tobacco, and soybeans (Barbour-Cooper and Associates, 1970; Santee-Wateree Regional Planning Council, 1972).

PREVIOUS INVESTIGATIONS

No previous reports have been devoted to describing the ground-water resources of Sumter and Florence Counties. However, several regional reports include data on some wells in the two counties. C. W. Cooke (1936) published data on 14 wells in Florence County and nine wells in Sumter County, which included well depths, water levels and water-quality data. G. E. Siple (1946) tabulated information on 39 wells in Sumter and Florence Counties and referred to high iron concentrations in the City of Florence wells. The results of two pumping tests for the City of Sumter were published by Siple (1957). Open-file reports on the ground-water resources in the Hagood Area, Sumter County, (G. E. Siple, written comm., 1967) and on Florence County (Siple, 1955), summarized potential well yields and included well and water-quality data. More recently, the SCWRC summarized the general geology and ground-water resources of the Pee Dee River Basin (Cannon and Spigner, 1977).

A number of consulting reports are also available. Reports to the City of Florence by Carolina Drilling and Equipment Company (1955) and Harwood Beebe (1955) included data from well logs, test holes, pumping tests, and chemical analyses. In a later report, Leggette, Brashears, and Graham (1961) briefly discussed the geology and hydrology of the City of Florence area and reported data from three test holes and a two-week pumping test. Similar reports briefly summarizing ground-water development, hydrogeology, and water-quality and well problems were written for the City of Sumter (Palmer and Malone, 1952; Legrand, 1957; Leggette, Brashears, and Graham, 1976; Nuzman, 1977). Additional well data and water-quality and water-use data are available from county and regional planning reports (Palmer and Mallard, 1968; Barbour-Cooper, 1970; Santee-Wateree Regional Planning Council, 1972).

WELL NUMBERING SYSTEM

The SCWRC well-numbering system is based on a latitudinal-longitudinal grid system. A grid is composed of five minutes of latitude and five minutes of longitude. Each five-minute grid is further divided into one-minute latitudinal-longitudinal grids. As wells are inventoried, they are assigned a four-part well number which consists of a number, a capital letter, a small letter, and a number (e.g., 16M-v1). The first number and capital letter refer to the five-minute latitude-longitude grid; the small letter refers to the one-minute latitude-longitude grid; and the last number refers to a well in the one-minute grid. The well grid system for the study area is shown in figure 4.

The USGS (District Office) uses a numbering system composed of a county prefix, and wells are numbered as they are inventoried. For example, well number SU-69 refers to the sixty-ninth well inventoried in Sumter County. The USGS number is listed in Appendix table 2, if one has been assigned.

Table 1. Summary of geologic formations and their water-bearing characteristics.

SYSTEM	SERIES	FORMATION	AQUIFER SYSTEM	LITHOLOGY	HYDROLOGIC PROPERTIES
Quaternary	Holocene and Pleistocene	Terrace Deposits /1	Shallow	Light-colored medium- to coarse-grained sands, gravels, and lenses of varicolored clays and sandy clays; locally sandy limestone. /2	Poorly known. Ground water probably occurs under water-table or semi-confined conditions. Apparently supplies sufficient water from drilled or dug wells for domestic use. Water may locally contain high iron.
Tertiary	Pliocene	Unnamed		Light-colored, fine- to coarse-grained sands interbedded with dark, sandy, calcareous marls; phosphate pebbles locally. /2	
		Duplin Formation		Light-grey, yellow, brown, and buff, fossiliferous, fine- to coarse-grained sands; and green and grey clays, marls, and soft fossiliferous limestone. Maximum thickness - 50 ft. /2 /3	Water-bearing characteristics unknown in most of study area. Confining unit in some areas. Yields sufficient good quality water for domestic uses and small public-supply systems.
	Miocene	Unnamed		Fine- to medium-grained argillaceous sands. /2	Only a few feet thick where present.
	Eocene Paleocene	Black Mingo Formation		Glauconitic fine-grained quartz sands; thin beds of grey to light-green silty clay; and beds of opaline (siliceous) claystone. /4	Hydraulic characteristics and water quality poorly defined. Sands and shelly sands may yield water for domestic purposes in some areas. Primarily a confining bed where composed of siliceous claystone.
Cretaceous	Upper Cretaceous	Peedee Formation	Peedee	Fossiliferous, calcareous, light-grey sandy clays; beds of dark-grey limestone; and beds of fine- to medium-grained sand.	Artesian aquifer. Hydraulic characteristics and water quality poorly defined. Should yield sufficient water for domestic and light industrial purposes. Aquifer system includes part of Black Creek Formation locally.
		Black Creek Formation	Black Creek	Fossiliferous, pyritic, lignitic, white to grey, fine- to medium-grained, micaceous, glauconitic, phosphatic sands; and blue-grey to black pyritic, plastic, or brittle clays.	Major artesian aquifer. Wells yield moderate to large quantities of ground water--commonly over 500 gpm/well. Dissolved solids generally low, but locally contains high iron concentrations. Often developed with Tuscaloosa aquifer system. Aquifer system includes rocks of Tuscaloosa Formation in most of Sumter County.
		Tuscaloosa Formation	Tuscaloosa	Lignitic, buff, yellow, tan, and grey, mixed fine- to coarse-grained feldspathic, micaceous sands, interbedded with grey, yellow, brown, and red kaolinitic clays, and silty to sandy clays.	Major artesian aquifer. Large diameter wells yield over 500 gpm/well. Transmissivity values range from 900 to 9,000 ft^2/d. Water often high in iron, acidic (pH=4.6-6.5), and low in dissolved solids. Aquifer system includes rocks of Black Creek Formation in southeastern part of study area.
Triassic		Unnamed Triassic Rocks	Bedrock	Red- to reddish-brown consolidated claystone, sandstone, shale, and conglomerate; occurring in a narrow Triassic basin west-southwest of Florence, S. C., and may extend to Sumter.	Occurs in subsurface only. No known wells tap bedrock in study area and hydrologic characteristics unknown. Mainly a confining unit and not a source of ground water in study area.
Paleozoic "Pre-Cretaceous"		Unnamed Crystalline Rocks		Mainly inferred as granite, gneiss, schist, phyllite.	

/1 Cook (1936) /2 S. C. Geological Survey, written communic. /3 DuBar and Howard (1964) /4 Pooser (1965)

ACKNOWLEDGEMENTS

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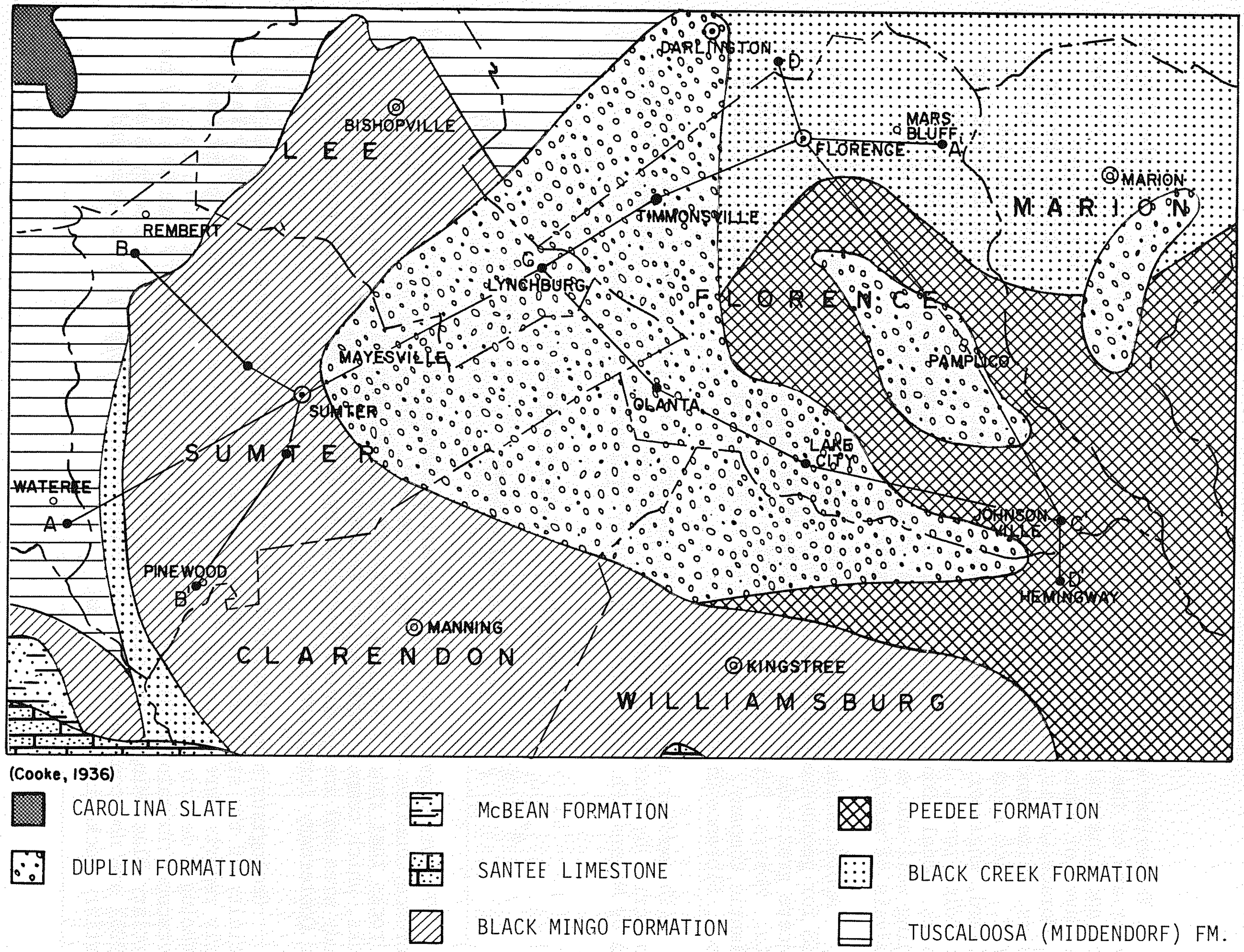
GEOLOGIC FRAMEWORK

STRATIGRAPHY

The stratigraphy and water-bearing characteristics of rocks in Sumter and Florence Counties are summarized in table 1. These two counties are underlain by rocks that range from Late Cretaceous to Holocene (fig. 2). Cretaceous rocks, which compose most of the sedimentary sequence, occur throughout the study area and are generally overlain by less than 100 feet of younger Tertiary and Quaternary formations.

Geologists have described the surface and near-surface geology in the vicinity of the study area, but the subsurface geology is still poorly known. Early reports were generally devoted to economic geology, but also included lithologic descriptions and provided the basic names now applied to the Cretaceous Tuscaloosa (Middendorf), Black Creek, and Peedee Formations and the Tertiary Black Mingo Formation. Some of the localities described by Sloan (1908) are now considered classic examples of outcropping Cretaceous and Tertiary rocks in South Carolina.



(Cooke, 1936)

FIGURE 2. GENERALIZED GEOLOGIC MAP OF SUMTER AND FLORENCE COUNTIES, AND VICINITY; AND LOCATIONS OF HYDROGEOLOGIC SECTIONS ON FIGURES 5, 6, 7, AND 8.

CRETACEOUS FORMATIONS

Tuscaloosa (Middendorf) Formation.--The geologic names, ages, and relations of Cretaceous formations in the study area have been subjects of much debate. C. W. Cooke (1926) revised the terminology and correlations of previous investigators, and included the "Middendorf" and lower beds of Sloan (1907) and the "Middendorf arkose member" of Berry (1914) in the Middendorf Formation. Cooke (1936) later considered the Middendorf and "Hamburg" beds of Sloan to be similar to the Tuscaloosa Formation of Alabama, and renamed the formation "Tuscaloosa". Dorf (1952) referred to the formation in Chesterfield County as the "Middendorf member" of the Black Creek Formation and to the underlying rocks as Lower Cretaceous (undifferentiated). Subsequently, Heron (1958) and Swift and Heron (1969) returned to the term Middendorf Formation for its occurrence in the Cape Fear area of North Carolina. The USGS has recently used the term for parts of South Carolina.

Although considerable disagreement exists, some geologists consider the Middendorf and Tuscaloosa Formations more or less geologically equivalent, and the terms are considered synonmous by the SCWRC. The term Tuscaloosa is preferred by the SCWRC because it is still commonly used by ground-water geologists and is more widely known by engineers, well-drilling contractors, and the general public.

In the study area, the Tuscaloosa Formation contains white, buff, yellow, tan, grey, fine-to coarsed-grained, feldspathic and micaceous quartz sands, with light-colored, medium-grained sands predominating. Lignitic wood fragments and mixed sand and gravel are common in many areas. Tuscaloosa clays are grey, red, brown, purple, or yellow, and may be silty or sandy; pink-clay lenses in the lower 150 to 250 ft of the formation are recorded in well logs for the area north and west of Sumter (Wells 22P-g1, 25N-q2, and 26Q-x1), but are not reported in logs of wells drilled at Sumter.

Black Creek Formation.--Ruffin (1843, p. 25) first noted black shales in Darlington and Florence Counties which were later referred to as the "Black Creek Shales" by Sloan (1907, p. 12-14) and which Sloan (1908) described as the Black Creek Formation. The term Black Creek Formation has since been used to include the Snow Hill Marl Member (Stephenson, 1923; Cooke, 1926; Dorf, 1952; Heron, 1958a, 1958b); and all or part of the Middendorf Formation as a member (Berry, 1914; Stephenson, 1914; Dorf, 1952). Swift and Heron (1969, p. 217), thought the Black Creek interfingered with the Middendorf (Tuscaloosa), a conclusion predominantly based on outcrop data. Woolen (1978) assembled both outcrop and subsurface data for northeastern South Carolina and suggested a similar contact.

The writer feels that existing subsurface data (geophysical and drilling logs) are inadequate for defining the nature of the Black Creek--Tuscaloosa (Middendorf) contact in the subsurface of Sumter and Florence Counties. However, an interfingering contact is one means of explaining the lateral change from Tuscaloosa lithology at wells near the Wateree River (26Q-x1) to Black Creek lithology in municipal wells at Sumter in the interval between 100 ft msl and -200 ft msl. If the contact interfingers, it appears that the interfingering occurs over a thickness interval of several hundred feet. This interfingering might be identified in core samples taken between the Wateree Valley and Sumter.

The lithology of the Black Creek Formation is dominated by interbedded white and grey, fine- to medium-grained sands, thin sandstone beds, and "brittle" and "plastic", grey, black, and dark-blue clays. Black Creek sediments are fossiliferous, including shells, sharks teeth, and microfauna; contain pyrite, pyrite-coated wood fragments, and marcasite; and may be phosphatic, glauconitic, and micaceous, with interbedded, finely-laminated, organic clays.

Peedee Formation.--The Peedee Formation underlies a small part of the Sumter panhandle and most of Florence County (fig. 2). Ruffin (1843, p. 7) first identified the "Peedee beds" which were later designated as the "Burches Ferry marl" at a type locality in eastern Florence County (Sloan, 1907, p. 12-14; 1908). Stephenson (1914) returned to the use of the term "Peedee". Many other geologists have also described the Peedee, particularly in relation to the underlying Black Creek Formation.

Stephenson (1912, p. 112) stated that no structural break occurs between the Black Creek and Peedee Formations, but Stephenson (1923, p. 12) and Cooke (1936) later suggested that a significant unconformity existed. The contact was described as disconformable by Swift and Heron (1969, p. 221). Further arguments concerning the relationship between the Black Creek and Peedee Formations have been published by Swift (1966, 1969), Benson (1969), and Woolen and Colquhoun (1977).

C. W. Cooke (1936, p. 34) described a Peedee outcrop southwest of Florence as: "Fine-grained light-grey sandy marl with hard ledges at the base; fine dark-grey argillaceous sandy marl at top. Shells abundant throughout; Exogyra Costata in upper part." Water-well drillers report dark, hard clays, shell-bearing sands, and one to 2-ft thick beds of "very hard white rock" (limestone) and hard "shellrock". Siple (1946, 1955, 1959) described the subsurface geology and thickness of the Peedee in Florence County and other parts of the Coastal Plain. His description of an outcrop near Effingham, Florence County, included three species of macrofauna and 14 species of foraminifera (Siple, 1959). The paleontology of the outcropping Peedee Formation in Florence County has been studied by a number of other geologists, the most recent being Van Nieuwenhuise and Kanes (1976).

POST-CRETACEOUS FORMATIONS

Post-Cretaceous formations in Sumter and Florence Counties consist of the Black Mingo and Duplin Formations, and generally discontinuous and undifferentiated rocks of Pliocene to Holocene age (table 1).

Black Mingo Formation.--The Black Mingo Formation was mapped by Cooke (1936) and was the name he applied to rocks associated with the Black Mingo "Shales" or "phase" of Sloan (1907, 1908). Cooke and MacNeil (1952) considered that the Black Mingo Formation could be of both Paleocene and Eocene age, a conclusion later confirmed by Pooser (1965). The Black Mingo Formation is composed of glauconitic quartz sands, thin layers of grey to light-green silty clay, pyritic dark-grey unctuous clays, and fuller's earth (Pooser, 1965, p. 11).

Black Mingo fuller's earth (opaline claystone) deposits are mined in southern Sumter County and have been described by Sloan (1908), Cooke (1936), Heron, Robinson, and Johnson (1965) and Heron (1969).

Duplin Formation.--Duplin Formation is the name proposed by Siple (1959, p. 10) and Pooser (1965, p. 22) to replace the term "Duplin Marl", which was introduced into South Carolina by Cooke (1936). The classic locality for the Duplin Formation in South Carolina lies in eastern Sumter County and has been described by Sloan (1908), Cooke (1936), Siple (1959), and Dubar and Howard (1964). The formation underlies a large part of the study area and consists mainly of light-colored quartz sands and thin layers of greenish and grey, arenaceous clays. Extensive fossil assemblages occur within the formation and have been cataloged at sites in Sumter County by Gardner and Aldrich (1919), Dubar and Howard (1964), Campbell (1974), and Campbell and others (1975).

Shallow Formations.--With the exception of the Duplin Formation (Early Pliocene), shallow Miocene to Holocene formations are only generally defined and delineated. Auger-hole logs of the South Carolina Geological Survey (SCGS) indicate that unnamed Miocene rocks occur at some locations; however, these rocks were probably thought to be the same age as the Duplin Formation, which has since been considered to be of Pliocene age. Some of these Pliocene rocks have been referred to as "Lake View Formation" and as Bear's Bluff, Waccamaw, and Dovesville equivalents, (SCGS, written communication), but the names have not been formally used.

C. W. Cooke (1936) reported Pleistocene rocks occurring as terrace deposits that cover much of the study area. He described the deposits at more than a dozen sites in Sumter and Florence Counties, assigning them to the Brandywine, Coharie, Sunderland, and Wicomico Formations.

Doering (1960, p. 189) included the Brandywine and Coharie Formations as part of the Citronelle Formation. However, his regional geologic map does not indicate that extensive Citronelle deposits are present in Sumter and Florence Counties.

If present, Citronelle deposits occur above elevations of 170 ft msl and extend from the west toward the eastern slope of the Sumter High Hills. This slope is part of the Citronelle Escarpment ("Orangeburg Scarp" in Colquhoun, 1962). The Sunderland Formation, composed of coalesced alluvial deposits (Doering, 1960; Brown, 1965), covers the low-lying area between the Sumter High Hills and the 100 ft topographic contour. Terrace deposits that are tentatively identified as "Wicomico" by Cooke (1936) and in SCGS auger-hole logs are found in Florence County.

PRE-CRETACEOUS ROCKS

Few wells in Sumter and Florence Counties have penetrated rocks below the Tuscaloosa (Middendorf) Formation. Therefore, present knowledge concerning lithology of the basement rocks is largely surmised from seismic data.

Bonini and Woolard (1960) conducted a seismic-reflection study of the basement surface underlying the Coastal Plain of North Carolina and South

Carolina, and eighteen of their measuring points were located in the study area or in adjoining counties (fig. 3). They interpreted seismic velocities to indicate gneiss or schist underlying most of the region and a possible northeast trending slate series underlying the Johnsonville area of Florence County. Low-velocity measurements 30 miles west-southwest of Florence were interpreted to indicate a narrow basin of Triassic sediments.

Wells penetrating Pre-Cretaceous rocks were reported by G. E. Siple to have penetrated pre-Cretaceous granite (?) at -620 ft msl in Sumter; and Triassic (?) olivine diabase at -568 ft msl in Florence (Maher, 1971).

STRUCTURE

Geologic formations in Sumter and Florence Counties occur as a wedge of unconsolidated sediments that pinch out northwest of the study area near the Fall Line, and thicken to the south and southeast. Within these formations, sedimentary units strike northeast and dip southeastward. The rate of dip appears to increase in the western part of the study area. Shallow sediments, such as those of the Peedee Formation, dip about 7 ft/mi, while the dip of the underlying sediments increases with depth to more than 15 ft/mi.

The basement structure in the South Carolina Coastal Plain was first mapped by Siple (1959), who included both seismic-survey and deep-well data. His map (fig. 3) shows that the basement surface strikes northeast in western Sumter County, but strikes eastward in Florence County. The average dip of the basement surface decreases from about 30 ft/mi in western Sumter County to less than 25 ft/mi in Florence County.

Two notable structural features are associated with the basement rocks underlying Sumter and Florence Counties; the Cape Fear arch, and the Florence Triassic basin. Sumter and Florence Counties lie on the southern flank of the Cape Fear arch, a prominent structural feature in the South Atlantic coastal region. The arch is a southeastward plunging basement anticline which axis intercepts the North Carolina coastline at Cape Fear (Mansfield, 1937) and which affects the structure of overlying sedimentary rocks.

Consolidated sedimentary rocks are thought to occur in a narrow Triassic basin (Florence basin) southwest of Florence. The Florence basin was originally postulated by MacCarthy (1936), and subsequent well data (Siple, 1959) and seismic refraction studies (Bonini and Woolard, 1960) tend to confirm the existence of the basin, which may extend to Sumter, South Carolina. The basin is approximately 40 miles long, 13 miles wide, and strikes east-northeast (Bonini and Woolard, 1960).

HYDROGEOLOGY

GENERAL PRINCIPLES OF GROUND-WATER OCCURRENCE

The occurrence, movement, availability, and chemical quality of ground water in Sumter and Florence are intimately related to the geology. Ground water occurs in and is obtained from aquifers, geologic formations that are

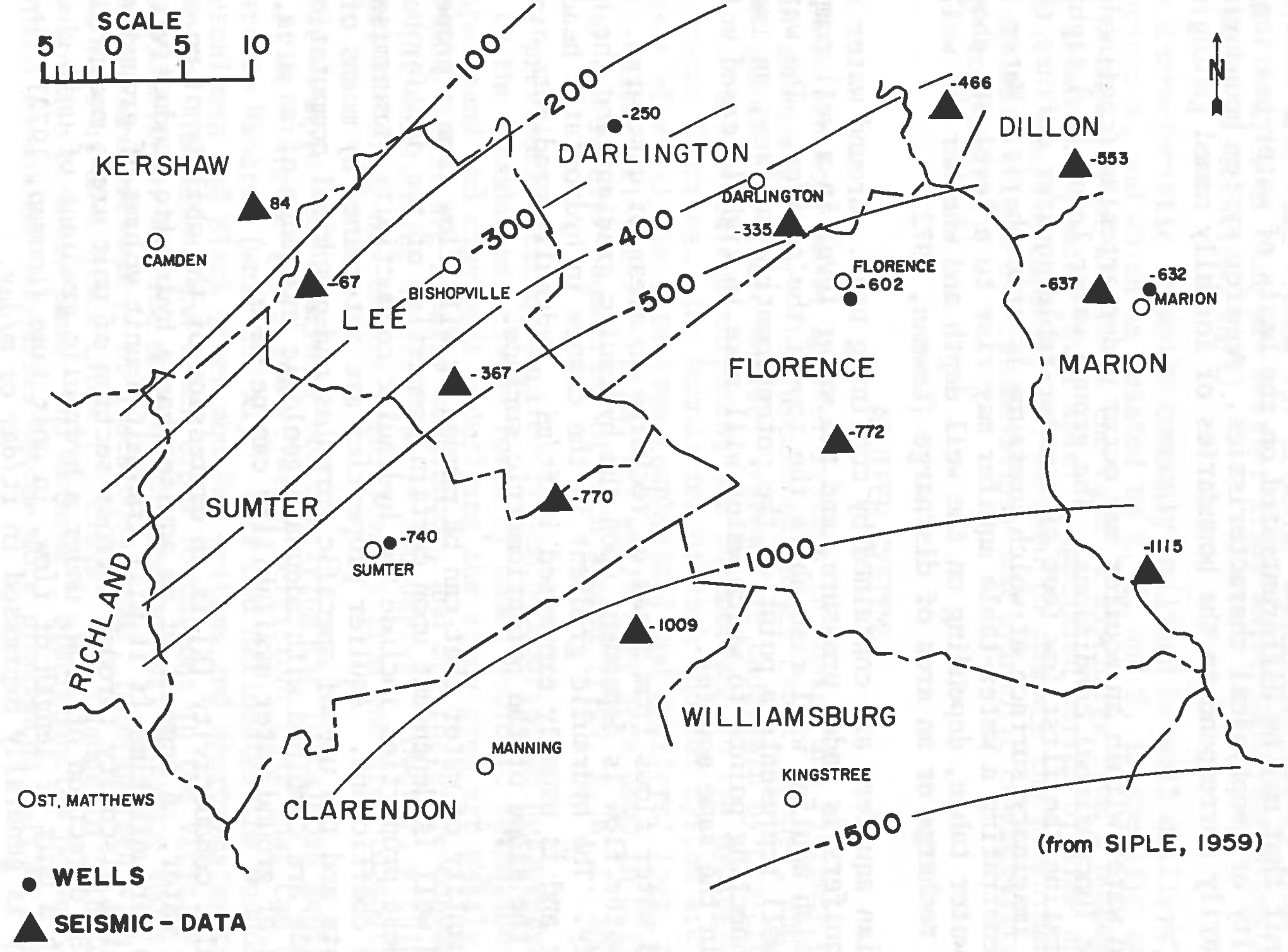


FIGURE 3. STRUCTURE CONTOURS ON TOP OF THE PRE-CRETACEOUS BASEMENT

water-bearing. In the study area, the most important aquifers consist of water-bearing sands. Confining beds may overlie or underlie aquifers and are strata that do not yield appreciable amounts of water to wells. In the study area, confining beds are generally composed of clays. A sequence of aquifers and confining beds make up an aquifer system--a generally recognizable hydrogeologic unit that may be differentiated on the basis of water-bearing, water-quality or geophysical characteristics. Aquifer system boundaries do not necessarily correspond to the boundaries of formally named geologic formations.

Ground water within an aquifer may occur under artesian (confined) or water-table (unconfined) conditions. The ground water level in a tightly cased well penetrating the first few feet of a water-table aquifer defines the water table, the imaginary surface at which pressure is atmospheric. Water levels in wells penetrating a water-table aquifer may rise to a level at, above, or below the water table, depending on the well depth and whether the well is in an area of recharge or an area of discharge (Lowman, 1972).

Artesian aquifers are contained by confining beds. Ground water in artesian aquifers is under pressure, and the water level in a well completed in an artesian aquifer will rise above the top of the aquifer. The water level in such a well represents a point on the potentiometric surface, an imaginary surface connecting points to which water will rise in tightly cased wells completed in the same aquifer.

Ground water flows from areas of recharge to areas of discharge. The rate of ground-water flow is dependent upon the hydraulic gradient and the hydraulic conductivity. The hydraulic gradient is the change in hydrostatic head per unit of distance and is usually expressed in ft/mi. Hydraulic gradients are determined from the slope of the potentiometric surface.

The quantity of water that can be pumped or will flow from a properly constructed well is dependent upon certain properties of the aquifer being tapped. These properties include the hydraulic conductivity, transmissivity, and storage coefficient. Aquifer properties are determined by means of aquifer tests and the use of specific formulas and graphical computations. When these methods are combined with adequate geologic knowledge of an area, useful projections of ground-water availability can be made.

Hydraulic conductivity (K) is an expression of the ability of an aquifer to transmit water. A segment of an aquifer has a hydraulic conductivity of unit length per unit time if it will transmit a unit volume of ground water at the prevailing viscosity through a cross-section of unit area, measured at right angles to the direction of flow, under a hydraulic gradient of unit change in head through a unit of length of flow, in unit time (Lowman, 1972). Hydraulic conductivity is generally expressed in ft/day or m/day.

The transmissivity (T) is the rate at which ground water, at the prevailing kinematic viscosity, is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity is K multiplied by aquifer thickness (m) and is expressed in ft^2/day or m^2/day (Lowman, 1972).

Storage coefficient (S) is related to the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head (Lowman, 1972). The storage coefficient is a dimensionless term, and typical values range between 0.3 and 0.03 for water-table aquifers and between 0.005 and 0.0005 for artesian aquifers. Values from 0.03-0.005 indicate conditions that are neither truly water-table nor artesian (American Water Works Association, 1973).

A characteristic of wells commonly utilized by well drillers, hydrologists, and engineers, and which is related to K, T, and S, is specific capacity. The specific capacity of a well is the rate of discharge from a pumped well divided by the drawdown in water level after a specified period of time and is expressed as gpm/ft. Specific capacity can be used to compare the performance of wells or to estimate values of transmissivity and hydraulic conductivity (but not storage coefficient).

AQUIFER SYSTEMS

There are four major aquifer systems in Sumter and Florence Counties, which are, in ascending order, the Tuscaloosa, Black Creek, Peedee, and shallow aquifer systems (table 1). These aquifer systems are underlain by pre-Cretaceous rocks which, for all practical purposes, are unimportant to the hydrogeology of Sumter and Florence Counties. The boundaries of each aquifer system are delineated on the basis of available data from geophysical and drillers' logs, and water-quality characteristics. Certain key wells have been used in defining the vertical and lateral boundaries of each system (figs. 5, 6, 7, and 8).

As previously stated, aquifer-system boundaries do not everywhere correspond to the boundaries between formally named geologic formations. The principal sand and clay beds underlying the study area are easily recognized in geophysical logs, are areally continuous, and are therefore convenient reference points for delineating aquifer system boundaries. However, within these aquifer systems, lithology may change significantly from one area to another.

For example, the confining bed overlying the Tuscaloosa aquifer system (fig. 5) at Florence (well 16M-v1) is a persistent clay that can be traced westward to Wateree (well 26Q-x1). This bed delineates the boundary between the Tuscaloosa and Black Creek aquifer systems and approximates the contact between the Tuscaloosa and Black Creek Formations in the vicinity of Florence. In the vicinity of Wateree most of the sedimentary sequence above the confining bed is composed presumably of Tuscaloosa sands, interspersed with only a few tens of feet of dark Black Creek (?) clays. The change in lithology is particularly notable between Sumter and Wateree. Discrepancies between aquifer system and formation boundaries become more pronounced farther updip.

Similarly, drilling logs for deep wells at Lynchburg indicate that shell and shell-fragments occur in sediments that are defined as part of the Tuscaloosa aquifer system in figures 5 and 7. Such fossiliferous sediments are common in the Black Creek Formation, but not in the Tuscaloosa Formation.

At well 16M-v1 in Florence (figs. 5 and 8) the confining bed overlying the Tuscaloosa aquifer system is correlated to a deeper confining bed at well 12R-b2 in Johnsonville (figs. 7 and 8). In the vicinity of Florence, drilling logs indicate that this confining bed contains "Tuscaloosa-like" sediments composed of white and yellow sands, "iron-stained sands", and white, grey, reddish, or brown clays. At Johnsonville (well 12R-b2) this same confining bed is largely composed of shell bearing, fine- to medium-grained sands and black and dark-blue clays that are typical of the Black Creek Formation.

TUSCALOOSA AQUIFER SYSTEM

DISTRIBUTION

The Tuscaloosa aquifer system is the most productive source of ground water in Sumter and Florence Counties and surrounding areas. Public (municipal) water systems in Pinewood, Sumter, Lynchburg, Timmonsville, and Florence use the aquifer system as a primary source of water supply. In addition, small public-supply and industrial water users and an increasing number of large irrigation systems are supplied by ground water from the Tuscaloosa aquifer system.

The Tuscaloosa aquifer system underlies all of Sumter and Florence Counties and is overlain by a 15 to 75 ft thick confining bed in the Black Creek aquifer system (figs. 5, 6, 7, and 8). The altitude of the bottom of the confining bed ranges from approximately sea level (msl) in northern Sumter County (fig. 6) to more than 700 ft below msl in southern Florence County (figs. 7 and 8). The thickness of the Tuscaloosa aquifer system varies from about 250 ft in northern Sumter County to about 400 ft in southern Florence County.

WATER LEVELS AND RECHARGE

Although geologists of the SCDHEC have constructed potentiometric maps of shallow aquifers near waste-disposal and contamination sites in the study area, data are currently insufficient to construct potentiometric maps of deeper aquifers. Therefore, most water-level data are based on well construction records.

These records indicate that water levels in wells tapping the Tuscaloosa aquifer system have declined locally. Prior to the 1950's, wells tapping Tuscaloosa aquifers at Florence and Sumter had water levels that were no more than 40 ft below land surface, and in a few early wells, water levels were above land surface. As municipal water use increased, water levels declined correspondingly. Recent wells near the principal downtown pumping area at Florence have water levels as low as 120 ft below land surface (20 ft msl), and water levels at Sumter well fields are generally 60 to 80 ft below land surface (105 ft to 85 ft msl). Well 22P-g1, four miles from the nearest Sumter well field, flowed at 125 gpm when drilled in 1955. When measured in August, 1977, the water level was 6 ft below land surface.

These water-level changes are moderate and do not presently pose a threat to ground-water availability at Sumter or at Florence. Whenever pumpage is increased, water levels will decrease until the additional discharge is balanced by a like amount of recharge. In the remainder of Sumter and Florence Counties, the Tuscaloosa aquifer system is not heavily used and water levels are presumably near or above land surface.

The USGS and SCWRC maintain observation wells at Sumter (23P-t3) and at Mars Bluff (13M-p2). Well 23P-t3 is located at Sumter Water Plant One and is screened in the principal sand of the Tuscaloosa aquifer system. The hydrograph (fig. 9) reflects pumpage at the water plant and natural water-level changes are obscured. However, there is no discernible downward trend in water levels.

At Mars Bluff, the hydrograph for well 13M-p2 (fig. 9) reflects the composite water levels of the Black Creek and Tuscaloosa aquifer systems. Comparison of annual average-monthly water levels with monthly departures from normal rainfall indicates a correlation between rainfall departure and water level. A period of above-normal rainfall from November 1972 to May 1973 appears to coincide with a water-level rise between November 1972 and April 1973. Likewise, a prolonged period of above-normal rainfall during early 1975 appears to correspond with a rise in water level during the same time interval. The brief lag time between periods of rainfall and rising water levels may be a response to loading as water in overlying shallow aquifers is replenished or depleted. Periods of declining or low water level generally occur during mid- to late-summer, and may, in part, reflect increased evapotranspiration and pumpage by city wells at Florence during the hotter, dryer, summer months.

The nearest known large-capacity well that could affect water levels at well 13M-p2 is located in Florence, about nine miles away. A two-week aquifer test conducted at the Mars Bluff site in March-April 1959 is reported to have influenced water levels in an observation well near the Florence Airport (G. E. Siple, oral communication, 1978); it is, therefore, probable that pumpage at Florence (5.5 Mgd average) affects water levels at well 13M-p2.

Ground-water movement in the Tuscaloosa aquifer system is believed to be toward the south and southeast from the area of recharge. The major areas of recharge appear to lie generally west and northwest of the study area in Darlington and Lee Counties; and in northern and western Sumter County. In these areas, rocks of the Tuscaloosa Formation occur at or near land surface (fig. 2) and consist of highly permeable sands and relatively thin confining beds. Additionally, recharge by leakage probably occurs within the cone of depression at Sumter and Florence where the potentiometric head of the Tuscaloosa system has been lowered below that of the Black Creek aquifer system. With the probable exception of northern Sumter County, the Tuscaloosa system apparently has a greater potentiometric head than the overlying Black Creek system.

WATER-BEARING CHARACTERISTICS

Grey, white, red, tan, brown, and blue clays and sandy clays separate the Tuscaloosa and Black Creek aquifer systems and divide the Tuscaloosa aquifer system into a number of aquifers. The uppermost aquifer, the principal Tuscaloosa aquifer, is identified on geophysical logs throughout the area and appears as a series of prominent deflections from the shale line (figs. 5-8). At well 16M-v1 (fig. 5) the aquifer occurs between 350 ft and 520 ft. The thickness ranges from more than 150 ft in Sumter County and northern Florence County to less than 100 ft in southern Florence County. This aquifer is the most productive source of ground water in the study area. The municipalities of Pinewood, Sumter, Lynchburg, Timmonsville, and Florence, and many industrial

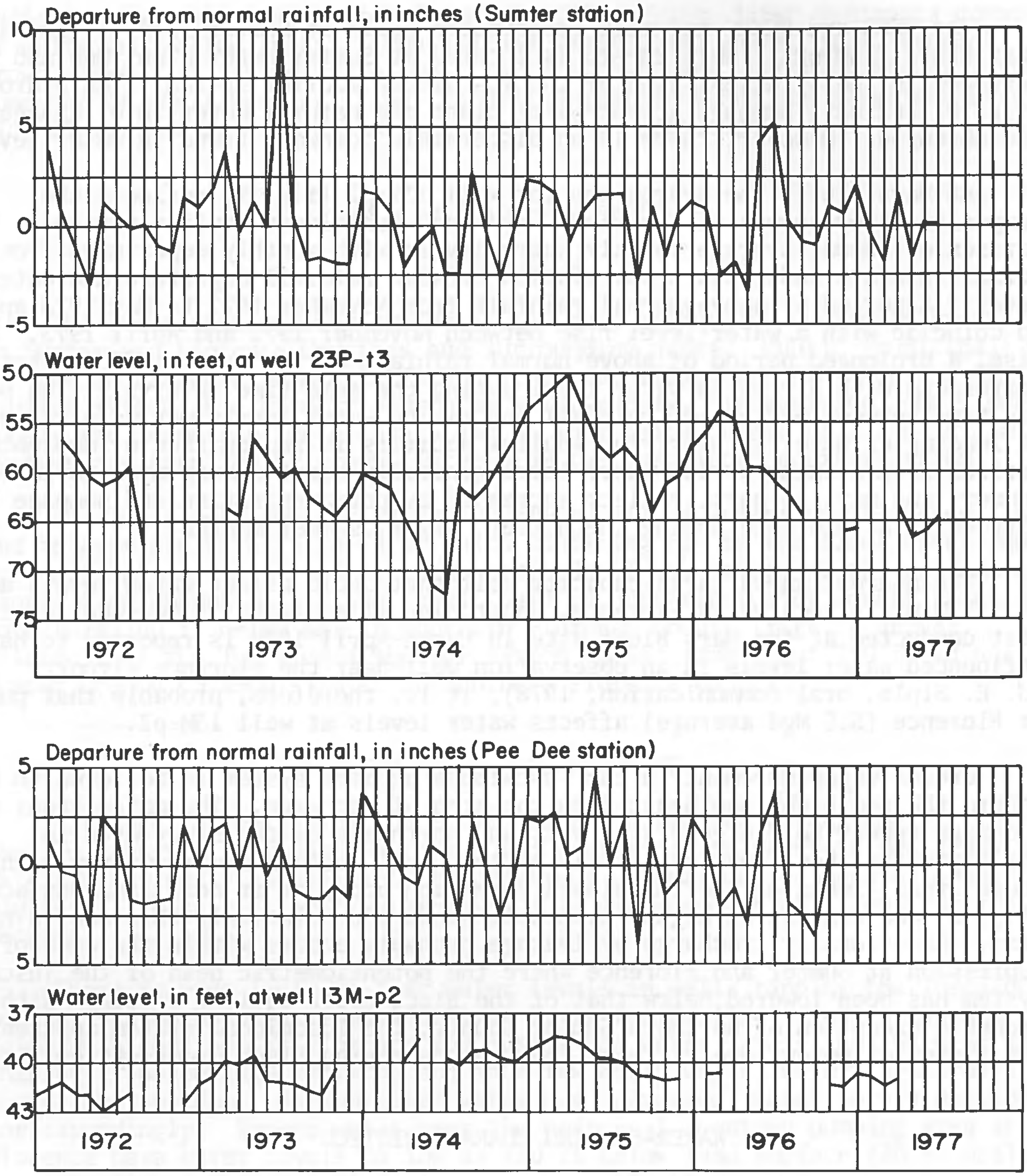


FIGURE 9. Rainfall and hydrograph data for observation wells 23P-t3 and 13M-p2, 1972-1977.

and agricultural water users operate wells screened in the principal Tuscaloosa aquifer.

The depth, yield, and specific capacity of wells tapping the principal Tuscaloosa aquifer vary significantly from one area to another. Wells at Sumter, with diameters of 8 to 12 inches and depths of 550 to 670 ft yield from 500 gpm to more than 2,000 gpm per well; specific capacities range from 11 to 30 gpm/ft. West of Sumter, toward Rembert and the Wateree River, the permeability (hydraulic conductivity) of the aquifer increases, and specific capacities of more than 30 gpm/ft are reported. East of Sumter, permeability decreases, and the yields of individual wells tapping the aquifer are less than 1,000 gpm with specific capacities of less than 15 gpm/ft. The only well known to tap the principal Tuscaloosa aquifer in southern Florence County (12R-b2) is 870 ft deep and yields 500 gpm with a specific capacity of about 13 gpm/ft of drawdown.

Additional aquifers underlie the principal Tuscaloosa aquifer in most of the study area, but are absent in much of Lee, northern Sumter, and Darlington Counties where they pinch out toward the outcrop areas. Most wells operated by the City of Florence are screened in both the principal Tuscaloosa aquifer and in underlying Tuscaloosa aquifers. Municipal wells at Florence commonly have 80 to 100 ft of screen set between depths of 300 ft and 750 ft, and yields range from 700 gpm to 2,000 gpm per well. Specific capacities are usually lower than for municipal wells at Sumter, and range from 5 gpm/ft to 18 gpm/ft. Two wells in southern Darlington County (16L-q1 and 16L-q2) are entirely screened in sands below the principal Tuscaloosa aquifer; each well yields approximately 500 gpm with a specific capacity of about 4 gpm/ft. Few wells tap lower Tuscaloosa aquifers in Sumter County because sufficient quantities of water are available from the overlying principal Tuscaloosa aquifer and from the Black Creek and shallow aquifer systems.

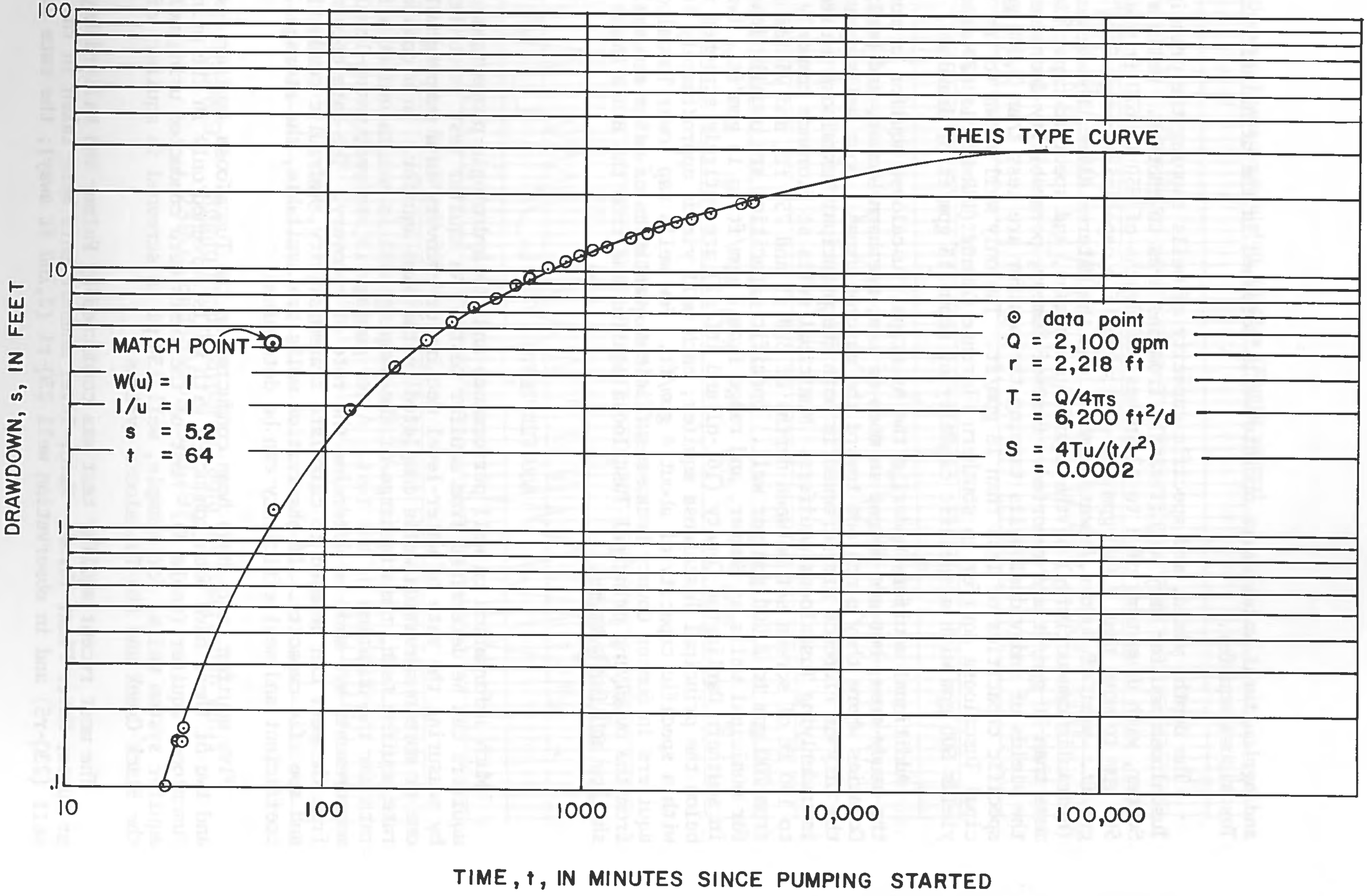
AQUIFER TESTS

Much information on well performance and the hydrologic properties of aquifers can be determined from aquifer tests. An aquifer test is conducted by measuring the rate of water-level decline or recovery in a pumping well and one or more observation wells completed in the same aquifer. In a constant-rate aquifer test, the discharge of the pumping well is maintained at a fixed rate for the duration of the test. After pumpage is stopped, water-level measurements are made to determine the rate of recovery. The data obtained from the test can be used to calculate transmissivity, hydraulic conductivity, and specific capacity. If observation wells are available, the storage coefficient and well efficiency can be determined.

Five aquifer tests have been conducted on the Tuscaloosa aquifer system and two of these have been conducted with wells screened only in the principal Tuscaloosa aquifer (table 3). Most of the tests were conducted using multi-aquifer system wells; for example, well 13M-p1 is screened in aquifers of both the Black Creek and the Tuscaloosa systems.

The most recent aquifer test was conducted by Palmer and Mallard Engineers at Sumter Water Plant Three. Water-level measurements were taken in the pumping well (23Q-r5) and in observation well 23Q-r1 (2,200 ft away); the rate of

FIGURE 10. TIME-DRAWDOWN PLOT OF AQUIFER-TEST DATA, WELL 23Q-r1 (SUMTER WATER PLANT THREE)



discharge was 2,100 gpm for 72 hours. Transmissivity and storage coefficients were calculated using both the Theis type-curve method and the Cooper-Jacob straight-line method. Transmissivity was 6,200 ft^2/day and storage was 0.0002. The logarithmic time-drawdown plot of observation well 23Q-r1 (fig. 10) indicates that the Tuscaloosa aquifer behaved as a non-leaky artesian aquifer for the pumping test period of three days.

Siple (1957) observed that for the South Carolina Coastal Plain in general, Tuscaloosa transmissibilities (transmissivities) are greatest in areas 20-40 miles downdip from the outcrop area. However, within the study area, the highest transmissivities occur in or near the outcrop area of the Tuscaloosa Formation.

Comparison of aquifer test results for wells 13M-p1, 16M-v1, 23Q-r5, and 26Q-x1 (table 5), and comparison of specific capacity data (appendix table 2) indicate that the transmissivity of Tuscaloosa aquifers generally increases from east to west toward the outcrop area. The trend in part reflects increasing permeabilities (K=20 to 90 ft/day). In addition, a greater thickness of sand occurs toward the western part of the study area; in the eastern part, confining beds compose a greater percentage of the aquifer system.

An aquifer test at well 16L-q1 indicates a transmissivity of approximately 950 ft^2/day for the sands underlying the principal Tuscaloosa aquifer. Hydraulic conductivity (19 ft/day) is comparable to that estimated for the principal Tuscaloosa aquifer in northern Florence County.

BLACK CREEK AQUIFER SYSTEM

OCCURRENCE

The Black Creek aquifer system underlies most of Sumter and Florence Counties (fig. 5). In updip areas, such as northwestern Sumter County, the lithology consists of white, buff, tan, and grey, medium- to coarsed-grained sands, poorly sorted gravels, and interbedded grey, brown and yellow clays that are characteristic of the Tuscaloosa Formation. Downdip, to the east and southeast, the lithology consists of fossiliferous, fine- to medium-grained white sands and dark-blue to black clays more typical of the Black Creek Formation.

The altitude of the top of the aquifer system ranges from about 50 ft above msl in western Sumter County to approximately 100 ft below msl in southern Florence County. In western Sumter County, the thickness increases from a few feet in the Rembert area to about 400 ft in well 24S-d2 at Pinewood (fig. 6). In Florence County, the thickness ranges from less than 250 ft to more than 500 ft (figs. 7 and 8).

RECHARGE

The Black Creek aquifer system in recharged by precipitation falling on outcrop areas in and adjacent to the study area. Outcrop areas include the

Black Creek Formation (fig. 2) and that part of the Tuscaloosa Formation which may be an updip extension of the Black Creek Formation.

Additional recharge probably occurs by leakage from the underlying Tuscaloosa aquifer system in much of Sumter County and northern Florence County. In southern Florence County, the confining bed separating Black Creek and Tuscaloosa aquifers is as much as 100 ft thick, and ground-water movement from one system to the other is assumed to be slight. Comparable conditions exists in Horry County, for which Zack (1977) reported that the Black Creek and Middendorf (Tuscaloosa) aquifer system are hydraulically independent.

WATER-BEARING CHARACTERISTICS

Many small public water systems operate wells which tap the Black Creek aquifer system. The wells are four to ten inches in diameter and range from 150 ft to 600 ft deep. Screens are usually set opposite sands that correlate to aquifers between 40 and -50 ft msl and between -90 and -150 ft msl at well 19Q-f1 (figs. 5 and 7). A number of 10- and 12-inch diameter multi-aquifer wells operated by Sumter and Florence also have screens set opposite these sands.

In Sumter County, 4- and 6-inch diameter wells having 10 to 20 ft of screen in Black Creek aquifers commonly yield 50 to 150 gpm per well; the specific capacity of these wells is generally less than 5 gpm/ft. The depths vary from about 100 to 250 ft. Deeper, large-diameter wells having 40 to 75 ft of screen yield from about 450 to 750 gpm; specific capacities range from 7 to 20 gpm/ft.

Comparable 8- and 10-inch diameter wells in Florence County yield 250 to 500 gpm per well, with specific capacities of 10 gpm/ft or less. The depths of these wells range from approximately 250 ft in northern Florence County, to about 500 ft in the vicinity of Lake City, Scranton, and Johnsonville.

The only estimates of the transmissivity and hydraulic conductivity of aquifers in the Black Creek system are from two wells in Florence County, (table 3). Because observation wells were not used, the storage coefficients could not be determined. The transmissivity of Black Creek sands at well 13P-d1 (Pamplico) is 3,100 ft2/day, and at well 12R-g3 (Johnsonville) is 1,500 ft^2/day. Both wells are screened in the middle and upper sands of the aquifer system.

Hydraulic conductivity values of Black Creek aquifers in eastern Florence County are within the range of those calculated by Zack (1977) for Black Creek aquifers in Horry County, east of the study area. Zack calculated storage coefficients of between 0.0001 and 0.0004.

Well records indicate a westward trend of increasing well yields and specific capacities per foot of aquifer screened. This increase occurs mainly in central and western Sumter County, where the Black Creek aquifer system contains a thicker and more permeable sequence of sands.

PEEDEE AQUIFER SYSTEM

The Peedee aquifer system underlies all of central and southern Florence County and the Sumter panhandle, and it is composed of dark clayey sands and sandy clays. The thickness of the aquifer system increases from a few feet near the updip limit to approximately 200 ft in southern Florence County.

WATER-BEARING CHARACTERISTICS

In Florence County, well drillers report drilling through 40 to 60 ft of "grey marl" before striking good water-bearing sands. These sands are generally fine-grained and are interbedded with sandy clays and hard, calcareous rocks. The most prominent sandy zone, identified in geophysical and drilling logs, dips southward and occurs between a depth of 150 and 180 ft below land surface at well 12R-b2 (figs. 7 and 8). The base of the clay underlying this sandy zone delineates the base of the Peedee aquifer system and, when correlated to cross-sections by Zack (1977) and Johnson (1978), marks the base of the Peedee Formation.

Peedee aquifers yield enough water to supply domestic and light industrial users in southern Florence County. The highest reported well yield is about 20 gpm. Individual 4- to 6-inch diameter wells will probably yield 50 to 60 gpm, but specific capacities of less than 5 gpm/ft are to be expected. In adjacent Clarendon and Williamsburg Counties, wells completed in Peedee aquifers are reported to yield 50 to 150 gpm per well (Johnson, 1978).

SHALLOW AQUIFER SYSTEM

The shallow aquifer system in Sumter and Florence Counties is composed of rocks of the Black Mingo and Duplin Formations, undifferentiated rocks of Miocene (?), Pliocene, and Pleistocene age, and Recent alluvial deposits (table 1). The lithology of these shallow formations has been described from auger-hole cuttings at more than 200 sites in or near the study area by geologists with the SCGS and by Sloan (1908), Cooke (1936), and others.

Ground water in the shallow aquifers occurs under confined, semiconfined, and unconfined conditions. Where unconfined conditions exist, the aquifer is recharged by local rainfall, and water levels respond to changes in rainfall and seasonal changes in the rate of evapotranspiration. Reported water levels are commonly 10 to 40 ft below land surface and in part reflect changes in topography. Water levels occur at greatest depths in areas of high elevation and are near, or at land surface near water bodies. Because of the prevalence of confining clays, ground water locally occurs under semiconfined or confined conditions.

The depths of wells tapping the shallow aquifer system range from 10 ft to more than 100 ft. Except in the belt of sand hills traversing western Sumter County, domestic water needs are commonly supplied by wells that are less than 60 ft deep. In the sand hills region southwest of Sumter, land surface elevations range from 200 to 350 ft above msl and, locally, wells must be drilled through as much as 100 ft of "black rock" and red and yellow sandy clays (Black Mingo?) before penetrating water-bearing sands. Locally, 10 to 20 ft thick sands occur within the Black Mingo (?).

Although the Duplin Formation is mainly composed of "marl", scattered auger-hole and well data indicate that water-bearing sands occur within the formation. These sands are sources of domestic, light industrial, and public water supplies, locally. The Town of Mayesville is supplied by wells 50 to 60 ft deep, apparently screened in sands of the Duplin Formation.

The City of Sumter operated shallow wells until the 1960's. These wells were 55 to 100 ft deep and reportedly yielded 100 to 450 gpm per well. At least one shallow well reportedly pumped as much as 1,000 gpm and had a specific capacity of 140 gpm/ft at 320 gpm. The deepest of these wells may be screened in the upper part of the Black Creek aquifer system, but most are screened in shallow sands of the Duplin Formation or in alluvial deposits. The shallow aquifer system in the vicinity of Sumter may have great potential as an inexpensively developed source of public and industrial water supply, and further study of this aquifer system is needed.

Large quantities of ground water may also be available to shallow wells developed in the alluvial deposits within the Wateree, Black, and Pee Dee River valleys. Sand and gravel are quarried at sites on the Wateree and Pee Dee Rivers. The quarries indicate the possible occurrence of permeable sediments that may supply large amounts of ground water to induced infiltration wells. Ten miles north of the study area, induced infiltration wells are already used at one site on the Wateree River and yield up to 250 gpm per well.

WATER USE

As part of a statewide water-use inventory program, the SCWRC publishes water-use reports for 5-year intervals (SCWRC, 1971; Duke, 1977). Table 4A, modified from Duke (1977), summarizes the estimated industrial and public supply water withdrawals in Sumter and Florence Counties in 1975. Rural domestic, and small public supply withdrawals are a significant part of water use and are given as totals for each county. Towns and industries using more than 0.1 Mgd are listed in table 4B.

Nonwithdrawal use, which includes hydroelectric power, navigation, recreation, fish and wildlife propagation, and the conveyance and dilution of sewage is not included. Nonconsumptive use for mining operations is included.

In 1975, 177 public water-supply systems (municipalities, military bases, subdivisions, and mobile home parks), most of which were privately owned, served a per capita average of about 190 gpd or about 20.5 Mgd. The water used included all that was pumped into each system; such as for fire protection, lawn and garden irrigation, industry, and commerce, as well as drinking water. All water used for public supply was ground water. Of the 20 Mgd of water used for public supplies, 7.5 Mgd was for industrial use and the remainder was for domestic and commercial use.

Table 4A. Estimated water use in Sumter and Florence Counties in million gallons per day (1975).

Sumter County	Public-Municipal	10.75
	Public-Rural water districts & subdivisions	0.53
	Public-Trailer parks	0.20
	Public-Military	1.5
	Rural-Domestic	2.0
	Self-supplied industry	0.1
	Self-supplied industry (sw)	3.6
	Total	16.88
Florence County	Public-Municipal	7.2
	Public-Rural water districts & subdivisions	0.25
	Public-Trailer parks	0.25
	Rural-Domestic	2.3
	Self-supplied industrial	1.9
	Self-supplied industrial (sw)	22.9
	Total	34.8

sw = surface water
(Sources: Duke, 1977; South Carolina Department of Health and Environmental Control, 1977)

Table 4B. Principal water users in 1975 (more than 0.1 Mgd).

User	Quantity (Mgd)
Sumter	10.50
Pinewood	0.10
Shaw Air Force Base	1.50
Becker Sand and Gravel (sw)	3.60
Florence	5.50
Johnsonville	0.30
Lake City	0.80
Pamplico	0.15
Timmonsville	0.30
Wellman Industries	1.75
Koppers Corp	0.10
E. I. DuPont (sw)	8.00
South Carolina Industries (sw)	13.50
Becker Sand and Gravel (sw)	1.35

(Source: Duke, 1977; South Carolina Water Resources Commission)

Industry used an average 28.5 Mgd of self-supplied water in 1975. About 26.5 Mgd of the self-supplied industrial use was obtained from surface-water sources by four industries; two Mgd was from ground-water sources. These self-supplied industries recycled 70.5 Mgd of water, for a total use of 97 Mgd.

The reported use of water for irrigation was not significant in 1975. However, there is an increasing interest in the use of supplemental irrigation for the production of soybeans and other crops. Fifteen high-capacity irrigation systems have been installed since 1977, eight supplied by wells. These systems irrigate about 2,000 acres and have a combined operating capacity of 21 Mgd; the projected average annual withdrawals for these systems is approximately 1.8 Mgd.

Rural-domestic water use includes household use and was estimated to be about 4 Mgd. Rural-domestic users are defined as rural and suburban homes not served by public water-supply systems and represent roughly 40 percent of the population of each county. All rural-domestic water users in the study area are supplied by ground water. Rural-domestic water use was computed by multiplying daily per capita use (60 gpd) by the population not supplied by public water systems (72,000).

GROUND-WATER QUALITY

Precipitation that recharges aquifers in Sumter and Florence County is nearly pure and contains only small amounts of dissolved gases and dust. As ground water seeps through various geologic formations, mineral matter from the surrounding rock is dissolved. The amount and kind of dissolved mineral matter depend upon the chemical composition of the ground water, the composition and solubility of rocks in the aquifers, and the length of time the ground water and rocks have been in contact. As a rule, the amount of dissolved mineral matter is relatively low in recharge areas and increases with depth and with distance from recharge areas.

Chemical analyses of ground water from selected wells in the study area are tabulated in table 6. The reader should note that these analyses were analyzed in several different laboratories and that sampling and analytical procedures were not uniform. Parameters such as free carbon dioxide concentrations, pH, and alkalinity change with time after a ground-water sample is exposed to the atmosphere and hence should be measured when the sample is taken. However, most of the samples listed in table 6 were analyzed after being stored for hours or even days. Furthermore, many samples were neither filtered for use in determining the concentrations of dissolved constituents nor treated to sequester reactive metals such as reduced iron.

Chemical quality is an important factor in determining the suitability of ground water for use in public and industrial water supplies. In Sumter and Florence Counties, chemical species that locally exceed recommended water-quality standards include iron, calcium, magnesium, fluoride, and silica. Commonly determined chemical properties associated with these and other dissolved species are total hardness, total dissolved solids, hydrogen-ion concentration (pH), and corrosiveness.

Ground water in Sumter and Florence Counties is generally of good chemical quality. Concentrations of dissolved constituents generally meet State primary drinking-water standards of the SCDHEC, although in one case fluoride exceeds the 1.6 mg/L limit. In many areas, iron concentrations exceed the secondary drinking-water standard of 0.3 mg/L. The sources and effects of these various chemical constituents are shown in table 5.

IRON

Iron compounds are present in most geologic formations, and dissolved or suspended iron commonly occurs in ground water in the study area. Locally, iron concentrations are in excess of the 0.3 mg/L maximum recommended by the SCDHEC. Such water may stain clothing and plumbing fixtures, turning them a yellow or rusty color. Domestic-well owners remove iron with small ion-exchange filters which are effective if iron concentrations are not too high. Public-supply systems remove iron by oxidation with chemicals, or areation, followed by filtration. Where iron concentrations are high, filters must be flushed frequently.

Iron exists in two chemical-oxidation states--ferric iron (Fe+++) which is relatively insoluble, and ferrous iron (Fe++) which is soluble. When water containing large concentrations of ferrous iron is pumped from a well and exposed to atmospheric oxygen, the ferrous iron is oxidized to ferric iron and precipitates as rust-colored ferric hydroxide ($Fe(OH)_3$). As a result, water containing dissolved iron may be clear when pumped from the well, but with time becomes cloudy from an insoluble ferric hydroxide precipitate.

The principal factors affecting the solubility of iron in ground water are pH, Eh (oxidation-reduction potential), and bicarbonate concentrations. Iron solubility is greatest under conditions in which pH, Eh, and bicarbonate concentrations are low, conditions that exist throughout a large part of the study area. Values of pH for ground water in Tuscaloosa and Black Creek aquifers, in the vicinity of Florence and throughout Sumter County, are generally less than 7.0 and, locally, are less than 5; artesian aquifers provide environments in which the Eh is low and reducing conditions occur (i.e., dissolved iron tends to go from the insoluble ferric state to the soluble ferrous state); and bicarbonate alkalinities are generally less than 50 mg/L as $CaCO_3$.

Partially as a consequence of these ground-water conditions, domestic, municipal, and industrial water users are plagued by high iron concentrations. As shown in table 6, total iron concentrations range from 0.01 mg/L to 8.1 mg/L. In 65 of 92 samples, concentrations exceeded the 0.3 mg/L maximum recommended by the SCDHEC, and 42 samples contained more than 1.0 mg/L iron.

At several sites within the study area, test holes have been used to sample individual aquifers and to determine screen settings that yield ground water containing less than 0.3 mg/L iron. Tests were conducted at wells 23Q-r1, 23Q-r5, and 25S-d2, and the results are included in table 6. At all three sites, the highest iron concentration (3.0 to 5.0 mg/L) generally occurred in an aquifer of the Black Creek system; only the shallow aquifer at well 23Q-r5 and

Table 5. The source and effects of selected constituents in ground water (Fairchild, 1972).

Constituent	Source and/or solubility	Effects
Silica (SiO_2)	Most abundant compound in earth's crust. Resistant to solution.	Causes scale in boiler and deposits on turbine blades.
Iron (Fe)	Very abundant element, readily precipitates as hydroxide.	Stains laundry and porcelain, bad taste.
Manganese (Mn)	Less abundant than iron, present in lower concentrations.	Stains laundry and porcelain, bad taste.
Calcium (Ca)	Dissolved from most rock, especially limestone and dolomite.	Causes hardness, forms boiler scale, helps maintain good soil structure and permeability.
Magnesium (Mg)	Dissolved from rocks, industrial wastes.	
Sodium (Na)	Dissolved from rocks, industrial wastes.	Injurious to soils and crops, and certain physiological conditions in man.
Potassium (K)	Abundant, but not very soluble in rocks and soils.	Causes foaming in boilers
Bicarbonate (HCO_3) Carbonate (CO_3)	Abundant and soluble from limestone, dolomite, and soils.	Causes foaming in boilers and embrittlement of boiler steel.
Sulfate (SO_4)	Sedimentary rocks, mine water, and industrial wastes.	Excess: cathartic, taste.
Chloride (Cl)	Rocks, soils, industrial wastes, sewage, brines, sea water.	Unpleasant taste, increases corrosiveness.
Fluoride (F)	Not very abundant, sparingly soluble, seldom found in industrial wastes except as spillage, some sewage.	Over 1.5 mg/L causes mottling of children's teeth, 0.88 to 1.5 mg/L aid in preventing tooth decay.
Nitrate (NO_3)	Rocks, soil, sewage, industrial waste, normal decomposition, bacteria.	High indicates pollution, causes methemaglobanemia in infants.
Hardness as $CaCO_3$		Excessive soap consumption, scale in pipes interferes in industrial process. up to 60 mg/L - soft 60 to 120 mg/L - moder. hard 120 - 200 mg/L - hard over 200 mg/L - very hard

the principal Tuscaloosa aquifer at well 25S-d2 yielded ground water having significantly less than 0.3 mg/L iron.

Siple (1946) noted that for the Coastal Plain as a whole, Tuscaloosa aquifers have high average concentrations of iron. In comparing iron concentrations for wells in the Tuscaloosa Formation at Florence, he also noted that, even locally, there may be substantial differences in iron concentrations in the same formation.

High iron concentrations are not only encountered when a new well is constructed. Leggett, Brashears, and Graham (1976) pointed out that iron concentrations in water pumped from City of Sumter wells increase with time. For example, well 25Q-r1 yielded water containing 0.1 mg/L iron in 1965, but contained 3.2 mg/L iron when analyzed in 1976. Similar, but less extreme increases are reported to have occurred at other City of Sumter wells.

The causes of these increases are not fully understood, but may be due in part to the mixing of ground water from different aquifers. Municipal wells at Sumter are multi-screened and have continuous gravel packs extending from the lowest to the highest screen settings. A few wells are screened only in the principal Tuscaloosa aquifer, but most have screens in both the principal Tuscaloosa aquifer and in overlying Black Creek aquifers. High iron concentrations (3.0 to 7.0 mg/L) are known to exist in some Black Creek aquifers, and water levels in the heavily pumped principal Tuscaloosa aquifer are below those of overlying aquifers (in the vicinity of the well fields). As a result, iron-bearing ground water may flow into Tuscaloosa aquifers when wells are unused or improperly abandoned. Multi-aquifer wells can also mix ground water having different oxidation-reduction potentials, causing iron compounds to precipitate or to be dissolved (Hem, 1970). Pyrite is a common minor constituent in Black Creek aquifers and, according to Hem (1960), pyrite rapidly increases in solubility with increasing redox potential.

In a study of shallow aquifers at Salisbury, Md., Heidel (1965) reported that leakage of iron-bearing ground water through a confining bed contributed to high iron concentrations in an adjacent aquifer. In a like manner, leakage may be partially responsible for increasing iron concentrations in Sumter municipal wells. Iron may also be derived from confining beds.

Increasing iron concentrations may also be related to the presence of iron-fixing bacteria. However, these bacteria should only have a slight effect on iron concentrations in municipal wells at Sumter, which are pumped at an average of more than 0.5 Mgd per well.

IRON BACTERIA

High iron concentrations can be conducive to the growth of iron-fixing bacteria, and such bacteria have been found in wells at Sumter and in water mains in Florence. The only genus specifically identified is Gallionella ferroginea; although the bacteria Crenothrix is so common and widespread that it probably occurs also.

Bacteria such as Gallionella are classified as autotrophic (Starky, 1945, p. 969). It is generally, but not universally, believed that these bacteria can develop in the absence of organic material, such as in water derived from deep wells; can satisfy their carbon requirements by using carbon dioxide; and can obtain energy from the oxidation of inorganic substances, such as the conversion of ferrous iron to ferric iron.

Where iron bacteria occur in large concentrations, the cost of using ground water increases greatly. The bacteria may form a gelatinous slime on well casing, screens, and gravel packs, which can greatly retard the flow of water into a well and reduce well efficiency. Iron bacteria also alter the chemistry of the water around them, catalyzing the precipitation or solution of iron compounds and accelerating well screen corrosion. Introduction of iron bacteria into water-distribution systems may cause clogging and impart an unpleasant odor to drinking water.

Conditions favorable to the existence of iron bacteria occur in many wells in the study area, although the bacteria would not necessarily thrive. Valkenburg, Christian, and Green (1975) attempted to isolate factors which affected iron bacteria growth in wells in Alabama and concluded that the following conditions are most favorable:

1. Wells less than 400 feet deep containing water with a temperature of about 10°C
2. Dissolved ferrous iron concentration greater than 0.25 mg/L
3. pH range of 6.0 to 8.0
4. Dissolved oxygen concentration of 1.0 to 3.0 mg/L
5. Specific conductance of 300-700 micromhos/cm

They believed that conditions that deviate from the above factors tend to limit growth. It should be noted that Valkenburg, Christian, and Green based their conclusions on a relatively small statistical sample, and they could not have determined the interrelationship of each of the above conditions.

Individual well yields are reported to have declined significantly in some wells in the study area, particularly Sumter municipal wells. Some consulting reports have attributed these declines to the growth of iron bacteria, but the writer feels that this is not the major cause. Sumter municipal wells have most screens set opposite the principal Tuscaloosa aquifer, the top of which is 400 to 650 ft below land surface. Very little dissolved oxygen would be expected at these depths and bacteria growth would be limited. However, a number of wells have screens as shallow as 300 ft and iron bacteria may have interferred with these shallower screens. It is likely that iron bacteria are, at most, only partially responsible for declining well yields and that the precipitation of iron compounds, iron cemented sand, or sand blockage are also important factors.

Many publications are devoted to the physiology and behavior of iron bacteria and a number of these are included in the selected references for this report. However these publications are in some cases vague or conflicting, which points to the need for much more research. Insofar as the study area is concerned, there is a need for additional bacteriological data in order to determine the significance of iron bacteria as a ground-water development problem.

FLUORIDE

Excessive amounts of fluoride (more than about 1.0 mg/L) may cause problems for some industries, such as food, beverage, and pharmaceutical companies. However, small amounts of fluoride in drinking water are beneficial. Research has shown that fluoride in concentrations of 0.8 to 1.5 mg/L reduces dental cavities in children. At concentrations exceeding about 1.5 mg/L, fluoride may cause permanent mottling of teeth (Van Burkalaw, 1946). Because air temperature affects the quantity of water children drink, the maximum acceptable limit varies according to the annual average maximum air temperature. In the study area, the maximum fluoride concentration limit for public drinking water is 1.6 mg/L and most ground water contains much less than this amount.

Generally, fluoride concentrations are no greater than 0.4 mg/L. The only exceptions are for samples taken at well 24P-f1 (2.3 mg/L) and well 12R-o5 (1.5 mg/L). Both wells tap the Black Creek aquifer system which contains high fluoride in Horry and Georgetown Counties and other Coastal Plain areas (Siple, 1946, 1957; Zack, 1977). Additional data on the geochemistry of fluoride in the Black Creek aquifer system is contained in a report by Zack (1979).

SILICA

Silica (SiO_2) in ground water results from the decomposition of silicate minerals which are common in most rocks. For simplicity, silica is commonly considered to occur in water as finely divided or colloidal suspended matter, although reported as "dissolved". In natural water, silica occurs in concentrations of up to 40 mg/L (McKee and Wolfe, 1963, p. 225) and usually poses no problem to health or for most industrial uses. However, silica is undesirable in boiler feed water, where it forms scale on heater tubes and steam turbine blades, and in some pulp, paper, and rayon production processes.

Reported silica concentrations do not exceed 20 mg/L in Cretaceous aquifers in Sumter County. However, in Florence County, silica locally exceeds 20 mg/L and occurs in concentrations which are excessive for boiler feed water (5.0 to 40.0 mg/L limit), soda and sulfate pulp production (20 mg/L limit), or rayon production (25 mg/L limit). The greatest concentrations range from 30 to 40 mg/L and occur in aquifers of the Peedee and Black Creek systems.

Opaline claystone occurs throughout the Black Mingo Formation and high silica concentrations are common in this formation in much of the South Carolina Lower Coastal Plain. Therefore, shallow wells developed in or hydraulically connected to Black Mingo aquifers in southern Sumter County will probably yield high silica water.

CALCIUM AND MAGNESIUM

Calcium and magnesium are dissimilar in many of their chemical reactions, but are usually considered together because both are important factors in determining hardness and scale formation. Calcium compounds are less soluble than magnesium compounds, and where scale formation is a problem, calcium is the major cause.

Because large amounts of shell or limestone occur in some Black Creek, Peedee and shallow aquifers, ground water in these aquifers generally contains higher concentrations of calcium than magnesium. Reported calcium concentrations range from less than 1.0 mg/L to about 70 mg/L; magnesium concentrations are generally less than 8 mg/L. Locally, calcium concentrations in shell-bearing aquifers are lower than might be expected. In such cases, it is probable that clays have promoted ion exchange and the natural softening of ground water.

HARDNESS

There are two types of hardness in ground water: (1) carbonate hardness caused by calcium and magnesium bicarbonates, and (2) noncarbonate hardness caused mainly by dissolved metals and chlorides, sulfates, and cheleates of calcium and magnesium. Ground water with a hardness of more than 60 mg/L (as $CaCO_3$) is classified as hard to very hard (table 5). The hardness of water interferes with the cleaning action of soaps and forms a precipitate or scale on plumbing fixtures, boilers, and utensils when the water is heated. Carbonate hardness can be treated by the addition of soda-ash or lime-soda, or removed by heating. Noncarbonate hardness is more difficult to treat, but can be reduced with ion-exchange filters.

In general, ground water in Cretaceous and shallow aqufiers in the study area is very soft; nearly all analyses of ground water obtained from the Tuscaloosa and Black Creek aquifer systems indicate a total hardness of less than 20 mg/L as $CaCO_3$. Several samples obtained from Peedee and shallow Black Creek aquifers had a total hardness of between 40 and 75 mg/L; and, in Florence County, wells screened in these aquifers may yield water that approaches or exceeds 60 mg/L in hardness. Wells tapping the shallow aquifer system can be expected to supply very soft water except when developed in calcareous sands such as those of the Duplin Formation.

HYDROGEN-ION CONCENTRATION (pH)

The concentration of hydrogen ions in water determines whether the water is acidic, neutral, or basic. The concentration of hydrogen ion varies greatly, and, for convenience, is expressed as a negative logarithmic scale (base ten) to represent the absolute concentration. Values of pH that are less than 7.0 represent acidic solutions, 7.0 is neutral, and values of 7.0 to 14.0 are basic. pH is important because of its effect on mineral solubility and the rate of well corrosion or encrustation.

The pH of ground water in the study area varies from about 4.5 to 9.0. In Sumter and northern Florence Counties, ground water in Black Creek and Tuscaloosa aquifers generally has a pH of less than 6.5; the low pH values reflect close proximity to the major recharge areas and the predominence of Tuscaloosa (Middendorf) lithologies. In central and southern Florence County pH values of ground water from Black Creek aquifers range from 7.5 to 9.5. Generally, the pH of ground water from Black Creek and Tuscaloosa aquifers increases from west to east. Shallow aquifers can be expected to yield acidic ground water except where shell and limestone are common.

CARBON DIOXIDE

Carbon dioxide (CO_2) is a highly soluble gas and dissolves in water to form carbonic acid (H_2CO_3). Chemical analyses including values for "free CO_2" are generally reporting the sum of dissolved CO_2 and carbonic acid concentrations. In ground water, the main source of CO_2 is the aerobic or anaerobic decomposition of organic matter in soil. Carbon dioxide increases the acidity of ground water and favors the dissolution of carbonate and iron compounds.

Most of the analyses listed in table 6 represent laboratory measurements rather than field measurements. Because the solubility of CO_2 is dependent upon pressure and CO_2 soon escapes after ground water is pumped to the surface, laboratory measurements usually indicate lower concentrations than are actually present within the aquifer sampled. However, field measurements of CO_2 are available for municipal wells owned by the City of Sumter. The wells, which tap the Black Creek and Tuscaloosa aquifer systems, yield water containing 28 to 42 mg/L free CO_2. The concentrations are high and are in part responsible for the corrosive nature of ground water obtained from these aquifers in much of Sumter County.

Foster (1950) has suggested that high CO_2 concentrations (which correspond to low pH values) are attributable to carbonaceous material within aquifers. Lignitized wood fragments are common in Black Creek and Tuscaloosa aquifers, particularly in western Sumter County, and may augment the production of CO_2 in the soil zone of recharge areas.

CORROSION

Corrosive ground water is a notable problem in central and western Sumter County. Where wells are constructed without regard to the effects of corrosion, two problems may occur: (1) The well pumps sand because corrosion has enlarged the screen-slot openings, and (2) the well fails because the well screen is weakened and subsequently collapses. Corrosion may also occur at the joints in a well casing causing the casing to break while the well is in use or while pulling the casing out of the ground.

The principal factors causing this corrosion are high carbon dioxide concentrations and low pH, low calcium concentrations, low concentrations of dissolved solids, and undersaturation with respect to ferrous iron. The relative corrosiveness of ground water can be calculated and compared by using the Langlier saturation index (Langlier, 1936). A positive index indicates oversaturation with respect to calcium carbonate. A negative index indicates undersaturation and corrosive water. Saturation indicies for water pumped from the Tuscaloosa and Black Creek aquifer systems vary from about -5.0 to -3.0 in the Sumter area. Ground water in these systems increases in alkalinity to the southeast and probably becomes less corrosive.

CONTAMINATION

Contamination of both shallow unconfined and deep confined aquifers is a documented problem in Sumter and Florence Counties. There are four reported cases of contamination of shallow aquifers, and there are undoubtedly many other cases that have not been reported or recognized.

R. L. Shaw (1975) reported the contamination of a shallow aquifer by nickel. Analyses of samples from a small public water supply near Sumter revealed local nickel concentrations of as much as 90 mg/L. An investigation traced the source of ground-water contamination to the chemical handling area of a nearby battery manufacturing plant. The SCDHEC determined that 0.005 mg/L was the maximum acceptable nickel concentration for public water supplies, and the shallow wells were abandoned. According to Shaw (1975), the aquifer will not be an acceptable source of water supply for at least 20 years.

In other cases, the source of contamination has not been as readily identified. Although shallow aquifers near Sumter are known to be contaminated by petroleum products and by nitrates (Harris and Ferguson, 1978), the sources have not been determined with certainty.

Contamination of shallow aquifers can also occur on a large scale. Harris and Ferguson (1978) report that the excessive application of fertilizers may have a regional impact on shallow ground water in the Florence area.

In addition to contamination by the introduction of man-made substances into aquifers, contamination may be caused by wells which bypass the natural filtering system of soil and rock or which alter the hydraulic or chemical balance in the subsurface. Thus, increasing iron concentrations and the presence of Gallionella in City of Sumter wells exemplify the contamination of deep artesian aquifers.

SUMMARY AND RECOMMENDATIONS

Ground water occurs in abundance in Sumter and Florence Counties and can continue to supply the water demands of the area well into the future. Ground water is obtained from various geologic formations that have been combined into four major aquifer systems on the basis of their hydrogeologic properties. They are, in ascending order, the Tuscaloosa, Black Creek, Peedee, and shallow aquifer systems.

The Tuscaloosa aquifer system is the most permeable and productive. Ten- and 12-inch diameter wells tapping Tuscaloosa aquifers yield from 500 to 900 gpm per well in northern Florence County and as much as 2,000 gpm per well in parts of Sumter County. The specific capacities of these large-diameter wells range from 4 to 30 gpm/ft. Transmissivity increases from about 2,000 ft^2/day in Florence County to more than 9,000 ft^2/day in western Sumter County. Hydraulic conductivities range from 19 ft/day to 94 ft/day, increasing from east to west. Water quality is marked by low to neutral pH; low concentrations of dissolved solids; common occurrences of high iron concentrations; and, locally, corrosiveness. Dissolved solids concentrations and pH increase toward the southeast.

The Black Creek aquifer system is an equally important source of ground water. Large-diameter wells tapping the system yield up to 500 gpm per well. Specific capacities are generally less than 10 gpm/ft, but may be higher in western Sumter County. The hydraulic conductivity of Black Creek aquifers is about 30 ft/day in eastern Florence County, but lithologic changes and increases in well yields and specific capacities indicate that hydraulic conductivities may average more than 50 ft/day in western Sumter County. Black Creek aquifers yield good quality water. Iron concentrations are somewhat higher than in Tuscaloosa aquifers, and concentrations of more than 0.3 mg/L are common. Fluoride concentrations are highest in southeastern Florence County and probably increase down the hydraulic gradient. Alkalinity, hardness, pH, and dissolved solids also apparently increase down the hydraulic gradient.

The Peedee aquifer system underlies eastern Sumter County and central and southern Florence County. Peedee aquifers probably yield up to 50 gpm per well and contain water that approaches or exceeds 60 mg/L in total hardness and is above 7.0 in pH.

Shallow aquifers are composed of Tertiary and younger rocks that are less than 100 ft thick in most areas. Wells tapping these aquifers supply enough water for domestic and livestock use. Relatively high yields may be possible over a large part of northern and central Sumter County; as much as 350 gpm per well has been obtained locally. Water quality is variable, high iron concentrations are common, and calcium hardness is high in some shell-bearing sands.

The data now available provide only a rough sketch of the ground-water resources of Sumter and Florence Counties. More information is needed in this area in which nearly all water users are, and will continue to be, supplied by ground water. The Sumter-Florence-Darlington area is a popular industrial corridor along or near I-20 and I-95, and new water-using industries should be expected to locate here. Additional ground-water withdrawals can also be expected as new irrigation systems are constructed.

Because of increasing demands for water, reconnaissance-level and planning-level studies are needed to identify factors controlling the recharge, movement, availability, and quality of ground water. Particular emphasis should be placed on obtaining more well-performance, aquifer-hydraulics, and water-level data, particularly near the principal urban areas of Sumter and Florence. Especially needed are more data on single aquifers within the major aquifer systems.

There is also a great need for improved water-quality information. Most current information is confined to a few major aquifers in the principal urban areas and does not provide an adequate picture of water quality in less developed areas. Future studies should also address a number of specific problems and resources, including: iron concentrations and iron bacteria; the availability of ground water from shallow aquifers at Sumter; and Cretaceous aquifers in the Florence-Darlington area.

A cooperative project should be initiated by state and federal ground-water agencies and the City of Sumter to investigate iron problems in Sumter wells. Monitoring the variability in iron concentrations at the new Sumter water plant should begin as soon as possible. Accurate pumping schedules and complete analyses which include measurements of ferrous- and ferric-iron concentrations and Eh may be particularly significant. In addition, there is a possibility that ground water containing less than 0.3 mg/L of iron can be obtained in areas to the northeast of Sumter and this possibility should be explored.

The practicality of developing shallow aquifers at Sumter for municipal water supplies should also be studied. Records show that individual 50 ft to 100 ft deep municipal wells have yielded 250 gpm or more and have provided ground water containing less than 0.3 mg/L iron. If the shallow aquifers are to be used, enough water-quality, potentiometric, streamflow, hydraulic, and water-use data should be obtained to predict changes in water quality, effects of municipal withdrawals on existing shallow wells, and potential sources of shallow aquifer contamination.

A comprehensive shallow-aquifer study would include:

1. A thorough inventory of shallow domestic and industrial wells, particularly in the vicinity of possible well field sites. The inventory would identify wells that might be affected by large ground-water withdrawals, and could be used to locate wells suitable for water-level and water-quality monitoring.
2. An inventory of potential sources of contamination such as septic tanks; petroleum storage tanks; industries which make or use chemicals; and areas where pesticides and fertilizers are applied.
3. The construction of test wells to be used for water-level measurements, chemical sampling, and aquifer tests.
4. The establishment of a network to monitor seasonal water-level fluctuations and to construct potentiometric maps.
5. A chemical sampling program to map iron concentrations and to determine the occurrence of other chemical constituents, including ground-water contaminants.
6. Aquifer tests to be used in predicting well yields and water-level changes. These tests would also determine whether or not leakage from adjoining aquifers or confining beds will alter water quality in the aquifers being tested.

Public and industrial water systems in the vicinity of Florence and Darlington withdraw more than 9 Mgd from the Black Creek and Tuscaloosa aquifer systems. The transmissivity of these aquifer systems is low and, as a result, large drawdowns and interference between wells may eventually become a problem. Further study is needed to predict the effects of increasing withdrawals on water levels.

Computer models can be used to predict water-level changes, but have not yet been applied to Cretaceous aquifers in South Carolina. The Florence-Darlington area is a practical starting point for such a modeling program once sufficient data become available. Designing a water-level model will require:

1. Additional geophysical log data to further define the structure, thickness, and extent of the Black Creek and Tuscaloosa aquifer systems in the area of study.

2. A potentiometric map for the Black Creek and Tuscaloosa aquifer systems, so that recharge boundaries, withdrawal points, and flow direction can be determined.

3. A water-use inventory which includes all major municipal and industrial water users and monthly water use.

4. Aquifer test data to determine transmissivities, storage, and leakage.

5. A network of water-level recorders to be used as a comparison with model predictions and to calibrate the model.

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Table 2. Summary of well data, explanation.

Column

1. SCWRC Well No. - (see fig. 4)
4. Total depth - Depth of pilot hole
5. Diameter - Diameter of casing and screen
6. Altitude - Land surface - Estimate from topographic maps unless given to nearest tenth of ft.
7. Aquifer system - T: Tuscaloosa
   - BC: Black Creek
   - P: Peedee
   - S: Shallow
8. Use - PS: Public supply
   - OB: Observation, water level and/or water quality
   - D: Domestic supply
   - IR: Irrigation
   - I: Self-supplied industrial
   - N: Not used
   - AB: Abandoned (plugged or destroyed)
   - TH: Test hole
   - AH: Auger hole
   - M: Military
9. Logs - E: Electric log
   - G: Gamma log
   - D: Drilling log
   - C: Core
10. Chemical analysis - X: See Table 6.
12. Pumping test -
    - PT: Measured at pumped well
    - AT: Measured at observation well

APPENDIX

Table 2. Summary of selected well data.

SUMTER COUNTY

SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	STATIC WATER LEVEL		PUMPING TEST DATA					SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
										DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY		
22Q-h1	Mayewood School SU-122	Heater 5/58	100	6	125	BC	PS	D		5/11/58	14	5/11/58	PT		100	11	73-77, 93-97	Bronze screen
22P-g1	Alfred Scarborough SU-80	Heater 4/55	445	10	145	BC T	N	D E G		8/09/77	6.3				1000		188' screen between 109' and 422'	
22P-r1		SCGS 1969	65		145	S BC	AH	D										
22P-y1	Sumter Water Plant 2 Well No. 3 SU-132	Hartsfield 1968	742	12	145	T	PS	D E	X	5/02/68	44	5/02/68	PT	24	1865	13.3	406-414, 448-456, 480-488, 496-500, 504-524, 538-542, 550-574, 588-604, 618-626	Stainless steel screen
22P-y2	Sumter Water Plant 2 Well No. 1A SU-119	Layne-Atlantic 5/65	777	12	145	T	PS	D E	X								436-456, 484-494, 502-512, 550-610	Stainless steel screen
22P-y3	Sumter Water Plant 2 Well No. 1 SU-71	Layne-Atlantic 8/53	766	10	145	T	N	D E	X	9/02/53	Flow	9/02/53			1426		416-426, 436-446, 454-464, 484-494, 500-510, 522-532, 556-566, 574-584, 588-593, 609-614, 732-742	Flowed 3 gpm. Gallionella Identified
22P-y4	SIFCO Ind.	R. Singleton 1953	60	4		S	I								40			
22P-y5	SIFCO Ind.	R. Singleton 1948	180	8		BC	I								250			
22P-y6	SIFCO Ind.	R. Singleton 1952	60	4		S	I								20			
22P-y7	SIFCO Ind.	R. Singleton 1953	60	4		S	I								20			
22P-y8	SIFCO Ind.	R. Singleton 1953	60	4		S	I								20			
22P-y9	SIFCO Ind.	R. Singleton	60	4		S	I								25			
22Q-e1	Sumter Water Plant 2 Well No. 2 SU-84	Layne-Atlantic 4/59	758	10	145	T	N	D		5/12/59	6	5/12/59	PT	8	1404	9.7	452-482, 494-504, 510-520, 526-536, 547-557, 564-574, 594-604, 710-720	Stainless steel screen

Table 2. Cont'd.

SUMTER COUNTY

										STATIC WATER LEVEL			PUMPING TEST DATA					
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHANNEL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
22Q-e2	Sumter Water Plant 2 Well No. 2A SU-161	Layne-Atlantic 2/75	640	10	145	BC T	PS		X	4/23/75	55	4/23/75	PT	24	1500	15.3	446-476, 482-502, 522-572, 594-604	
23P-b1	Sumter Technical College	Heater 6/71	158	10	175	BC	IR	G C							86		Approx. 148-158	
23P-q1		SCGS 1962	80		180	S BC	AH											
23P-t1	Sumter Water Plant 1 Well No. 5 SU-69	Layne-Atlantic 1953	805	8	177	T	AB	D E	X	2/53	38	2/53	PT		500	12.8	525-608	
23P-t2	Sumter Water Plant 1 Well No. 1C SU-146	Layne-Atlantic 1973	804	12	177	BC T	PS	D E G	X								394-419, 470-545	Stainless steel screen
23P-t3	Sumter Water Plant 1 Well No. 1A SU-9	Layne-Atlantic 2/44	714	8	177	T	OB	D		3/25/44	30	3/25/44	PT		1400	17	508-528, 550-570, 605-625	Everdur screen
23P-t6	Sumter Water Plant 1 Well No. 3A SU-111	Layne-Atlantic 12/63	717	12	177	BC T	PS	D E	X	12/63	65	12/63	PT		2474	27.2	336-346, 401-406, 413-418, 473-483, 490-505, 525-550, 565-575, 580-590, 598-608	
23P-t7	Sumter Water Plant 1 Well No. 4A SU-140	Layne-Atlantic 10/69	801	12	177	BC T	PS	D E G	X	12/15/69	63.3	12/15/69	PT		1401	29.2	325-380, 400-430, 500-520, 540-580, 600-620	
23P-t8	Sumter Water Plant 1 Well No. 4 SU-64	Layne-Atlantic 1951	795	10	177	BC T	N	D	X	6/51	45	6/51	PT		700 900	25 28.1	493-503, 516-526, 542-552, 562-572, 592-607	Stainless steel screen
23P-t9	Sumter Water Plant 1 Well No. 3 SU-56	Layne-Atlantic 4/47	735	10	177	T	N	D G				7/29/47			1100		518-538, 600-620, 690-710	526' 3 ppm Fe 720' 1.5-2 ppm Fe
23P-t10	Sumter Water Plant 1 Well No. 2 SU-7	Layne-Atlantic 6/41	737	8	177	BC T	AB	D		8/23/41	24	8/23/41	PT		1250	29.2	415-435, 508-528, 570-590, 605-625	Everdur screen
23P-t11	Sumter Water Plant 1 Well No. 2A SU-104	Layne-Atlantic 11/61	740	10	177	BC T	PS	E D	X	6/22/61	41.3	6/26/61	PT	8	1714	14.3	320-345, 400-425, 470-480, 490-495, 505-515, 535-540, 560-565, 600-615	

Table 2. Cont'd.

SUMTER COUNTY

										STATIC WATER LEVEL			PUMPING TEST DATA					
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
23P-w1	Sumter Iris Test Well SU-65	Layne-Atlantic 4/52	782	8	165		TH	D E										
23Q-d1		SCGS 1962	95		167	S BC	AH	D										
23Q-i2	Sumter Water Plant 4 Well No. 3 SU-165	Layne-Atlantic 1978	753	12		BC T	PS	D E G C									280-350, 380-390, 413-438, 484-514, 520-550, 564-584, 600-625	C. A. for 160-170 ft Interval (Black Creek) Fe = 5.9 mg/L Hardness = 24 mg/L
23Q-r1	Sumter Water Plant 3 Well No. 4 SU-153	Hydraulics Supply 5/76	783	12	165	T	PS	E G	X	8/30/76	77.6	8/30-31/76	PT	24	1400	14.3	533-633	.060 opening Stainless steel. C.A. at several screen settings
23Q-r2	Sumter Water Plant 3 Well No. 3 SU-136	Layne-Atlantic 10/65	725	12	165	BC T	PS	D E	X	10/12/65	36.5	10/12/65	PT	24	1750	18.6	292-317, 550-570, 580-590, 606-626, 638-663	Stainless steel screen
23Q-r3	Sumter Water Plant 3 Well No. 1 SU-120	Layne-Atlantic 1/65	760	12	165	BC T	PS	D E	X	10/08/65	33	10/8/65	PT	24	1800	18.7	294-304, 400-410, 542-582, 600-620, 642-652, 660-670	Stainless steel screen
23Q-r4	Sumter Water Plant 3 SU-115	Layne-Atlantic	234		165	BC	AB	D E										Temporary water supply
23Q-r5	Sumter Water Plant 3 Well No. 5 SU-155	Layne-Atlantic 7/77	936	12	165	T	PS	D E G C	X	11/08/77	84.7	11/8-11/77	AT	72	2104	10.9	550-560, 572-602, 614-639, 659-705	Stainless steel screen Chem. Anal. for 3 depth settings
23Q-r6	Sumter Water Plant 3 Well No. 2 SU-133	Layne-Atlantic 9/65	710	12	165	BC T	PS	D E	X	11/18/76 10/16/65	76.2 47	11/18/76 10/16/65	PT PT	1.7 8	1000 1800	9.7 15.2	296-326, 562-582, 612-622, 642-682	Stainless steel screen
23Q-t1	Pocalla Subdiv. SU-170	Layne-Atlantic	203	6	165	BC	PS	D			14		PT		250	8.1		15' of stainless steel
23R-f1	Furman School SU-126	Heater 11/60	131	8	160	BC	N	D		12/02/60	18	12/02/60	PT		120	3.7	60-75, 123-128	
240-r1	Hillcrest School SU-127	Heater 3/56	302	8	390	BC	N	D		4/11/56	221	4/11/56	PT		100 75 50	5.2 5.0 5.5	232-236.5, 264-268.5, 284-288.5	
240-v1	Dazell Community SU-187	Jennings	160	6	225	BC	PS		X						160 app.		120-160	Plastic screen
240-v2	Dazell Community SU-188	Jennings			228													
24P-c1	Shaw AFB No. 10 SU-144	Heater 1973	293		250	BC	M	D E		6/26/73	53	6/26/73	PT	8	250	42	26-30, 150-154, 170-174, 186-194, 197-201, 224-230, 275-283	

Table 2. Cont'd.

SUMTER COUNTY

											STATIC WATER LEVEL		PUMPING TEST DATA					
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
24P-c2	Shaw AFB No. 6 SU-86	Layne-Atlantic 5/25/59	75	3	210	S?	M				17	05/19/59			20		70-75	
24P-d1	Shaw AFB No. 5 SU-85	Heater 7/59	352	10	300	BC	M	D		8/5/59	120	8/05/59	PT		850	17	167-177, 185-190, 216-221, 230-235, 250-260, 268-278	Repaired 1964; screen settings changed.
24P-d2	Shaw AFB No. 5A SU-137	Layne-Atlantic 1964	345	10	300	BC	M	D,G E	X	1964	125	1964	PT		752	17.5	227-292	Stainless steel
24P-e1	J. E. Soler SU-182	Heater 12/57	166	4	310	S	D	D			159	12/57	PT		8	4	20 feet	
24P-e2	High Hills RWD SU-145	Heater 3/74	492	8	348	BC	PS	D E	X		190		PT	24	465		242-272, 302-322, 382-387, 392-402	Stainless steel screen
24P-e3	High Hills RWD SU-166	Heater 1974	460	8	340	BC	PS	D	X	3/7/74	165	3/07/74	PT	24	461	4.9	292-330, 390-404, 424-444	
24P-e4	Long Branch Baptist Church SU-184	Heater 3/64	260	4	350	BC	PS	D		3/64	235	3/64	PT		15	1	257-261	Brass screen
24P-e5	Heater Utilities SU-142	Heater 5/70	350	6,8,10	325		PS	D		5/15/70	190	5/15/70	PT		300	15?	299-307, 309-317, 318-328	
24P-e6	Heater Utilities SU-128	Heater 6/58	300	8,10	320		PS	D		7/14/58	180	7/14/58	PT		239	5.8	265-274, 287-296	
24P-e7	High Hills RWD SU-147	Heater 12/73	605		335		TH	D										T. H. next to 24P-e3
24P-f1	Shaw AFB No. 4 SU-72	Layne-Atlantic 7/60	515	10	360	BC T	M	D E	X	8/60	207	8/60	PT		600	18.5	270-340	Repair of 1956 well Stainless steel
24P-f2	Shaw AFB No. 3 SU-72A	Layne-Atlantic 5/51	401	10	315	BC T	M	D		7/7/51	60	7/07/51	PT		503	7.2	240-250, 260-270, 280-290, 330-340	Repair 1956
24P-f2	Shaw AFB No. 3 SU-72A	Layne-Atlantic 9/56 (Repaired)	401	10	315	BC	M	D	X	9/19/56	145	12/13/56	PT	12	602	13.8	200-210, 235-265	
24P-f3	J. B. Baker SU-183	Heater 1/58	268	6	300	BC	N	D		2/58	197	2/58			45		8 feet	Sand problems
24P-f4	Sumter Concrete Co.	Heater 9/66	250	6	328	BC	IN	D			220	9/66	PT		50	3.6	10 feet	Stainless steel screen
24P-g1	Shaw AFB No. 1A SU-159	Layne-Atlantic 8/75	288	8	250	BC	M	D E	X	9/15/75	75	9/15/75	PT	7	650	12	182-207, 227-242	
24P-h1	Shaw AFB No. 8 SU-138	Layne-Atlantic 7/64	100	6	222		M	D	X	7/64	24	7/64	PT		85	1.5	85-95	Stainless steel screen
24P-i1	Shaw AFB No. 7 SU-87	5/59	95	4	212	BC	PS			5/59	17	5/59	PT		40	4.4	90-95	

Table 2. Cont'd.

SUMTER COUNTY

										STATIC WATER LEVEL			PUMPING TEST DATA					
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
24P-i2	Shaw AFB No. 9 SU-171	1966	108	6	210	BC	M										85-95	
24P-k1		SCGS 1963	75			S BC	TH	D		6/19/63	16							
24P-o1	Shaw AFB No. 2 SU-26	Layne-Atlantic 1941	160	8	250	BC	M	D							450		140-160	
24P-o2	J. H. Ray	Heater 12/62	207	4	290	BC	PS	D									203-207	Sand problems
24P-o3	J. H. Ray SU-168	Heater 3/58	187	4	308	BC	PS	D	X						15		183-187	
24P-o4	J. H. Ray SU-169	Heater 7/58	187	4	308	BC	PS	D			152	7/58			15	.5	183-187	
24Q-b1		SCGS 1962	65		184	S BC	AH	D		10/4/62	20							
24Q-o3		SCGS 1962	50		200	S	AH	D		8/11/62	25							C-VC sand @ 34-50'
24S-d2	Pinewood SU-151B	Hydraulics Supply 1976	760	8	185	M	PS	D E	X	7/20/76	58.6	7/20/76	PT	7	265	5.8	700-750	No. 50 slot stainless steel. Fe & pH at 726-736. 500 - 510
250-g1	Allen Wooten SU-156	Heater 5/77	350	10	165	M	IR	D E		6/8/77	25.3	6/8-9/77	PT	24	1212	35.6	145-160, 167-172, 185-205, 217-232, 243-258, 276-281, 286-296, 308-318	
25N-q2	Marsh Farm SU-160	Berrie 1/79	335	10,12	175	BC T	IR	D E C							2000		110-155, 156-326	
25Q-a1	Wedgefield Statesburg Water District SU-83	Heater 4/57	234	8	280	BC	PS	D	X			4/16/57			200		74-84 , 104-109, 186-191, 204-208, 218-224	
25Q-a2	Wedgefield Statesburg Water District SU-154	Demco 5/69	245	4	280	BC	PS	D		5/20/69	139	5/20/69	PT	24	100	2.4	210-238	Stainless steel, .060 opening
25N-w1	Rembert RWD SU-141	Demco 1970	165	6	230		PS	D G	X	2/9/70	69.7	2/9/70	PT	23	55	3.2	145-161	Stainless steel screen
25N-w2	Rembert RWD SU-167	Demco 1970	155	6	230		PS	D G		3/2/70	63	3/2/70	PT	24	60	4.2	139-155	Stainless steel screen

Table 2. Cont'd.

FLORENCE COUNTY

										STATIC WATER LEVEL		PUMPING TEST DATA						
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
12Q-v1	Wellman Indus. FLO-141	Layne-Atlantic 9/61	429		55	BC	I	D E		10/07/76	96	10/07/76	PT	1	393	5.4	240-275, 311-321, 370-400	
12R-b1	Wellman Indus. FLO-116	Layne-Atlantic 1/54	434	6	80	BC	N	D		3/01/54	25	3/01/54	PT	24	215	2.5	270-280, 390-405	
12R-b2	Wellman Indus. FLO-155	Layne-Atlantic 6/68	936	12	80	T	I	D E	X	10/08/76	55.67	10/08/76	PT	1	668	13.8	789-829, 830-870	Stainless steel screen
12R-b3	Wellman Indus. FLO-148	Layne-Atlantic 11/65	507	10	79	BC	I	D	X	11/65	90	11/65	PT		500	9.3	264-279, 290-300, 380-420, 486-496	Stainless steel screen
12R-c1	Johnsonville No. 2 FLO-185	Pierce Ditching 5/72	460	10	83		N	D									296-336, 405-415	Pumped sand
12R-g1	Johnsonville No. 3 FLO-178	Pierce Ditching 10/73	403	8,10	80	BC	PS	D			92		PT	12	408	4.7	292-302, 326-366, 376-386	
12R-b4	Johnsonville No. 1 FLO-184	Southern Gulf 6/63	423	10	90	BC	PS	D	X		94		PT	24	350	5.3	285-295, 320-350, 365-375, 390-410	
12R-i1	Wellman Indus. FLO-180	Layne-Atlantic	424		65		I	D				1976	PT		216	3.1		
13M-p1	E. I. DuPont FLO-126	Sydnor 5/59	715	8	95	BC T	N	E D	X	4/24/59	40.7	4/24-5/18/54	AT	480	510		242-262, 274-279, 335-345, 377-382, 399-404, 437-442, 472-482, 675-695	
13M-p3	E. I. DuPont FLO-128	Sydnor 4/59	802	4	98.6	BC T	N	D E									6 Screens between 265-690	DuPont Ob. Well 1
13M-p2	E. I. DuPont FLO-129	Sydnor 4/59	702	4	97.7	BC T	OB	D		4/24/59	35.7	3/59			165		7 Screens between 268-691	DuPont Ob. Well 2 C.A. @ 5 depth settings
14M-t1	E. I. DuPont FLO- 130	Sydnor 4.59	802	4	99.4	BC T	N	D E	X								5 Screens between 260-691	DuPont Ob. Well 3
130-h1	J. P. Stevens Co. No. 2 FLO-151	Heater 5/66		10	92	BC	I		X								131-135, 140-143, 166-176, 202-210	
130-h2	J. P. Stevens Co. No. 1 FLO-152	Heater 6/66	518	10	92	PD BC	I	D E	X			5/16/66	PT	250			117-125, 127-133, 149-165, 172-180, 206-210	Chem. Anal. for 9 depth settings
13P-d1	Pamplico No. 3 FLO-147	Gulfstan 1/65	405	8	80	BC	PS	D E	X		40	2/03/65	PT	12	500	7.0	210-230, 250-260, 270-300	Stainless steel shutter
13P-e1	Pamplico FLO-10		202	10	80	BC	PS	G			19				100	1.3	182-192	Renovated 1974
13P-e2	Pamplico FLO-11		157	10	80	BC	N				20				50	1.0	147-157	

Table 2. Cont'd.

FLORENCE COUNTY

										STATIC WATER LEVEL			PUMPING TEST DATA					
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
14M-k1		SCGS 1968	50		95	S BC	AH	D		8/21/68	8							F-M sand @ 23-46 ft
14M-p1		SCGS 1969	40		95	S BC	AH	D										
15M-p1	Florence No. 16 FLO-125	Sydnor 12/58	740	12	135	BC T	AB	D E	X	1958	85	1958	PT	24	1000	11.0	260-295, 320-325, 330-352, 356-366, 405-422, 485-495	Stainless steel screen
15R-y1	FCX FLO-104	Heater 6/54	343	8	70	BC	I	D E		7/12/54	18	7/12/54	PT		150	1.6	152-157, 198-203, 242-247	
16M-r1	Florence No. 21 FLO-154	Layne-Atlantic 11/67	825	12,16	140	T	PS	D	X	12/04/67	123	12/4-5/67	PT	25	1950	18.4	303-343, 368-378, 386-396, 420-435, 445-460, 476-486, 532-547, 622-632, 681-706	Stainless steel screen
16M-r2	Florence No. 12 FLO-87	Layne-Atlantic 7/50	758	10	140	T	N	D	X	8/01/50	3	8/01/50	PT		750	4.4	385-400, 450-460, 470-480, 620-635, 650-670, 680-705	
16M-s1	Florence No. 10 FLO-5	Layne-Atlantic 8/44	768	10	140	T	AB	D	X			9/24/44			740		320-330, 375-395, 530-540, 580-600, 620-630	Everdur screen
16M-s2	Florence No. 8 FLO-2	Layne-Atlantic 6/30	860	8,10,13	140	BC T	AB	D		12/12/30	Flow	12/12/20			1179		200-220, 320-330, 482-492, 543-563, 698-728	
16M-s3	Florence No. 17 FLO-127	Sydnor 5/58	750	10	140	T	AB	D	X			1958	PT		700 1000	12.0 10.0	No. 20 slot 309-327, No. 30 slot 376-409, 424-434, 440-448, 464-495	304 Stainless steel screen .030 slot
16M-s4	Florence No. 4	Virginia Mach. and Well Co. 11/30	860	8,10	142	BC T	AB	D							400			
16M-s5	Florence No. 6 FLO-3	Layne-Atlantic 12/30	736	6,8	143	BC T	AB	D	X	12/22/30	41	12/22/20	PT		1120	14.2	208-220, 315-330, 424-435, 533-544, 617-638, 713-724	Renovated 1943
16M-L1	Florence No. 11 FLO-33	Layne-Atlantic 6/47	740	10	145	T	AB	D	X	8/06/47	76	8/06/47	PT		1150	13.7	325-330, 400-405, 445-455, 558-588, 628-648	Everdur screen
16M-t1	Florence No. 9 FLO-4	Layne-Atlantic 12/36	728	10,8	145	BC T	AB	D		1/05/37	50	1/05/37	PT		1180	10.7	261-271, 319-334, 384-389, 440-450, 565-575, 615-625, 706-726	Repaired 1944

Table 2. Cont'd.

FLORENCE COUNTY

										STATIC WATER LEVEL		PUMPING TEST DATA						
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
16M-t2	Florence No. 9A FLO-198	Layne-Atlantic 1953	653		145		N	E	X									
16M-t3	Florence No. 15 FLO-112	Heater 6/55	398	10	140	BC T	AB	D	X	7/05/55	60	7/05/55	PT		800 1000	10.2 10.5	150-154, 178-182, 196-200, 222-226, 304-308, 316-324, 334-338, 346-350, 360-364, 374-378	
16M-t4	Florence No. 20 FLO-149	Layne-Atlantic 5/67	765	10	140		PS	D E	X	8/08/67	123	8/08/67	PT		721	4.9	Estimated 450-465, 555-570, 640-650, 715-765	1958 T. H. at site
16M-v1	Florence No. 18 FLO-140	Layne-Atlantic 1961	712	12	111	T	PS	D E	X	4/21/61	49	4/24-25/61	PT	24	2100	21.5	344-444, 454-459, 622-627, 660-680	
16M-w1	Florence NO. 19 FLO-146	Layne-Atlantic 4/62	690	12	120	T	PS	D E	X	4/23/62	53	4/23-24/62	PT	24	1400	11.3	354-414, 459-464, 490-505, 555-590, 620-660	
16M-w2	Florence No. 14 FLO-103	Carolina Drilling and Equipment Co. 1954	715	10	107.7		N	D		1954	29	1954	PT	24	600	8.2		To basement? Test well
16M-x1	Florence No. 22 FLO-161	Layne-Atlantic 10/70	738	12,16	125	BC T	PS	D E G	X	7/15/71	24.5	7/15-18/71	AT	71	1250	8.6	250-272, 292-343, 382-408, 436-463, 629-660	Stainless steel screen
16M-u1	State of S. C. FLO-150	Heater 9/55	436	8	110	T	PS	D		9/20/55	84	9/20/55			400 est.		416-436	Repair
16Q-k1	Lake City FLO-105	Heater 4/54	434	10	75	BC	PS	D E	X	5/18/54	4	5/08/54	PT		1250 1000 550	11.8 10.0 10.0	152-157, 232-242, 289-294, 314-319, 349-354, 372-377, 397-402, 416-426	Stainless steel screen
16Q-k2	Lake City FLO-17	Layne-Atlantic 2/47	617	10	65	BC	PS	D	X			3/11/47	PT		250	2.5	451-481	No. 7 opening Everdur screen
16Q-t2	Lake City FLO-162	Heater 5/69	602	10	75	BC T	PS	D E	X	7/14/69	15	7/14/69	PT	24	750	11.5	160-164, 202-206, 238-242, 292-300, 316-320, 374-378, 418-422, 468-472, 516-524, 540-544, 552-556	Stainless steel screen
17M-t1	Florence No. 23 FLO-179	Hartsfield	578	12	140	T	PS	E	X				PT		1300	6.5	306-314, 320-324, 328-332, 340-400, 406-410, 418-426, 438-442, 448-452, 456-468, 478-482, 500-504, 532-554, 570-578	Stainless steel screen

Table 2. Cont'd.

FLORENCE COUNTY

										STATIC WATER LEVEL			PUMPING TEST DATA				
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER (IN)	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS	CHEMICAL ANALYSIS	DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
17M-v1	Union Carbide FLO-160	B. Carson 8/66	580	12	140	T	N	D E									385-435	
17M-v2	Oakdale Golf Club	Ackerman 7/65	504	6	135	T	IR	D									369-399	Stainless steel screen
17N-c1	Sheraton Inn	Pierce Ditching 1969	208		140	BC	PS	E G										
17N-e1		SCGS 1969	50		145	S PD		D										
18N-i1	Timmonsville FLO-85	Layne-Atlantic	549	8	142	BC T	PS	D		6/24/49	14	6/24/49			756		235-240, 260-270, 410-415, 480-485, 505-515	Everdur screen
18N-i2	Timmonsville FLO-153	Layne-Atlantic 10/67	600	8	145	T	PS	D E	X	2/08/68	15	2/8-9/68	PT	24	517	5.2	355-395, 445-475	
18N-L1	A.Q. Industries FLO-118	Layne-Atlantic 9/53	302	6	142	BC	N	D E		9/21/53	26.5	9/21/53	PT		488	8.8	211-221, 236-256	Stainless steel screen
18P-s1	Olanta No. 1 FLO-114	Heater 1955	366	8	110	BC	PS	D E	X	12/21/55	8	2/21/55	PT		450	6.3	240-244.5, 296.5-274, 324-328.5, 333-337.5	
18P-v1	Olanta No. 2 FLO-156	Layne-Atlantic 1968	545	8	100	BC	PS	D E	X	5/13/68	5	5/13-15/68	PT	36	306	3.4	175-185, 200-220	Renovated 1976
19N-w1		SCGS 1969	65		145	S PD	AH	D										

										STATIC WATER LEVEL		PUMPING TEST DATA						
SCWRC WELL NUMBER	OWNER/ USGS NO.	DRILLER/ DATE DRILLED	TOTAL DEPTH (FT)	DIAMETER INCHES	ALTITUDE LAND SURFACE	AQUIFER	USE	LOGS		DATE	ABOVE (+) OR BELOW LAND SURFACE	DATE	TYPE	DURATION (HR)	DISCHARGE (GPM)	SPECIFIC CAPACITY	SCREEN SETTINGS (FT BELOW LAND SURFACE)	REMARKS
WILLIAMSBURG COUNTY																		
12S-b1	Hemingway WIL-65	Layne-Atlantic 8/70	897	8	60	T	PS	D E		8/12/70	Flow				743		826-884	Stainless steel screen
DARLINGTON COUNTY																		
16L-q1	Fiber Indus. DAR-89	Layne-Atlantic 2/73	660	12	130	T	I	D E	X	4/16/73	98	4/10/73	AT	8	500	3.7	530-550, 576-586, 604-624	
16L-q2	Fiber Indus. DAR-88	Layne-Atlantic 11/72	615	4	130	T	D	D E G	X	4/14/73	89						532-553, 574-595	Well destroyed
LEE COUNTY																		
190-g2	Lynchburg LE-19	Layne-Atlantic 1/73	755	8	140	T	PS	D E G		1/18/73	Flow	3/13/73	PT	24	798	5.9	390-415, 466-486, 496-506, 526-536	
190-g1	Lynchburg LE-18	Layne-Atlantic 11/72	800	8	140	T	PS	D G E	X		Flow		PT	24	805	10.5	316-336, 440-445, 456-466, 486-511	
RICHLAND COUNTY																		
26R-c1	Hercules RIC-63	Sydnor 6/74	594	10	145	T	N	D E G	X	8/06/74	23.3	8/06/74	PT	24	2000	22.1	417-420, 425-445, 456-476, 478-498, 500-520, 522-542	
26Q-x1	Hercules RIC-58	Sydnor 11/73	670	4	165	T	PS	D E G		12/16/73	40	12/16/73	PT	24	60	10.9	452-492, 503-563	

Table 3. Summary of hydraulic coefficients.

Well	Location	Aquifer System	Date of Test	Transmissivity (ft^2/d)	Hydraulic Conductivity	Storage Coefficient	Test By
12R-g3	Johnsonville	Black Creek	Oct., 1973	1,500	26	Not Determined	Pierce Ditching Co.
13M-p1	Mars Bluff	Black Creek Tuscaloosa	Apr., 1959	2,100	31	0.0008	E. I. Dupont Co.
13P-d1	Pamplico	Black Creek	Feb., 1965	3,100	51	Not Determined	Gulfstan Corp.
16L-q1	Fiber Ind.	Tuscaloosa	Apr., 1972	940	19	0.0003	Lyane-Atlantic
16M-v1	Florence	Tuscaloosa	Jun., 1961	2,400	19	0.0006	Layne-Atlantic
22P-y1	Sumter Water Plant #2	Tuscaloosa	May, 1968	5,400	54	Not Determined	Hartsville Water Co.
23P-t9	Sumter Water Plant #1	Black Creek Tuscaloosa		10,900		Not Determined	(From Siple, 1957)
23Q-r5	Sumter Water Plant #3	Tuscaloosa	Nov., 1977	6,200	54	0.0002	Palmer and Mallard
24S-d2	Pinewood	Tuscaloosa	Apr., 1976	2,800	56	Not Determined	Sydnor Hydrodynamics
26Q-x1	Hercules Ind. Wateree	Tuscaloosa	Oct., 1974	9,000	90	0.0001	Sydnor Hydrodynamics

Table 6. Summary of selected chemical constituents.

Column 3.

C = Commercial Laboratory

S = South Carolina Dept. of Health and
Environmental Control or
South Carolina Water Resources Commission

U = U. S. Geological Survey

Concentrations given in mg/L (milligrams/liter)

Table 6. Summary of selected chemical constituents.

SUMTER COUNTY

Well Number	Sample Depths	Laboratory	Collection Date	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Total Alkalinity	Bicarbonate Alkalinity (HCO_3)	Carbonate Alkalinity (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Carbon Dioxide (CO_2)	Dissolved Solids (Residue on evaporation)	Hardness (as $CaCO_3$)		Total Hardness	Specific Conductance (Micromohs at 25°C)	pH
																					Calcium Magnesium	Non-Carbonate			
22P-y1	406-626	C	9/19/68	9	1.1	.0	4	2				30	.0	6	3	.1		1.0	300	38			18		5.3
22P-y1	406-626	S	2/22/78		0.3	0.05	0.9	0.6	3.2		6	6	0	10	3	0.1	0.02	0.05	34	20	5	0	5	29	5.7
22P-y2	436-610	C	5/08/75	14	2.0	.0	2.4	1.2	9		15	15	.0	10	8	.0			32	51			11	72	6.3
22P-y2	436-610	S	2/14/78		3	0.05	2.0	1.3	2.8		17	17	0	10	3	0.1	0.02	0.06	34	6	15	0	15	50	6.0
22P-y3	416-742	C	11/20/61	16	2.5	.0	8.5	3.5				24	.0	.0	12				13	38			12		6.3
22Q-e2	446-604	C	5/08/75	14	2.0	.0	2.4	1.2	9.0		15	15	.0	10	8	0.0			32	51			11	72	6.3
23P-t1	525-608	C	11/20/61	18	7.3	.0	4.0	.0				8	.0	.0	10				28	21	4		4		4.9
23P-t2	394-545	S	2/14/78		3	.05	0.9	0.7	1.4		3	3	.0	10	2	0.1	0.02	0.05	34	24	3	7	10	32	5.5
23P-t6	336-608	S	2/14/78		2	.05	1.0	0.7	1.5		6	6	.0	10	3	0.1	0.02	0.05	38	16	6	3	9	33	5.5
23P-t7	325-620	S	2/14/78		5	.05	2.0	1.1	1.4		16	16	.0	10	3	0.1	0.02	0.05	12	4	16	3	19	45	5.9
23P-t8	493-607	C	11/61	16	1.48	.0	4.0	.0				4.0	.0	.0	7.0				24	22	4		4.0		4.8
23P-t11	320-615	S	2/14/78		6	.05	2	1.1	1.2		19	19	0	10	3	.01	.02	.05	38	8	19	3	21	50	6.2
23Q-r1	673-683	C	6/1/76		3.8		.52	.53			15	15	.0		15								6.0		6.4
23Q-r1	609-619	C	6/1/76		1.8		.45	.52			9	9.0	.0		15								6.0		6.2
23Q-r1	548-558	C	6/1/76		1.86		.57	.93			11	11.0	.0		13.5								8.0		6.2
23Q-r2	294-304	C	6/1/76		3.16		2.06	1.26			30	30.0	.0		11.5								20.0		7.5
23Q-r2	292-663	C	10/18/65		1.2		4.0	.7			15	15	.0		7				17	40			13		6.2
23Q-r2	292-663	S	2/22/78		3	0.06	3	0.9	2.2		29	29	0		3	0.48	0.02	1.64	34	52	11	0	11	64	6.4
23Q-r3	294-670	C	10/13/65		.1		5.2	1.5			18	18	.0		6				10	47			19		6.3
23Q-r3	294-670	S	2/14/78		3	0.05	4	1.3	3.2		16	16	0	10	3	0.1	0.12	0.59	32	8	16	4	20	56	6.1
23Q-r5	266-679	S	8/01/77		1.6																				
23Q-r5	193-203	S	8/04/77		5.0																				
23Q-r5	87-97	S	8/09/77		.18																				
23Q-r6	296-682	S	2/22/78		4	0.09	4	1.3	2.6		30	30	0	10	3	0.43	0.02	1.41	36	66	15	0	15	60	6.4
240-v1	120-160	C	5/19/64		.02		4	.0			4	4	.0		13				22	49			10		5.6
24P-d2	227-292	U	2/01/72	8.8	.183		.2	.2	39			95	.0	1.0	4.4	.4	.4			102		.0	2	165	6.9
24P-e2	242-402	S	6/21/74		.3		.3	.3			2				4					30					4.7
24P-e2	242-402	S	2/22/78		0.1	0.05	0.3	0.23	2.8		4	4	0	10	3	0.1	0.22	0.05	34	28	2	0	2	16	4.6
24P-e3	292-444	S	2/22/78		0.1	0.05	0.4	0.23	2.0		0	0	0	10	3	0.1	0.03	0.05	42	36	0	2	2	20	4.6
24P-f1	270-340	U	1/31/72	7.8	.377		.3	.2	5.7			0	.0	1.0	4.0	2.3	1.7			23		2	2	58	4.0
24P-f2	200-265	U	2/01/72	8.1	.072		.4	.3	3.8				.0	2.0	3.1	.0	5.2			23		2	2	38	4.3
24P-g1	182-242	C	10/13/75	8	6.0	.0	2.8	.5	1.9		7	7	.0	1	4	.06			13	19			9	32	6
24P-h1	85-95	U	2/01/72	5.9	.287		.7	.8	4.3			2	.0	.6	4.6	.0	7.2			25		4	5	31	5.3
24P-o3	183-187	S	2/17/76		.1	.05	1.2	.6			2				4	.1	2.40			30			6		4.8
24S-d2	700-750	C	3/22/76	12	.12	.0	4	.7	33.5		70	70	.0	.0	4	0.1			6	138			13	168	7.7
24S-d2	726-736	C	3/16/76		.24																				8.1
24S-d2	500-510	C	3/19/76		.32																				8.05
24S-d2	170-180	C	3/23/76		4.80																				6.5
25N-w1	145-161	S	2/09/70		.47						0				1					26					4.4
25Q-a1	74-224	C	5/11/67		.05						5	5	.0		7				19	25			5		5.7
Hagood	Rafting Creek	U	9/25/68	7.5	1.6	.08	.6	.5	3.8	.6	3			2.4	5.8	0.1	0.9			31	4	0		29	5.6 F

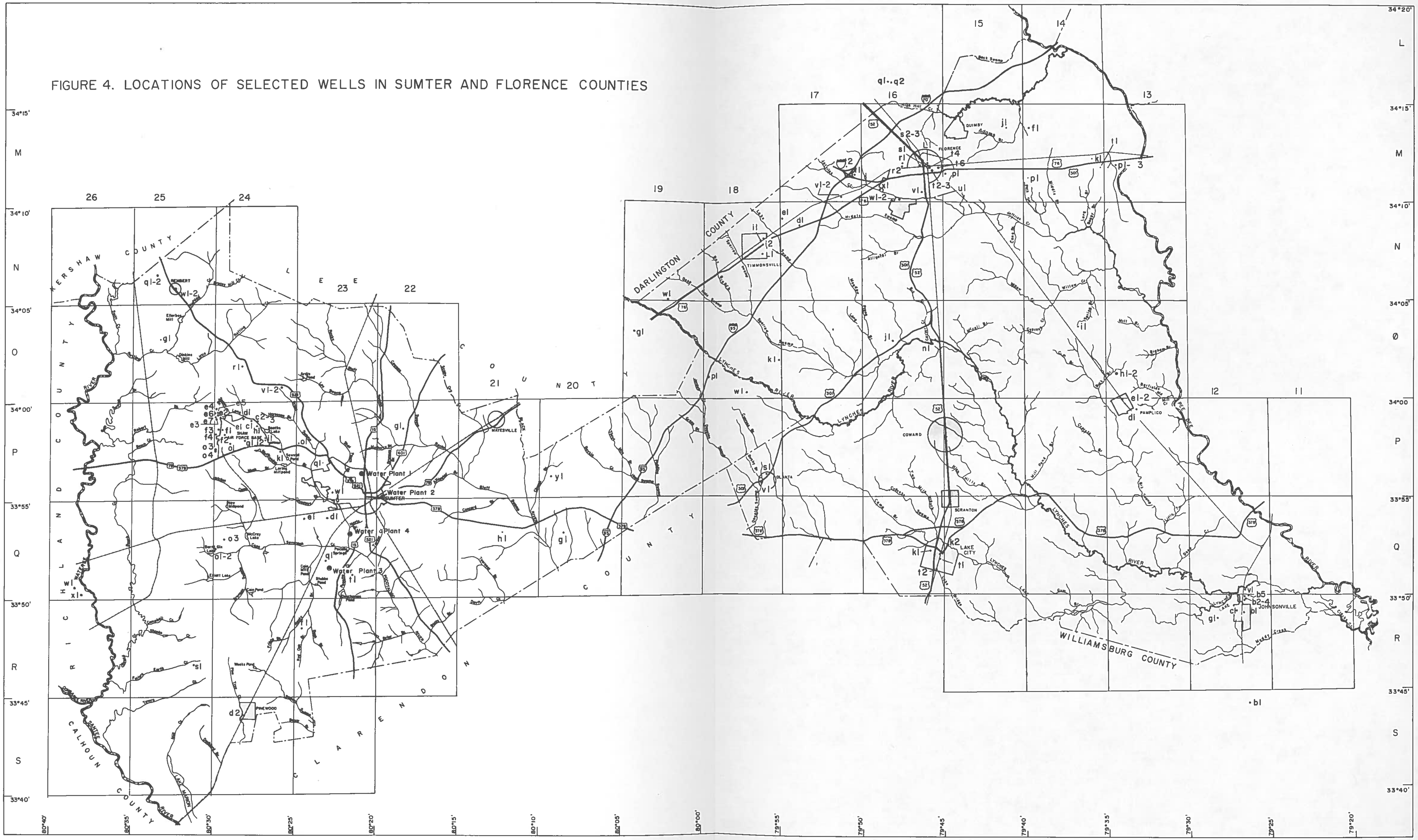
Table 6. Cont'd.

FLORENCE COUNTY

Well Number	Sample Depths	Laboratory	Collection Date	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Total Alkalinity	Bicarbonate Alkalinity (HCO_3)	Carbonate Alkalinity (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Carbon Dioxide (CO_2)	Dissolved Solids (Residue on evaporation)	Hardness (as $CaCO_3$) Calcium Magnesium	Hardness (as $CaCO_3$) Non-Carbonate	Total Hardness	Specific Conductance (Micromohs at 25°C)	pH
12R-b4	285-410	C	9/13/63		.01						188	188	0		7				.0	283			6		8.8
12R-b2	789-870	C	4/16/68		.17	.0	2.8	.00			253	240	13	10	33	1.5			.0	360			7		8.5
12R-b3	264-496	C	11/23/65		.01		2.4	.00			220	210	10		9.00				.0	260			6		9.0
13M-p1	242-695	C	5/08/59		.00							8	.0		5.0				2.0				.0		7.6
13M-p2	264-690	C	4/08/59		.4							10	.0		8.0				2.0				.0		7.6
13M-p2	264-292	C	4/09/59		.4							10	.0		6.0				2.0				8.0		7.6
13M-p2	327-333	C	4/09/59		.4							10	.0		8.0				2.0				10.0		7.6
13M-p2	375-381	C	4/09/59		.4							10	.0		6.0				2.0				10.0		7.6
13M-p2	678-690	C	4/09/59		.6							10	.0		6.0				2.0				10.0		7.6
14M-t1	260-691	C	4/10/59		.2							10	.0		8.0				2.0				.0		7.6
14M-t1	427-439	C	4/10/59		.4							10	.0		6.0				2.0				8.0		7.5
14M-t1	472-478	C	4/10/59		.4							10	.0		6.0				2.0				9.0		7.5
14M-t1	679-691	C	4/10/59		.4							10	.0		5.0				.0						7.6
130-h2	117-210	C	1/14/67	32	27	.0	3.0	1.0	64.0			54.0	4.0	7.0	7.0				.0	110	4.0		4.0	125	8.7
130-h2	299	C	4/22/66	35	1.75		7.4	3.6				70.0	14.0	50	14.0				.0		11.0				8.7
130-h2	273	C	4/22/66	35	1.25		8.0	2.8				70.4	6.0	40	16.4				.0		10.8				8.5
130-h2	252	C	4/22/66	35	.75		8.0	1.8				82.0	56.0	45	17.0				.0		9.8				8.5
130-h2	231	C	4/22/66	40	.75		6.8	1.6				72.0	10.0	43	16.0				.0		8.4				8.7
130-h2	210	C	4/22/66	40	.375		7.3	1.6				70.0	.0	36	12.0				.0		9.0				8.1
130-h2	175'10"	C	4/22/66	20	.75		45.1	8.1				92.0	.0		16.0				8.0		53.0				8.1
130-h2	147	C	4/22/66	15	1.25		74.3	2.7				104.0	.0	62	15.0				12.0		77.0				7.7
130-h2	126	C	4/22/66	15	.15		43	8.0				66.0	.0	56	14.0				15.4		51.0				8.6
130-h1	131-210	C	1/14/67	32	.24	.0	9.0	2.0	76.0		70		6.0	7.0	8				0	208			11.0	170	8.6
13P-d1	210-300	S	4/07/73		0.1	0.7	0.2		32.8		75				4					98			4		8.3
15M-p1	260-495	C	4/16/65	50	1.2		1.6	1.0			19	19	.0		5				9						6.5
16M-r1	303-706	C	10/16/75	19	1.6	.03	6	14	22			16	.0	18	8.0								20	73	6.4
16M-s1	320-630	U	4/28/54	20	5.1		3.2	2.2	12			30	.0	11	5	.2	.0			69			17	82.6	6.6
16M-s3	309-495	C	4/16/65		1.0		2.0	1.5			30	30	.0	12	12								11		6.7
16M-s5	208-724	U	12/18/51	31	3.4	.0	7.6	2.6	12			19	.0	9.8	20	.3	.0		10	96		14	30	129	5.8
16M-l1	325-648	U	4/28/54	17	1.6	.04	3.3	2.8	31			44	.0	20	21	.3	.0			117			20		6.7
16M-t2		C	4/15/65		1.0		3.2	1.7			33	33	.0		21				10	88			15		6.6
16M-t3	150-378	C	7/31/57		.35						24	24	.0						20	86			20		6.3
16M-t4	450-765	C	10/16/75	17	.5	.03	8	14	136			66	.0	17	.75				14				22	260	7.3
16M-v1	344-680	C	10/16/75	16	.98	.03	6	6	15			13	.0	11	3				19				12	57	6.2
16M-r2	385-705	C	5/13/55	20	2.2	.0	6.0	14			20	20	.0	0.0	14								20		5.9
16M-w1	354-660	C	4/16/65		.80		5.2	1.0			26	26	.0							54			17		6.6
16M-x1	250-660	C	10/16/75	23	1.5	.03	4	10	19			15	.0	17	1				20				14	50	6.4
16Q-k1	152-426	S	10/3/77		1.40	.017	2.88	.54	32.1	3.55													8.08	148	8.0 F
16Q-k2	451-481	C			.096	.018	.76	.12	28.9	1.72													7.07	119	7.8 F
16Q-t2	160-556	S	10/3/77		.082	.012	1.56	.18	33.2	2.18													4.04	138	8.0 F
17M-t1	306-578	C	7/19/77		.50	.0	2.8	1.0	3.30		10	10	.0	12.0	3	.0			8	28			7	48	6.1
18N-i2	355-475	S	10/3/77		2.450	.031	1.63	1.0	2.69	2.71												9.09		42	6.25 F

Table 6. Cont'd.

Well Number	Sample Depths	Laboratory	Collection Data	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Total Alkalinity	Bicarbonate Alkalinity (HCO_3)	Carbonate Alkalinity (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Carbon Dioxide (CO_2)	Dissolved Solids (Residue on evaporation)	Hardness (as $CaCO_3$ Calcium Magnesium	Non-Carbonate	Total Hardness	Specific Conductance (Micromohs at 25°C)	pH
18P-s1	240-338	S	10/3/77		.081	.067	8.9	2.99	4.33	10.6													37.05	108	6.45 F
18P-v1	175-210	C	4/30/68		1.6	.0	6.0	1.2			38	38	.0	12.0	5	.20			8	78			20		6.9
18P-v1	175-210	S	10/3/77		2.67	.035	11.9	3.27	3.9	14.7													45.05	119	6.5 F
DARLINGTON COUNTY																									
16L-q1	530-624	C	4/29/76	16.1	3.6		16	10				36	.0	22	16				8				26	150	7.3
LEE COUNTY																									
190-g1	316-511	C	11/9/72		2.2	0.0	1.2	.5			8	8	.0	1.0	4	0.0			15	23			5	47	
RICHLAND COUNTY																									
26R-c1	425-542	C	8/15/74	9.5	0.7		3.6	2.4					36.0	0	11				8	72					

 FIGURE 4. LOCATIONS OF SELECTED WELLS IN SUMTER AND FLORENCE COUNTIES

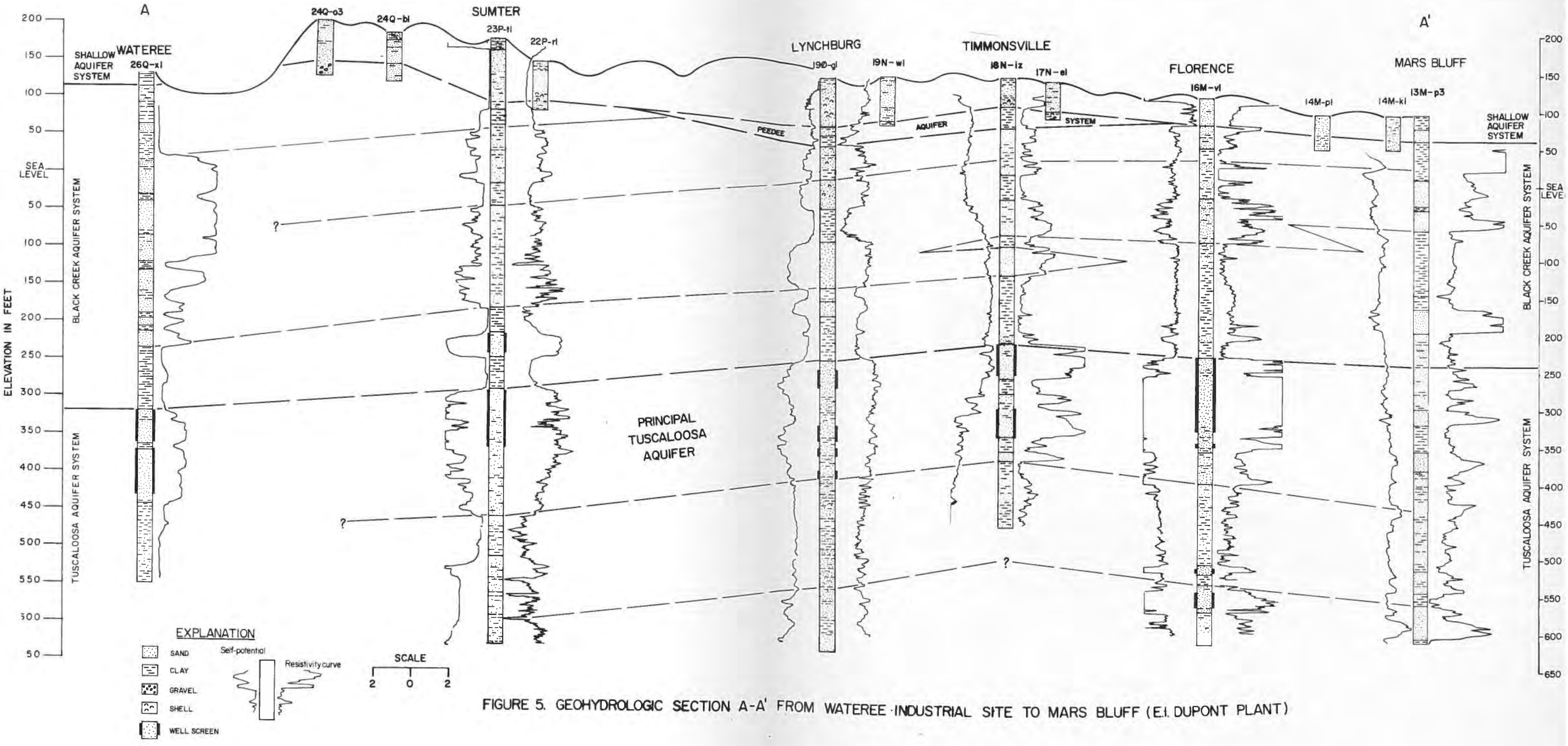


FIGURE 5. GEOHYDROLOGIC SECTION A-A' FROM WATEREE INDUSTRIAL SITE TO MARS BLUFF (E.I. DUPONT PLANT)

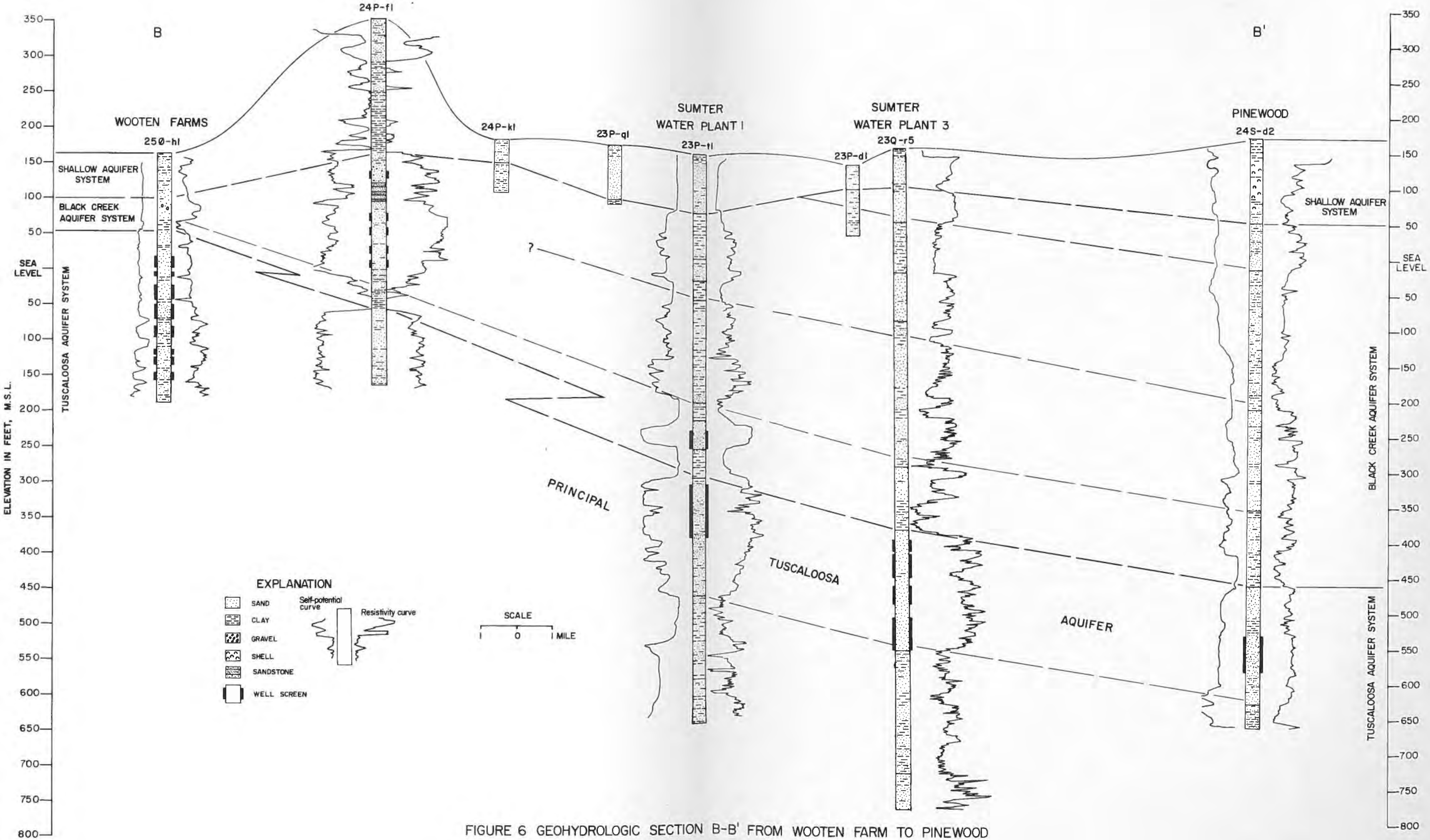


FIGURE 6 GEOHYDROLOGIC SECTION B-B' FROM WOOTEN FARM TO PINEWOOD

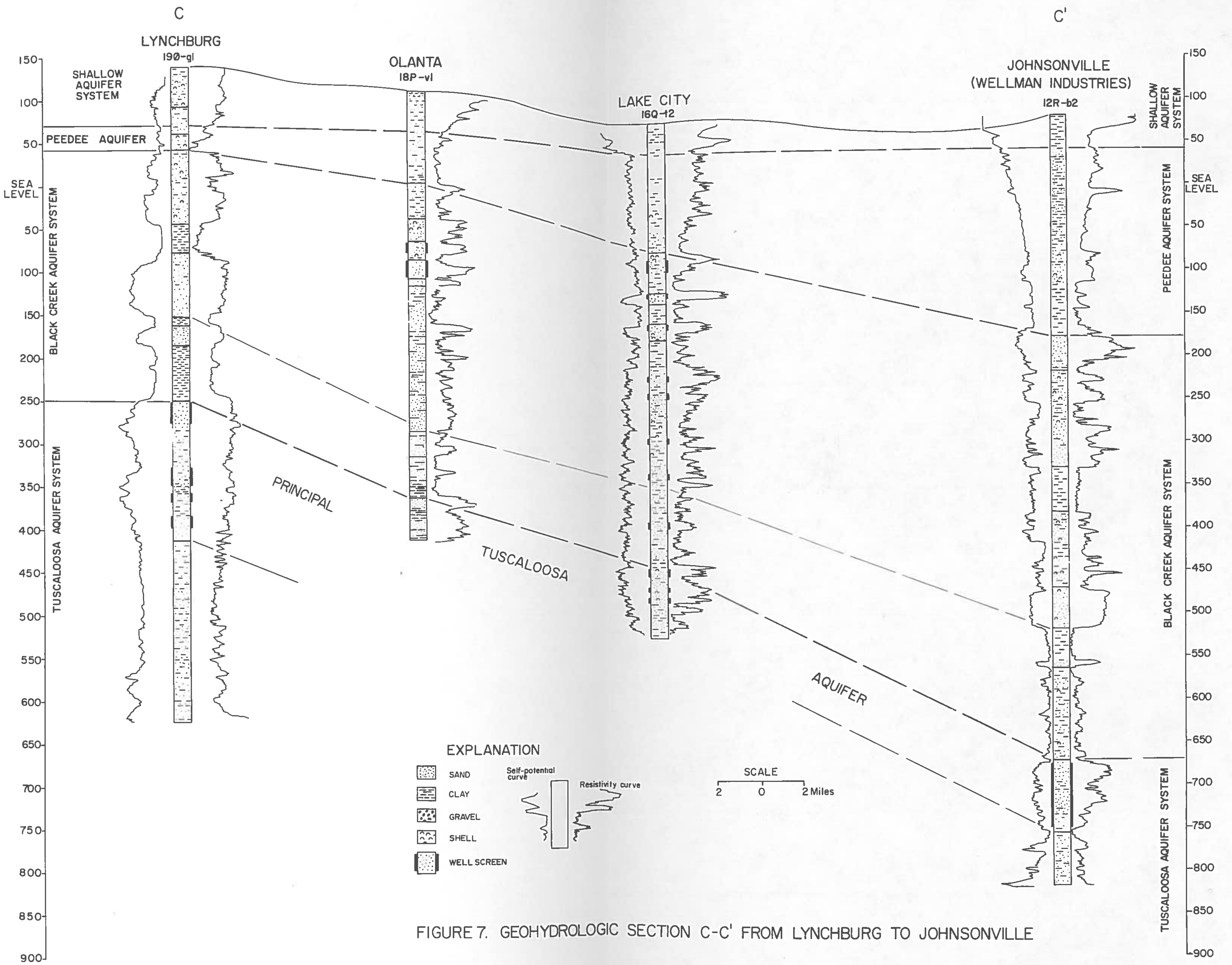


FIGURE 7. GEOHYDROLOGIC SECTION C-C' FROM LYNCHBURG TO JOHNSONVILLE

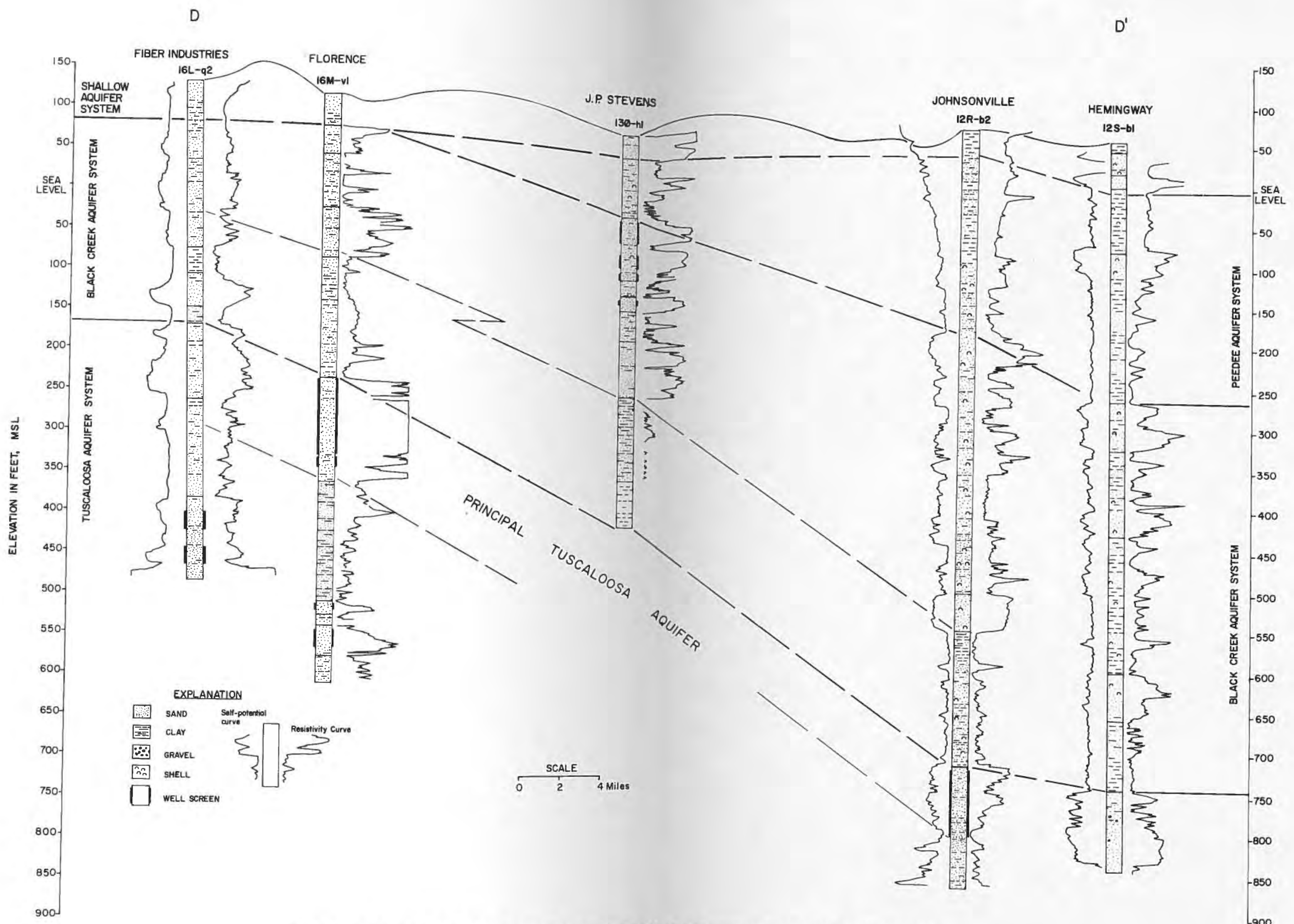


FIGURE 8. GEOHYDROLOGIC SECTION D-D' FROM FIBER INDUSTRIES TO HEMINGWAY